South Sudan

Secondary

Geography 2

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South Sudan

Secondary

Geography 2

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South Sudan

SECONDARY 2

Geography

Student's Book 2

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FOREWORD

I am delighted to present to you this textbook, which is developed by the Ministry of General Education and Instruction based on the new South Sudan National Curriculum. The National Curriculum is a learner-centered curriculum that aims to meet the needs and aspirations of the new nation. In particular, it aims to develop (a) Good citizens; (b) successful lifelong learners; (c) creative, active and productive individuals; and (d) Environmentally responsible members of our society. This textbook, like many others, has been designed to contribute to achievement of these noble aims. It has been revised thoroughly by our Subject Panels, is deemed to be fit for the purpose and has been recommended to me for approval. Therefore, I hereby grant my approval. This textbook shall be used to facilitate learning for learners in all schools of the Republic of South Sudan, except international schools, with effect from 4th February, 2019.

I am deeply grateful to the staff of the Ministry of General Education and Instruction, especially Mr Michael Lopuke Lotyam Longolio, the Undersecretary of the Ministry, the staff of the Curriculum Development Centre, under the supervision of Mr Omot Okony Olok, the Director General for Quality Assurance and Standards, the Subject Panelists, the Curriculum Foundation (UK), under the able leadership of Dr Brian Male, for providing professional guidance throughout the process of the development of National Curriculum and school textbooks for the Republic of South Sudan since 2013. I wish to thank UNICEF South Sudan for managing the project funded by the Global Partnership in Education so well and funding the development of the National Curriculum and the new textbooks. I am equally grateful for the support provided by Mr Tony Calderbank, the former Country Director of the British Council, South Sudan; Sir Richard Arden, Senior Education Advisor of DfID, South Sudan. I thank Longhorn and Mountain Top publishers in Kenya for working closely with the Ministry, the Subject Panels, UNICEF and the Curriculum Foundation UK to write the new textbooks. Finally, I thank the former Ministers of Education, Hon. Joseph Ukel Abango and Hon. Dr John Gai Nyuot Yoh, for supporting me, in my previous role as the Undersecretary of the Ministry, to lead the Technical Committee to develop and complete the consultations on the new National Curriculum Framework by 29 November 2013.

The Ministry of General Education and Instruction, Republic of South Sudan, is most grateful to all these key stakeholders for their overwhelming support to the design and development of this historic South Sudan National Curriculum. This historic reform in South Sudan's education system is intended to benefit the people of South Sudan, especially the children and youth and the future generations. It shall enhance the quality of education in the country to promote peace, justice, liberty and prosperity for all. I urge all Teachers to put this textbook to good use.

May God bless South Sudan. May He help our Teachers to inspire, educate and transform the lives of all the children and youth of South Sudan.

Deng Deng Hoc Yai, (Hon.)

Minister of General Education and Instruction, Republic of South Sudan

TABLE OF CONTENTS

Unit 1 THE PHYSICAL FEATURES OF SOUTH SUDAN

Introduction

South Sudan is a landlocked country with a border stretch of 4,797 Km. It gained independence from Sudan in 2011. The country covers an area of 640,000 sq. km (239,285 sq. miles). The Official language in South Sudan is English while simple Arabic is widely spoken. Other languages include the 64 national languages. According to the most recent census the population of South Sudan is 12,785,459 people.

The Physical Geography of South Sudan is primarily made up of tropical forests, swamps and grasslands among other landforms and waterbodies. Major mountains and Hills of South Sudan include: The Imatong Mountain ranges, Mount Lotuke, Didinga Hills, and Dongotono mountains among others. Major rivers of South Sudan are the White Nile, The Sudd, Bahr el Ghazal and Sobat River. The impenetrable Sudd swampland found within the Nile basin is one of the world's largest fresh water wetlands. Its covers 130,000 square kilometers of land.

Figure 1. The administrative map of South Sudan

Formation of Land forms

What are landforms and how are they formed?

A land form is a natural feature on the earth's surface. They include mountains, hills, rivers, waterfalls, lakes, valleys among others.

Volcanic Mountains

Creative activity 1

Making a clay volcano

Organize yourselves in groups and follow the steps provided below.

Ensure that you have the following requirements:

1. Lamp of clay or plastacine.
2. A small plastic bottle.
3. Vinegar.
4. Baking soda.
5. Tray or an open surface.

Procedure

1. Place the small plastic bottle on the tray. The bottle will represent the magma chamber and the main vent.

2. Use lamps of clay or plastacine to make the steep sides of a mountain. Make sure that the bottle remains at the center. Do not cover the top of the bottle.

3. Pour baking soda into the bottle, followed by a little amount of vinegar.
4. Observe what happens at the top of the volcano model you have just made. That is basically how volcanic mountains occur. s

5. Clean your area of work and dispose the waste appropriately.

Formation of volcanic mountains

High temperatures and pressure beneath the earth's surface cause rocks to melt and be converted to magma, which rises through the fissures in the direction of Earth's surface. When magma reaches the earth's surface it is referred to as lava.

Lava cools down along the vent to form various volcanic structures on the earth's surface over a long period of time. Volcanic ash and several gases are extruded into the Earth's surface during a volcanic eruption. The entire process takes many years since numerous layers of solidified lava are required for the formation of volcanic mountains.

Examples of volcanic mountains include Mount Kilimanjaro in Tanzania, Mount Kenya in Kenya, Mount Jebel Marra of Sudan and Mount Nyamuragira in the Democratic Republic of Congo.

Volcanic activity can also be witnessed in the oceans, where the accumulation of volcanic matter continues for years and eventually results in the formation of islands when the volcanic materials reach the surface of the ocean.

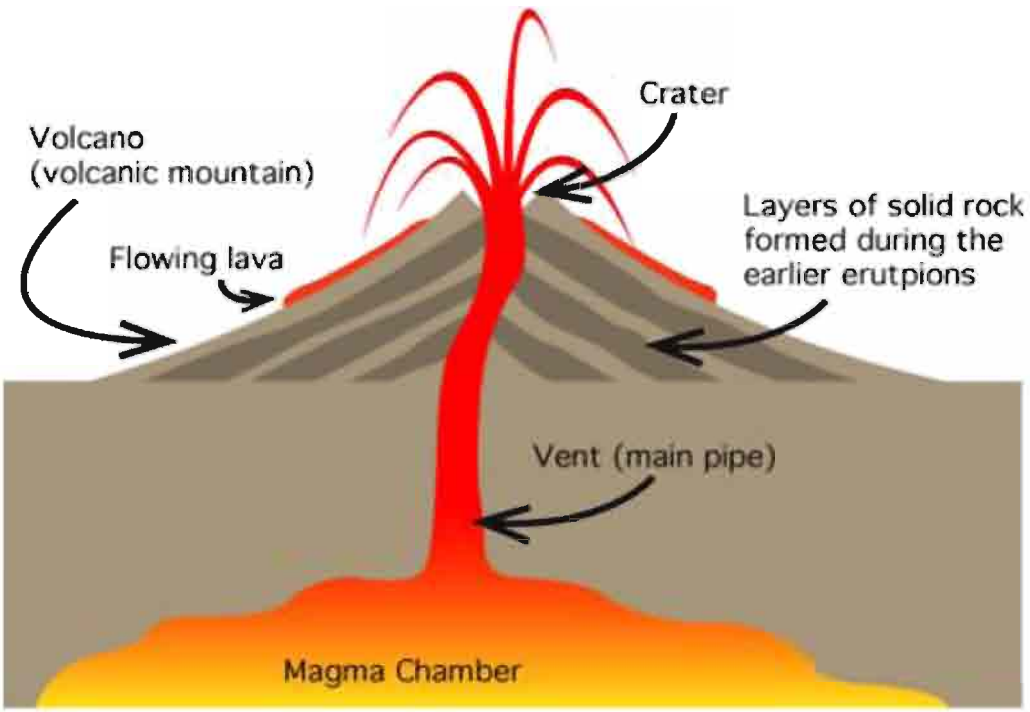


Figure 2. Features of a developing volcanic mountain

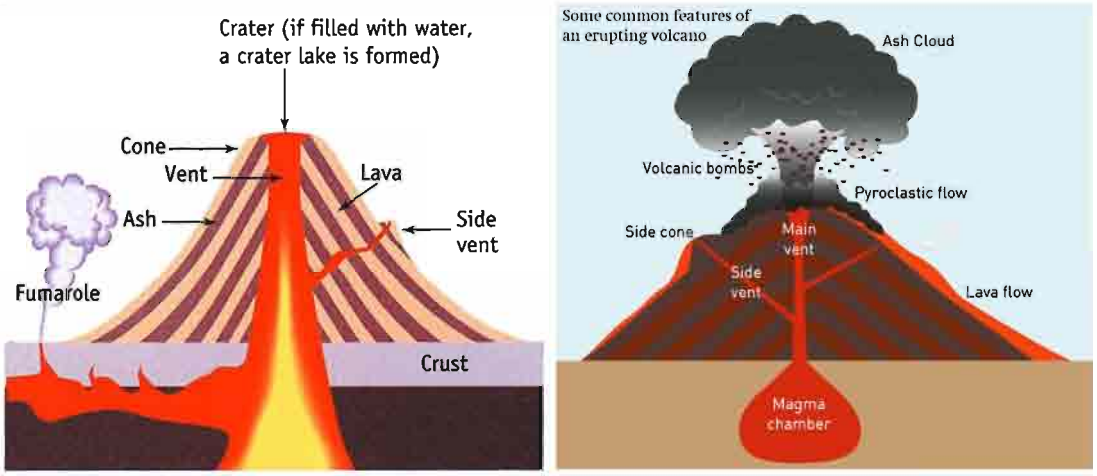


Figure 3. Features of an active volcanic mountain.

An alternative way of the formation of volcanic mountains is when two tectonic plates move away from each other. This is referred to as a **divergent zone** which causes the earth to open up and release magma through the cracks in the earth. This leads to the formation of underwater volcanic mountains which are smaller compared to other volcanic mountains.

Vulcanicity and Volcanicity

Vulcanicity:

This is the processes by which magma is intruded into the Earth's crust but also extruded from the Crust.

Volcanicity:

These are the processes by which magma rises from beneath the earth's crust, through cracks and crevices, reaching the surface of the earth and solidifying. This results to the formation of extrusive volcanic features.

When magma fails to reach the earth's surface and solidify inside the crust before it reaches the surface. It results to the formation of intrusive volcanic features.

Types of volcanicity

There are two types of volcanicity namely:

Intrusive/Plutonic volcanicity

When magma is forced through cracks beneath the earth, only a small volume of it reaches to the surface. Most of the magma is intruded into the crust where it solidifies into a variety of features that are exposed at the surface by erosion.

There are two categories of lava and magma, acidic and basic. Acidic lava is sticky and solidifies quickly. It doesn't spread far but gathers around the vent. Basic lava on the other hand is more liquid or less sticky and spreads for great distances before cooling. Other materials released include gases, ashes and dust. The solid materials are called pyroclasts. Materials come out through a hole/vent (vent eruption) or crack/fissure (fissure eruption).

Landforms that originate from this intrusive volcanicity include Batholiths, laccolith, dykes and sills among others.

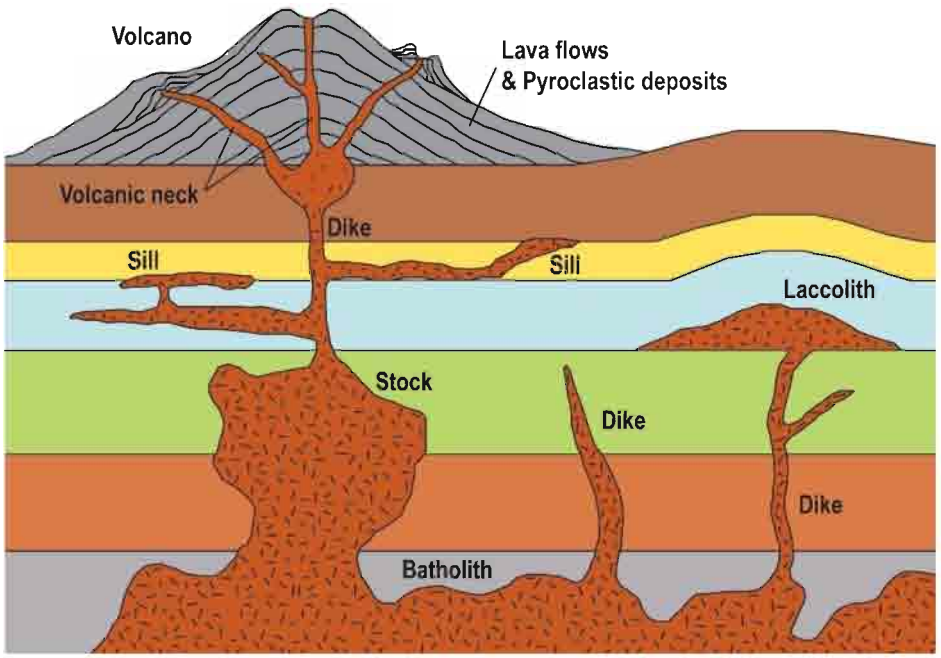


Figure 4. Intrusive volcanic landforms

Extrusive Volcanicity

When volcanic activity takes place above ground, so that hot molten magma is released onto the landscape, we say that the volcanic activity is extrusive, meaning it is on the exterior, or outside of the Earth. Magma that reaches the service is known as lava.

Lava flows are extraordinarily hot, and destructive. In many cases, these lava flows are slow and continuous, as is the case with the volcano on the Hawaiian Island. Hot lava flows year after year down the volcano, creating new terrain, rarely exploding.

In other cases, volcanoes can erupt with unbelievable force and power. These types of eruptions can send lava, rock, and hot ash, known as pyroclastic material shooting outward for hundreds of square miles, in some cases, even sending up a worldwide cloud of dust and ash.

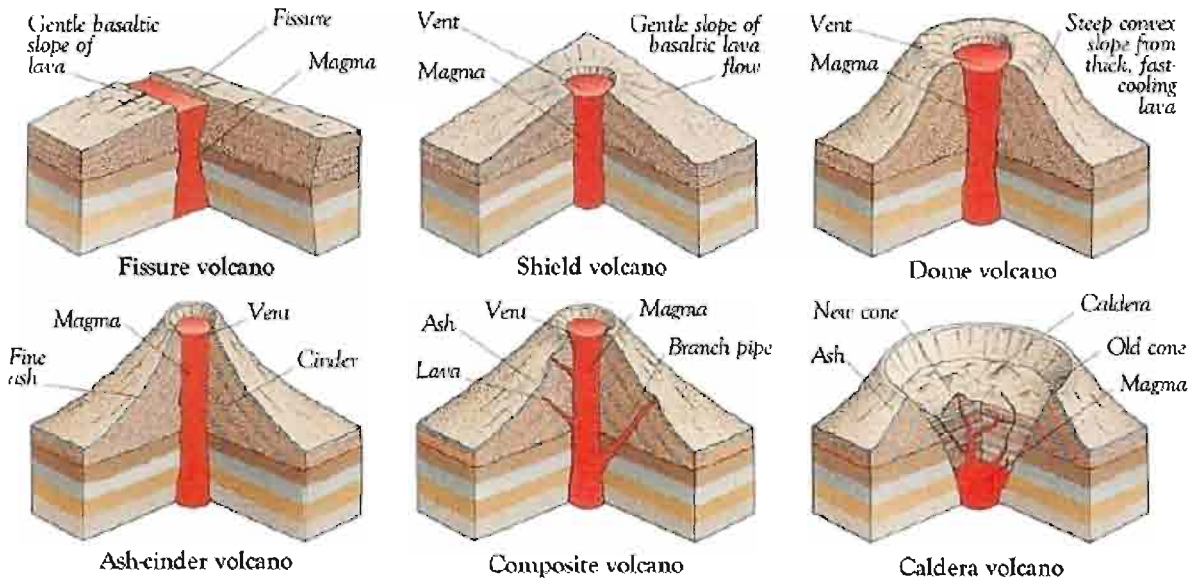


Figure 5. Extrusive volcanic landforms

Causes of volcanicity and volcanic eruptions.

The causes of volcanicity and volcanic eruption can include:

- Increased quantity of magma in the mantle leading to increase to pressure pushing this magma out wards.
- Presence of fissure and cracks allowing magma to move towards the crust.
- Increase in the temperature of magma inside making the magma very light to move along a crack.
- Increase in the vent allowing a big quantity of magma to move in at once.

Classification of volcanoes

1. **Active volcano:** these are volcanoes known to have erupted in recent times e.g., Jebel Marra in Sudan, Ol donyo Lengai in Tanzania and Mt. Cameroon, and Mauna Loa in Hawaii.
2. **Dormant volcano:** these are volcanoes known to have erupted in the recent past but show signs of volcanic activity such as presence of hot springs, geysers and fumaroles e.g. Mt.Kilimanjaro, Longonot and Menengai of Kenya.
3. **Extinct volcano:** these are volcanoes that have not shown signs of possible future eruptions e.g. Mountains Kenya and Elgon.

Progress Check

In pairs, create a table to show the similarities and differences of extrusive volcanoes and intrusive volcanoes.

Types of volcanoes

Acid Larva domes

Acid lava is much thicker than lava which flows from shield volcanoes. Dome volcanoes have much steeper sides than shield volcanoes. This is because the lava is thick and sticky. It cannot flow very far before it cools and hardens. An example is Puy de Dome in the Auvergne region of France which last erupted over 1 million years ago.

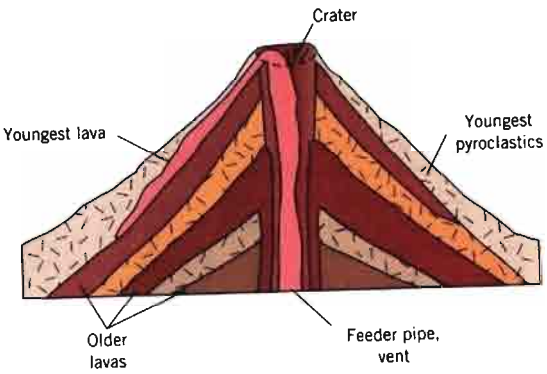


Figure 6. Cross section of an acid lava volcano

Basic larva domes/ shield volcanoes

These are low lying, dome shaped volcanic hills made of basic lava. They have gentle slopes and broad bases. They are formed when basic magma flows out to the surface through a vent. The lava then flows over a long distance before solidifying. Volcanic eruptions happen later and lava spreads above the old lava.

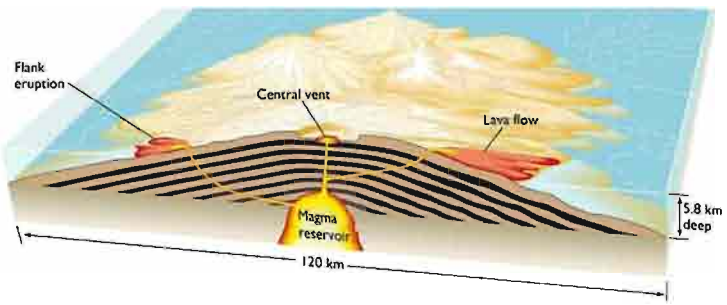


Figure 7. A shield volcano

Ash and cinder cones

This is a volcano built from ash and cinder or small fragments of lava. This type of volcano experiences violent vent eruption with ash and pyroclasts emitted and thrown high in the sky from its vent. Some materials from the eruption, fall and settle around the vent forming a hill. After the volcanic eruption, light materials are blown by wind to the leeward side.

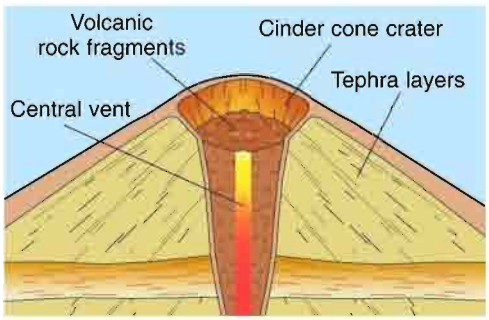


Figure 8. Ash and cinder cones

Examples include Chyulu Hills, Teleki and Likaiyu near L. Turkana.

Characteristics of Ash and Cinder cones

1. They have steep slopes.
2. They have bowl-shaped craters.
3. Their eruption tend to be weak as compared to other volcanoes.
4. They have a shorter life span as compared to other volcanoes.

Stratified volcanoes/ composite cone/ complex volcanoes

Composite cone volcanoes, which are also called 'stratovolcanoes' or simply 'composite volcanoes,' are cone-shaped volcanoes composed of layers of lava, ash and rock debris.

These are steep-sided volcanoes composed of many layers of volcanic rocks, usually made from high-viscosity lava, ash and rock debris. These types of volcanoes are tall conical mountains composed of lava flows and other ejection in alternate layers known as strata.

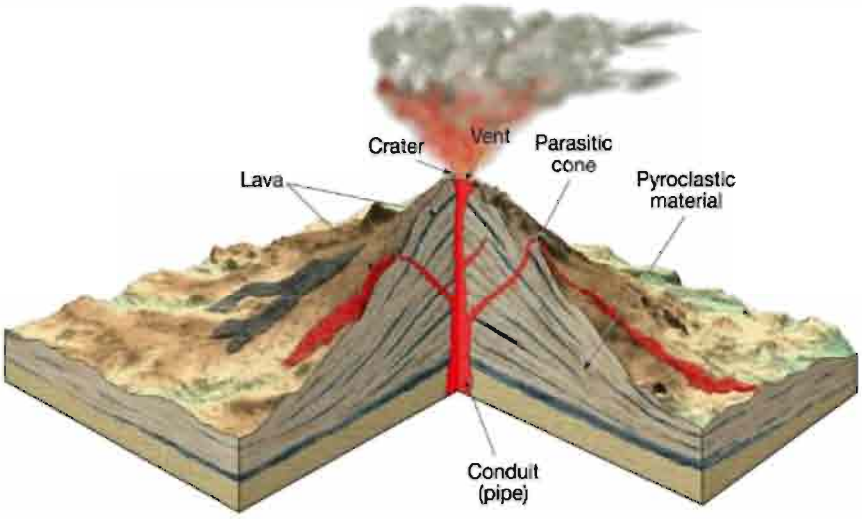


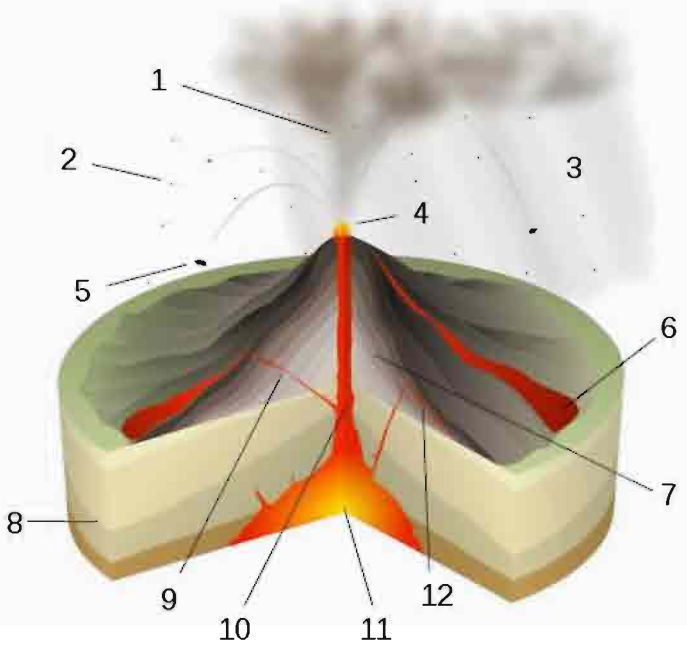
Figure 9. Cross section of a composite volcano

Progress Check

Which types of volcanoes do these photographs represent?

Comprehensive Activity 1

1. In pairs name the following parts of a volcano



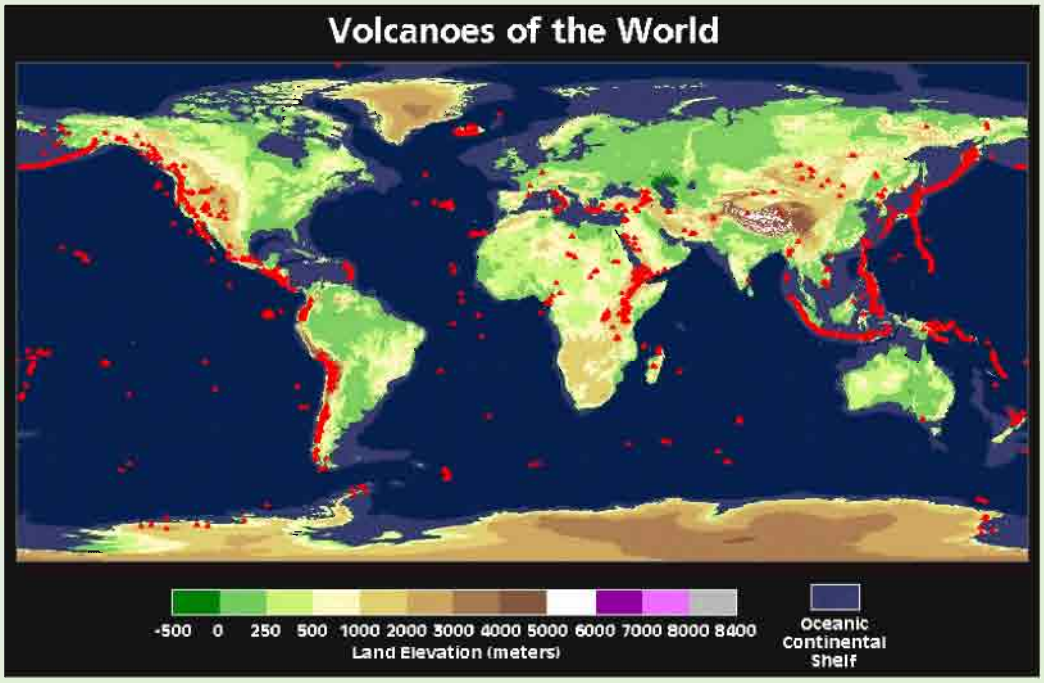
Case study 1

In groups research on the impacts of volcanic mountains to human activities. Your research should answer the following question:

- What are the advantages and disadvantages of volcanic mountains to human activities? ***Present your findings before to the class (each group should take less than 20 minutes)***

Exercise 1

1. Differentiate volcanicity from Vulcanicity.
2. Explain the following terms:
   a) Intrusive volcanicity.
   b) Extrusive volcanicity.
3. How are volcanic mountains formed? (Use well illustrated diagrams.)
4. What are the different types of volcanoes?
5. Using the map given below, research and come up with a list of the world's most violent and dormant volcanoes. **(Use any reference materials provided by your teacher.)**



6. Using examples in Africa, describe the three major classifications of volcanoes.

Fold Mountains

Folded mountains are formed when there is a pushing together of part of the earth's crust from the ends, causing it to fold and ripple in the middle. The same phenomenon can be seen if you push the ends of a rug together; it ripples in the center.

The convergence of the earth's crust lifts the earth to form an anticline (the rising part of a fold mountain) and a syncline (the valley like feature of the fold mountain)

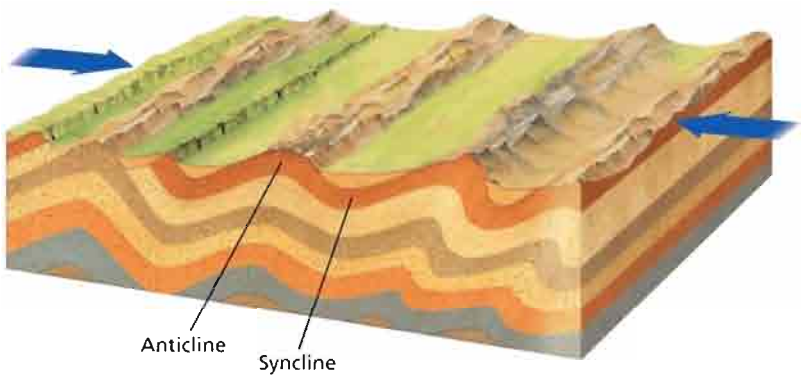


Figure 10. Formation of a fold mountain

Examples of Fold Mountains in Africa include: the Imatong mountain range of South Sudan, the Cape Fold Mountains of South Africa and the Atlas Mountains.

Creative Activity 2

Making a fold mountain

Organize yourselves in groups and follow the steps provided.

Steps:

1. Ensure that your group has a piece of paper.
2. Pick a sheet of paper and hold it on the sides. Gently push the sides of the paper to the center. *Note: The movements of the piece paper represent the compressional forces that lead to the formation of Fold Mountains.*
3. Label the anticline and the syncline on the model you have made.

Types of folds

Monocline folds

This is a type of fold where characterized by local warping in horizontal strata. Rock beds lying at two levels separated by steep inclined limbs. It is form by vertical movement and generally found fault below monocline. A step-like fold in rock strata consisting of a zone of steeper dip within an otherwise horizontal or gently-dipping sequence.

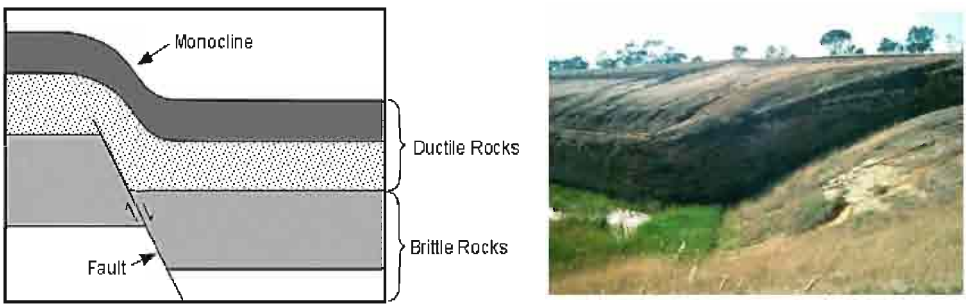


Figure 11. The formation of a monocline (left) and a picture of a monocline land fold (right)

Symmetrical folds

A fold whose limbs have approximately the same angle of dip relative to the axial surface. Also known as normal fold.

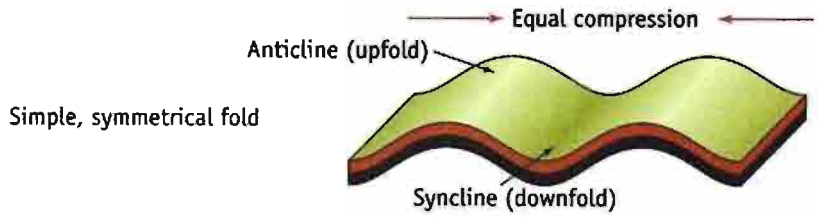


Figure 12. Symmetrical folds

Isoclinical folds

Isoclinal folds are similar to symmetrical folds, but these folds have the same angle and are parallel to each other. 'Iso' means 'the same' (symmetrical), and 'cline' means 'angle,'

so this name literally means 'same angle.' So isoclinal folds are both symmetrical and aligned in a parallel fashion.

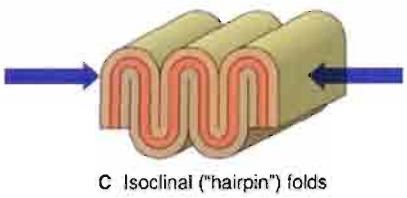


Figure 13. Isoclinal folds

Asymmetrical folds

These are folds whose limbs are unequal in length, and axial plane is inclined, dipping in the same direction as that of the gently dipping limb. Degree of asymmetry is given as the ratio of length of short to that of long limb. Thus, the smaller the ratio, greater is the degree of asymmetry. A perfect example of these types of Fold Mountains are the Ghisauli gneisses of Central India

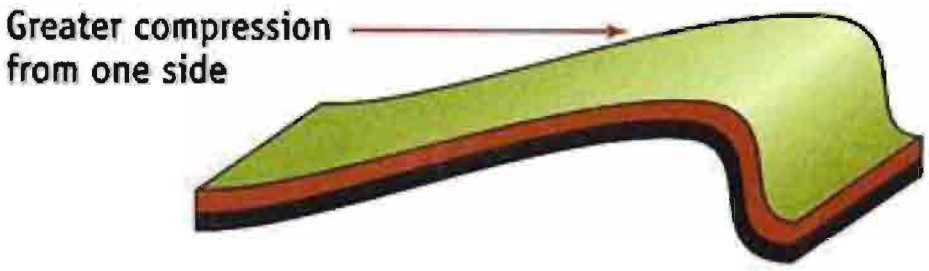


Figure 14. Asymmetrical folds

Recumbent folds

A recumbent fold has an essentially horizontal axial plane. Linear, fold axial plane oriented at low angle resulting in overturned strata in one limb of the fold.

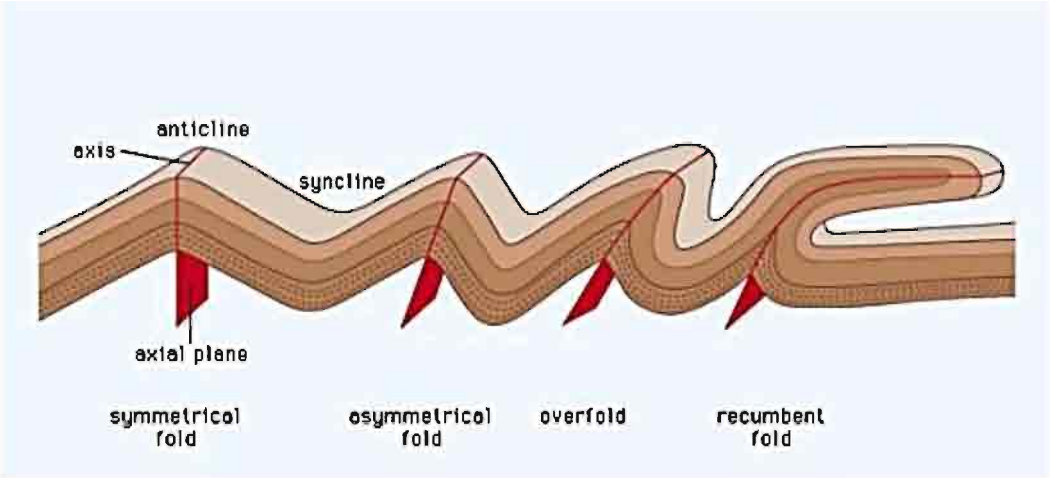
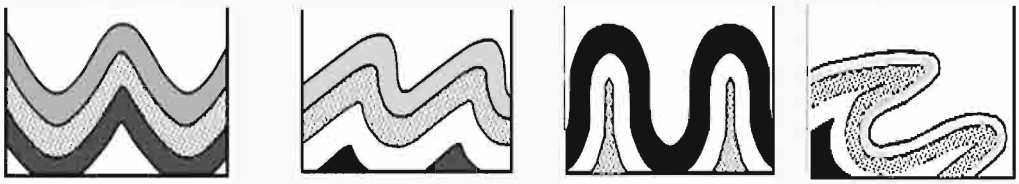


Figure 15. Comparing recumbent folds with other folds

Comprehensive Activity 2

1. Label the following types of folds



Case study 2

Impacts of Fold Mountains to human activities

Research on the impacts of Fold Mountains to human activities. Your research should answer the following question:

- What are the advantages and disadvantages of Fold Mountains to human activities?

Exercise 2

1. Describe the process of folding.
2. Define the following terms:
    a) Anticline and syncline.
    b) Axial planes.
    c) Axis.
    d) Monocline folds.
    e) Recumbent folds.
    f) Isoclinal folds.
3. Differentiate symmetrical folds from asymmetrical folds.

Faulting and Block Mountains

What is faulting?

A **fault**, in geographical/geological terms, is a fracture or rupture in the rock strata due to strain in which displacement is observable.

The crustal rocks are fractured due to tensional/compressional movement caused by the endogenetic forces, along a plane called the fault plane. The movement responsible for the formation of a fault may operate in vertical, horizontal or any other direction. This process is known as **faulting.**

Most faults occur in groupings which is called a fault zone/fracture zone. Faults, in fact, represent weaker zones of the earth where crustal movements become operative for longer duration.

Types of faults

A fault caused by tension is called a **normal fault** and the displacement of the two faulted blocks is *away* from each other; whereas a fault caused by compressional forces is called a **reverse fault** and the movement of the fractured blocks is *towards* each other. Reverse faults are also called thrust faults. A fault caused by shearing forces (i.e. the forces are not along the same axis, but are parallel) is called a **transverse** or **lateral fault.**

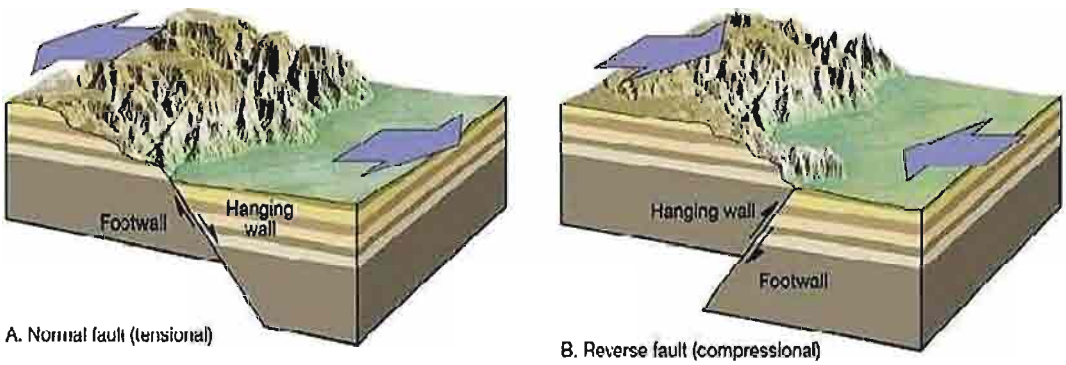


Figure 16. Normal and reverse faults

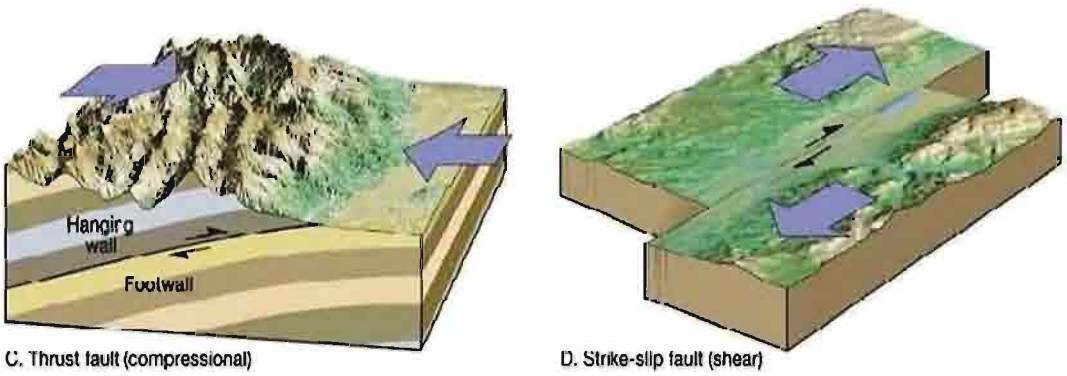


Figure 17. Thrust and shear faults.

Formation of Block Mountains

Block Mountains are formed when a movement in the earth's crust forces the rocks to break. As a result, enormous cracks or faults are formed when sets of faults run parallel to each other and the ground between is forced up, a block mountain also known as a horst is formed.

Usually Block Mountains do not extend over wide areas as Fold Mountains do. Example of block mountains are the Usambara, Uruguru and Ruwenzori mountains in East Africa, the Vosges and Black forest mountains in Europe and mount Sinai in Asia.

Other features associated with faulting and Block Mountains are rift valleys or grabens. Rift valleys are formed when the land between two sets of faults sink down. The Great East African Rift valley is the longest rift valley in the world. It stretches from the Baka's valley east of the Lebanon Mountains, through the Red sea, Ethiopia, East Africa to the lower Zambezi Area. A branch of the valley runs along Lake Tanganyika in Tanzania to Lake Albert in Uganda.

Another less extensive rift valley is the middle Rhine Rift valley between the Vosges and black forest mountains. The walls of a rift valley form fault lines or escarpments. Trenches formed by rift valley are sometimes filled with water to form Lakes like Lake Nyasa, Lake Albert, Lake Eyas, and Lake Turkana all of which are in East Africa and the Dead Sea in Jordan.

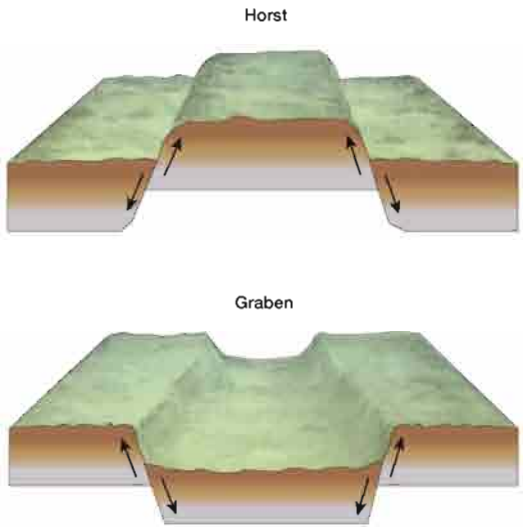
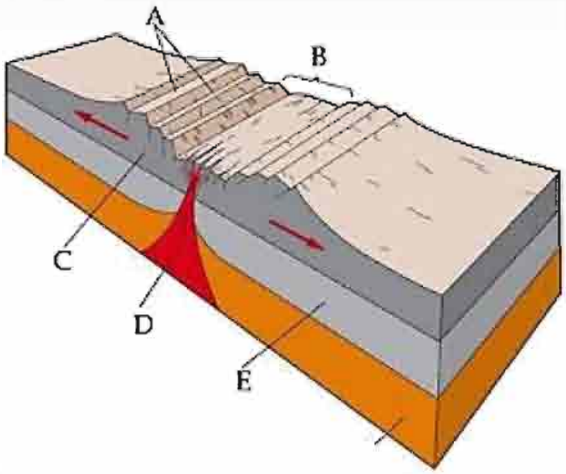


Figure 18. Formation of a block mountain (top) and a Graben / rift valley (bottom).

Comprehensive Activity 3

1. Label the diagram below



Residual Mountains

Apart from the three types of mountains (volcanic, block and fault mountains), there are Residual Mountains which are formed by a prolonged denudation. Denudation involves removing weaker rocks from the land the result of which landforms are lowered leaving behind resistant rock. The remaining resistant rock is known as residual mountains. Examples of residual mountains include the Haggard Mountains of central Sahara, the Sekenke hills of Singida in Tanzania, the Adamawa Mountains of Eastern Niger,

Figure 19. Residual mountains in Ahaggar plateau, Southern Algeria

Exercise 3

1. Differentiate faulting from folding.
2. Define the following terms:
    a) Horst.
    b) Fault.
    c) Escarpment.
    d) Tension and compressional forces.
    e) Normal fault.
    f) Reverse fault.
    g) Thrust fault.
    h) Shear fault.
3. Giving examples in Africa. Explain how Fault Mountains (horsts) and rift valleys (grabens) are formed.

The Mountains and Hills of South Sudan

The following are the major mountains of South Sudan:

The Imatong Mountains

The Imatong Mountain range is located in the Southeast of South Sudan in the Eastern Equatoria state, and extend into Northern region of Uganda. The mountains are highest in the Southeast where a group of peaks reach about 3,000 meters and the tallest, Mount Kinyeti, reaches a height of 3,187 meters.

Figure 20. The Imatong mountain range (left) and Mount Kinyeti (right)

Figure 21. Location of Imatong Mountain Ranges in South Sudan

Mount Lotuke

Mount Lotuke is a mountain and is located in Eastern Equatoria, South Sudan. It is the second highest mountain in South Sudan after Mount Kinyeti. The elevation is 2795 meters above sea level.

Dongotana Mountains

Dongotona Mountains is a mountain within South Sudan and is Southwest of Emogadong and north of Aripewi and Toghogha. Dongotona Mountains has an elevation of 2,213 meters above sea level.

Mont Abourasséin

Mont Abourasséin is a mountain in central Africa. It is 1113 meters tall and stands on the international boundary between the Central African Republic and South Sudan

Jebel Kujur

Jebel Kujur is a mountain located on the outskirts of Juba Town to the west, standing at an altitude of 1,684 meters above sea level.

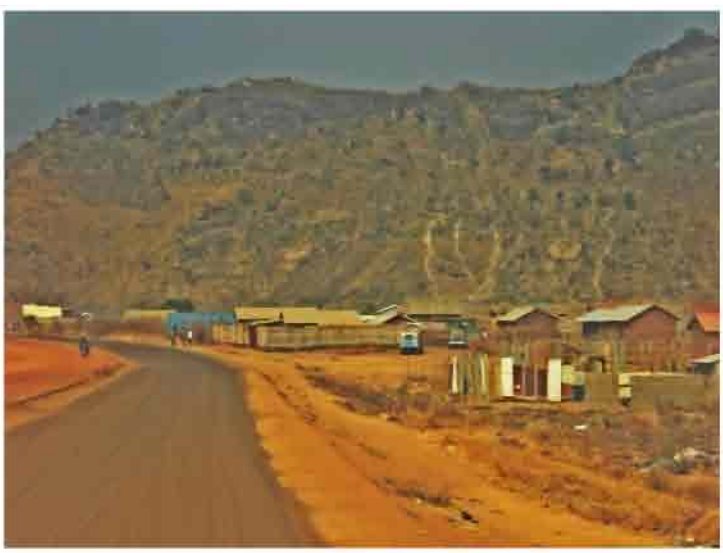


Figure 22. Jebel Kujur Mountains, South Sudan

Other mountains in South Sudan include Jebel Rejaf, Jebel Ladu, Mount Itibol, Mount Garia, Mount Kamia, Mount Isubhak, and Mount Konoro among others.

The Didinga Hills

The Didinga Hills are an upland area in Eastern Equatoria State of South Sudan, lying mainly within Budi County. The Didinga Hills have rich and fertile soil that is used for cultivation of tobacco, potatoes, maize, and Dura.

Figure 23. An aerial view of Didinga Hills.

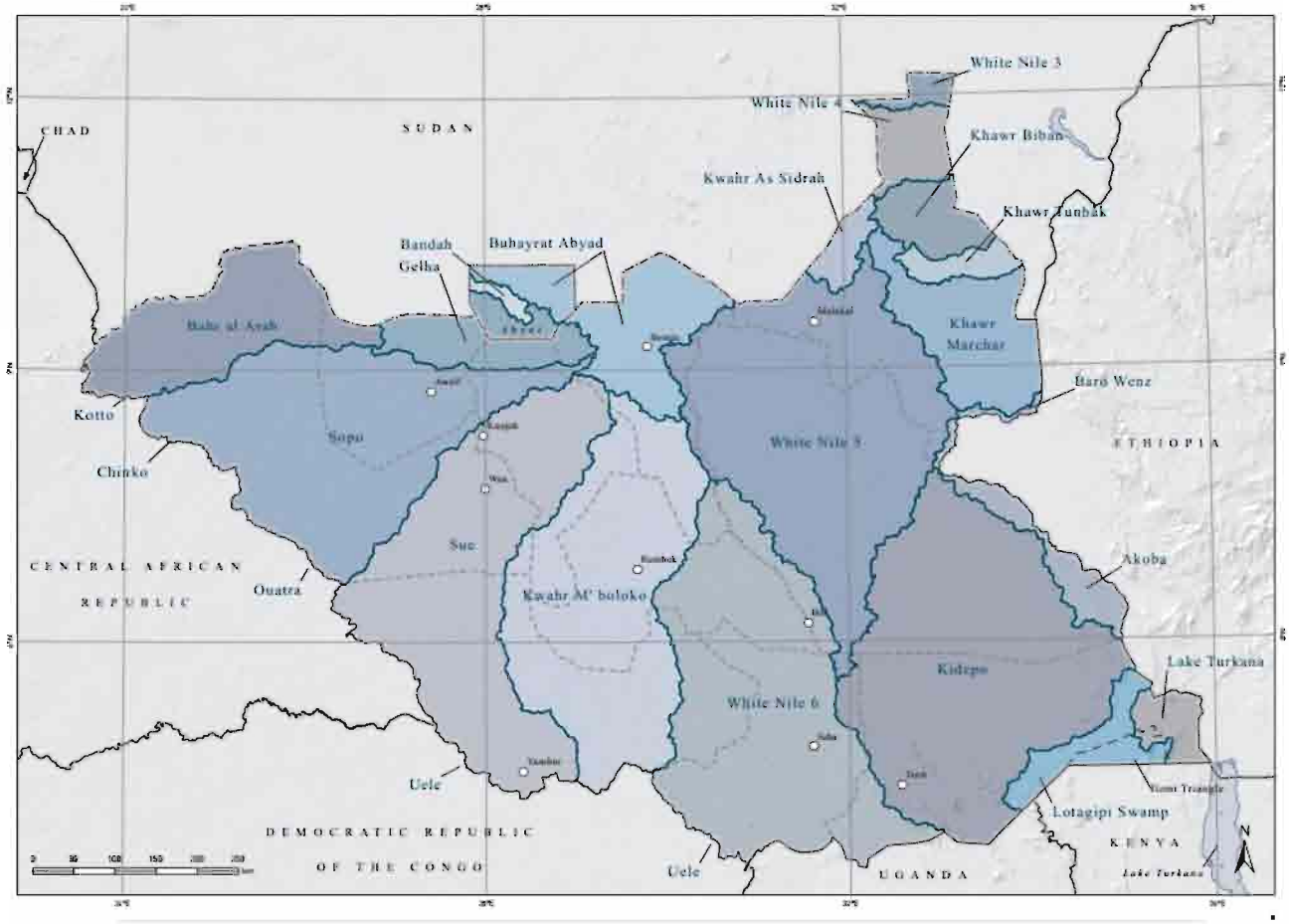
Lopit hills

Lopit hills are located in Torit district within the Eastern Equatoria state of South Sudan. The area around the hills have rich and fertile soils for the cultivation of sorghum, bulrush, millet, pumpkin; groundnuts, simsim, and okra.

Figure 24. The Lopit hills, Eastern Equatoria, Torit district, South Sudan

Comprehensive Activity 4

1. In pairs arrange the following mountains from the highest to the lowest. (State their location in South Sudan and their respective heights.)
    a) Mount Abourasséin
    b) Mount Lotuke
    c) Imatong Mountains
    d) Dongotana Mountains.
2. List some of the mountains you know in South Sudan.
3. In groups, **use small triangles** to pin point the location of the major mountains of South Sudan on the map provided below.



Rivers

What is a river?

In your respective groups come up with an appropriate definition of a **river** and **a river system.**

Creative Activity 3

Creating a river system

Go out of the classroom and organize yourselves in groups. Follow the instructions provided.

Ensure that you have the following requirements:

1. A spade and a bucket of water.

Steps:

1. Heap soil together to form a hill.
2. **Gently** pour water on the highest point of the hill and observe the flow of water.

How does the water flow from the highest point of the hill to the lowest point of the hill?

A **river** is a large amount of fresh water flowing continuously in a long line across the land. Typical rivers begin with a flow from headwater areas made up of small tributaries, such as springs. They then travel in meandering paths at various speeds; finally, they discharge into desert basins, into major lakes, or most likely, into oceans.

Every river is part of a larger system. The diagram that shows the full composition of a river from its source to its mouth is referred to as a **river system.**

Parts of a river system

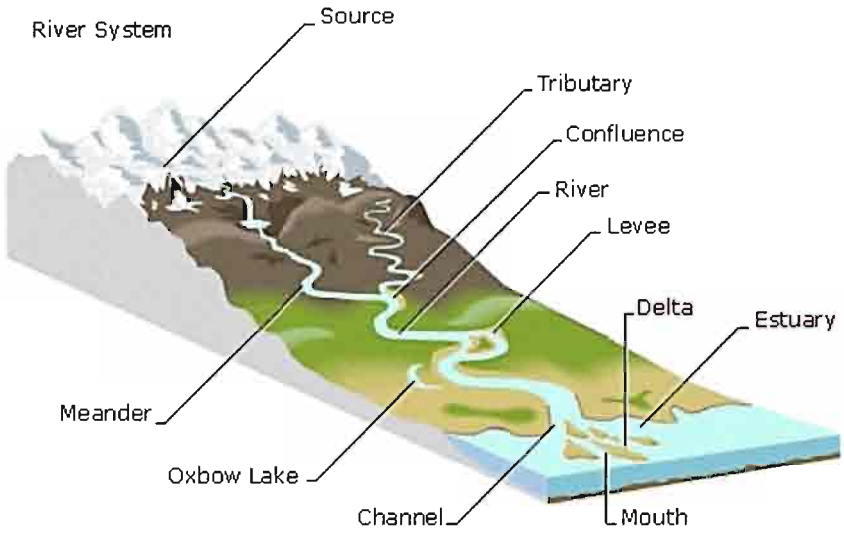


Figure 25. Parts of a river system.

a) **The source or headwaters** of a river or stream is the furthest place in that river or stream from its estuary or confluence with another river, as measured along the course of the river.

b) **Tributary** or **affluent** is a stream or river that flows into a larger stream or main stem (or parent) river or a lake. A tributary does not flow directly into a sea or ocean. Tributaries and the main stem river drain the surrounding drainage basin of its surface water and groundwater, leading the water out into an ocean.

c) A **confluence**, where two or more bodies of water meet together, usually refers to the joining of tributaries. The opposite of a tributary is a distributary, a river or stream that branches off from and flows away from the main stream. Distributaries are most often found in river deltas.

d) A **meander** is one of a series of regular sinuous curves, bends, loops, turns, or windings in the channel of a river, stream, or other watercourse. It is produced by a stream or river swinging from side to side as it flows across its floodplain or shifts its channel within a valley.

e) **Levee:** an embankment alongside a river, produced naturally by sedimentation or constructed by man to prevent flooding

f) An **oxbow lake** is a U shaped body of water that forms when a wide meander from the main stem of a river is cut off, creating a free-standing body of water. This landform is so named for its distinctive curved shape, resembling the bow pin of an oxbow.

g) A **river delta** is a landform that forms from deposition of sediment carried by a river as the flow leaves its mouth and enters slower-moving or standing water. This occurs where a river enters an ocean, sea, estuary, lake, reservoir, or (more rarely) another river that cannot transport away the supplied sediment. River deltas are important in human civilization, as they are major agricultural production centers and population centers. They can provide coastline defense and can impact drinking water supply. They are also ecologically important, with different species assemblages depending on their landscape position.

h) **An estuary is** the tidal mouth of a large river, where the tide meets the stream.

Processes of river formation

The following are the two major processes of river formation:

a) By climatic influences.

b) By exudation.

Formation of river by climatic Influence

The following are processes of river formation by climatic influence:

Precipitation

Precipitation, such as rainwater or snow, is the source of the water flowing in rivers. Rainwater can either return to the oceans as run-off, it can be evaporated directly from

the surface from which it falls, or it can be passed into the soil and mantle rock. Water can reappear in three ways:

1. By evaporation from Earth's surface;
2. By transpiration from vegetation;
3. By **exudation** out of the earth thereby forming a stream. This process is of primary importance to the formation of rivers.

When a heavy rain falls on ground that is steeply sloped or is already saturated with water, water run-off trickles down Earth's surface, rather than being absorbed. Initially, the water runs in an evenly distributed, paper-thin sheet, called surface run-off. After it travels a short distance, the water begins to run in **parallel rills** and, at the same time, gathers turbulence. As these rills pass over fine soil or silt, they begin to dig shallow channels, called runnels. This is the first stage of erosion. These parallel rills do not last very long, perhaps only a few yards. Fairly soon, the rills unite with one another, until enough of them merge to form a stream. After a number of rills converge, the resulting stream is a significant, continuously flowing body of water, called a brook. The brook now flows through what is termed a valley. As a brook gains sufficient volume from ground water supplies, the volume of water it carries becomes more constant. Once the volume of water carried reaches a certain level, the brook becomes a river.

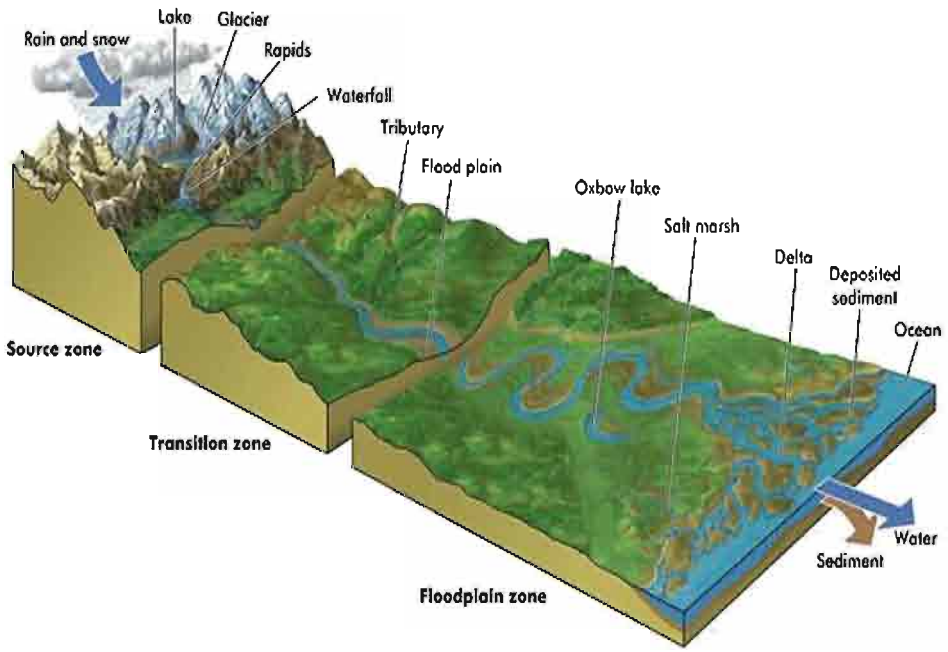


Figure 26. Formation of rivers by precipitation

Glaciation

As glaciers melt the water starts flowing through the least resistant part. Initially these water are in the form of small streams. These forms rills then gullies. As time passes their path gets deepened due to downward cutting. According to Davis theory, rivers have three stages young, mature and old.

The **upper course** stage, rivers are mainly in mountainous region where due to Slope Rivers have huge energy. So they can carry huge load and participate in erosion. During this stage river is engaged in downward cutting through attrition, abrasion, collision etc. We generally find these types of features: V shaped valley, gorges and canyons, rapids, cataracts, waterfalls and plunge pools, river capture due to head ward erosion etc.

In their **middle course** stage we find that their speed decreases due to reduced difference in the base level and present river level of river. So the vertical erosion is reduced and lateral erosion predominates. This leads to widening of river valleys giving rise to U-shaped valleys. River cuts laterally and side walls of valley are eroded and plain area starts developing. Its load carrying capacity is also reduced so deposition of large rocks starts in river bed. General features seen are meanders and oxbow lakes, Alluvial fans and piedmont plains, reduced water divide, levees etc.

In the **lower course,** the river has lost all erosional capacity and deposition is on peak. Prominent features are sluggish river flow, very wide channel, flattening of river, water divide eroded away, peneplain, boondocks and delta.

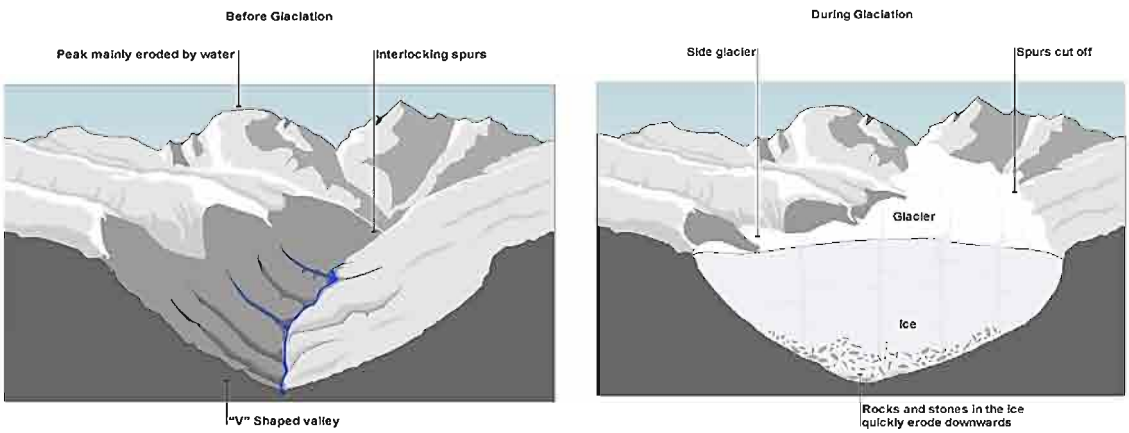


Figure 27. Before and during glaciation

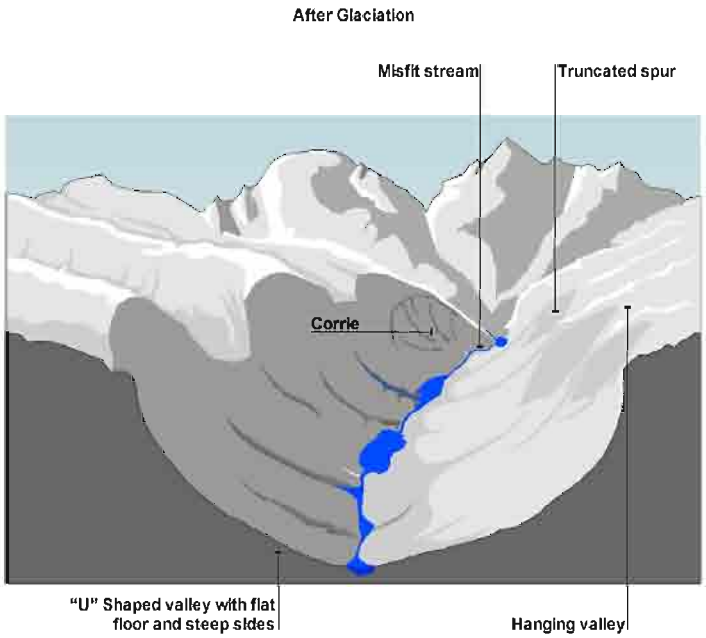


Figure 28. After glaciation

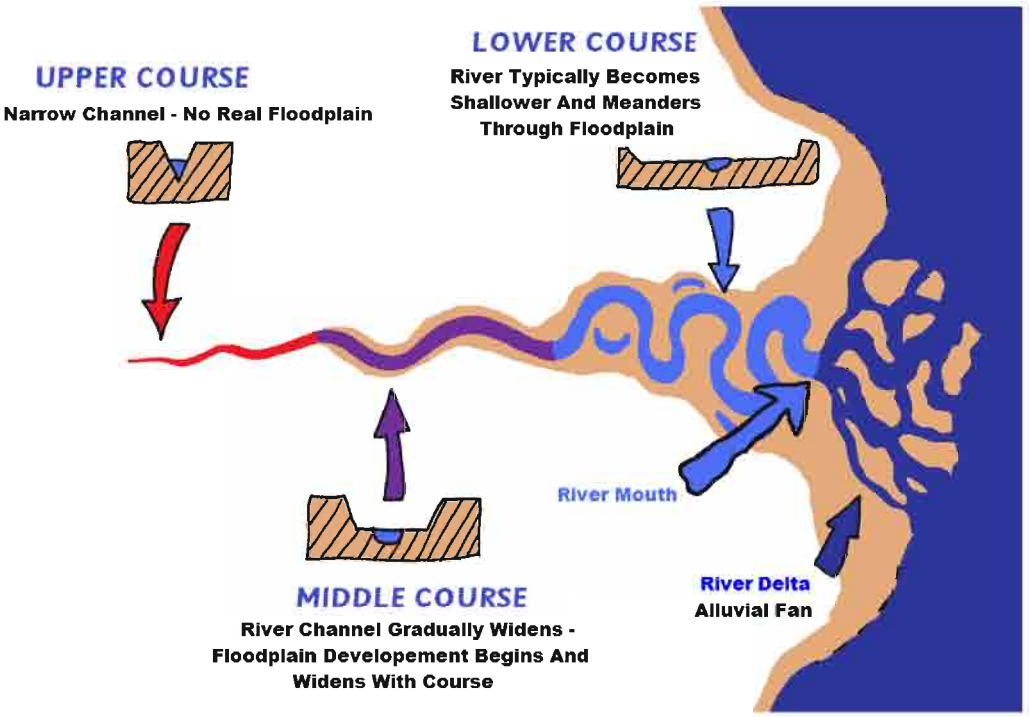


Figure 29.Phases of a River

Progress Check

In pairs formulate a table indicating the parts of a river system that occur within:

1. The upper course of a river.
2. The middle course of a river.
3. The lower course of a river.

Formation of underground rivers

Underground rivers also known as subterranean rivers they are flowing reservoirs of rainwater. Rainwater percolates down through the earth's surface to collect at a level where solid rock prevents the water from going any deeper.

As more and more rainwater percolates through, it increases the pressure on this trapped water. A slight crack, a small opening, is all that the water needs to push through and flow. You then have an underground river.

The flow of water within rocks depends upon two properties: the rock's porosity and permeability. Porosity is that part of a rock's volume, which is made up of empty space or with vessels that allow liquids to flow through. Crystalline rocks have low porosity which is why water finds it difficult to go through. However, sedimentary rocks have high porosity, hence water cuts through easily.

Permeability basically describes a substance that allows liquids and gases to flow through. Therefore, if underground water is surrounded by porous and permeable rocks, the water will push its way through easily.

Underground water follows the steepest slope down. Limestone rocks are honeycombed with tunnels and cones. When rainwater – which contains a certain amount of acid – falls on them, an interesting process takes place. The water starts flowing through the tunnels and caves seeking a way out.

As the water moves along, it wears away more and more of the surrounding rock to produce long tunnels, which eventually turn into underground rivers. These rivers finally reach the sea by surfacing at certain places.

Underground rivers are also born when a powerful spring is unable to surface because of the solidity and compactness of the uppermost layer of rock. It simply redirects its energy and starts flowing underground, looking for an alternate way out.

The distance travelled underground by such a river varies. In some cases it is more and in some others less. The famous Rhine of France travels only a short distance underground.

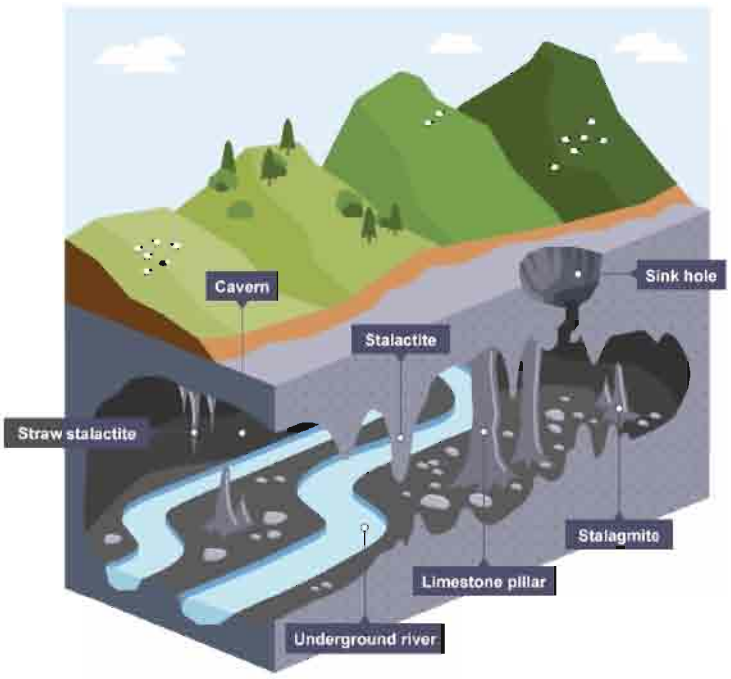


Figure 30. Parts of an underground/ subterranean river.

Parts of an underground river

a) *Cavern:* a large chamber within a cave, mostly underground.
b) *Stalactite:* a column of rock that hangs from the roof of a cave and is formed over a very long period of time by drops of water containing lime falling from the roof
c) *Sink hole:* a hole in the ground, especially in an area of limestone rock, formed naturally, for example by water that has worn away the rock: Rain gradually dissolves the limestone, forming features such as limestone pavements, sinkholes, and caves.
d) *Stalagmite:* a deposit, composed of calcium carbonate, formed on the floor of a cave or the like by the dripping of percolating calcareous water.

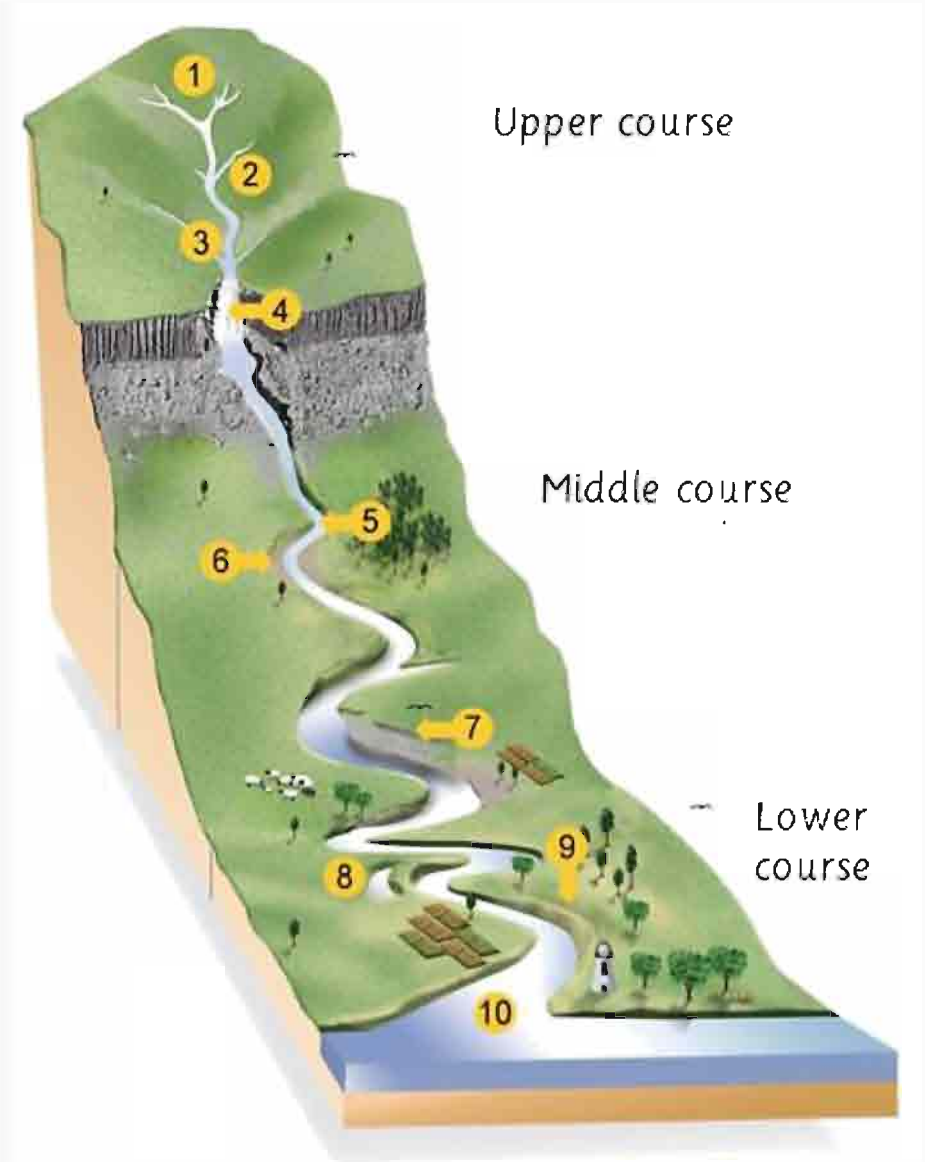
Case study 3

Look at the picture below and answer the questions that follow:

- Is there any river near your home or school?
- Based on what you know describe some of the dangers that may occur in rivers?
- What are the advantages of rivers in relation to human activities?

Comprehensive Activity 5

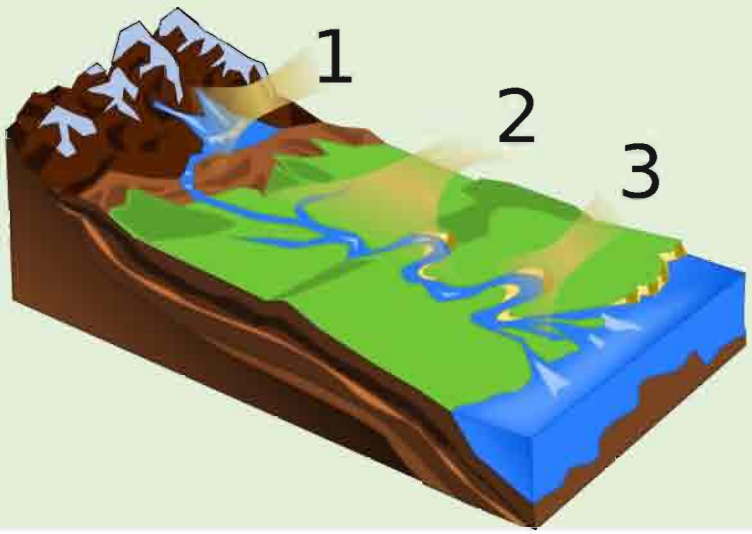
1. Label the diagram below



2. Using a wood plank, clay, water colours, paint brushes, glue, twigs, and pieces of paper (provided by your teacher) make a labelled 3D model of a river system. **Refer to the illustration above.**

Exercise 4

1. Explain the following terms:
    a) Source.
    b) Tributary.
    c) Confluence.
    d) Meander.
    e) Estuary.
    f) Delta.
    g) Mouth.
2. Using well labelled diagrams, explain the following processes on river formation by climatic influence:
    a) Precipitation.
    b) Glaciation.
3. How are underground rivers formed?
4. Using well labelled diagrams, explain the following processes of a river
    a) Erosion.
    b) Transportation.
    c) Deposition.
5. Using the picture below to explain the following stages of a river.
    a) Upper course.
    b) Middle course.
    c) Lower course.



The Rivers of South Sudan

South Sudan is endowed with various water bodies including Rivers. The following are the major rivers of South Sudan:

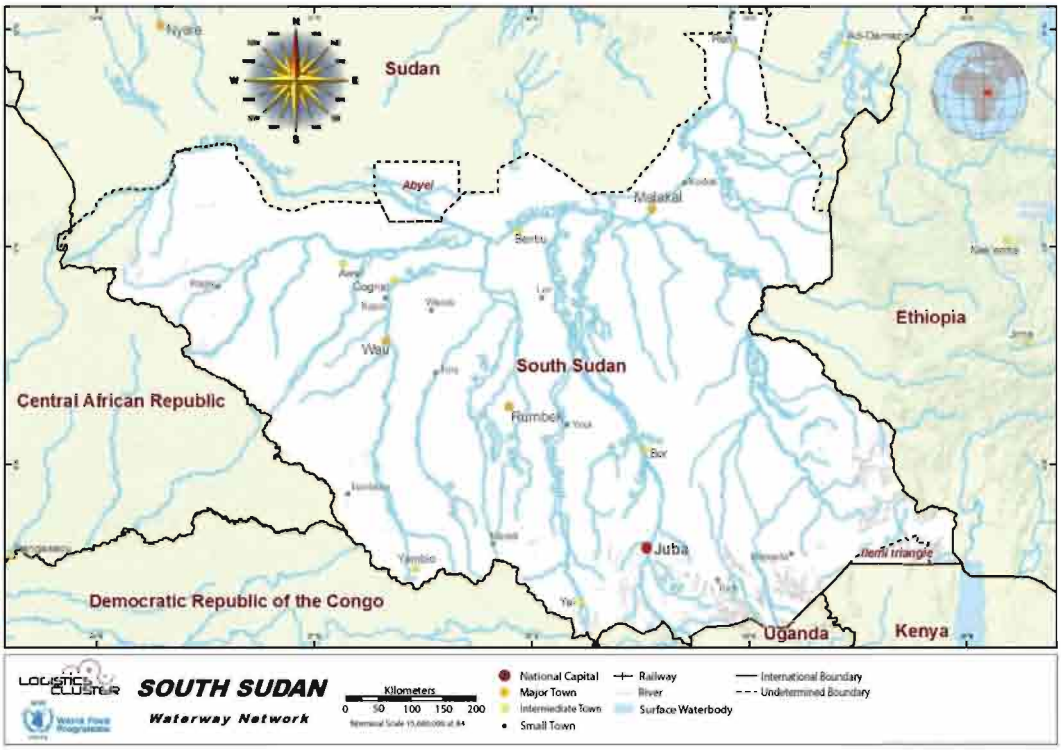


Figure 31. Distribution of rivers in South Sudan

The White Nile

The White Nile enters the country from the south through rapids at Nimule on the Uganda border. After the White Nile confluence with the left- (west-) bank tributary known as the Bahr Al-Ghazal At the heart of the country where is a clay plain, the center of which is occupied by an enormous swampy region known as Al-Sudd (the Sudd Region). A little farther north along its course, the White Nile receives much of its water from the right-bank Sobat River, which flows from the Ethiopian Plateau to join the White Nile near Malakal.

Figure 32. The Bahr Al Jabal (left) and the White Nile (right)

Jur River/ Sue River

Jur River/Sue River is a river in western South Sudan, flowing through the Bahr el Ghazal and Equatoria regions. About 485 kilometres long, it flows north and northeast, joining the Bahr el Ghazal River on the western side of the Sudd wetlands. The Jur River is part of the Nile basin, as the Bahr al-Ghazal flows into the White Nile. The upper course of the Jur is also called the Sue. This river is permanent.

Bahr el Ghazal

Bahr el Ghazal is a river in South Sudan. The name translates as "sea of gazelles". The South Sudanese region of Bahr el Ghazal takes its name from the river. The Bahr el Ghazal is the main western tributary of the Nile. It is 716 kilometres long, flowing through the Sudd wetlands to Lake No, where it joins the White Nile.

Bahr al-Arab (Kiir River)

Bahr al-Arab is a river which flows approximately 800 kilometres through the Southwest of Sudan and marks part of its boundary with South Sudan. It is part of the Nile river system, being a tributary of Bahr el Ghazal, which is a tributary of the White Nile. This is a permanent river.

Sobat River

Sobat River is a river of the Greater Upper Nile region in northeastern South Sudan, Africa. It is the most southerly of the great eastern tributaries of the Nile. The Sobat River is formed by the confluence of the west-flowing Baro River and the north-flowing Pibor River, on the border with Ethiopia. The river enters the White Nile at Doleib Hill, near the city of Malakal in Upper Nile State. Sobat River is a permanent river.

Figure 33. The Sobat River

Adar River

Adar River is a tributary of the White Nile in the state of Upper Nile, South Sudan. It flows North West from the Machar Marshes and enters the White Nile just upstream of the town of Melut.

Yabus River

Yabus River raises in the far west of Ethiopia, in Asosa Zone, flows west into Sudan past the town of Yabus, and then enters South Sudan. At the town of Boing it turns south west and enters the Machar Marshes, where it loses its identity.

Daga River

Daga River is a river in South Sudan. It rises in the mountains of the Mirab Welega Zone in Ethiopia, just east of the South Sudan – Ethiopia border, where it is known as the Deqe Sonka Shet. It flows west past the town of Daga Post and enters the Machar Marshes where it loses its identity.

Exercise 5

1. Using the map, answer the questions that follow.

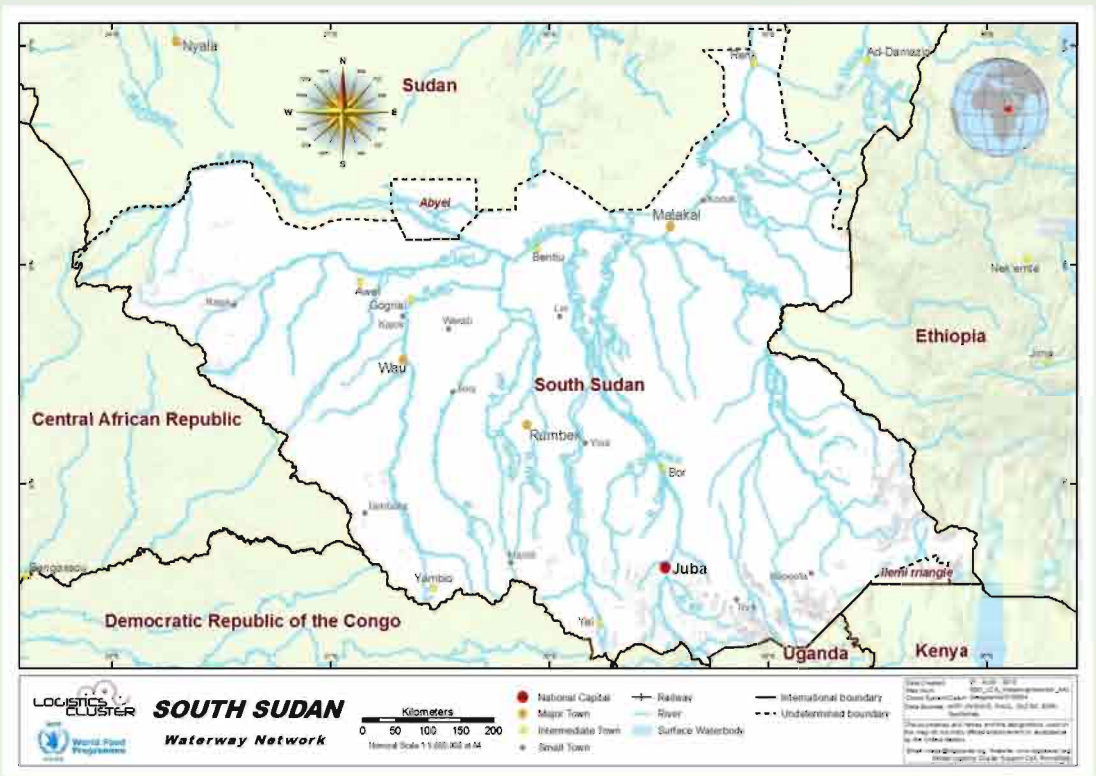


Figure 34. Distribution of rivers in South Sudan

a) Identify the major rivers of South Sudan.
b) What is the source of the Nile River?
c) List any other river in South Sudan.
d) Identify permanent and seasonal rivers in South Sudan.

Formation and types of lakes

A **lake** is a body of water that is surrounded by land. There are millions of lakes in the world. They are found on every continent and in every kind of environment, in mountains and deserts, on plains, and near seashores. The water in lakes comes from rain, snow, melting ice, streams, and groundwater seepage. Most lakes contain freshwater.

All lakes are either **open** or **closed**. If water leaves a lake by a river or other outlet, it is said to be open. All **freshwater lakes** are open. If water only leaves a lake by evaporation, the lake is closed. Closed lakes usually become **saline**, or **salty**. This is because as the water evaporates, it leaves behind solids, mostly salts. The Great Salt Lake, in the U.S. state of Utah, is the largest saline lake in North America. Its water is saltier than the ocean. Surrounding the Great Salt Lake are salt flats, areas where the lake has evaporated, leaving only stretches of white salt. An example of a salt lake in Africa is Lake Magadi of Kenya.

Progress Check

Discuss the differences between:

a) Open and closed lakes.
b) Salty and fresh water lakes.

How Lakes Are Formed?

By glaciation

All lakes fill bowl-shaped depressions in the earth's surface, called basins. Lake basins are formed in several ways. Many lakes, especially those in the Northern Hemisphere, were formed by glaciers that covered large areas of land during the most recent ice age, about 18,000 years ago.

The huge masses of ice carved out great pits and scrubbed the land as they moved slowly along. When the glaciers melted, water filled those depressions, forming lakes. Glaciers also carved deep valleys and deposited large quantities of earth, pebbles, and boulders as they melted.

Caldera lakes

Many lakes form as a result of volcanoes. After a volcano becomes inactive, its crater may be filled with rain water or melted snow. Sometimes the top of a volcano is blown off or collapses during an eruption, leaving a depression called a caldera. It, too, may fill with rainwater and become a lake. Lake Ngozi in Tanzania is a good example of a caldera. It is the second largest caldera in Africa.

Figure 35. Lake Ngozi, Tanzania

Oxbow lakes

Oxbow lakes are formed by rivers. Mature rivers often wind back and forth across a plain in wide loops called meanders.

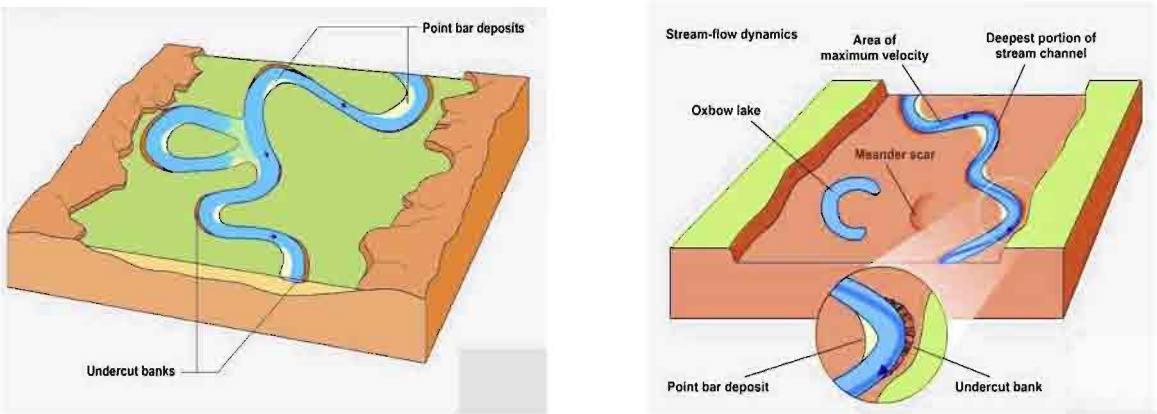


Figure 36. Formation of an oxbow lake

During periods of flooding, a swollen, rushing river may create a shortcut and bypass a meander, leaving a body of standing water. This type of small lake is called an *oxbow lake*

Landslide lakes

Lakes may also be created by landslides or mudslides that send soil, rock, or mud sliding down hills and mountains. The debris piles up in natural dams that can block the flow of a stream, forming a lake. Dams that beavers build out of tree branches can plug up rivers or streams and make large ponds or marshes.

Figure 37. Usoi dam in Asia is an example of a landslide lake.

Artificial lakes.

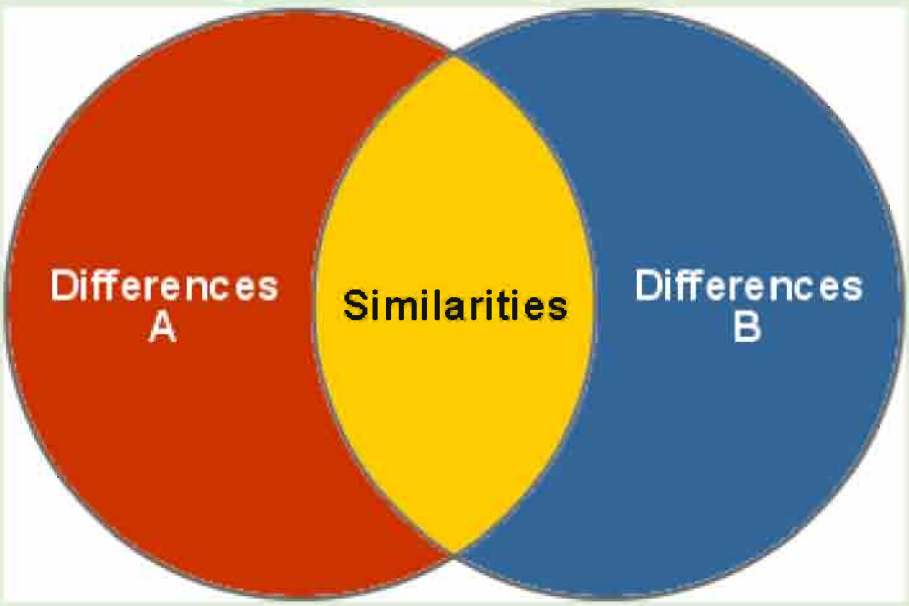
People make lakes by digging basins or by damming rivers or springs. These artificial lakes can become reservoirs, storing water for irrigation, hygiene, and industrial use. Artificial lakes also provide recreational use for boating, swimming, or fishing.

Artificial lakes can provide electricity through hydroelectric power plants at the dam.

Progress Check

Making a Venn diagram showing relationships between the major lake formation processes.

A Venn diagram is an illustration of the relationships between and among sets or groups of things that share something in common. A Venn diagram consists of overlapping circles. Each circle contains all the elements of a set. Where the circles overlap shows the elements that the set have in common. Look at the example below:



Now that you have a clue of what Venn diagrams are, in pairs, design a Venn diagram showing the similarities and differences of how lakes are formed.

Lakes in South Sudan

There are basically 11 lakes in South Sudan. We are going to look at 4 major lakes;

Lake No

Lake No is a lake in South Sudan. It is located just north of the vast swamp of the Sudd, at the confluence of the Bahr al Jabal and Bahr el Ghazal rivers. It marks the transition between the Bahr al Jabal and White Nile proper. Lake No is located approximately **1,156 km** downstream of Uganda's Lake Albert, the major lake on the White Nile preceding Lake No. The lake is considered the center of the Reweng people of Panrou section of Dinka people.

Figure 38. Lake No, North of the Sudd swamp.

Lake Fajarial

Lake Fajarial is a natural lake that covers a surface area of 3 km2 (0.95 mi2), has an average depth of 0.9 meters (3 feet). Lake Fajarial has a total shore line of 8 kilometers (5 miles).

Lake Ambadi

Lake Ambadi is a lake of South Sudan. It forms one of the world's largest wetlands, and is home to large numbers of the rare Shoebill.

Lake Gwer

Lake Gwer is a natural lake covers a surface area of 1 km^2. It has an average depth of 0.5 meters (2 feet). Lake Gwer has a total shore line of 5 kilometers The Lake, which sits at an elevation of 405 meters (1,329 feet).

Case study 4

- How do lakes influence human activities? *Discuss this in pairs.*
- Which lake in South Sudan would you want to live by? Explain

Exercise 6

In groups and answer the following questions:

1. Define the following terms:
    a) Lake.
    b) Pond.
2. Using well illustrated diagrams, explain how an oxbow lake is formed.
3. List other processes through which a lake can be formed.
4. How are lakes classified? Explain.

Plains and plateaus

What are plains and plateaus?

Plains and plateaus are different from mountains in that they are made up of rock formations that are in the same horizontal position. They are majorly flat.

Plains are flat surfaces at low levels. Coastal plains are made up of bits of rock that are carried along from rivers to the ocean or are worn away from rocks along the seashore. Sometimes inland plains are formed when seas or lakes get filled in with sediment or soil and become flat plains. Many extensive plains are a result of down warping of the earth's crust for example, Siberia in Asia, North European plains, Indo-getic plains and the Great central plains of North America

Plateaus are raised areas of land with a flatter top. It differs from a mountain in that a mountain has a jagged peak at the top. Plateaus form both when mountains get worn down and their tops are not as jagged or when a large portion of flat earth is pushed up from the earth.

There are several special kinds of plateaus. One is a **butte**. A butte is like a plateau but its top is a bit more rounded. A **mesa** is a plateau with quite a flat top.

Figure 39. A butte (left) and Mesa (right)

Plains and plateaus of South Sudan

South Sudan's vast plains and plateaus are drained by the Nile River and its tributaries. This river system runs from South to north across the entire length of the east-central part of the country. At the heart of the country is a clay plain, the center of which is occupied by an enormous swampy region known as Al-Sudd (the Sudd).

The main plateaus of South Sudan are;

1. The Boma plateau.
2. The Lomareng plateau.
3. Ironstone plateau.

The Boma Plateau

The Boma Plateau is a region in the east of South Sudan, located in the **Jonglei** and **Eastern Equatoria** provinces. It is inhabited by the **Anuak, Murle** and **Toposa** people. It contains important wetlands for birdlife in the region. Wildlife is threatened by overgrazing by cattle, and by overhunting by local tribes with firearms. Within it, Boma National Park (2,280,000 ha) was established in 1977.

The Boma Plateau is also one of the few places in the world where wild Coffee Arabica grows.

Figure 40. Images of the Boma plateau

The Ironstone Plateau

The Ironstone Plateau is a region in the South and west of Sudan. The Ironstone Plateau takes its name from the **hard red lateritic** soil called ironstone that covers almost the entire area. These soils are often thin and may be unsuitable for agriculture, except in the **Green Belt** in the extreme Southwest of Western Equatoria and in a region around the Acholi Mountains in the Torit County of Eastern Equatoria.

The north and east of the ironstone plateau is covered in **clayish black cotton soil**, mostly grasslands that are prone to flooding. The black cotton soil cracks when it is dry, but expands and becomes sticky in the rain, making travel difficult. The ironstone plateau has more trees and travel is easier. The plateau and peneplain are mostly wooded.

The Ironstone Plateau lies between the Nile-Congo watershed and the clay plain; its level country is marked with inselbergs (isolated hills rising abruptly from the plains). On the Uganda border there are massive ranges with peaks rising to more than 10,000 feet (3,000 meters). The Imatong Mountains contain Mount Kinyeti (elevation 10,456 feet *[3,187 meters]*), the highest point in South Sudan.

Figure 41. Location of the Iron stone plateau in South Sudan.

The Lomareng Plateau

Lomareng Plateau is a plateau within South Sudan and is Southwest of **Moru Kurun, Eyata Moru and Apaiyaputh.** Lomareng Plateau has an elevation of **444 meters.**

Case study 5

In pairs, identify the importance of plateaus and plains to humans. Present your finding before the class.

Exercise 7

1. Using examples in South Sudan, explain how plains and plateaus are formed.
2. Define the following terms:
    a) Plain and plateau.
    b) Butte and mesa.
    c) Inselberg
3. Where are the following physical features found in South Sudan? (**use a sketched map to pinpoint the location of the physical features below**)
    a) The ironstone plateau.
    b) The Lomareng plateau.
    c) Boma plateau.

Unit 2

NATURAL ECOSYSTEMS

What are natural ecosystems?

An **ecosystem** is comprised of all the non-living elements and living species in a specific local environment. Components of most ecosystems include water, air, sunlight, soil, plants, microorganisms, insects and animals. Ecosystems may be terrestrial – that is, on land – or aquatic. Sizes of ecosystems vary; they could entail a small puddle or an enormous swath of desert. Likewise, natural ecosystems can look quite different from one another.

Natural ecosystems can be described as self-sustained ecological units, low in human involvement or disruption, living in balance, and having a high proportion of native biodiversity. Natural ecosystems offer opportunities for scientific study and for enjoying the complexity and beauty of nature.

Figure 42. The Amazon rainforest in Brazil, South America, the world's largest tropical rainforest. It is home for many indigenous plant and animal species

Artificial ecosystems or simply man-made ecosystems including urban, suburban and agricultural areas, are significantly altered and maintained by human activity.

Figure 43. Juba, the Capital city of South Sudan is an example of a man-made ecosystem.

Creative activity 4

Making models of Natural and Man-made ecosystems.

Organize yourselves in groups and follow the steps provided.

Natural ecosystem	Man- made ecosystem
Requirements: clay/ plastacine, pieces of twigs, pieces of grass. *Steps* 1. Make sure your group has the materials required. 2. Be creative, using the materials come up with designs of a forest with all the natural features within it: rivers, trees, grass fields, wild animals etc.	*Requirements:* clay/ plastacine, pieces of twigs, pieces of grass, wooden blocks, carton boxes, glue and pieces of paper. *Steps* 1. Make sure your group has the materials above. 2. Be creative, using the materials provided come up with models of human settlements including cities. (*Include roads, vehicles, etc.)*

Characteristics of natural ecosystems

They Are Hierarchical

All ecosystems have a feeding hierarchy. The hierarchy includes an energy source (e.g., the sun) and producers, consumers, decomposers and non-living chemicals such as minerals and other elements. These components depend on one another.

Ecosystems may contain **grazer** food webs in which plants (i.e., producers) absorb non-living nutrients with the help of the sun. Animals (i.e., consumers) eat plants and other animals to take in nutrients. When plants and animals die or when animals excrete waste, bacteria (i.e., decomposers) feed on the waste materials. The nutrients then go back into the water and/or soil for re-absorption by producers. A **detritus** food web occurs in the absence of sunlight. In a detritus food web, the energy comes from dead matter (i.e., detritus) instead of green producers. One example of a detritus food web is the ecosystem of a deciduous forest floor.

They have biodiversity

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.

Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being. Biodiversity is important in human-managed as well as natural ecosystems. Decisions humans make that influence biodiversity affect the well-being of themselves and others.

Figure 44. African elephants herding in Nimule national park, South Sudan and left, a sea turtle swimming in the northern Pacific Ocean, Hawaiian coast.

Earth is thought to have over 10 million different species of life, and ecosystems depend on such biodiversity for survival. Because each organism in an ecosystem has a purpose (i.e., a niche), the loss of just one species from an ecosystem could significantly shift the balance.

If biodiversity in an ecosystem declines, the system may become more susceptible to environmental occurrences such as drought and other problems such as disease and pests. For example, tropical rain forests are complex ecosystems full of biodiversity. Plants and animals in a rain forest thrive because of the natural balance of the ecosystem. When a rain forest ecosystem is altered to support a banana farm, pest problems abound. Seemingly, when we don't conserve the environment we suffer natural disasters such as famine and drought.

Figure 45. Dead livestock as a result of famine in Noorpur Thal area, Sargodha, Pakistan.

They have regular temperature and rainfall patterns

Due to complicated global climate patterns, different areas have unique and relatively cyclical climates.

Ecosystems form in response to the unique but predictable climate of each geographic area. Unique ecosystems will form in different climates. Likewise, since elevation and topography affect climate, different ecosystems will form at different elevations. The life that exists in any given ecosystem is the direct result of elevation, topography and temperature and rainfall patterns. For example, the vegetation of a desert ecosystem is sparse due to temperature extremes and lack of rainfall. The plant life that does exist is adapted to conserve water. Desert fauna also have adapted for water conservation, and since desert plants are important sources of water for the animals, many desert plants have developed extreme protection methods (e.g., cactus needles).

Figure 46. A cactus plant.

Progress Check

Discuss how different plants and animals have adapted to the different ecosystems of the world.

Forest ecosystems

A **forest** is a large area dominated by trees. Forests are the dominant terrestrial ecosystem of Earth, and are distributed across the globe. Forests account for 75% of the gross primary productivity of the Earth's biosphere, and contain 80% of the Earth's plant biomass.

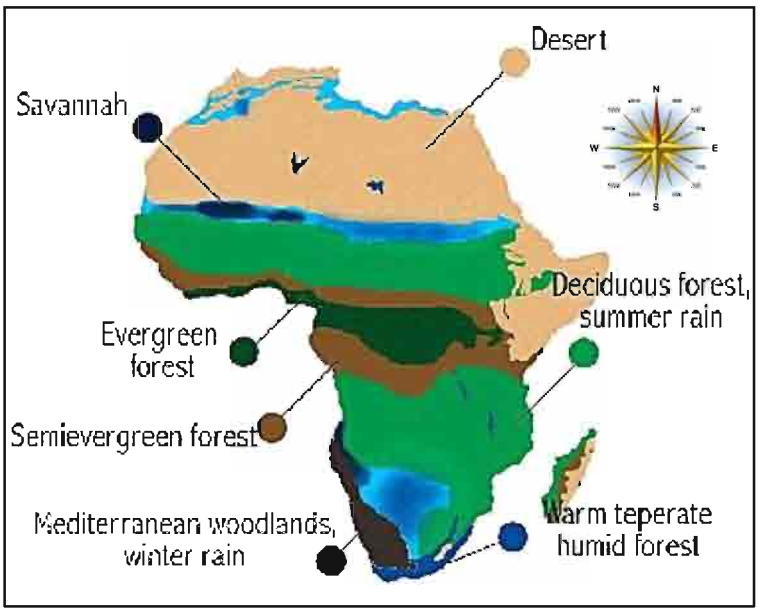


Figure 47. Distribution of forests in Africa.

Forests at different latitudes and elevations form distinctly different eco-zones: boreal forests near the poles, tropical forests near the equator and temperate forests at mid-latitudes. Higher elevation areas tend to support forests similar to those at higher latitudes, and amount of precipitation also affects forest composition.

The following are types of forests:

1. Tropical and subtropical forests.
2. Temperate forests.
3. Savanna woodlands.
4. Forest plantations.

Tropical rainforests

Located in tropical regions, rainforests possess a greater diversity of plant and animal life than any other type of ecosystem. As their name implies, precipitation/ rainfall is significant, leading to dense, green vegetation. Trees grow very tall as they compete for sunlight, and animals live in their canopy.

Most of Africa's remaining rainforests are found in the Congo River basin on the Atlantic Ocean side of the continent. The Congo rainforest is famous for its gorillas, chimpanzees, and elephants as well as its native population of forest dwellers known as pygmies.

Figure 48. The Congo rainforest (left) famous for its chimpanzee (pictured right) and gorillas.

Rainforests in the Congo are mostly under threat from logging, subsistence activities like small-scale agriculture and firewood collection, and commercial agriculture, including large plantations. Wildlife is endangered from hunting.

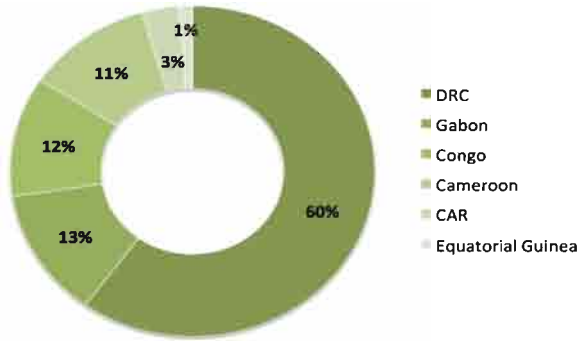


Figure 49. Congo basin rainforest cover.

Rainforests in South Sudan

The forests of the **Imatong Mountains**, rising to 10,456 feet (3,187 meters), in Southern South Sudan are part of the Eastern **Afro-montane** ecosystem. Although the afro-montane forests reach only into limited areas of South Sudan, they offer an estimated half of South Sudan's plant biodiversity. These forests are home to many endemic and possibly unique species.

Figure 50. The Imatong mountain forest reserve.

The Imatong forests have been heavily degraded and deforested, and Mount Dongotono is now bearing the brunt of clearing that threatens to fragment the ecosystem further. The mountain's tree cover has been reduced by two-thirds since 1986, and, if deforestation in the area continues, the forests of Mount Dongotono will also disappear before the end of the decade.

Northeast of Mount Dongotono, the Didinga hills were largely cleared by 1986, and in 2010 small farmers continued deforesting the eastern side of Mount Dongotono. The Imatong Mountains are critical to Africa's biodiversity, yet also crucial to the economic development of South Sudan. Deforestation in South Sudan is mainly driven by the harvesting of wood fuels and other subsistence needs, and people's survival will be jeopardized further should the region's forests be cleared and its resources entirely lost.

Temperate rainforests

Temperate rainforests are **coniferous** or **broadleaf forests** that occur in the temperate zone. Unlike the tropical rain forest, the temperate rain forest has seasonal variation,

with summer temperatures rising to about 80 degrees Fahrenheit and winter temperatures dropping to near freezing.

Figure 51. Temperate rain forest in Taiga national park, Russia

Compared to the tropical rain forest, the temperate rain forest has a less complex ecology. Temperate rainforests consist of only 2 layers of vegetation; the emergent layer and the canopy layer. The understory layer and the forest floor consist of less vegetation. The tallest trees in rainforests have their leaves typically approximately 15 to 30 centimeters from the ground, including a dense layer of small trees and shrubs beneath, at about 5 to 10 meters. This is the reason why the soil in temperate rainforests receives a lot more light than their tropical counterparts. The undergrowth in temperate rainforests is lush, consisting mainly of mosses, lichens, and ferns.

Figure 52. Distribution of temperate rainforests in the world.

In the course of growth during spring, when the tree leaves have not wholly formed, there is a lot of light penetrating to the forest floor. This aspect allows plant species to thrive on the ground, which explains why plant species that exist on the ground surface grow, flower and produce fruits before late summer. Later on, sciophilus plants (plants species that love shade) begin to grow. These plant species have developed immaculate mechanisms to harness and utilize low-light intensity, which gives them the ability to get by even when the vegetation or greenery grows and entirely covers the soil below.

The main kinds of trees found in the temperate rainforest biome include oaks, beeches, walnut trees, lime trees, sycamores, aspens, elms, tulip trees, and birches.

Savanna woodlands

A **savanna** or **savannah** is a mixed woodland grassland ecosystem characterized by the trees being sufficiently widely spaced so that the canopy does not close. The open canopy allows sufficient light to reach the ground to support an unbroken herbaceous layer consisting primarily of grasses.

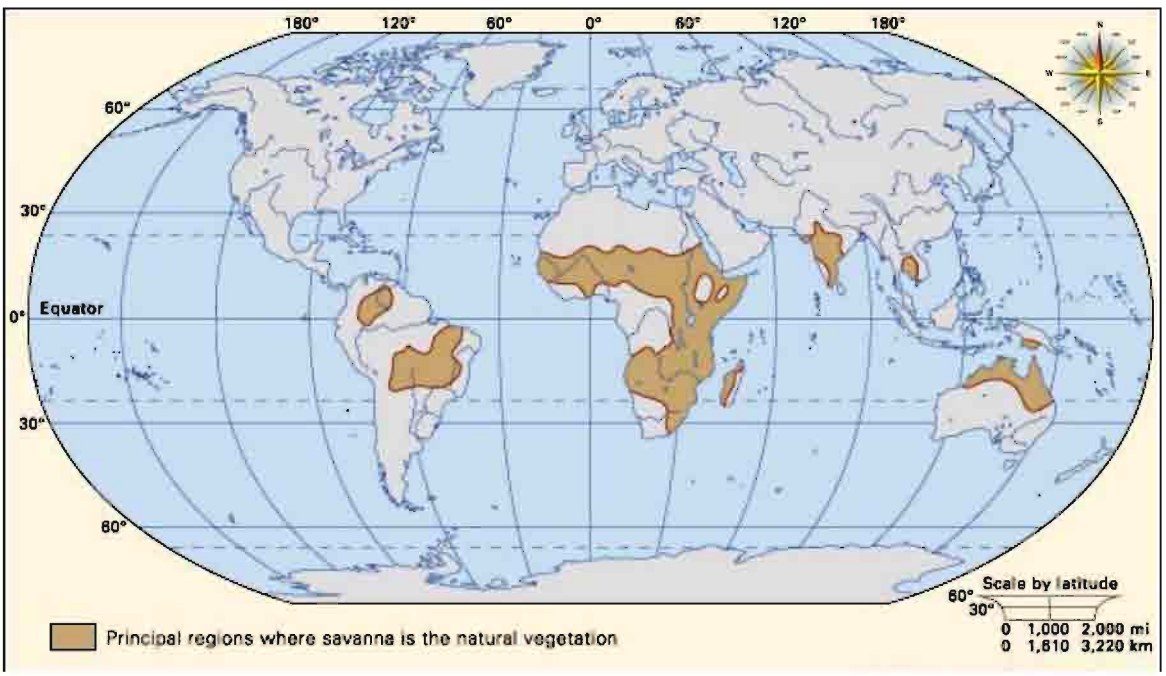


Figure 53. Savanna distribution in the world

Types of savannas

Tropical and subtropical savannas

Tropical and subtropical savannas are classified with tropical and subtropical grasslands and shrublands as the tropical and subtropical grasslands, savannas, and shrublands biome. The savannas of Africa, including the Serengeti, famous for its wildlife, are typical of this type. The Brazilian savanna (Cerrado) is also included in this category, known for its exotic and varied flora.

Figure 54. The Brazilian savanna also known as Cerrado (left) and the Serengeti in Tanzania (right).

Temperate savannas

Temperate savannas are mid-latitude savannas with wetter summers and drier winters. They are classified with temperate savannas and shrublands as the temperate grasslands, savannas, and shrublands biome, which for example cover much of the Great Plains of the United States.

Mediterranean savannas

Mediterranean savannas are mid-latitude savannas in Mediterranean climate regions, with mild, rainy winters and hot, dry summers, part of the Mediterranean forests, woodlands, and scrub biome. The oak tree savannas of California, part of the California chaparral and woodlands ecoregion, fall into this category.

Flooded savannas

Flooded savannas are savannas that are flooded seasonally or year-round. They are classified with flooded savannas as the flooded grasslands and savannas biome, which occurs mostly in the tropics and subtropics.

Montane savannahs

Montane savannas are mid- to high-altitude savannas, located in a few spots around the world's high mountain regions, part of the montane grasslands and shrublands biome. The Bogotá savanna, located at an average altitude of 2,550 meters (8,370 ft) on the Altiplano Cundiboyacense, Eastern Ranges of the Andes, is an example of a montane savanna. The savannas of the Angolan Scarp savanna and woodlands ecoregion are a lower altitude example, up to 1,000 metres (3,300 ft).

Figure 55. The Bogota savanna located in the eastern ranges of the Andes Mountains, Colombia

The savannas of South Sudan

The East Sudanian Savanna

The East Sudanian Savanna is a hot, dry, tropical savanna ecoregion of Central and East Africa. This is the eastern half of the broad savanna belt which runs east and west across Africa, this section lying east of the Cameroon Highlands. The Sahel belt of drier acacia savanna lies to the north and beyond that is the Sahara Desert, while to the South lies the humid forests of the DR Congo.

The Sudd flooded grasslands of South Sudan divide this area into eastern and western blocks. The land is mainly flat, although there are some hillier sections around Lake Albert and in Western Ethiopia.

The western block covers portions of northern Cameroon, Southern Chad, northern Central African Republic, and Southeastern South Sudan.

Figure 56. The East Sudanian savanna

The Eastern block lies in a belt stretching from northern Uganda along the Sudan-Ethiopia border region, bounded on the east by the Ethiopian Highlands of Ethiopia and to the South by the Victoria Basin forest-savanna mosaic of Uganda. The climate is tropical with a rainy season (from April to October) and a dry season.

The Saharan flooded grasslands (Sudd / al-sudd swamplands)

Al-Sudd, swampy lowland region of central South Sudan, 200 miles (320 km) wide by 250 miles (400 km) long. It is drained by headstreams of the White Nile, namely the Al-Jabal (Mountain Nile) River in the Centre and the Al-Ghazāl River in the west. The Al-Jabal River overflows in the flat, saucer like clay plain of the Sudd to form countless swamps, lagoons and side channels, and several lakes along its course. The river's flow is further slowed in the swamps by the luxuriant growth of tall papyrus (Arabic al-sudd, "the papyrus"), aquatic grass, and water hyacinth.

Figure 57. The coverage and location of the Sudd swamplands in South Sudan.

The White Nile loses more than half of its water in the Sudd Region through evaporation. The Sudd presents an almost impenetrable barrier to navigation on the river and is only sparsely inhabited by the pastoral Nilotic tribes such as The Nuer and Dinka people.

Figure 58. Left, an aerial view of the wide Sudd swampland and right, swamp papyrus reeds growing in the Sudd swamplands

Progress Check

Using a sketched map, research on which types of forest ecosystems are found in South Sudan. Locate the ecosystem on the sketched map you have just drawn.

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The Tundra ecosystem

Tundra is the coldest of all the ecosystems. Tundra comes from the Finnish word *tunturia,* meaning treeless plain. It is noted for its frost-molded landscapes, extremely low temperatures, little precipitation, poor nutrients, and short growing seasons. Dead organic material functions as a nutrient pool. The two major nutrients are nitrogen and phosphorus. Nitrogen is created by biological fixation, and phosphorus is created by precipitation.

Characteristics of the Tundra ecosystem

1. Extremely cold climate
2. Low biotic diversity
3. Simple vegetation structure
4. Limitation of drainage
5. Short season of growth and reproduction
6. Energy and nutrients in the form of dead organic material
7. Large population oscillations

Types of Tundra

Tundra is separated into two types: *arctic tundra* and *alpine tundra.*

The Arctic Tundra

Arctic tundra is located in the northern hemisphere, encircling the North Pole and extending south to the coniferous forests of the taiga. The arctic is known for its cold, desert-like conditions. The growing season ranges from 50 to 60 days. The average winter temperature is -34° C (-30° F), but the average summer temperature is 3-12° C (37-54° F) which enables this biome to sustain life.

Rainfall may vary in different regions of the arctic. Yearly precipitation, including melting snow, is 15 to 25 cm (6 to 10 inches). Soil is formed slowly. A layer of permanently frozen subsoil called permafrost exists, consisting mostly of gravel and finer material. When water saturates the upper surface, bogs and ponds may form, providing moisture for plants. There are no deep root systems in the vegetation of the arctic tundra, however, there are still a wide variety of plants that are able to resist the cold climate.

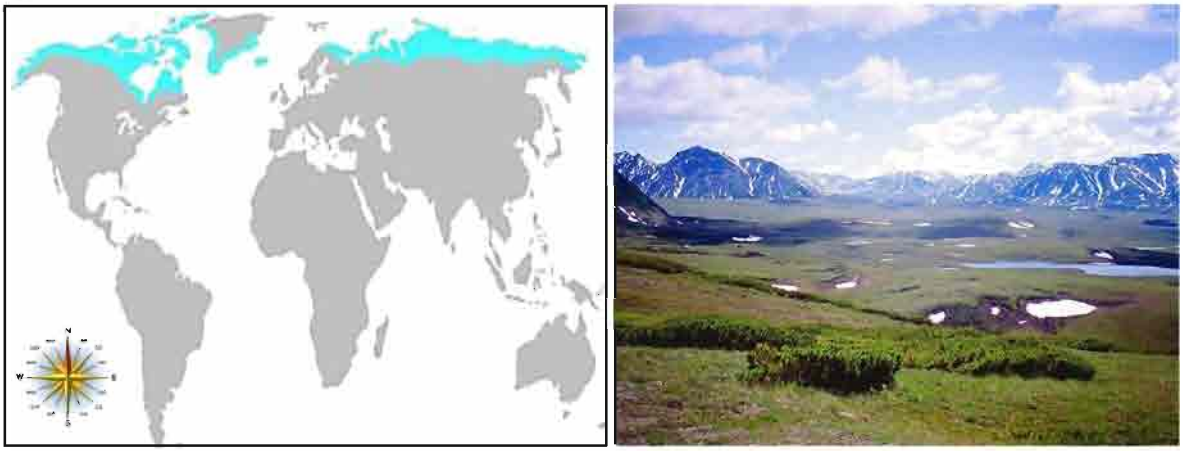


Figure 59. Left, Distribution of the arctic tundra ecosystem in the world and right, the tundra ecosystem in the arctic region.

All of the plants are adapted to sweeping winds and disturbances of the soil. Plants are short and group together to resist the cold temperatures and are protected by the snow during the winter. They can carry out photosynthesis at low temperatures and low light intensities. The growing seasons are short and most plants reproduce by budding and division rather than sexually by flowering. The fauna in the arctic is also diverse:

a) **Herbivorous mammals**: lemmings, voles, caribou, arctic hares and squirrels
b) **Carnivorous mammals:** arctic foxes, wolves, and polar bears.
c) **Migratory birds**: ravens, snow buntings, falcons, loons, ravens, sandpipers, terns, snow birds, and various species of gulls.
d) **Insects:** mosquitoes, flies, moths, grasshoppers, blackflies and arctic bumble bees.
e) **Fish:** cod, flatfish, salmon, and trout.

Figure 60. Animals in the arctic tundra ecosystem

Animals are adapted to handle long, cold winters and to breed and raise young quickly in the summer. Animals such as mammals and birds also have additional insulation from fat. Many animals hibernate during the winter because food is not abundant. Another alternative is to migrate South in the winter, like birds do. Reptiles and amphibians are few or absent because of the extremely cold temperatures. Because of constant immigration and emigration, the population continually oscillates.

The Alpine Tundra

Alpine tundra is located on mountains throughout the world at high altitude where trees cannot grow. The growing season is approximately 180 days. The nighttime temperature is usually below freezing. Unlike the arctic tundra, the soil in the alpine is well drained. The plants are very similar to those of the arctic ones and include: Tussock grasses, dwarf trees, small-leafed shrubs, and heaths.

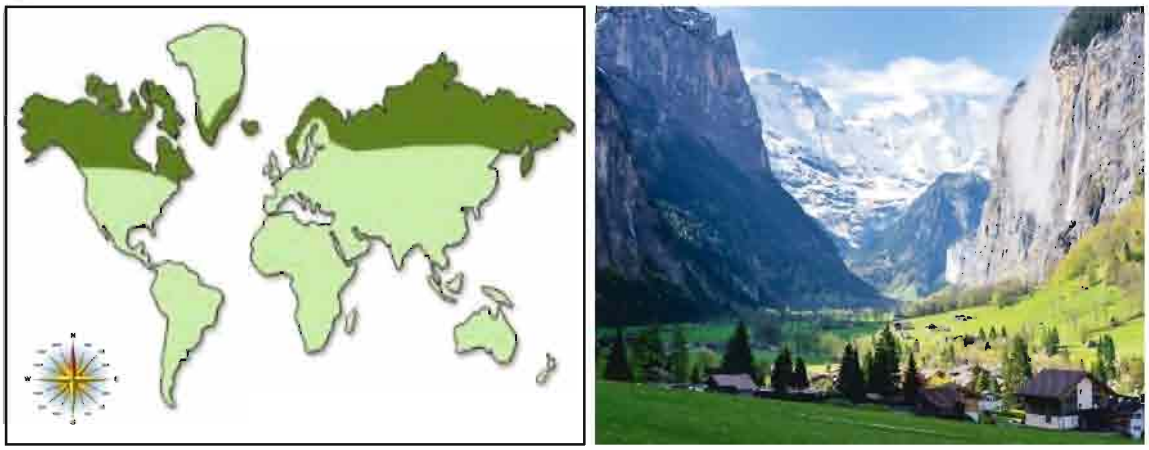


Figure 61. Left, distribution of the alpine tundra ecosystem in the world and right, the Swiss Alps, Switzerland.

Animals living in the alpine tundra are also well adapted. They include:

1. **Mammals:** pikas, marmots, mountain goats, sheep, elk.
2. **Birds:** grouselike birds.
3. **Insects:** springtails, beetles, grasshoppers, butterflies.

Figure 62. The Big horn sheep in the alpine tundra of Colorado, United States of America.

Progress Check

Compare and contrast the arctic and the tundra ecosystem

Ecosystem Management

What is ecosystem management?

Ecosystem management is a process that aims to conserve major ecological systems and restore natural resources while meeting the socioeconomic, political and cultural needs of current and future generations. The principal objective of ecosystem management is the efficient maintenance and ethical use of natural resources. It is a multifaceted and holistic approach which requires a significant change in how the natural and human environments are identified.

Human populations have been increasing rapidly, introducing new stressors to ecosystems, such as climate change and influxes of invasive species. As a result, the demand for natural resources is unpredictable. Although ecosystem changes may occur gradually, the cumulative changes can have negative effects for humans and wildlife. Geographic Information Systems (GIS) and Remote Sensing Applications can be used to monitor and evaluate natural resources by mapping them in local and global scales. These tools will continue to be highly beneficial in natural resources management.

Progress Check

Discuss how human development possess a threat to natural ecosystems.

Case study 6

1. Based on what you know, discuss the various ways we can conserve the environment and protect the plants and animals in an ecosystem. Work in groups and present your findings before the class.
2. Write a brief essay on how human activities affect the ecosystems? Your essay should tackle the following points:
   - Environmental pollution.
   - Effects of pollution to animal and plant species.

Field Trip 1

Visiting a nearby National Park

Take a visit at any nearby National Park or game reserve and observe the relation of the animals within the National Park or game reserve to the environment.

After the visit, answer the following questions:

a) What ecosystem is found in the National Park or Game Reserve?
b) What indigenous plant species and endangered animal species are found in the National Park or Game Reserve?
c) How do the animals in the Game Park or the Game Reserve relate in the ecosystem within the Game Park or the Game Reserve? (Draw a food web to justify your answer).

Exercise 8

1. Define the following terms:
    a) Ecosystem.
    b) Food web.
    c) Forest.
    d) Tundra ecosystem.
    e) Alpine ecosystem
    f) Savannah.
2. Using appropriate examples, explain the difference between natural and man-made ecosystems.
3. What are the characteristics of natural ecosystems?
4. List the types of forest ecosystems.
5. What are the differences between the arctic tundra and the alpine tundra?
6. What are the different types of savanna woodlands? Use appropriate examples.
7. Where is the sudd swampland located in South Sudan?
8. What do you understand by ecosystem management?

Unit 3 THE ECONOMY OF SOUTH SUDAN

Introduction

Being a young nation in the East African region and in the African continent, South Sudan's economy is improving despite facing many challenges. Although South Sudan has vast and largely untapped natural resources, beyond a few oil enclaves, it remains relatively undeveloped, characterized by a subsistence economy. South Sudan is among the most oil-dependent countries in the world, with oil accounting for almost the totality of exports, and around 60% of its gross domestic product (GDP).

Figure 63. An oil pipeline at Gumry Oil field, South Sudan.

The country had begun to post improved results, particularly in health and primary education in the years following the 2005 Comprehensive Peace Agreement, and the resumption of oil flows in 2013 was expected to boost economic growth significantly. However, the impact of the conflict on the population and the breakdown in services continue to have deep economic and social consequences for a country where human development is already among the worst in the world.

Progress Check

1. In your own words, describe the economy of South Sudan.
2. Discuss the impacts of the recent human conflicts on the economy of South Sudan.

The Currency of South Sudan

The official currency of South Sudan is the **South Sudanese Pound**. It is divided into **100 units** called **piasters** and was approved during the July 2011 secession upon approval by the legislative assembly of South Sudan.

Figure 64. The South Sudanese pound.

History of the South Sudanese Pound

The new currency was introduced following the secession from Sudan on July 18, 2011. The South Sudanese pound note features the image of John Garang, who was the leader of the rebel movement from the South. The banknotes include 6 different denominations in the form of pounds and another 5 denominations in the form of piasters.

Currently, the highest banknote is **500 pounds**, while the least is **1 pound.** Other notes include 5, 10, 25, 50 and 100 pounds banknotes. The 25 South Sudanese pound note was replaced by the 20-pound note in 2016.

The 1 Pound banknote has since been replaced by 1 Pound coin as part of reducing the confusion in currency and to ease transactions. Alternatively, banknote redesigns have also been implemented on 10, 20 and 100-pound notes. There have been recent claims that the Bank of South Sudan plans on introducing new denominations notes of 200, 500 and 1,000 South Sudanese pounds. However, this is not the case as confirmed by the governor of the Bank of South Sudan.

Figure 65. South Sudanese piaster coins (Currently not used)

Banknotes and Coins

The introduction of the new piaster notes was to facilitate ease of transaction by introducing low-value notes for purchasing smaller items that cost less than 1 pound. This introduction was welcome among the South Sudanese people according to various reports. With the introduction of the new low-value piaster notes, the 50-piaster denomination note was dropped in preference to the coin currency. The piaster notes were printed by the South African firm, De la Rue.

These notes are differentiated from the pound notes in that the portrait is placed on the right side of the note instead of the left side. The piaster notes maintain the same signature as found in the higher denomination pound notes. Another different element of the piaster notes is that they do not have a windowed security thread.

Figure 66. A 50 Piasters South Sudanese coin

The coins were introduced during Independence Day and circulation began on 9 July 2015 as the country marked its fourth Independence Day. The coin consists of an engraved image of the court of arms. The coins that were in denominations of 5, 20 and 50 piasters are currently not in circulation.

Comprehensive Activity 6

Can you recall?

1. Look at the two different notes below. Identify the differences between the South Sudanese piaster notes and the South Sudanese pound note.

2. What type of currency is currently used in South Sudan?
3. In pairs, role play a radio interview with the South Sudanese minister of finance on the advantages and disadvantages of the changes of the South Sudanese currency before independence to current date.

The Economic activities and resources of South Sudan

The Natural resources of South Sudan

Oil

South Sudan is among Africa's oil producers. Currently, petroleum is South Sudan's most important natural resource. In recent years, a significant amount of foreign-based oil drilling has begun in South Sudan, raising the land's geopolitical profile.

Oil and other mineral resources can be found throughout South Sudan, but the area around **Bentiu** and upper Nile is commonly known as being especially rich in oil, while Jonglei, Warrap, Equatoria and Lakes states have potential reserves. Khartoum partitioned much of Sudan into blocks, with about 85% of the oil coming from the South.

Figure 67. An oil facility in Unity state, South Sudan

Sudan and South Sudan Oil pipeline Map

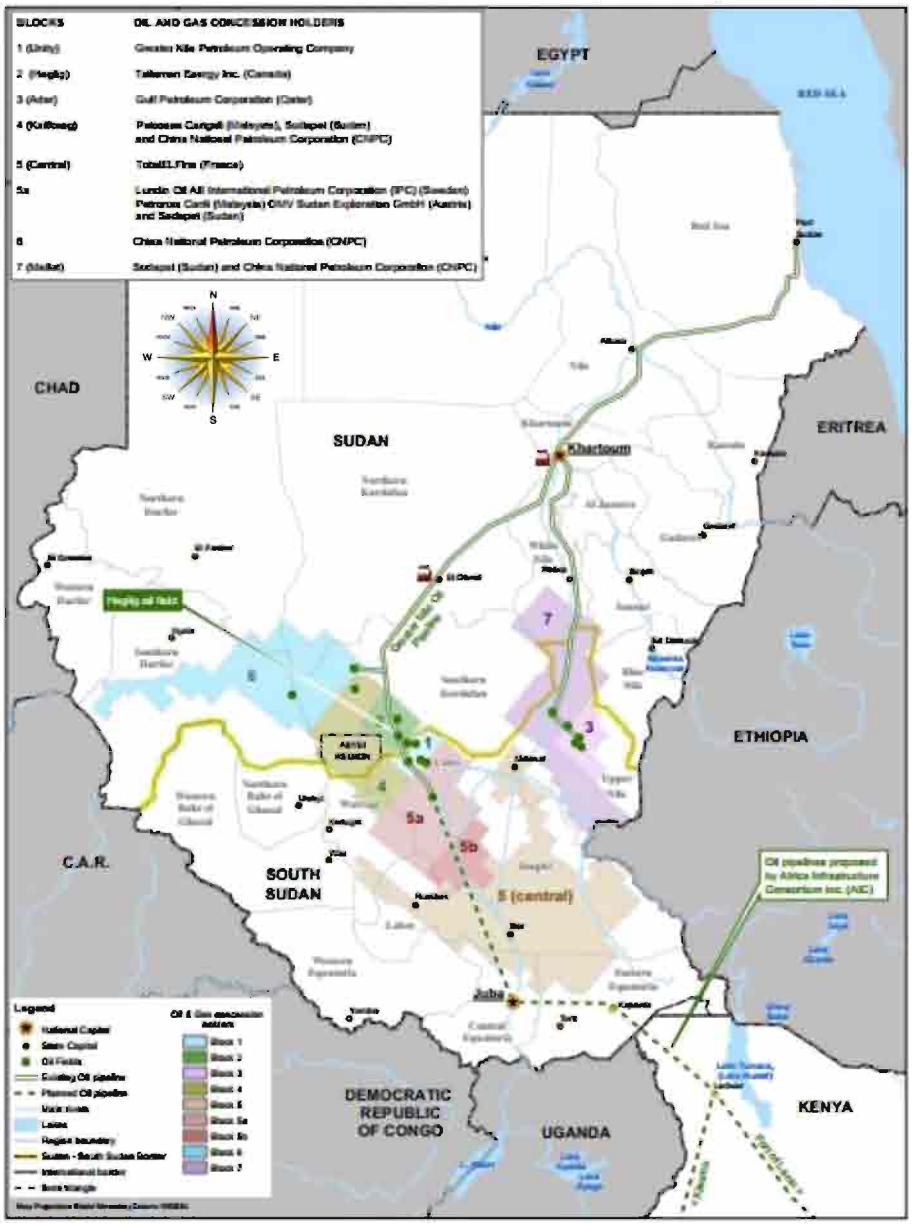


Figure 68. A map showing Sudan's and South Sudan's oil production and distribution

Progress Check

1. Make a presentation on the challenges facing oil production in South Sudan.
2. Discuss how oil has contributed to the Economy of South Sudan.

Power and Electricity

Power sources used in South Sudan vary across urban and rural areas. Only a small portion of the population has access to electricity via public sources or private generators: in urban areas about one-sixth of the population has access to electricity as a source of lighting, while in rural areas access is available to less than 1 percent of the population.

At the time of independence, several new power stations were under construction or recently completed, promising to increase the amount of power available in the country. Firewood is an important fuel for cooking, used by almost all of the rural population and about two-fifths of the urban population. In urban areas charcoal is used by about half of the population for cooking. The country has considerable hydroelectric potential, but it was not fully developed at the time of independence.

Figure 69. A market at a town outside Bentiu, Unity State, South Sudan with electricity infrastructure but no electricity.

Progress Check

What could be other alternative ways that the citizens of South Sudan can generate electricity in small scale to meet their needs? Research and make a general class presentation

Minerals and Mining

The mining industry of South Sudan started operating from the time South Sudan became a regional government of Sudan in 2005. Its inheritance was a well-developed petroleum industry with an extensive network of pipelines passing through Sudan.

Minerals in South Sudan include **Gold, Zinc, lead**, **aluminum** and **manganese** among others. On the other hand South Sudan is among Africa's biggest producers of **oil**.

Quarrying i.e. sand mining and rock quarrying around Juba and many parts of South Sudan is also an example of the mining industry within the country.

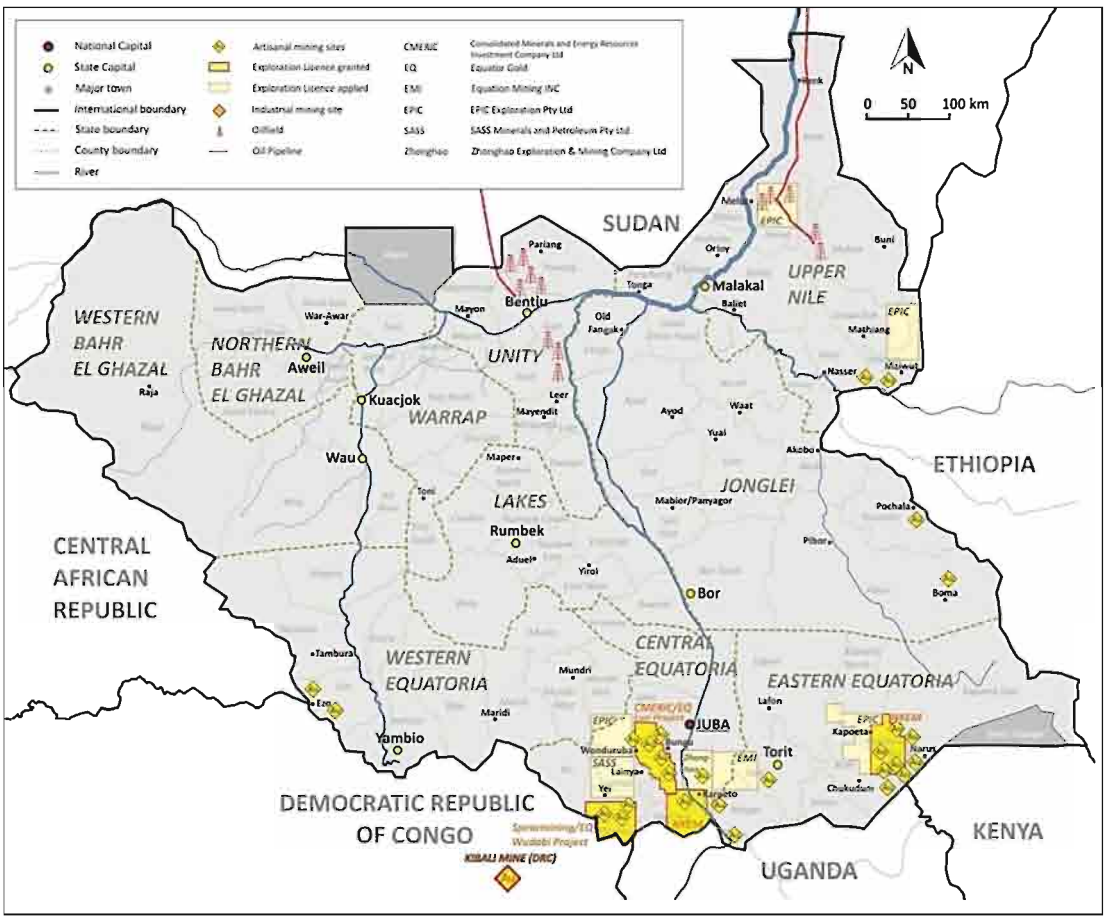


Figure 70. Distribution of oil fields and mines in South Sudan

Gold

Gold occurs in several areas including Napotipot, Nasarie, Namorunyang, Nanakanak, Moru-angiboloin, Nyangia, Lopua, Lauro, Nathalani, Bunio in Eastern Equatoria state and in Luri, Central Equatoria state.

Figure 71. Panning for Gold in South Sudan

Copper

The only known copper ore occurrence is at Hofrat en Nahas near the border with S. Darfur. Four copper occurrences have been reported in different locations in the Kapoeta district.

Zinc and lead

Zinc and lead usually occur together in massive sulphide deposits, which have been identified in the Juba-Yei-Tori zone, with the highest zinc concentration detected around Juba, while lead concentrations are spread further South and also between Torit and Wau.

Aluminum

South Sudan has three areas of anomalous aluminum values of above 4.5% around Juba (coinciding with areas of nepheline syenite); Raga-Wau-Rumbek zone and west of Yambio up to the border with DRC.

Iron

A large area stretching from Yambio all the way to the border with South Darfur is anomalous in iron.

Marble/Dolomite

In Kapoeta area there are several occurrences. The largest is about 4 km NE of Kapoeta town. Several dolomite occurrences have been reported in Torit district in large amounts suitable for dimension stones in construction, lime and a wide range of other industries such as fertilizers, refractory, glass, furnace flux and flux

Talc

A gritty and coarse-grained form of talc is found along the Kit river area South East of Juba. Despite being of low quality, the talc is useful as a ceramic raw material; a heat resistant hardener in drill fluids used in for example petroleum drilling or road construction in hot climates. Several other talc deposits have been found to the east of Juba in Central & Eastern Equatoria. A large, white and soapy deposit of talc covering a one square kilometer area has been identified to the east of Kapoeta town

Case study 6

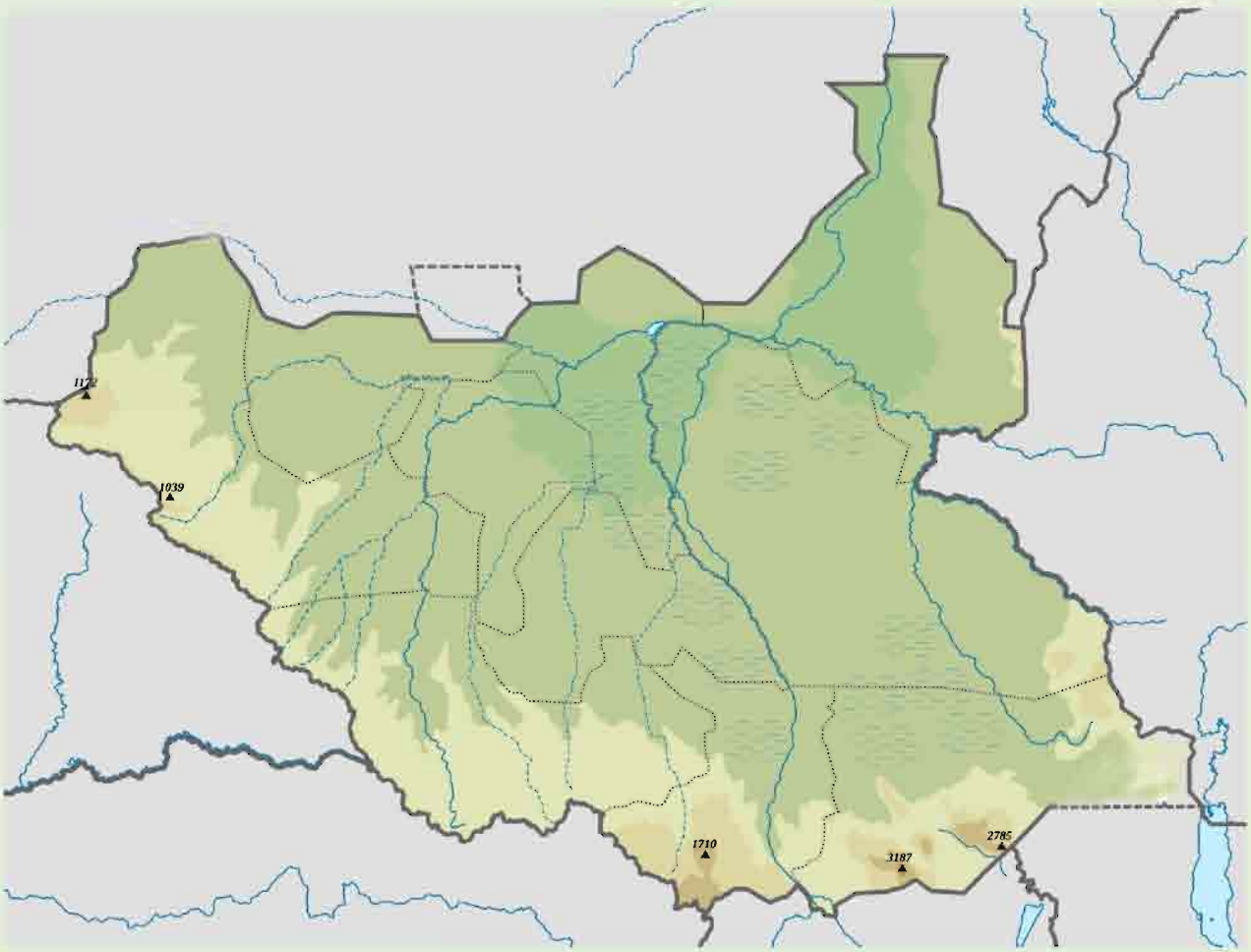
Challenges facing the development of the Mining Industry in South Sudan

- From what you have learnt and from your knowledge about mining in South Sudan, what are some of the challenges facing the development of mining industry in South Sudan?
- What can you suggest as potential solutions to the mentioned problems?

Progress Check

Locating minerals in South Sudan

Use the map below to locate the major mineral deposits found in South Sudan. Use symbols to design a map legend.



Agriculture in South Sudan

Crop, fruit and timber production

South Sudan is the world's newest nation having a huge agricultural potential that can be leveraged to improve the national economy and household living standards. The country's endowment of favorable land, water, and weather conditions makes 70 percent of land suitable for agriculture.

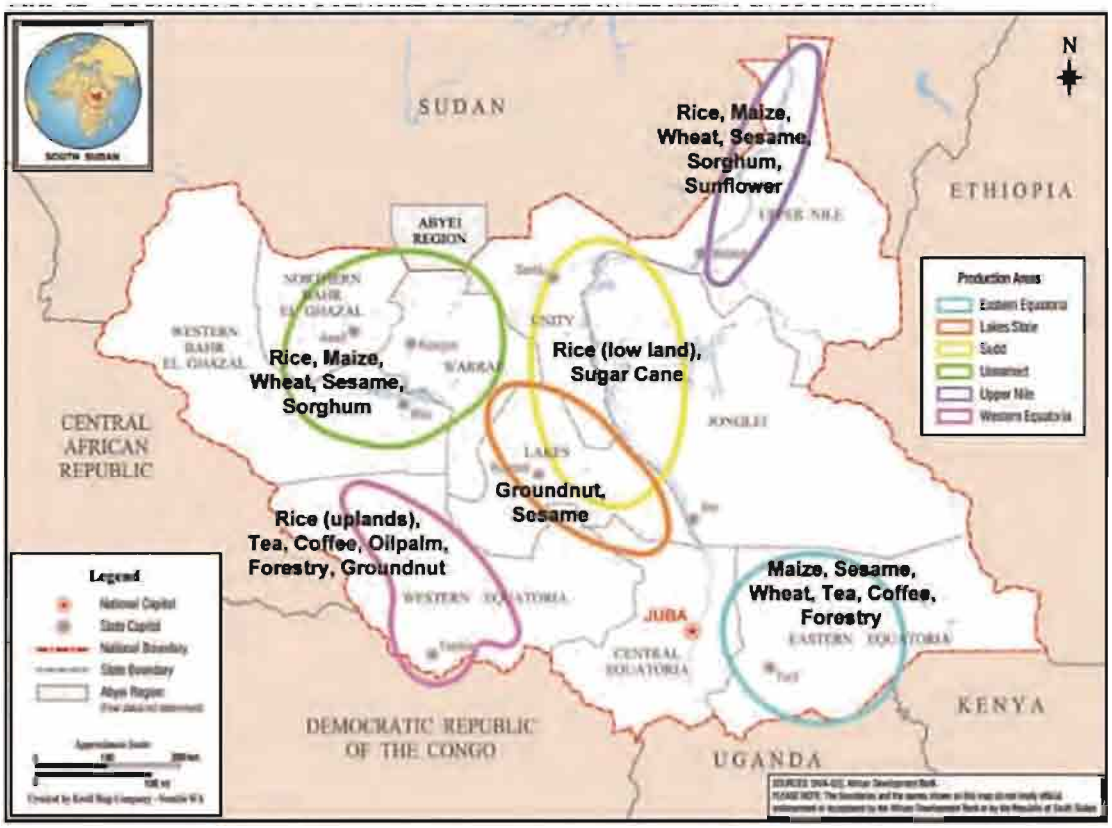


Figure 72. Agricultural productivity in South Sudan.

South Sudan is rich in agricultural land and has one of the largest populations of pastoralists in the world. However, since 1999, when Sudan first started exporting oil, agricultural production in the country has declined.

South Sudan relies on food imports from neighboring countries, such as Uganda, Kenya and Sudan. These come at a high transportation cost which, coupled with inflation, has

caused food prices to rise dramatically in South Sudan. The declining agricultural production and the reliance on expensive foreign food supplies have contributed to a severe food shortage in South Sudan.

Figure 73. A farmer hanging sorghum heads up to dry.

Agriculture is one of the growing sectors for South Sudan being largely practiced by majority of rural population for **subsistence** purposes, with minimal cash crop production. The major crops produced in this subsector include, **Groundnuts, Sorghum, maize, Rice, Sunflower, Cotton, sesame, Cassava, beans and peanuts.** Other crops that are produced in small scale include: **coffee, tea, sugarcane and tobacco**. There is also great potential for growing fruits and vegetables such as **bananas, mangoes, lemons, pineapples, onions, okra, tomatoes, egg plants, potatoes and cabbages.**

The forests of South Sudan yield **hardwood timber**, such as mahogany and sant (a type of acacia), and softwoods. **Gum Arabic**, a water-soluble gum obtained from acacia trees and used in the production of adhesives, candy, and pharmaceuticals, is an important agricultural export. It is found in Upper Nile and Eastern Equatoria states.

Livestock rearing

Livestock production represents a significant proportion of agricultural activity in South Sudan. The main populations of livestock are cattle, goats, sheep, camels, donkeys and poultry: the main products are meat, dairy products, hides and skin and eggs. Livestock production, especially cattle, is undertaken in the more arid and semi-arid areas such as Eastern Equatoria. Livestock systems are either **nomadic pastoralist** or **mixed crop livestock farming system** and are a major source of livelihoods, especially in the floodplains and the semi-arid pastoral areas.

Figure 74. The long-horned breed of cattle are common in South Sudan. South Sudan has over 31 million heads of cattle, sheep and goats.

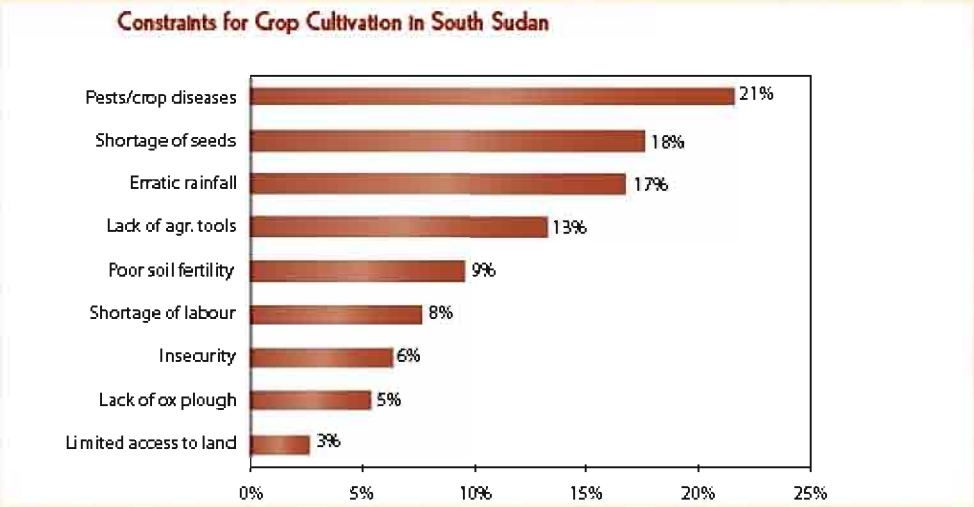
State	Cattle	Goats	Sheep	Total	
				Number	Share (%)
Upper Nile	990	651	447	2 088	5.4
Unity	1 189	1 511	1 784	4 484	11.7
Jonglei	1 475	1 423	1227	4 126	10.7
Northern Bahr el Ghazal	1 590	1 306	1 658	4 554	11.9
Western Bahr el Ghazal	1 256	1 184	1 139	3 579	9.3
Lakes	1 320	1 252	1 489	4 061	10.6
Warrap	1 539	3 131	1 392	6 061	15.8
Central Equatoria	883	1 286	1 173	3 342	8.7
Eastern Equatoria	895	1 042	1 152	3 088	8.0
Western Equatoria	680	1 189	1 152	3 020	7.9
Total	11 816	13 974	12 612	38 402	100.0

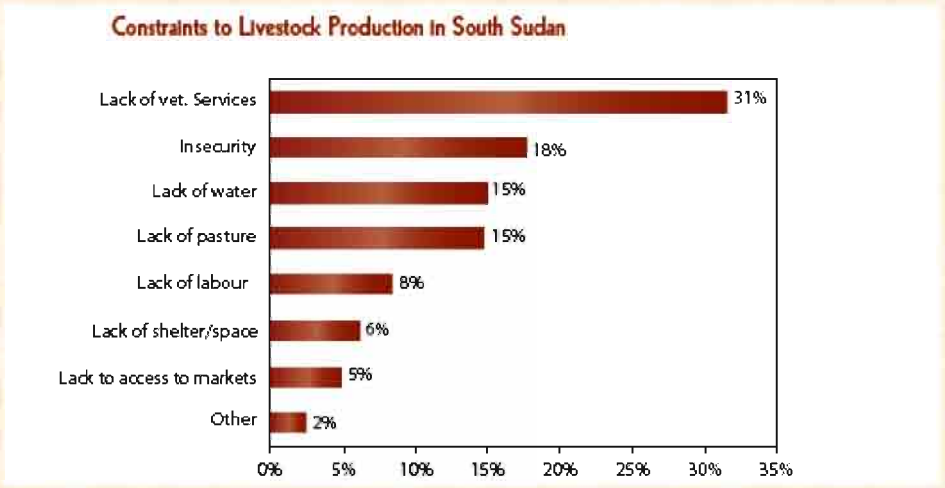
Figure 75. State distribution of livestock in South Sudan. (In thousands)

Case study 7

Finding solutions to the problems facing agriculture in South Sudan

You are a minister in the country's agricultural sector. You have been presented with the following information about problems facing agriculture in South Sudan.





1. What do these graphs tell you about agriculture in South Sudan?
2. What strategies would you suggest to address the key challenges above?

Fishing in South Sudan

South Sudan is a country with abundant natural resources, among them fisheries. Due to its location along the Nile River Basins and other rivers, and within the biggest wetland in the world, the fisheries sector has its own socio-economic and cultural importance. If well exploited and managed, fisheries can be one of the greatest contributors to poverty alleviation, food security and improved nutrition in the country.

Figure 76. Left, a fisherman transporting his harvest and right, fishermen drying their produce out in the sun. Among the major types of fish found in the Nile is the tilapia and Nile perch.

Where firewood is available, fish processing consists in mainly smoking. Where it is not, fish is dried and salted. In rural areas, some dried fish is of very poor quality and greatly deteriorated due to insect infestation and loss from breakages. Fish producers and traders market dried and smoked fish in Juba and other towns. One well-identified place for domestic market is hotels and restaurants. Large-scale fish traders use ice to transport fish to the North to hotels and restaurants. However, there are no accurate figures available on the fish trade.

There is large potential for aquaculture development in Central Equatoria, Eastern Equatoria, Western Equatoria, Northern Bahr el Ghazal, Western Bahr el Ghazal and Warrap States. However, the Government capacity to realize this potential is still weak. The need for assistance in fish farming is, therefore, enormous particularly in the area of fingerlings and fish feed production. The fishery in South Sudan is an open access regime, with no prevention controls on numbers of fishers or entry. Apart from rudimentary licensing mechanisms there is no institutional organization/capacity to perform data collection, analysis and processing.

Problem facing fishing in South Sudan

Fishing is hampered by poor transport infrastructure and poor storage facilities (cool boxes, mobile freezers and availability of ice). Though there are no recorded statistics on these issues, overall losses of fresh fish between capture and landing are probably comparable with or higher than those of most countries in East Africa (up to 50%).

Post-harvest losses are important, exceeding 60 percent in some areas and fish sold is very poor quality. Poor government policies that have promoted subsistence fish farming, the lack of good quality fingerlings, feed and skills hamper efforts to develop aquaculture. Most producers depend on imported tilapia fingerlings and feeds from Uganda.

Case study 8

Group discussion and presentation: Solutions to problems facing fishing in South Sudan

Organize yourselves in groups and tackle the following research questions:

You have been appointed as a team of specialists by the South Sudanese ministry of Agriculture to research and come up with suggested solutions on the problems facing fishing in the nation. Present your finding to the class.

Transportation and Communication

South Sudan's transport system is underdeveloped and is a serious constraint on economic growth. Prior to the region's secession from the north, it was estimated that there were some 2,500–3,400 miles (4,000–5,500 km) of main roads, of which only some 30 miles (50 km) were paved.

There were also about 4,700 miles (7,500 km) of secondary roads, unpaved and in various states of disrepair. The utility of the unpaved roadways is compromised during the rainy season, when many of them are impassable. There are some 150 miles (240 km) of railway track linking the city of Wau with Sudan. After years of disrepair due to long-running conflict, the railway line resumed operations for a shot while in 2010. It is used to transport freight. Road construction and expanding the rail system have been priorities of the government.

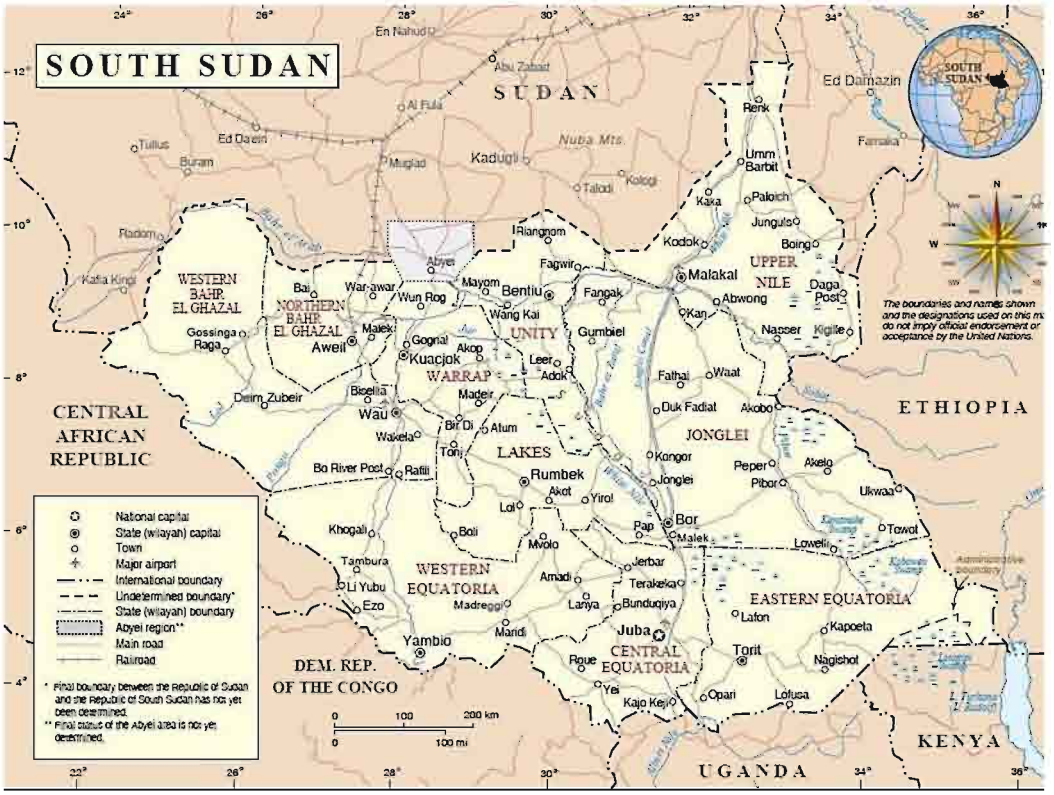


Figure 77. Distribution of infrastructure in South Sudan

South Sudan is landlocked, and its rivers, particularly the White Nile and its tributaries, are important transportation links. The White Nile and the Baḥr Al-Ghazāl are navigable throughout the year, and steamer services are available on the White Nile. Ports include those at Juba and Bor, located on the Mountain Nile, and at Malakal, on the White Nile.

The country has several dozen airfields, but few have paved runways, and, as a result, many are inoperable during the rainy season. By far the busiest facility is the international airport at Juba; other heavily used airports include those at Malakal, Rumbek, and Wau. South Sudan is served by several international and domestic airlines, including Southern Sudan Airlines, which was created in 2005 to serve the newly semiautonomous region.

Figure 78. The Juba international airport.

Decades of civil conflict have hindered the development of telecommunications infrastructure in South Sudan, but this area has seen quite a bit of expansion since the CPA was signed in 2005. There is no network of landlines for telephone service, but mobile phone providers have established coverage in and around the country's main cities and towns. Internet service is available in many of the main cities and towns.

Progress Check

Describe the type of transport and communication used in South Sudan.

Case study 9

The Transport Industry of South Sudan (roads)

Figure 79. The current state of Juba Bor Highway, South Sudan

Organize yourself in groups and tackle the question below:

- Identify some of the hindrance/ challenges that the transport system faces in South Sudan?
- What would you recommend as a solution to the challenges facing the South Sudanese transport Industry?

Trade in South Sudan

South Sudan relies heavily on imported goods, while the economy relies heavily on oil revenue which accounts for 90% of all exports and 98% of public revenue. Global fall of oil prices have led to critical shortage of foreign exchange and devaluation of the South Sudan currency. South Sudan's chief export is crude petroleum. Other exports include

gum Arabic. Because of food insecurity and the limited manufacturing sector, the country must import most items, including many foodstuffs, motor vehicles and machinery, and manufactured goods.

The country recently acceded to the **East African Community** (EAC), within which it hopes to trade more with its neighbors, strengthen its governance structures, and increase economic activity. However it faces challenges in implementing EAC commitments.

Figure 80. A business man cleaning his stall at a market in Juba. The capital of South Sudan

Progress Check

1. What are the major exports and imports in South Sudan?
2. How can we make South Sudan not rely on imported goods?

Tourism and other services

The country is a beautiful tourist destination with vast diversity of wildlife and vegetation, attractive landscapes, diverse culture, historical sites and variable climate. It has wonderful wetlands which are inhabited all year round with thousands of bird's species including some migratory birds.

The Nile and the other Rivers represent a major attraction and provide a venue for other tourist activities such as cruise launching, sport fishing, white water rafting, birds watching and excellent photography. The rivers have several waterfalls and rapids, the most notable one being the Fulla Falls at Nimule National park.

Figure 81. Some of the wild animals found in Boma National Park, South Sudan.

The fledgling services sector consists primarily of government employees and small businesses, largely shops and restaurants that have been opening in South Sudan. South Sudan shows promising potential for a lucrative tourism industry, as it is known for its scenic beauty and diverse array of wildlife and vegetation and is home to many national parks and game reserves. The government has encouraged the growth of a burgeoning hotel and hospitality industry, which is much needed to support the growth of tourism.

Figure 82. Juba Grand hotel, an example of the flourish hotels in Juba, South Sudan.

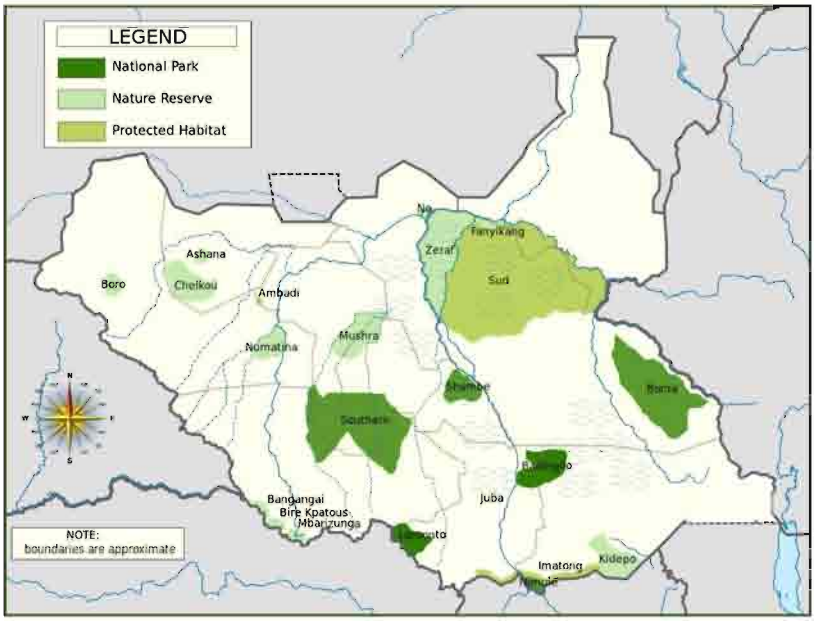


Figure 83. Distribution of national parks, national reserves and protected habitats within South Sudan.

Progress Check

1. What could be some of the challenges facing the tourism industry in South Sudan?
2. What are the major hotels in South Sudan?
3. How can these hotels support tourism?
4. Imagine that you have just completed the construction of an exclusive hotel in one of the national parks in South Sudan. Design an advertisement encouraging people to come and stay to your hotel.

Labour and taxation

Agriculture is the main area of employment in South Sudan, with some four-fifths of all households depending on agricultural activities as their main source of livelihood. Before independence, most of the government's revenue was derived from its oil-revenue-sharing arrangement with the national government in Khartoum; similar arrangements were expected to continue after the secession of South Sudan. Very little revenue is raised by direct or indirect taxation.

Case study 10

The Economy of South Sudan

- Organize yourselves into groups and do the following tasks, present your finding before the entire class.
    a) Discuss the measures that can be applied to sustain the economy of South Sudan.
    b) Discuss the various factors affecting the economy of South Sudan.
- How can we compare the economic activities of South Sudan to other regions? In your various groups, do a research on this and come up with findings. Present your findings before the class.
- What are some of the hindrances to economic development of South Sudan?
- Research on the different types of taxes in South Sudan.

Comprehensive Activity 7

1. Using your atlas, identify the key oilfields, mining sites and fishing sites of South Sudan.

Exercise 9

a) Using appropriate examples explain the major natural resources and economic activities of South Sudan.
b) List the major sources of revenue in South Sudan.
c) Explain the major challenges facing the following economic activities in South Sudan:
    a) Mining.
    b) Tourism.
    c) Fishing.

Unit 4

POPULATION TRENDS

The population trends of South Sudan

South Sudan is home to around 60 indigenous ethnic groups and 80 linguistic partitions. In 2016, the population of South Sudan was estimated to be **between 8-12 million** according to the recent population census.

South Sudan demographic information.

- The current estimated population of South Sudan is 12,575,714 (**according to the recent population census although this figure is likely to change due to factors such as migration among others.**)
- The total land area is approximately 640,000 Km^2
- 19.7 % of the population is urban (2,481,364 people in 2017)

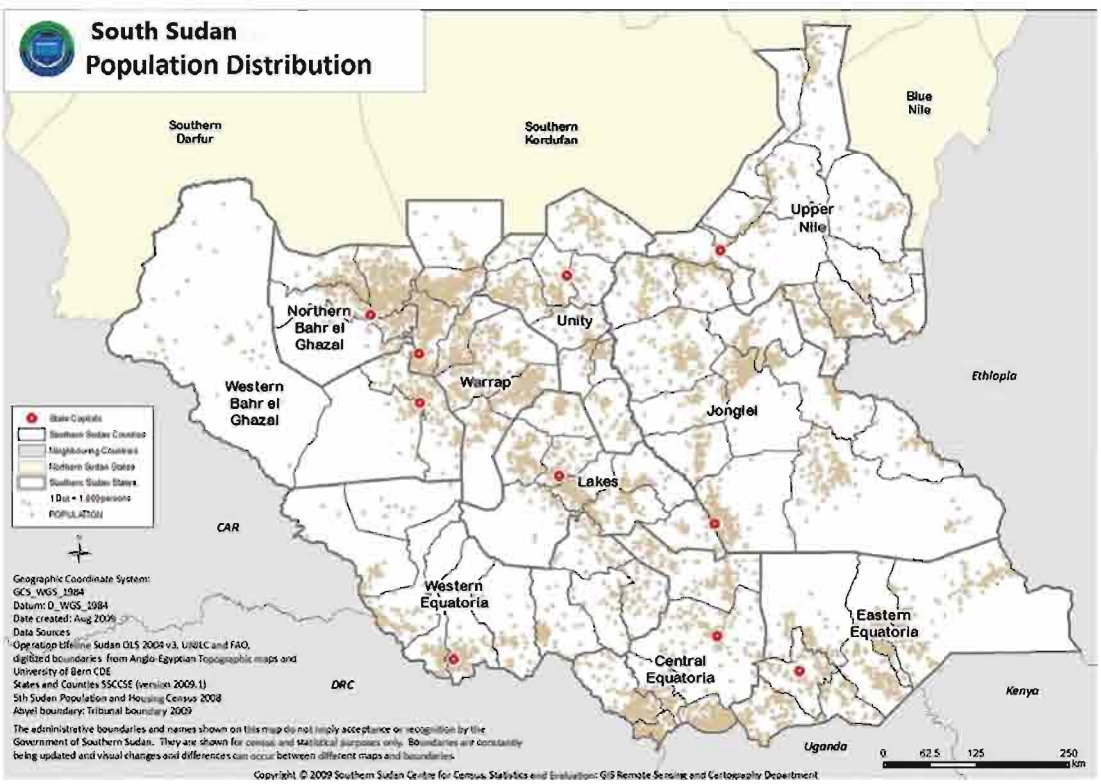


Figure 84. The population distribution of South Sudan.

Progress Check

In pairs look at the demographic information presented in the table below and tackle the questions that follow:

Year	Population	% Male	% Female	Density (km²)	Growth Rate
2017	12,575,714	50.10%	49.90%	20	2.88%
2015	11,882,136	50.08%	49.92%	19	3.37%
2010	10,067,192	49.99%	50.01%	16	4.42%
2005	8,108,877	49.89%	50.11%	13	3.89%
2000	6,700,656	49.81%	50.19%	11	4.18%
1995	5,459,519	49.75%	50.25%	9	-1.09%
1990	5,768,481	49.71%	50.29%	9	1.14%
1985	5,450,424	49.70%	50.30%	9	2.98%
1980	4,705,224	49.73%	50.27%	8	2.69%
1975	4,119,438	49.78%	50.22%	7	2.46%
1970	3,647,709	49.87%	50.13%	6	2.25%
1965	3,263,638	50.01%	49.99%	5	2.01%
1960	2,955,152	50.23%	49.77%	5	1.66%
1955	2,721,544	50.54%	49.46%	4	1.05%
1950	2,582,929	51.00%	49.00%	4	0.00%

Figure 85. South Sudan's population history.

1. Calculate the population density of South Sudan use the formulae:

$$Population\ density = \frac{Number\ of\ people\ within\ an\ area}{the\ land\ area}$$

2. The population density of Juba city is **52 persons per km²**. How does the population density of South Sudan compare with that of Juba? Justify your answer.
3. Calculate the population densities of 2017 and 1950. Explain the differences between the two periods.
4. Between which two years was the greatest population increase? Explain why this happened.

The Population Trend of South Sudan

What is population trend?

Population trend can be defined as the change in the size of population influenced by natality, mortality, immigration and emigration.

Population trend according to age

The population of South Sudan is overwhelmingly young, with more than two-fifths of the population under the age of 15 and more than one-fourth between the ages of 15 and 29. Life expectancy is much lower than the world average and is lower than that of neighboring countries.

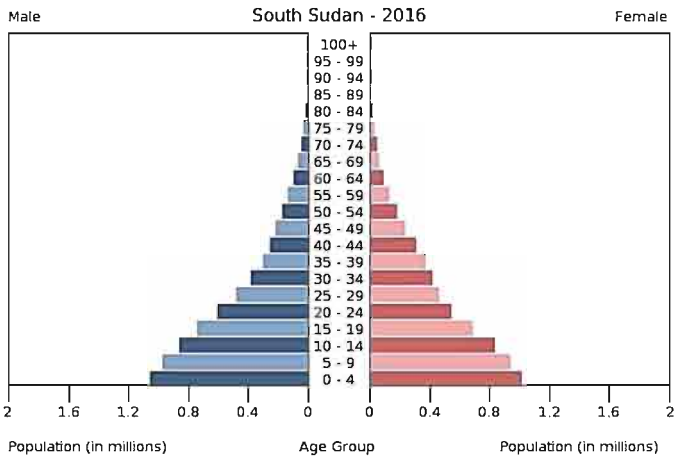


Figure 86. Population distribution of South Sudan as in 2016

Birth (fertility) rates of South Sudan

Fertility refers to the ability to conceive and produce. It is measured by counting the number of people (live births in a population). Fertility rate is influenced by factors like;

1. Level of education.
2. Urbanization. Birth control measures.
3. Cultural belief.
4. Prestige.

5. Early marriage.
6. Source of labor.
7. Preference of sex.

The birth rates of South Sudan fell gradually from 51.5% per 1,000 people in 1966 to 36.3% per 1,000 people in 2015. Famine, civil clashes and immigration are some of the reason as to why the birth rates dropped drastically in the recent years.

Figure 87. The birth rates of South Sudan

Death/ Mortality rates

Refers to the number of deaths within a given population. Death rate can be categorized into;

a) **Infant mortality rate**: The number of death from 0-2 years.
b) **Child mortality rate**: Number of death of children aged between 1-5 years per 1000 live birth.
c) **Adult mortality rate:** Number of adults dying per 1000 of the total population. Hence;

Large scale mortality may be caused by;

1. Severe hunger/famine.
2. Diseases.
3. Natural disasters, war and accidents.

The value for Death rate, (per 1,000 people) in South Sudan was 11.35 as of 2015. As the graph below shows, over the past 55 years this indicator reached a maximum value of 32.46 in 1960 and a minimum value of 11.35 in 2015.

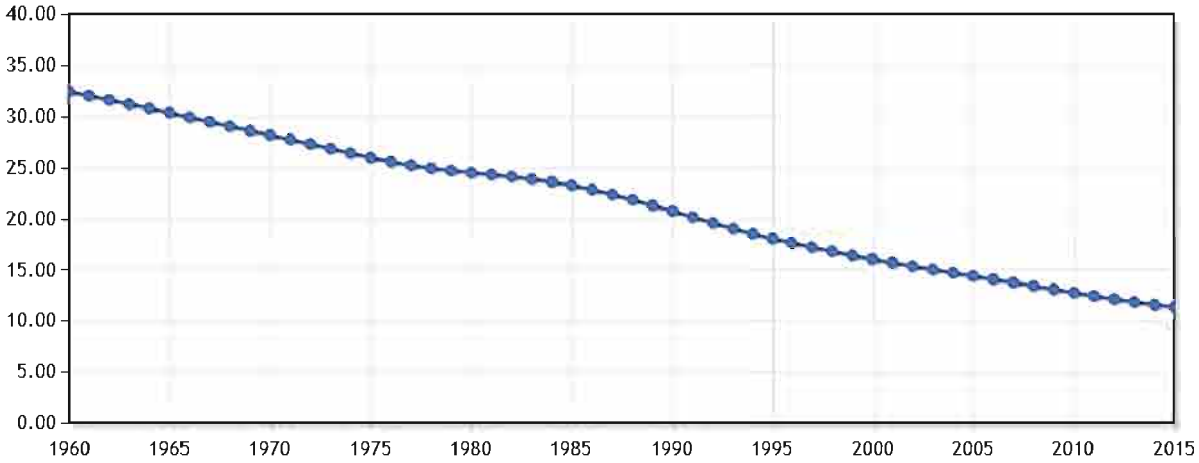


Figure 88. DEATH RATE IN SOUTH SUDAN: Malaria, among other diseases, is one of the leading cause of death in South Sudan. The life expectancy in South Sudan is 56 yrs. Famine and civil clashes are among other causes of death in South Sudan.

Figure 89. Statistics on the mortality rates of South Sudan

Comprehensive Activity 8

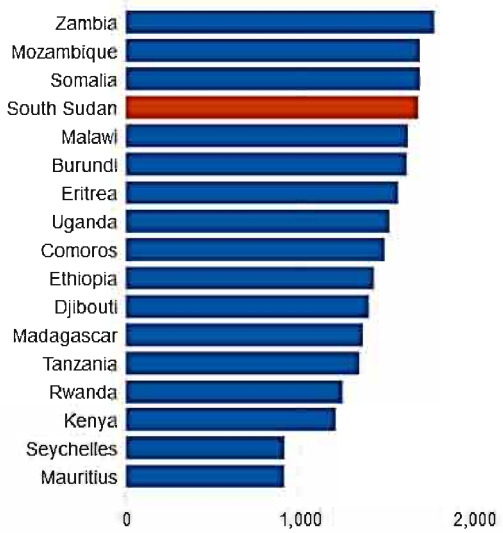
Look at the table below and answer the following questions:

South Sudan Relative to Other Locations in Eastern Sub-Saharan Africa

Mortality | Disability-Adjusted Life Years (DALYs)

All Causes | Both Sexes | Age-Standard

Relative to the average for regions in Eastern Sub-Saharan Africa, South Sudan had a higher mortality rate, considering all causes of harm.

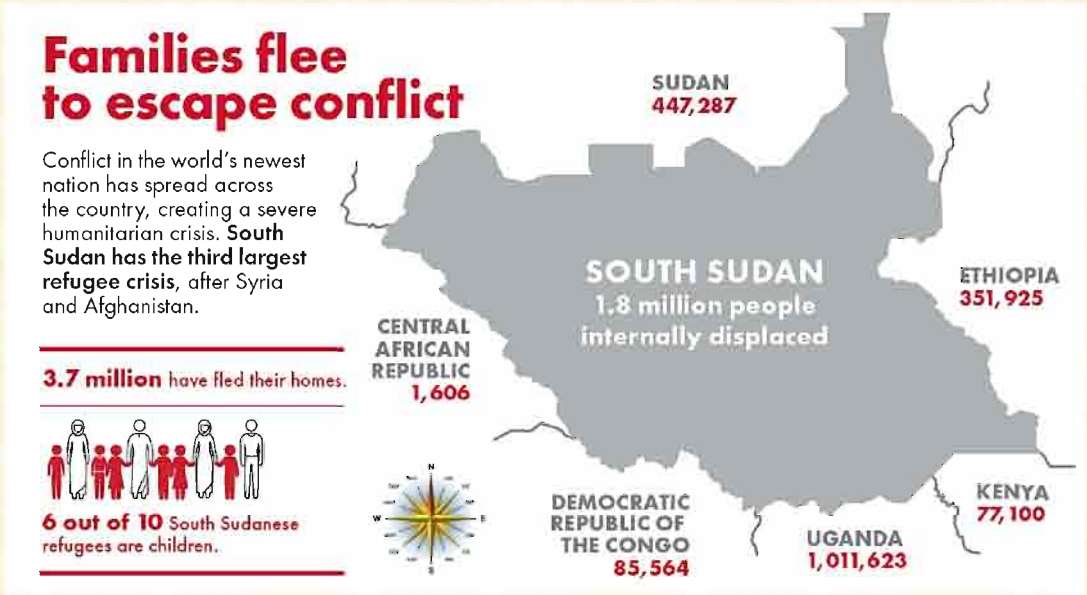


1. What are the major causes of death in South Sudan?
2. What is the life expectancy of South Sudan?
3. Discuss the birth rates of South Sudan.
4. What is the population trend of South Sudan according to age?
5. What do you think contributes to the higher mortality rates in Zambia, Mozambique and Somalia?

Case study 11

In groups, do a research on the following:

1. The population trend according to migration of South Sudan. *(Use appropriate examples to explain reasons for the migration and displacement of people in South Sudan. Refer to the image below)*



Exercise 10

1. Define the following terms:
   a) Population distribution.
   b) Population trend.
   c) Mortality rates and Birth rates
2. Discuss the factors that affect population distribution.
3. What is the total population of South Sudan?

Types of Human settlement

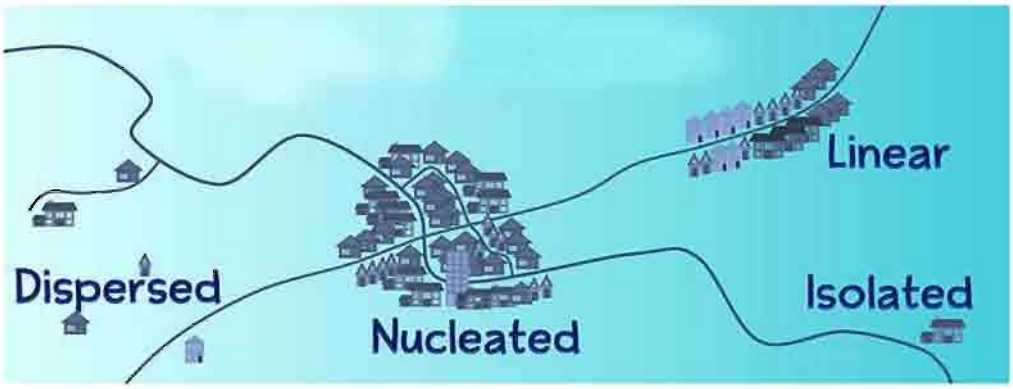
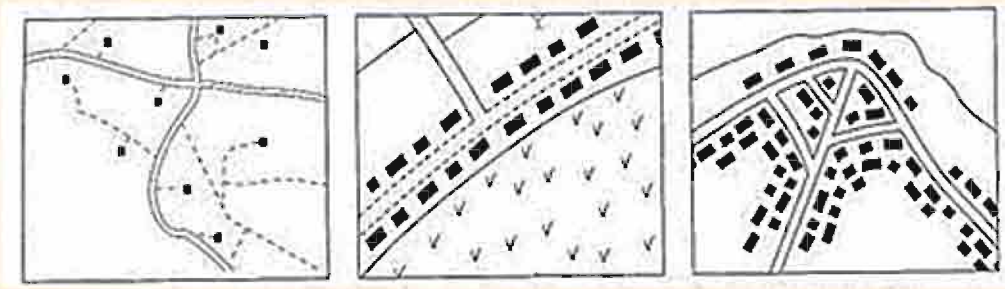


Figure 90. Types of Human settlement.

- **A dispersed settlement pattern** is where the buildings are spread out and is often found in upland areas;
- **A nucleated settlement pattern** is where a lot of buildings are grouped together and is often found in lowland areas;
- **A linear settlement pattern** is where the buildings are built in lines and is often found on steep hillsides.

Comprehensive Activity 9

Identify the settlement patterns in the sketches provided.



Human Settlements in South Sudan

Do you live in a village or a town? Some people live in very small settlements with very few people. Others live in very large cities. Some of the biggest cities in the world, like Shang Hai in China or Karachi in Pakistan have over twice as many people as the whole of South Sudan. The population of South Sudan was 11.74 million in 2014. Here are some of the densely populated cities in the world:

Shanghai
24,150,000

Karachi
23,500,000

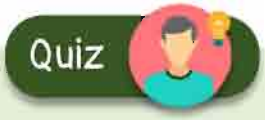
Lagos
21,324,000

Delhi
16,787,941

Istanbul
14,377,019

Rural settlements of South Sudan

The greatest population densities are found in rural areas. About four-fifths of South Sudan's population is rural. Rural settlements in South Sudan are usually clustered and sometimes scarcely distributed. The most common type of housing in rural areas is a round hut known as a tukul. It has a thatched conical roof and is made of mud, grass, millet stalks, and wooden poles. Most rural homes are located near rivers and roads.



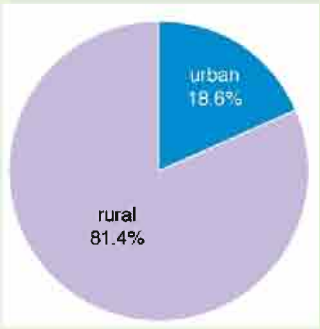


Figure 91. South Sudan settlement Information

In your own words, describe the reasons for the differences between the population densities in rural and urban areas.

Figure 92. The rural settlements patterns of South Sudan

Urban settlements of South Sudan

South Sudan was the least-urbanized area when Sudan became independent in 1956 but has since experienced a high rate of urban growth. Still, only about one-fifth of the population is urban. Major towns include Wau, Malakal, Yei, Yambio, and Juba, the capital. Settlement in urban areas are nucleated, linear and located near roads.

Figure 93. Juba, the capital city of South Sudan

Population distribution according to ethnicity

The ethnic groups that constitute the population of South Sudan are all of African origin and heritage. There are a total of 64 ethnic groups in South Sudan. These ethnic groups can be further classified into **three** major groups namely; **The Sudanic, Hamito-Semitic and Bantu language groups**. Although English is the official language, not many people speak it. Simple Arabic or Local Arabic is widely spoken by majority of the population in South Sudan. Hence, it acts as a unifying and standard language in day-to-day communications.

Figure 94. Ethnical distribution in South Sudan (Teus is the 64th tribe)

Population distribution according to religion

Religion is an important spiritual, social and economic aspect in South Sudan. Socially, religion is considered a unifying factor in a country that has been ravaged by decades of civil war. Religion has been used to bridge the ethnic differences in the country which are the leading causes of war.

The groups that make up the majority of Christians are the Roman Catholic, Episcopal, Presbyterian, Pentecostal, Sudan Interior Church, Presbyterian Evangelical, and the African Inland Church. Smaller populations of the Seventh-day Adventists, Jehovah's Witness, Eritrean Orthodox, Ethiopian Orthodox, Coptic Orthodox and Greek Orthodox are also present. A substantial part of the population in isolated parts of the country adheres to indigenous beliefs or combines Christianity, Islamic and indigenous practices.

The Roman Catholic Church makes up 37.2%, Protestant churches and other forms of Christianity 36.5%, Traditional African beliefs and animism 19.7%, Islam 6.2% and other beliefs 0.4%.

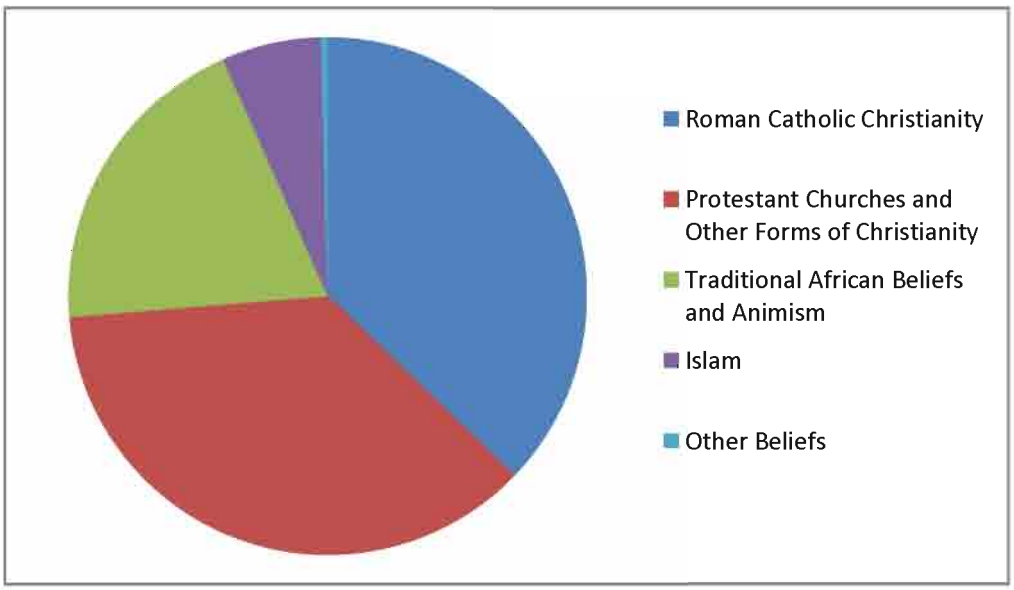


Figure 95. Population distribution of South Sudanese people according to religious affiliation

Case study 12

- In groups, conduct a research on the regional population distribution of South Sudan.
- Give a description of the type of settlement around your home. (Is it rural, urban, clustered, linear or nucleated?)
- Describe the migration pattern of the people of South Sudan. (*Present your findings to the class*)

Use the data below:

State	Population	Area
Northern Bahr el Ghazal	820,834	30,543.30
Western Bahr el Ghazal	358,692	91,075.95
Lakes	782,504	43,595.08
Warrap	1,044,217	45,567.24
Western Equatoria	658,863	79,342.66
Central Equatoria	1,193,130	43,033.00
Eastern Equatoria	962,719	73,472.01
Jonglei	1,443,500	122,580.83
Unity	645,465	37,836.39
Upper Nile	1,013,629	77,283.42

Unit 5

INDUSTRIALIZATION

What is Industrialization?

Industrialization can be defined as the large-scale introduction of manufacturing, advanced technical enterprises, and other productive economic activity into an area, society, country, etc.

An **Industry** can be defined as an economic activity concerned with the processing of raw materials and manufacture of goods in factories. Industries are factories established for processing raw materials and manufacturing goods.

Classification and Types of Industries

Primary Industries

Extract raw materials (which are natural products) from the land or sea e.g. oil, iron ore, timber, fish. Mining, quarrying, fishing, forestry, and farming are all example of primary industries.

Figure 96. A minefield in Canada

Secondary Industries (Manufacturing industry)

Involve the manufacture of raw materials, into another product by manual labour or machines. Secondary industries often use assembly lines e.g. a car factory.

Figure 97. A car assembling industry in New Jersey, USA

Tertiary Industries (Services industry)

Neither produce a raw material nor make a product. Instead they provide services to other people and industries. Tertiary industries can include doctors, dentists, refuse collection and banks.

Figure 98. A waiter at Juba Grand Hotel, Juba, South Sudan, the hotel industry is classified under service industry.

Quaternary Industries

Involves the use of high technology in industries. People who work for these companies are often highly qualified within their field of work. Research and development companies are the most common types of businesses in this sector.

Factors influencing the location of an industry

Consequently, the factors influencing the location of industry can be divided into two broad categories i.e.

1. Geographical factors
2. Non- geographical factors

Geographical Factors

The following are the important geographical factors influencing the location of industries:

Raw materials

Raw materials are the ones to be transformed or processed into finished products. Raw materials include gold, tin, oil, uranium, bauxite, etc. When they are present, they attract industries at that place. Water is another important requirement for industries. Many industries are established near rivers, canals and lakes, because of this reason. Iron and steel industry, textile industries and chemical industries require large quantities of water, for their proper functioning.

Climate

Climate plays an important role in the establishment of industries at a place. Harsh climate is not much suitable for the establishment of industries. There can be no industrial development in extremely hot, humid, dry or cold climate. Cotton textile industry, for example, requires humid climate because thread breaks in dry climate.

Site requirements

Site requirements for industrial development are of considerable significance. Sites, generally, should be flat and well served by adequate transport facilities. Large areas are required to build factories. Now, there is a tendency to set up industries in rural areas because the cost of land has shot up in urban centers.

Some modern industries require particular types of site. For example an integrated steelworks needs a large area of flat land, while a chemical plant may need a site where it is possible to dispose easily of dangerous waste. Iron and steel industry are likely to be found near water bodies or near mines of iron and coal to reduce on transport costs.

Figure 99. A worker inside an iron and steel company in China

Presence of a source of energy

They provide the energy necessary for the functioning of machines in the industry. Sources of energy include oil, natural gas, uranium, wood, hydroelectric power, solar energy, biogas, etc. Some of them are renewable while others are non-renewable.

Presence of a ready market

Industries are likely to be established in big cities and towns where people are concentrated. People form the market for industrial products since they can buy industrial products and facilitate the production process to move on. In the town, people have a good standard of living allowing them to buy the products from industries.

Non-Geographical Factors

Availability of labor

Industries require both skilled labor and normal labors. Areas where people are concentrated are well indicated for creation of industries because such areas avail labors for industry. Areas where people are concentrated, workers are cheap and available.

Government policies

Industries develops from an area where the assistance of the local government can be found. This assistance can include investments in terms of capital, even location of industries in the country, search of market outside for industrial products. In most cases many politicians create industries in their own areas instead of distributing then equally in the country. The role of the government can include controlling the way industries are working, places where they are located, the problems they cause in the environment, etc.

Availability of Capital

Capital is very necessary for establishment of industries. The capital shall be used for Purchasing the space where the industry shall be established, Paying workers. Paying transport and communication expenses.

Efficient organization

Efficient and enterprising organization and management is essential for running modem industry successfully. Bad management sometimes squanders away the capital and puts the industry in financial trouble leading to industrial ruin.

Bad management does not handle the labour force efficiently and tactfully, resulting in labour unrest. It is detrimental to the interest of the industry. Strikes and lock-outs lead to the closure of industries. Hence, there is an imperative need of effective management and organization to run the industries.

Banking and Insurance facilities

Areas with better banking facilities are better suited to the establishment of industries also, there is a constant fear of damage to machine and man in industries for which insurance facilities are badly needed.

Case study 13

Organize yourself in groups and tackle the following questions:

1. The government of South Sudan has decided to open up a **manufacturing plant** near your village.

a) What are some of the **benefits** to people near the industry?
b) What will be some of the **disadvantages** of the industry?
c) You are an investor and would like to build an industry in South Sudan. What could be some of the aspects that you would consider when choosing a suitable location for your industry?

Industrial Revolution in Britain

Before the beginning of the Industrial Revolution, most people lived in small, rural communities where their daily economic activities for survival was farming. Life for the average person was difficult, since their incomes were inadequate, and malnourishment and disease were common. People produced agricultural products, clothing, furniture and tools. Most manufacturing was done in homes or small, rural shops, using hand tools or simple machines.

A number of factors contributed to Britain's role as the origin of the Industrial Revolution:

- It had great deposits of coal and iron ore, which proved necessary for industrialization.
- Furthermore, Britain was a politically stable society, as well as the world's leading colonial power, which meant its colonies could serve as a source for raw materials, as well as a marketplace for manufactured goods.

As demand for British goods increased, traders needed more cost-effective methods of production, which led to the rise of mechanization and the factory system.

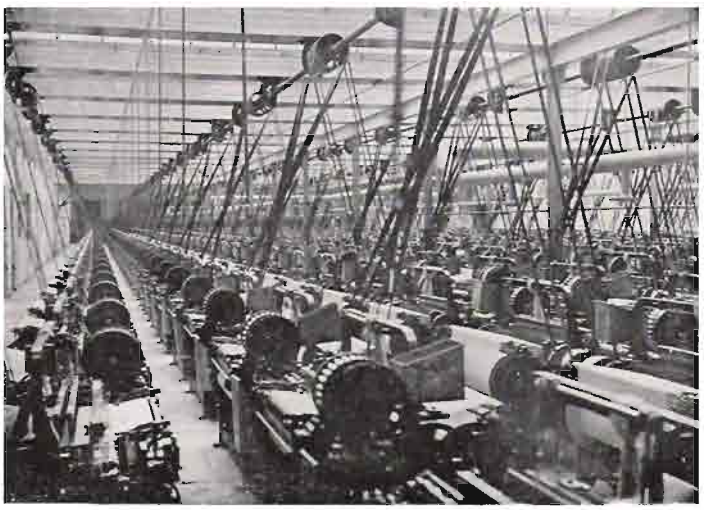


Figure 100. A textile mill in England during the Industrial Revolution

The Textile Industry in Britain

The Textile Industry, was transformed by industrialization. Before mechanization and factories, textiles were made mainly in people's homes (giving rise to the term cottage industry), with merchants often providing the raw materials and basic equipment, and then picking up the finished product.

Workers set their own schedules under this system, which proved difficult for merchants to regulate and resulted in numerous problems. In the 1700s, a series of innovations led to rapid productivity, which required less human labour. For example, around 1764, Englishman James Hargreaves (1722-1778) invented the spinning jenny ("jenny" was an early acronym of the word "engine"), a machine that enabled an individual to produce multiple reels of threads at once.

Figure 101. Left, the spinning "jenny" and right, a modern textile mill in South west England

After Hargreaves' death, there were over 20,000 spinning Jennies in use across Britain. The spinning jenny was improved upon by British inventor Samuel Compton's (1753-1827) spinning mule, as well as later machines. Another key innovation in textiles, the power loom, which mechanized the process of weaving cloth, was developed in the 1780s by English inventor Edmund Cartwright (1743-1823).

The Iron Industry in Britain

Developments in the Iron Industry also played a central role in the Industrial Revolution. In the early 18th century, Englishman Abraham Darby (1678-1717) discovered a cheaper, easier method to produce cast iron, using a coke-fueled (as opposed to charcoal-fired) furnace. In the 1850s, British engineer Henry Bessemer (1813-1898) developed the first inexpensive process for mass-producing steel. Both iron and steel became essential materials, used to make everything from appliances, tools and machines, to ships, buildings and infrastructure.

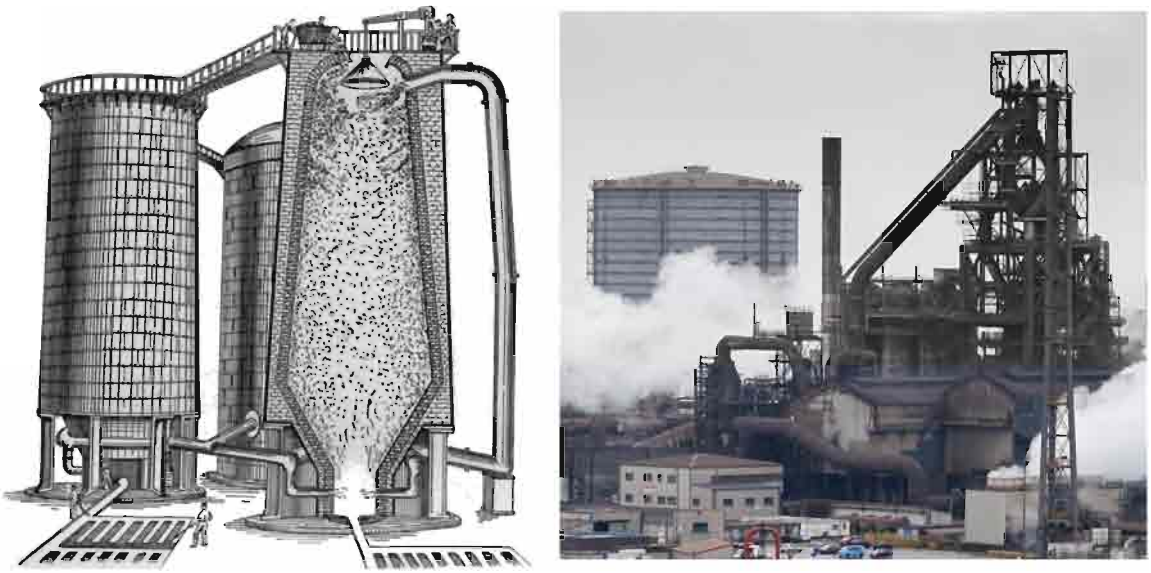


Figure 102. Left, The coke-fueled furnace and right, Tata steel plant in Port Talbot, South of England.

Transportation and the Industrial Revolution

The transportation industry also underwent significant transformation during the Industrial Revolution. Before the arrival of the steam engine, raw materials and finished goods were towed and distributed via horse-drawn wagons, and by boats along canals and rivers. In the early 1800s, American Robert Fulton (1765-1815) built the first commercially successful steamboat, and by the mid-19th century, steamships were carrying cargo across the Atlantic.

Figure 103. A Steam locomotive.

As steam-powered ships were making their entrance, the steam locomotive was also coming into use. In the early 1800s, British engineer Richard Trevithick (1771-1833) constructed the first railway steam locomotive. In 1830, England's Liverpool and Manchester Railway became the first to offer regular, timetabled passenger services. By 1850, Britain had more than 6,000 miles of railroad track. Additionally, around 1820, Scottish engineer John McAdam (1756-1836) developed a new process for road construction. His technique, which became known as macadam, resulted in roads that were smoother, more durable and less muddy.

Figure 104. Left, the macadam roads during the Industrial Revolution and right, a modern highway in Cheshire, England

Quality of life during the Industrial Revolution in Britain

The Industrial Revolution brought about a greater volume and variety of factory-produced goods and raised the standard of living for many people, particularly for the middle and upper classes. However, life for the poor and working classes continued to be filled with challenges.

Wages for those who worked in factories were low and working conditions could be dangerous and uninteresting. Unskilled workers had little job security and were easily replaceable. Children were part of the labor force and often worked long hours and were used for such highly hazardous tasks as cleaning the machinery. In the early 1860s, an estimated one-fifth of the workers in Britain's textile industry were younger than 15. Industrialization also meant that some craftspeople were replaced by machines.

Figure 105. Children workers during the Industrial Revolution

Additionally, urban, industrialized areas were unable to keep pace with the flow of arriving workers from the countryside, resulting in inadequate, overcrowded housing and polluted, unsanitary living conditions in which disease was widespread. Conditions for Britain's working-class began to gradually improve by the later part of the 19th century, as the government introduced various labor improvements and workers gained the right to form trade unions.

Progress Check

Produce a role play of a conversation between family members who lived in one of the industrialized communities during the industrial revolution in Britain. The conversation should be about:

a) A brief description of what happened during the industrial revolution and the three industries that flourished during this era.
b) The quality of life during the industrial revolution.
c) The key challenges faced by industrial workers during the industrial revolution.
d) The impacts of the industries in the lives of people during this era.

Industrialization moves beyond Britain

The British passed bills to forbid the export of their technology and skilled workers; however, they had little success. Industrialization spread from Britain to other European countries, including Belgium, France and Germany, and to the United States. By the mid-19th century, industrialization was well-established throughout the western part of Europe and America's northeastern region. By the early 20th century, the U.S. had become the world's leading industrial nation.

Modern Industrialization

Modern industrialization has grown rapidly with the embrace of scientific knowledge and rapid development in technology such as the use of artificial intelligence and renewable energy resources. Through modern industrialization, a variety of products are produced with the use of readily available resources.

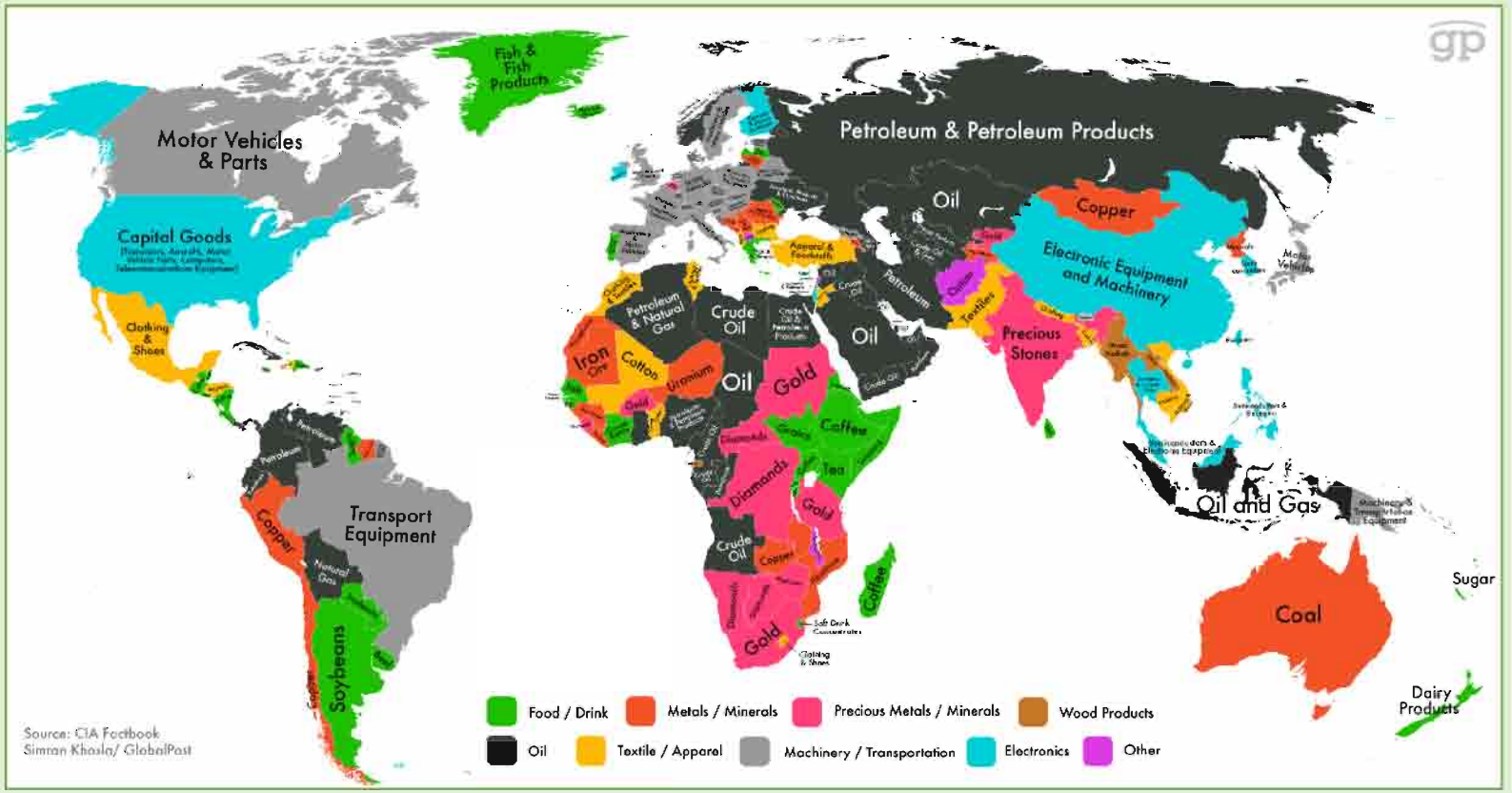
China and the United States of America are currently the leading countries in the world in terms of industrial production. Other nations thriving in industrial production include The United Kingdom, Russia, Japan, Brazil, Australia, Canada, Germany, France, Italy, Spain, Finland, Switzerland, Sweden, Israel, Singapore and the Netherlands.

Progress Check

Look at the map provided in the next page and answer the following question in pairs:

1. How do you think the location of a country affects its industrial productivity?
2. Which countries lead in the production of:
    a) Electronic equipment and machinery?
    b) Petroleum and petroleum products?
    c) Food and drinks?
    d) Precious metals and minerals?
    e) Medicine?
    f) Textiles?
3. How might this map change in the next 15 years? Justify your answer.

A map of Global industrial productivity-2016. (*Each country is marked with its area of industrial specialization)



Factors driving industrial development today

The following factors have led to the rapid growth of industrialization witnessed in the world today:

Scientific Innovations and Technological Development

Over the different phases of industrialization, scholars and scientists around the world have come up with a series of innovations starting from mechanical and steam powered industrial equipment to the current computerized industrial equipment. This has gradually enhanced the level and efficiency of industrial productivity.

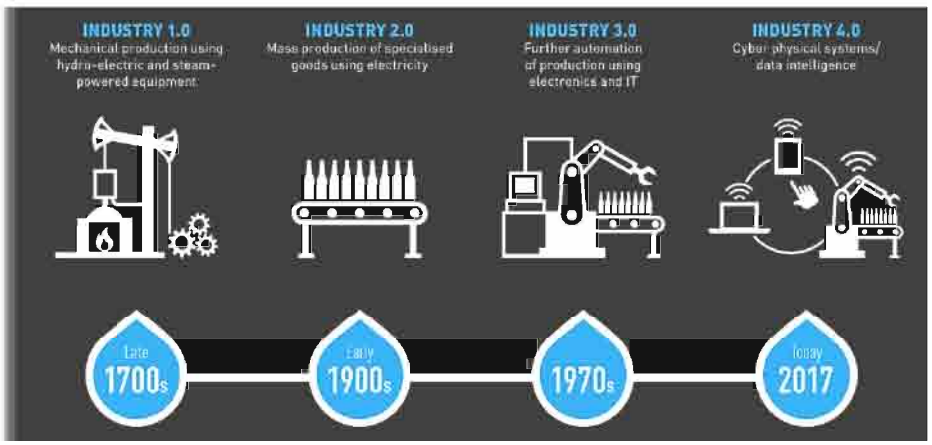


Figure 106. History of industrial development in relation to scientific and technological development.

Figure 107. Industrial robots at AUDI car assembly industry, Germany.

Natural Factors

The natural factors such as physical, geographical and climatic exercise considerable impact on the industrial productivity. The relative importance of these factors depends upon the nature of the industry, goods and services produced and the extent to which physical conditions are controlled. The geological and physical factors play a very dominant role in determining the productivity of extractive industries likes coal-mining in which the physical output per head is greatly influenced by the depth of the coal-mines, the thickness of the coal seams, the topography of the region and the quality of coal available. In other industries like tailoring, grain-milling, hosiery, soap-making, confectionary, medium and coarse cotton manufacturing, etc., the geographical, geological and physical factors exercise little influence on productivity.

Government Policies

The industrial policies of the Government have an important impact on the industrial productivity; The Government should frame and implement such policies which create favourable conditions for saving, investment, flow of capital from one industrial sector to another and conservation of national resources. Certain industries may be granted protection, and incentives may be given to the others for the development in view of the national interest.

Case study 14

Comparing industrial growth from the past to the present

Organize yourselves in groups and tackle the following questions:

- In your own words, how can you describe the level of industrial growth from the past to the present?
- Has South Sudan grown industrially? What can it do in order to develop industrially?
- To what extent do the following factors affect industrial development?
    a) Quality of human resources.
    b) Availability of finance.
    c) Proper management of industrial resources.
    d) High demand of industrial produce and availability of markets.

Case study 15

Industrialization in South Sudan

- Which local industries are located in South Sudan? **In pairs** research the various types of industries found in South Sudan and classify them according to the **major classification of industries.**

- In groups investigate the **problems** facing industrialization in South Sudan by comparing the development of its existing local industries with other regions around the world such as the United States of America, Britain etc. Suggest a possible solution to the key challenges facing industries in South Sudan. (*Present your findings to the class)*

Comprehensive Activity 10

Use your atlases and other related materials to locate local industries in South Sudan.

Exercise 10

1. Define the following terms:
    a) Industrialization.
    b) Industry.
2. What are the classification of industries? (*Use appropriate and relevant examples in your answer*)
3. Look at the pictures below and answer the questions that follow:

    a) What are the effects of industrialization on a region? (*Use appropriate and relevant examples in your answer*)

4. South Sudan is a country rich with natural resources and investment opportunities. As a citizens of South Sudan, organize yourselves in groups and discuss some of the means to provide solutions to the problems facing the following industries:
    a) Tourism industry.
    b) Mining industry.
    c) Transport industry.

Differentiating between weather and climate

Weather

Weather describes conditions in the atmosphere that are happening at the moment. It is the short term occurrence, or daily measurement, of fair or harsh weather. When dealing with weather, daily decisions are necessary. When it is raining, bring an umbrella; when it is stormy outside, take cover inside. Daily temperature, precipitation, and severe weather are all a part of everyday weather. If the meteorologist on TV says that it will be sunny today, this is defined as weather of the day.

Climate

Climate is the average weather in a place over 30 years or more. While the weather can change in just a few hours, climate takes hundreds, thousands, even millions of years to change.

Figure 108. Different types of weather

Measuring the elements of weather

Why measure weather?

In everyday language weather means such qualities as wet or fine, warm or cold. For most people, such descriptive terms are acceptable. However, many industries today require more quantitative assessments of the weather, with the use of standardized terms measured by suitably designed instruments. The science of the study of weather is called meteorology; the meteorologist measures temperature, rainfall, pressure, humidity, sunshine and cloudiness, and makes predictions and forecasts about what the weather will be in the future.

Temperature

The hotness or coldness of a place is called its temperature and is measured with a thermometer. The ordinary thermometer consists of a hollow glass bulb attached to a narrow stem with a thread-like bore. The bulb is filled with liquid, usually mercury, but also alcohol when very low temperatures need to be measured, which expands when the temperature rises and contracts when the temperature falls. The amount of expansion and contraction is measured by a calibrated scale.

Figure 109. Normal thermometer

Although thermometers may measure their own temperature, they are usually needed to measure the temperature of the surrounding environment. To ensure that the temperature

of the surrounding environment is the same as the thermometer, it must be covered from sunlight and be exposed to sufficient ventilation. These conditions are provided by covering the thermometer in a wooden box with louvered sides, called a Stevenson screen.

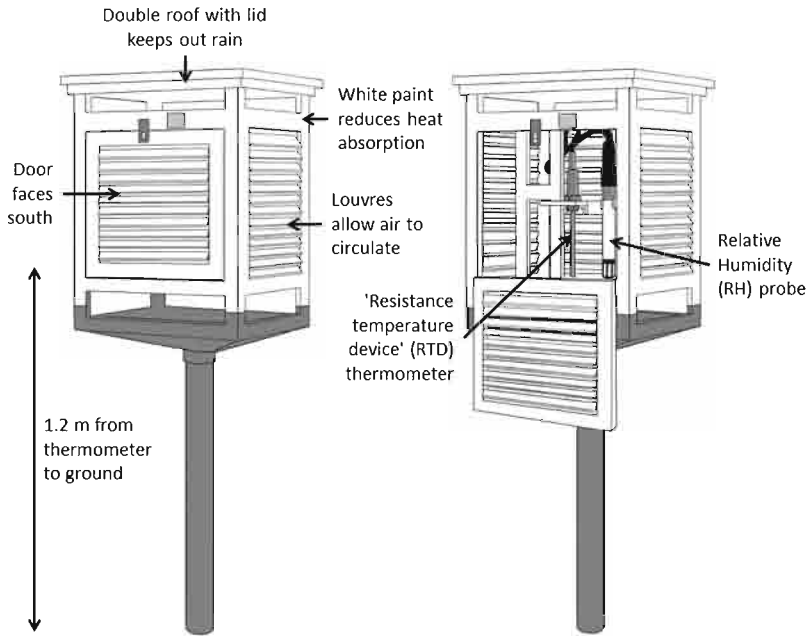


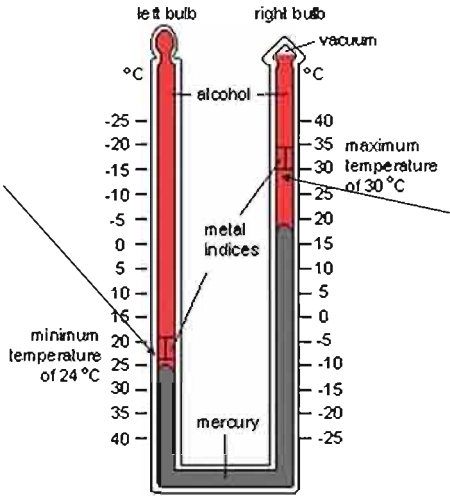
Figure 110. The Stevenson's screen

Most temperature scales today are articulated in degrees Celsius (C), although one will sometime see Fahrenheit (F) in use. The Celsius scale is fixed by two points, the freezing and boiling point of water, which at normal atmospheric pressure are 0^0C and 100^0C respectively. The scale is then divided into 100 units. 0^0C is equivalent to 32^0F and 100^0C to 212^0F. The Kelvin temperature scale is the absolute temperature scale. Absolute zero, the coldest temperature possible in the universe is 0K or -273^0C. Because one Kelvin is equivalent to one degree Celsius, 0^0C is the same as 273K. 15^0C is the same as 288K.

Special thermometers are used to indicate the maximum and minimum temperatures reached over time, usually after a day. For beginners, a combined maximum and minimum thermometer is referred to as the U-shaped thermometer. Thermometers are also used to measure the temperature of the ground at night, which may fall several degrees below that of the air above.

When the temperature falls, the alcohol in the tube contracts (shrinks) and pulls the metal index along the left thermometer.

When the temperature rises and the alcohol expands again, the metal index is left behind. So it will always show the lowest (minimum) temperature recorded that day.



When the temperature rises the alcohol expands and pushes the mercury inside the thermometers up the right hand side and the metal index moves with it.

If the temperature falls again the alcohol contracts but the metal index stays where it is. So it will always show the highest (maximum) temperature recorded that day.

Figure 111. The maximum and the minimum thermometer

Pressure

Atmospheric pressure is measured by a barometer. A mercury barometer measures the pressure by observing the length of mercury which is supported by the weight of the atmosphere. One centimeter of mercury is equal to 13.33 millibars (mb), so normal atmospheric pressure can support a column of mercury about 75 cm (or 30 inches) high.

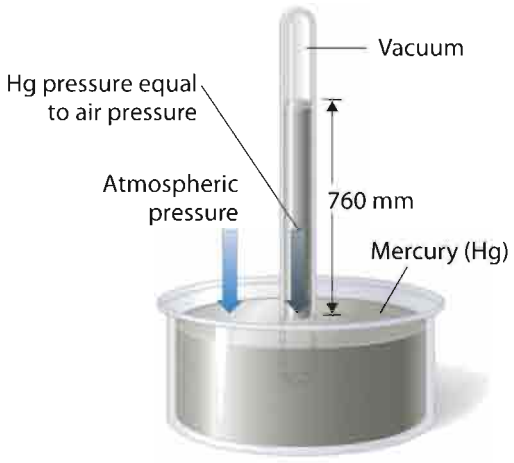


Figure 112. The mercury barometer

An aneroid barometer is an instrument used to measure pressure. It consists of a box of with little amount of air which expands and contracts as the pressure falls and rises. The box is connected through a system of levers to a pointer which indicates the pressure.

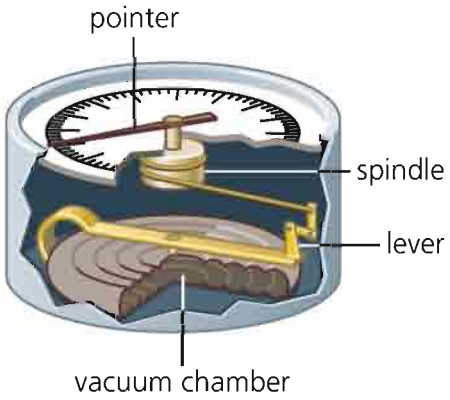


Figure 113. The aneroid barometer

Variations in atmospheric pressure lead to the development of winds that play a significant role in shaping our daily weather.

Humidity

Water in the form of invisible vapour is mixed with the air throughout the atmosphere. It is the condensation of this vapour which gives rise to most weather conditions: clouds, rain, snow, dew and fog. There is a limit to how much water vapour the air can hold and this limit varies with temperature. When the air contains the maximum amount of vapour possible for a particular temperature, the air is said to be saturated. Warm air can hold more vapour than cold air. In general the air is not saturated, containing only a fraction of the possible water vapour.

Humidity is measured by a hygrometer which has two thermometers, one dry bulb or standard air temperature thermometer, and one wet bulb thermometer. The wet bulb thermometer is an ordinary thermometer which has the bulb covered with a muslin bag, kept moist via a permeable wick dipped into water. Evaporation of water from the muslin lowers the temperature of the thermometer. The difference between wet and dry bulb temperatures is used to calculate the various measures of humidity.

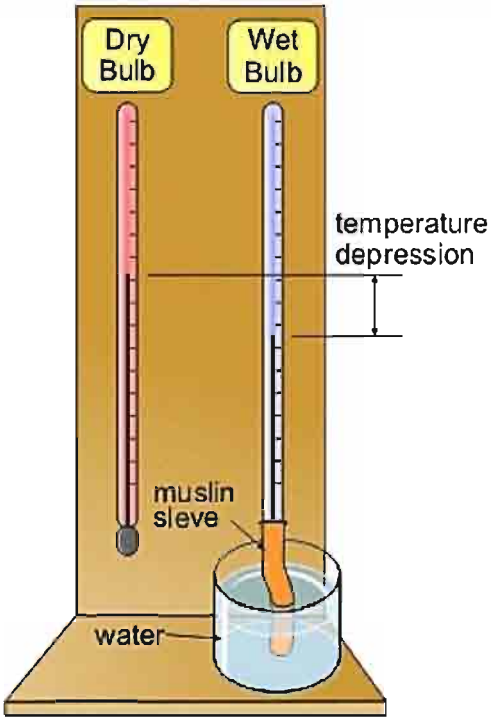


Figure 114. The hygrometer

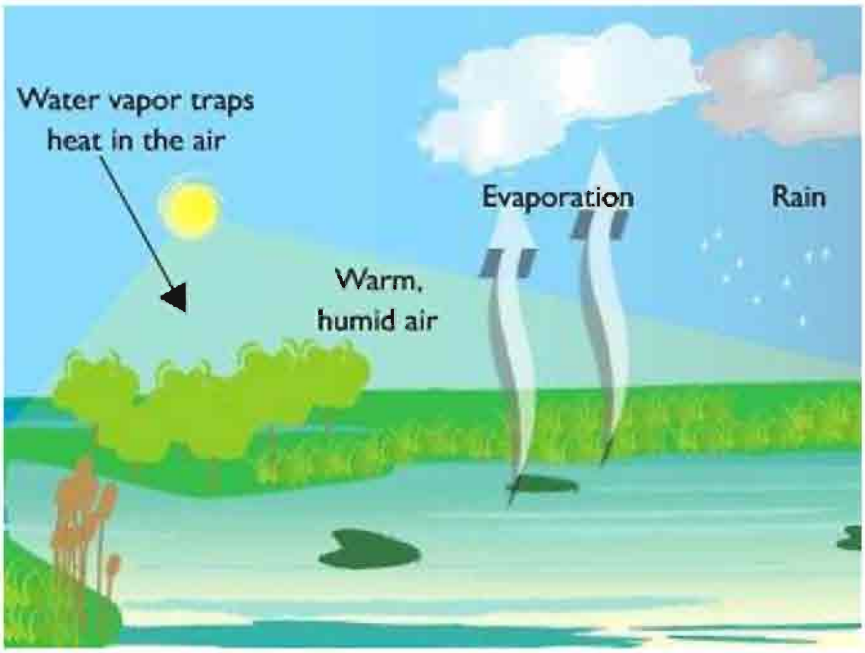


Figure 115. How humidity contributes to rainfall

Wind

The air is nearly always in motion, and this is felt as wind. There are two measurements of wind that is its speed and direction. The direction of wind is measured using compass directions from where the wind is blowing. Air moving from the north-east to the South-west is called a north-east wind. The wind speed can be measured in miles or kilometers per hour, meters per second, and knots or as a force on the Beaufort scale below:

Force	Description	Conditions	Wind speed (mph)
0	Calm	Smoke rises vertically	0
1	Light air	Smoke drifts	1-3
2	Light breeze	Leaves rustle; vane moved by wind	4-7
3	Gentle breeze	Leaves in constant motion; light flag extend	8-12
4	Moderate breeze	Raises duct and loose paper; small branches move	13-18
5	Fresh breeze	Small trees sway; crested wavelets on inland water	19-24
6	Strong breeze	Large branches in motion; whistling in telegraph	25-31
7	Moderate gale	Whole trees in motion	32-38
8	Fresh gale	Breaks twigs off trees; impedes walking	39-46
9	Strong gale	Slight structural damage to buildings	47-54
10	Whole gale	Large branches broken; some trees uprooted	55-63
11	Storm	Large trees uprooted	64-72
12	Hurricane	Widespread damage occurs	73 and beyond

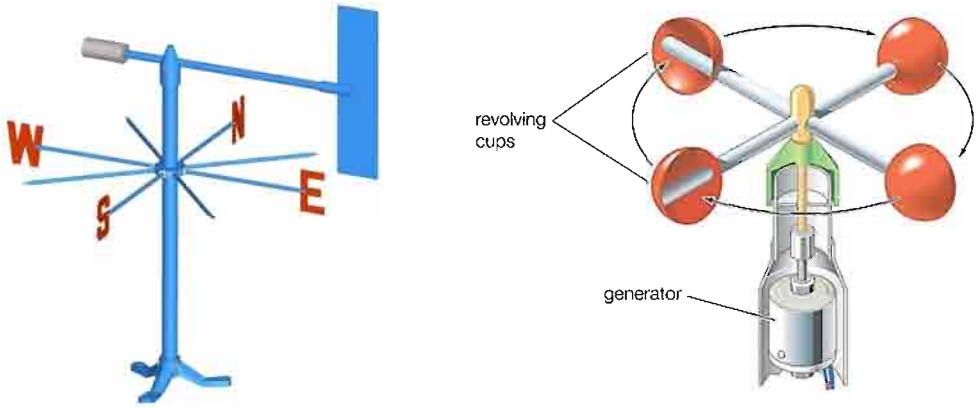


Figure 116. The wind vane (left) and the anemometer (right).

Creative activity 5

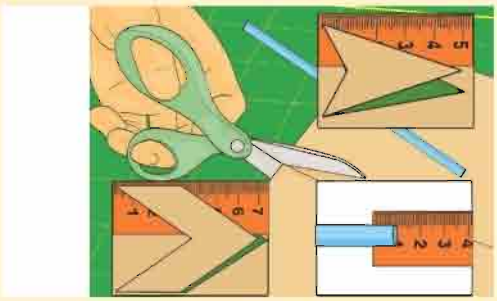
Making a wind vane

Organize yourselves in pairs and follow the instructions below:

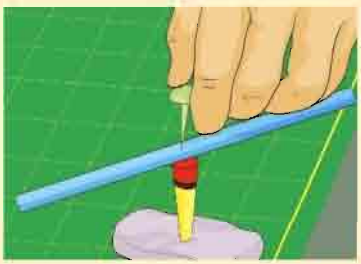
1. *Gather your supplies:* To make a wind vane at home, you will need the following supplies:

    - A manila file folder
    - A pin
    - A pair of scissors
    - Glue
    - A pencil with an eraser, a straw, modeling clay and a paper plate

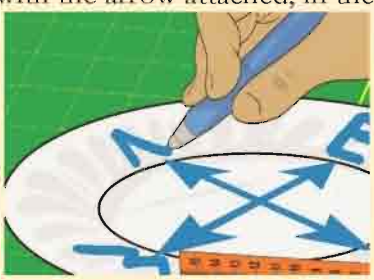
2. *Make the arrow.* Use the manila folder to cut out an arrow point that is 5cm long. Then, cut out a tail for the arrow that is 7cm long. Take the straw and make 1cm cuts on each end of the straw. Form the arrow by sliding the arrow point on one end of the straw and the arrow tail on the other end of the straw.

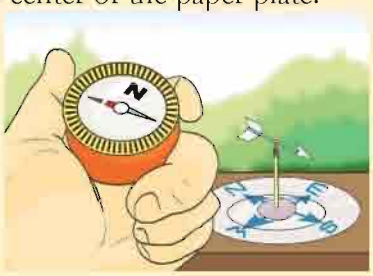


3. *Create the base of the wind vane.* Do this by pushing the pin through the middle of the straw and then into the eraser on the pencil. Push the sharp end of the pencil into a small lump of modeling clay to form the base of the wind vane



4. *Note the four wind directions on the paper plate.* Take the paper plate and write the four directions, North, South, East, and West on each end of the plate. Place the clay base, with the arrow attached, in the center of the paper plate.





5. *Try out the wind vane.* You can do this by blowing directly on the wind vane and noting if the arrow spins freely when you blow on it. Observe the wind vane. If it becomes very windy, hold down the paper plate so the vane does not blow away. Note the direction the arrow points to as the wind blows.

Precipitation/ Rainfall.

The amount of rain, snow or hail which falls in a specified time is measured as the depth of water it would produce on a large, flat waterproof surface. Rainfall is measured in millimeters although inches may sometimes be used. It is measured daily (24 hours) by means of a rainguage. Today's rainguages are simple to use with pre-calibrated scales on their sides. When measuring rainfall, certain precautions have to be taken against the effects of obstructions, wind, splashing and evaporation.

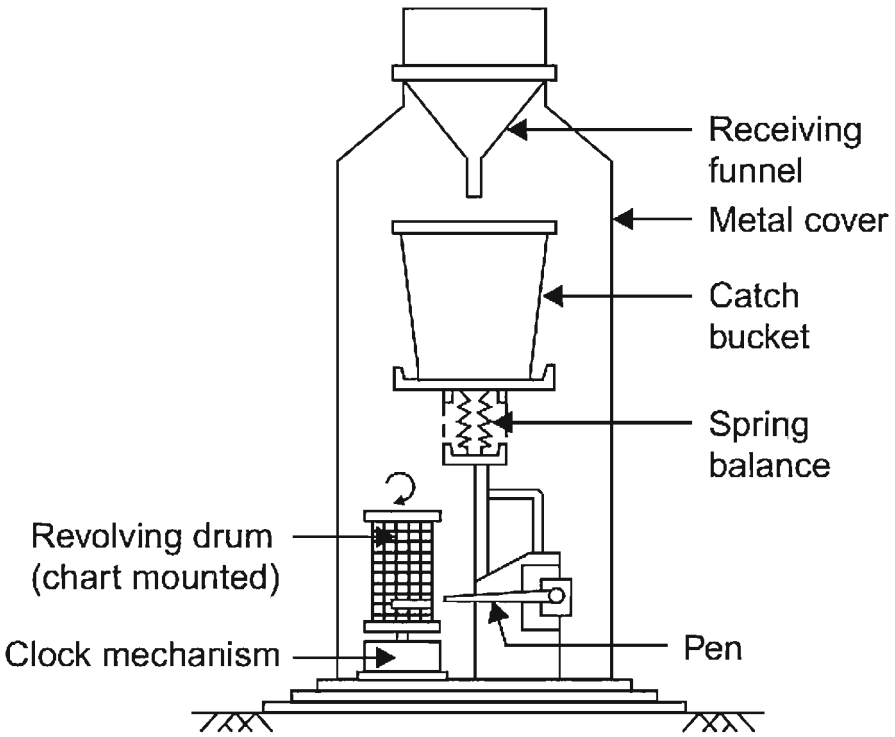


Figure 117. Modern rain gauge

Sunshine

Many weather stations record the amount of bright sunshine during daylight hours. The instrument used to measure sunlight is the Campbell-Stokes sunshine recorder which consists of a glass ball that focuses the sun's rays, burning a hole in an index card. As the Sun moves around the sky, the burnt hole extends along the index, which is marked in hours to record the amount of direct sunshine.

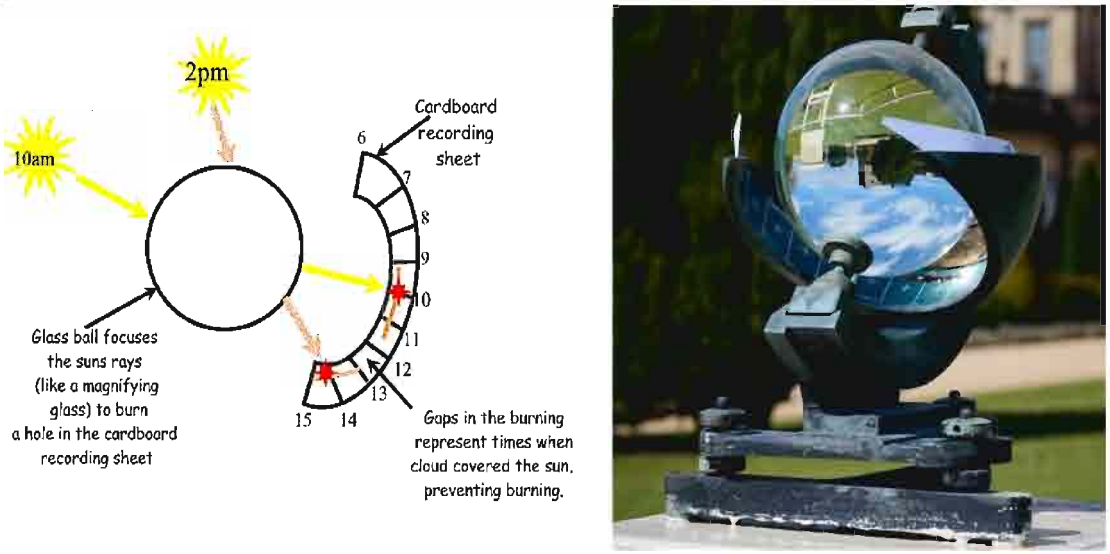


Figure 118. The Campbell stokes sunshine recorder

Field trip 2

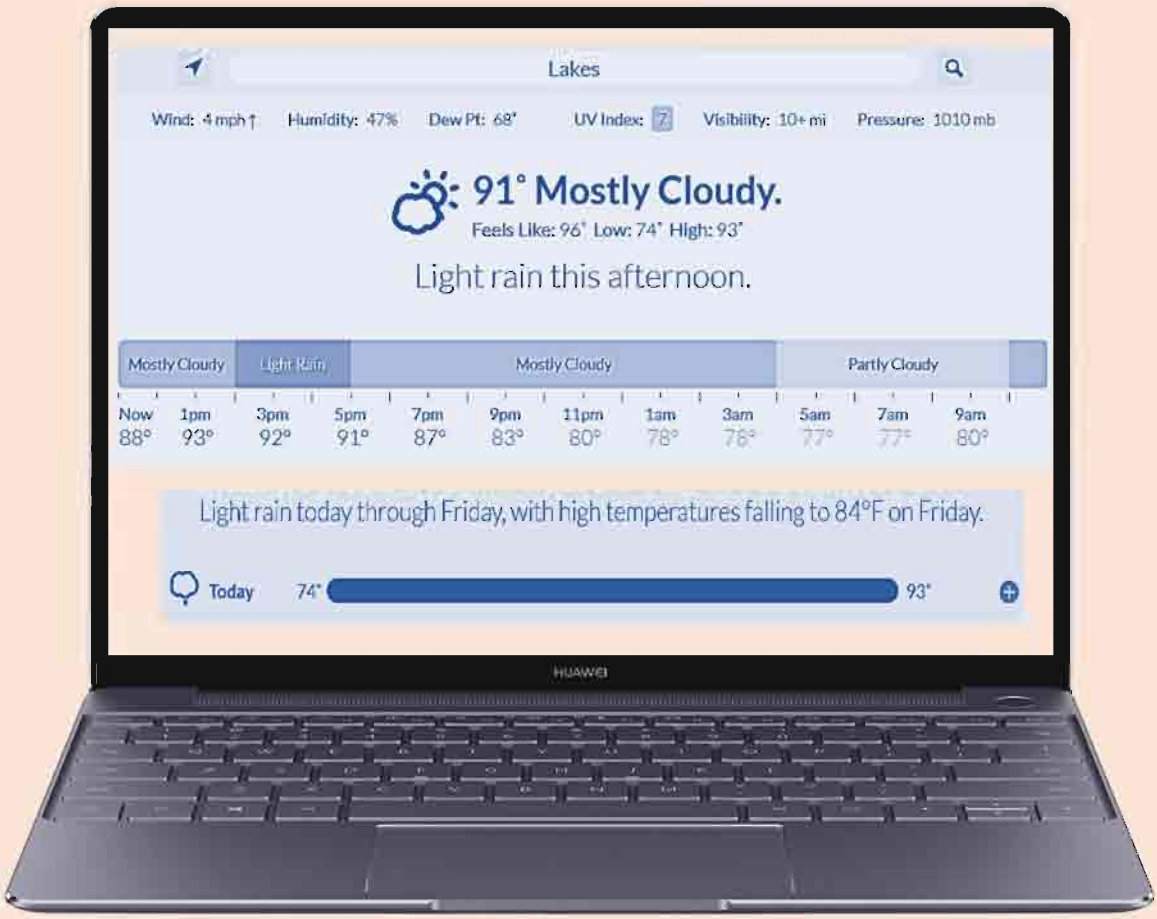
Visiting a weather station

If possible, visit any local weather station and observe the weather instruments. Be prepared to ask any questions about how the following weather instruments work:

1. The Rainguage
2. Aneroid barometer.
3. Wind vane, wind sock and anemometer.
4. The hygrometer
5. The hydrometer.
6. The barometer.

Progress Check

Robin used his laptop to find out the weather forecast of lakes state, South Sudan, he found this information in the internet.



1. From the information above briefly describe the weather of Lakes states in one paragraph.
2. What might be the weather after 9am?
3. At what time of the day did Lakes state receive the highest temperature reading?
4. Convert the following temperature reading to degrees Celsius:
   a) 90^0F, 87^0F, 78^0F

USE THE FOMULAE: $Celsius\ readings = \frac{5}{9}(Farenheit\ readings - 32)$

Exercise 11

Answer the following questions:

1. Explain the difference between climate and weather.
2. How are the following elements of weather measured?
    a) Precipitation.
    b) Wind.
    c) Sunshine.
    d) Atmospheric pressure.
    e) Humidity.
3. Give reasons for the following characteristics of the Stevenson's screen:
    a) Double roof with lid.
    b) White paint on the walls.
    c) 1.2 m Distance from the thermometers to the ground.
    d) Louvres on the sides.
4. Explain the benefits of using a maximum and minimum thermometer works.
5. Draw and label the following weather instruments appropriately:

    a) The minimum and maximum thermometer.
    b) The anemometer.
    c) The barometer.
    d) The Campbell stokes sunshine recorder.
    e) The mercury barometer.
    f) The Stevenson's screen.

Climate change

What is climate change?

Climate change may refer to a change in average weather conditions, or in the time variation of weather within the context of longer-term average conditions.

Factors affecting the climate of a given area

Latitude or distance from the equator

Temperatures drop the further an area is from the equator due to the curvature of the earth. In areas closer to the poles, sunlight has a larger area of atmosphere to pass through and the sun is at a lower angle in the sky. As a result, more energy is lost and temperatures are cooler. In addition, the presence of ice and snow nearer the poles causes a higher *albedo,* meaning that more solar energy is reflected, also contributing to the cold.

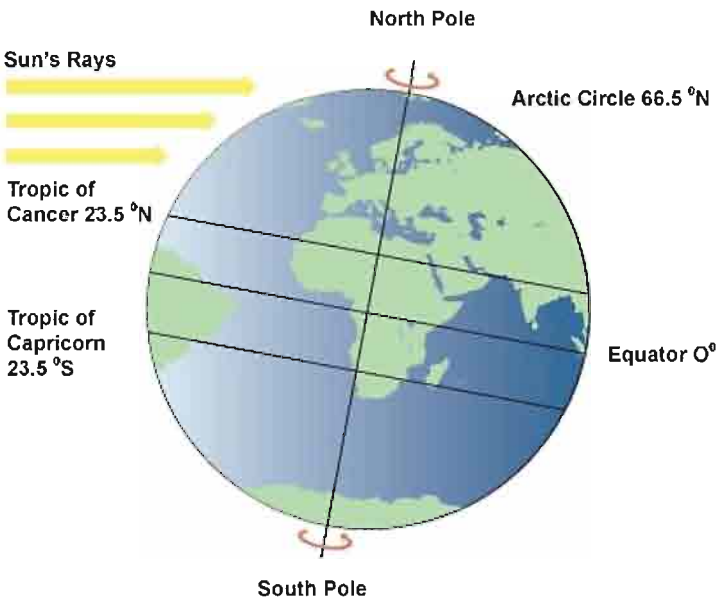


Figure 119. Effects of latitude on climate

Altitude or height above sea level

Locations at a higher altitude have colder temperatures. The higher you go, the cooler it becomes.

Distance from the sea

Oceans heat up and cool down much more slowly than land. This means that coastal locations tend to be cooler in summer and warmer in winter than dry lands at the same latitude and altitude.

Ocean currents

Weather patterns are controlled by ocean currents, which are influenced by surface winds, temperature, the earth's rotation, and ocean tides. Ocean currents flow clockwise in the Northern Hemisphere and anti-clockwise in the southern Hemisphere.

They bring warm water and rain from the equator to the poles and cold water from the poles toward the equator. These ocean currents help to neutralize the high levels of solar radiation that the earth's equator receive. Without these currents, it would be much hotter at the equator, much colder at the poles, and our planet's land would be much less habitable.

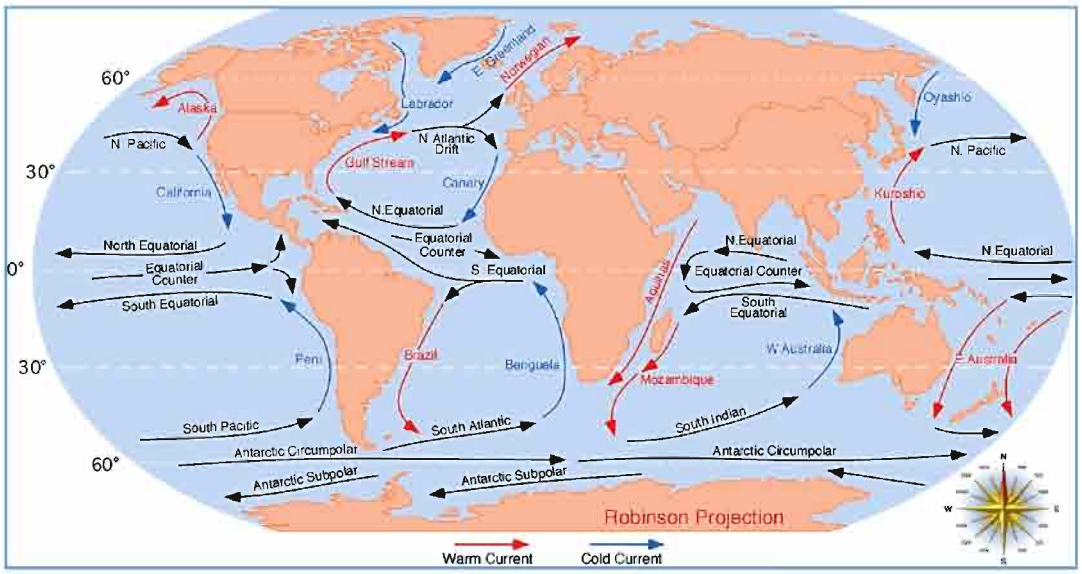


Figure 120. Ocean currents

Prevailing winds

The prevailing wind is the most frequent wind direction a location experiences. When prevailing winds blow over land areas, it can contribute to creating desert climate. There are 3 major wind patterns found in the Northern Hemisphere and also 3 in the Southern Hemisphere. As seasons change, the wind patterns shift north or South. So does the intertropical convergence zone, which moves back and forth across the Equator.

Topography

The Topography of an area can greatly influence our climate. Mountain ranges and forest covers are natural barriers to air movement. This may cause an area to have rain or lack rain. Areas near mountains have a high amount of rainfall while areas with no tree covers or mountain ranges have prevailing dry conditions.

Effects of Geographical location

The position of a town, city or place and its distance from mountains and large water bodies regulate its prevailing wind patterns and what types of air masses affect it. Coastal areas may experience refreshing breezes in summer, when cooler ocean air moves onto dry land. Places near lakes and other large waterbodies experience a *convectional* type of rainfall characterized by thunderstorms. Similarly areas on the lee ward side of mountains have a *relief* type of rainfall while areas on the windward side of the mountain experience inadequate amount of rainfall.

Surface of the Earth

The surface of the earth is another important factor which has an influence on climate. The amount of sunlight that is absorbed or reflected by the surface determines how much atmospheric heating occurs. Darker areas, such as heavily vegetated regions, tend to be good absorbers; lighter areas, such as snow and ice-covered regions, tend to be good reflectors. The ocean absorbs and loses heat more slowly than land. Its waters slowly release heat into the atmosphere, which then distributes heat around the globe.

Progress Check: Describing regional climate

Using the map provided below:

1. Describe how the climatic conditions of towns located around the equator.
2. How do Africa's mountains affect regional climate?
3. What climate do regions around the Saharan desert experience?
4. Briefly describe South Sudan's climate.

Causes of climate change

Natural causes

The Earth's climate can be affected by natural factors that are external to the climate system, such as changes in volcanic activity, solar output, and the Earth's orbit around the Sun. out of these, the two factors relevant on climate change are changes in volcanic activity and changes in solar radiation. In terms of the earth's energy balance, these factors primarily influence the amount of incoming energy. Volcanic eruptions are occasional and have relatively short-term effects on climate.

Human causes

Climate change can also be caused by human activities, such as the burning of fossil fuels and the conversion of land for forestry and agriculture. In addition to other environmental influences, these activities change the land surface and emit various substances to the atmosphere. The dominant product of fossil fuel combustion is carbon dioxide, a greenhouse gas. The overall effect of human activities since the Industrial Revolution has been a warming effect, driven mainly by emissions of carbon dioxide and enhanced by emissions of other greenhouse gases.

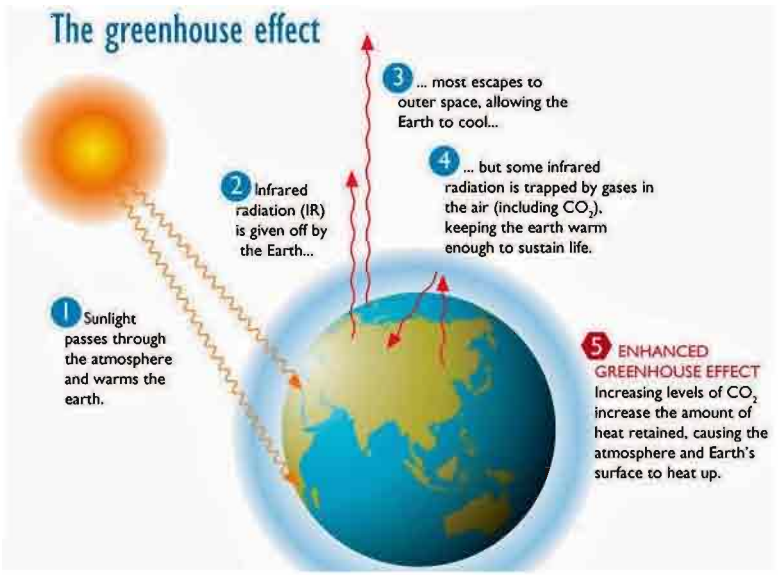


Figure 121. The greenhouse effect

The build-up of greenhouse gases in the atmosphere has led to an enhancement of the natural greenhouse effect. The emission of greenhouse gases has the potential to warm the planet to levels that have never been experienced in the history of human civilization. Such climate change could cause unpredictable environmental, social, and economic consequences.

Measures to prevent climate change

Reduce emission

Greenhouse gas emission from industries, vehicles and burning of charcoal among other human activities is the main cause of global warming. Many governments around the world today are working on strategies to help reduce global emissions of greenhouse gases by phasing out the use of fossil fuels and using alternative energy sources such as wind, solar and hydroelectric energies.

Figure 122. A coal power plant emitting massive smoke at a coal plant in Georgia, U.S.A

Stop deforestation

Trees reduce the amount of carbon dioxide in the atmosphere. When we cut trees without replacing them, the level of carbon dioxide increases in the atmosphere causing global warming.

Figure 123. Deforestation in Myanmar.

Boosting energy efficiency

The energy used to power, heat, and cool our homes, businesses, and industries is the single largest contributor to global warming. Energy efficiency technologies allow us to use less energy to get the same (or higher) level of production, service, and comfort. This approach has a huge potential to save both energy and money, and can be installed quickly.

Greening transportation

Emissions from cars and trucks have increased at a faster rate than industries. Many people own personal vehicle that use fossil fuels thus increasing the level of carbon emission in the atmosphere. Possible solutions to reduce the amount of carbon emitted by vehicles include switching to low carbon fuels, using public transport to reduce the amount of carbon emitted in the atmosphere and using vehicles that use renewable energy resources such as biomass and electricity.

Figure 124. An eco-friendly hybrid car.

Using renewable energy resources

Renewable energy sources such as **solar, wind, hydropower** (also known as **hydroelectric energy** which involves generating electricity using the energy of moving water), **geothermal and bioenergy** are available around the world. When used well, renewable energy resources can replace the usage of fossil fuels to meet our energy needs. Renewable technologies can be deployed quickly, are increasingly cost-effective, and create jobs while reducing pollution. Such technologies include: **Hydroelectric dams, wind** and **solar farms.**

Figure 125. A hydroelectric dam and a wind farm.

Reducing the use of fossil fuels or non-renewable energy resources

Reducing the use of fossil fuels is important to tackle climate change. There are many ways to begin this process. Key action steps include: not building any new coal power plants, beginning the shutdown of coal plants starting with the oldest and dirtiest, and capturing and storing carbon emissions from power plants.

Developing and deploying new low-carbon and zero-carbon technologies.

Research into and development of the next generation of low-carbon technologies will be critical to the reductions of global carbon emissions. Current research on battery technology, new materials for solar cells, harvesting energy from environmental friendly sources like bacteria and algae, and other advanced areas could provide important revolutions.

Figure 126. Solar technology

Ensuring sustainable development

The countries of the world (from the most to the least developed) differ in their contributions to the problem of climate change and in their responsibilities and capacities to meet it. A successful global unity on providing solutions to climate change must include financial assistance from richer countries to poorer countries to help make the transition to low-carbon technologies and to help adjust to the effects of climate change.

Did you know?

RENEWABLE SMALL SCALE TECHNOLOGIES THAT CAN BE USED IN SOUTH SUDAN

Micro-hydro power

Micro-hydro power is the small-scale harnessing of energy from falling water, such as steep mountain rivers. Using this renewable, indigenous, non-polluting resource, micro-hydro plants can generate power for homes, hospitals, schools and workshops.

How it works

Micro-hydropower systems do not require a dam or storage facility to be constructed. Instead they divert water from the stream or river, channel it in to a valley and drop it in to a turbine via a pipeline called a penstock. The turbine drives a generator that provides the electricity to the local community. By not requiring an expensive dam for water storage, run-of-the-river systems are a low-cost way to produce power. They also avoid the damaging environmental and social effects that larger hydroelectric schemes cause, including a risk of flooding. Water from the river is channeled through a settling basin, which helps to remove sediments that could harm the turbine. The water then flows into the Forebay Tank where it is directed downhill through a pipe called a penstock. When the water reaches the bottom, it drives a specially designed turbine to produce the electricity. This technology can be used to generate electricity in South Sudan.

Figure 127. Left, a diagram showing the components of a micro-hydropower plant and right a micro hydropower plant in Swatai Village, Pakistan. This technology is cheap, affordable and effective.

Case study 16

Global warming /Climate change

- Organize and prepare a debate on **"oil as a great contributor to global warming".**
- In groups, discuss on the various method or suggestions that the South Sudanese government can use to mitigate climate change.

Exercise 12

1. What is climate change?
2. What are some of the factors affecting the climate of a given area?
3. Define the following terms:
    a) Greenhouse effect.
    b) Global warming.
4. What are some of the measures that can be useful in preventing global warming?

Unit 7 READING AND INTERPRATING MAPS AND PHOTOGRAPHS

Understanding Photography in Geography

Comprehensive Activity 11

Look at the picture below and answer the questions that follow in pairs.

Figure 128. A camera.

1. Have you ever held a camera before?
2. How does a camera work?
3. In your own terms, what do you understand by the term photography?

What is photography?

Photography is the art or process of producing images by the action of radiant energy and especially light on a sensitive surface (such as film or an optical sensor). A photograph is

an image of an object which is recorded by a camera and then printed on paper or, is a picture taken by means of chemical lights prepared on a special paper.

Parts of a photograph

A photograph has three main parts as described below:

- Background the area farthest from the camera.
- Foreground: this is the area nearest to the camera.
- Middle ground: this is the area between the background and the foreground, which is at middle distance from the camera.

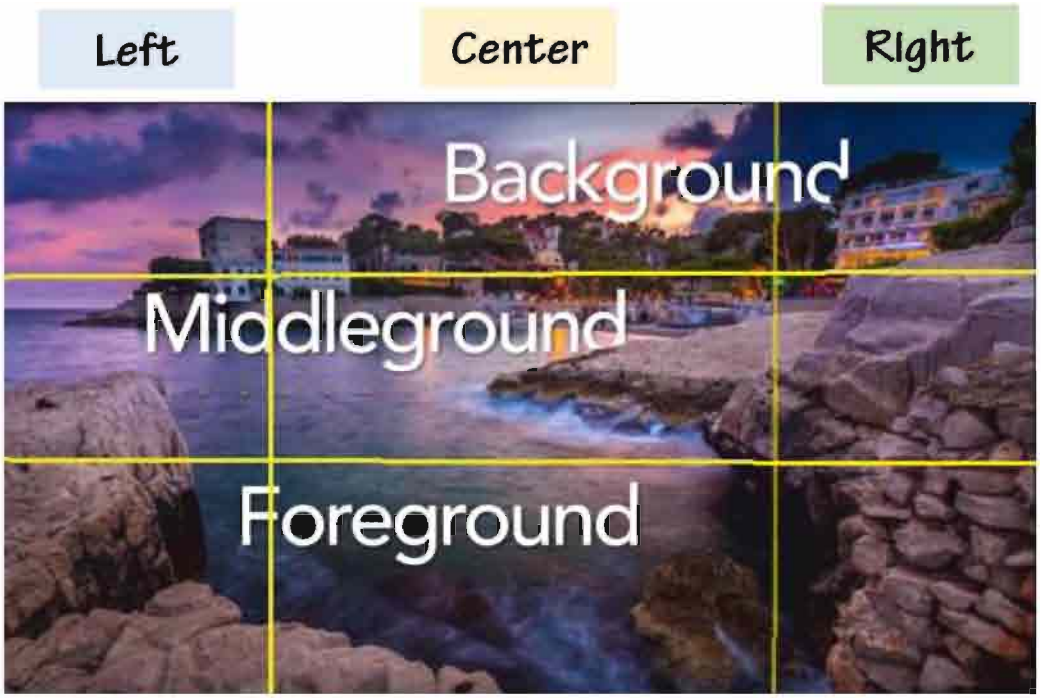


Figure 129. Parts of a photograph

Each of the three parts of the photograph can further be sub-divided into three parts to give nine combinations which form the nine minor parts of the photograph namely:

- Left background, center background and right background.
- Left middle ground, center middle ground and right middle ground.
- Left foreground, center foreground and right foreground.

Types of photographs

There are three types of photograph that includes the following:

1. Horizontal photographs/Group photographs
2. Oblique photographs
3. Vertical photographs/Aerial photograph

Horizontal photographs/ group photographs

These are photographs that are taken from the ground when the camera is at the same level as the object being photographed. Objects are large and clearly shown in these photographs when they are close than those far from the camera, the fore ground and the horizon is seen but the back or dead ground is not seen. There is no fixed scale in horizontal photographs.

Figure 130. A horizontal photograph of a family of cheetahs in Tsavo national park, Kenya.

Oblique photographs

These are photographs taken when a camera is slanting at an angle less than 90°. They are taken when the photographer is standing on an elevated ground and hold the camera on an angle towards the lower ground. They normally cover the horizon. There are two types of oblique photographs:

- **Low oblique photographs**: These are taken when the photographer is standing in elevated ground, such as top of a hill, building or cliff, and holds the camera at an angle pointing towards the lower ground. The photograph can also be taken when the photographer is standing at the bottom of an elevated ground, with the camera pointing towards the higher ground.

Figure 131. An example of a low oblique photograph of the World Bank headquarters (Washington DC, USA).

- **High oblique photographs:** these photographs are taken from the sky with the camera tilted at an angle towards the ground. The photographer may take the photograph from a helicopter or low-flying airplane. These photographs cover quite a large area of land.

Figure 132. A high oblique photograph of Juba, the capital city of South Sudan

Vertical/ aerial photographs

These are photographs taken from the aircraft with the camera directly above the object pointing vertically to the ground. Only the top view is seen. Instruments used to capture pictures are called air crafts or the satellites. Aerial photographs are used for mapping rescue and security surveillance.

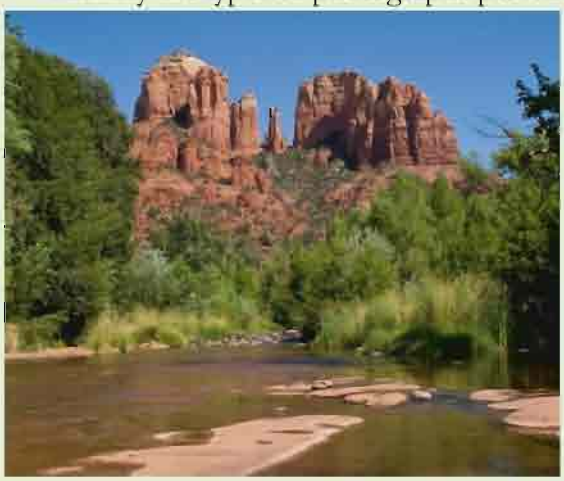
Figure 133. An aerial oblique photograph of an airplane flying over buildings in Midtown Manhattan, USA

Figure 134. A satellite vie of Chelsea, England, United Kingdom

Exercise 13

1. What do you understand to be the importance of photography in Geography?
2. Using the sketch provided, describe the different parts of a photograph.

3. Differentiate between the following terms:
   a) Horizontal photographs and oblique photographs.
   b) High oblique photograph and low oblique photograph.
   c) Aerial photographs and oblique photographs.
4. Identify the types of photographs provided below:



Reading and Interpreting Photographs

This is the process of reading, measuring, translating and explaining the meaning of objects identified on that photograph. It is done so as to obtain reliable information about the natural or cultural features on their environments. It involves the following;

- Determining the title,
- Estimating time and the season,
- Estimating direction, identifying and interpreting physical features,
- Identifying and interpreting human activities and suggesting possible location of the scenery in the place.

Determining the title

This is obtained by carefully studying the photograph, information determines the choice of the title. Photos show landscapes, activities on land, what is on the surface and the sky. The information contained in the foreground, middle ground and dead ground can help in determining a suitable title.

Estimating time and season

It is possible to estimate the time of day when the photo was taken if we know where the photograph was taken.

- If the photo was taken during the morning its evidence is through the shadow during the morning; the shadow of the object lies in the western side because the sun rises from the east.
- During the evening; the shadow lies in the eastern side because the sun sets on the west.
- During the afternoon; the shadow lies around the object because the sun is over head of the object seasons.
- A bright sky with dry vegetation may indicate a dry period or season.
- Thick vegetation young crops or flowering plants in the field and a sky full of rain clouds indicate a rainy season.

- Clear sunny conditions with health vegetation and flowering plants or plants with fruits indicate summer season.
- Plants with young leaves others bloom and field full of grass indicates spring season.
- Hazy sky with leafless trees and some snow on the ground indicates winter season.
- Also when people appear to be wearing heavy clothes with faces almost completely covered, hand gloves and heavy boots it indicates cold weather.
- When people wear light clothes and some may even have broad-brimmed hats, this indicates hot weather.
- When houses appear to have slanting roofs it indicates the region experiencing a lot of precipitation which facilitates the easy flow of water from the roof of the house.
- If people appear to be planting then it is planting season the rains either are about to come or have just started.
- If the people appear to be weeding it is growing season for the crops and there is reduced rainfall.
- If people appear to be harvesting a crop it is harvesting season and probably dry season because harvesting normally takes place during dry weather.

Figure 135. Left, a photograph of the sun setting in summer at Zambezi national park and right a photograph of a rainy season at Manyara national park, Tanzania

Estimating direction in photographs

This refers to identifying the position of the photographer after studying the relative sizes of objects in the photograph. It is possible to estimate the direction on a photograph using shadows. This is possible if the time and place where the photograph was taken are known. For example, if a photograph shows a tree whose shadow is on the right and it is indicated that it was taken within the tropics and in the morning, then the photographer was facing south.

The sun and the shadow are always in the opposite sides of the photograph. If the sun is in the east, the shadow will always be cast westwards and vice versa. If the shadow is pointing towards you and the photograph was taken in the afternoon (meaning that the sun was in the west), the photographer was facing westwards. With such information, it is then possible to fix compass points on a photograph.

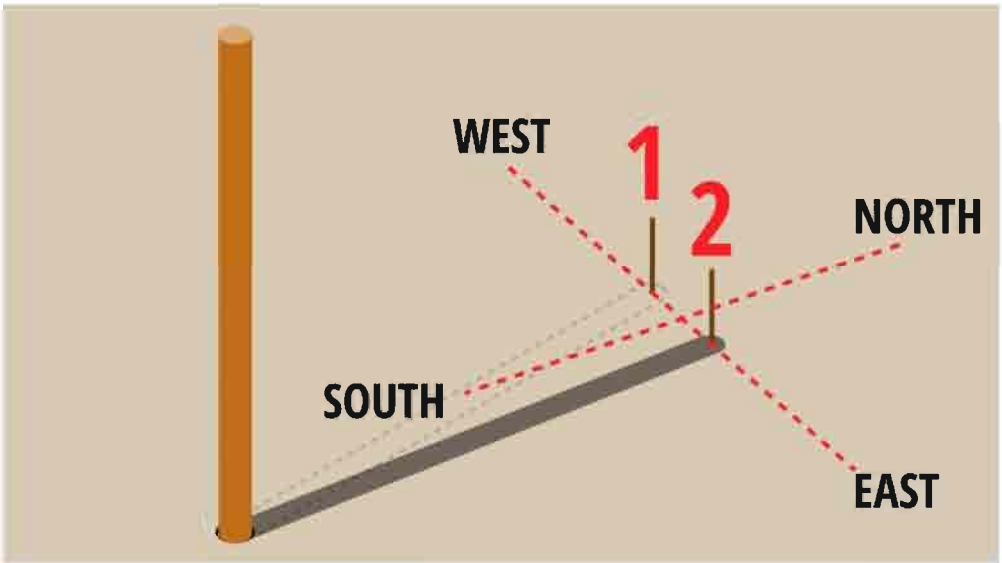


Figure 136. Estimating directions in photographs using shadows and sun direction.

The other alternative for identifying the position of the photographer or cameraman is by observing the size of objects in the photograph. The objects close to the photographer appear larger those far away. The objects apparently appear to decrease in size as their distance from the photographer increase. Therefore, the part of the photograph showing huge objects is the place close to where the photographer stood.

Case study 18

Reading and interpreting photographs

Organize yourselves in pairs and tackle the following task;

1. Provide an appropriate title for the photograph provided.
2. Identify and describe the following physical and human features in the photograph provided:
    a) Relief, drainage, vegetation, climate and soil.
    b) Agriculture, settlement, transport and communication industrial and mining activities.
3. How can you classify the photograph provided? Justify your answer.

Understanding Map Interpretation

What is a map?

A map is a portion or part of the features of the earth's surface drawn to scale on a plane surface such as paper, card, plastic, cloth or some other material. Or a map is a representation on any plane surface of the features of part or portion of the earth's surface drawn to scale.

Essentials of a map

A map is good if it contains all the five essentials, they include:

1. **A Key:** Used to interpret symbols and signs found on a map. They appear in a box at one of the bottom corner of the map.
2. **Title:** Used to show what's map is all about. This is the heading of the map. It can appear on top of the map or anywhere else.
3. **North direction**; this is an indication of the north direction. It shows where north is and by knowing north one can know the direction and bearing of the place.
4. **Margin;** this is a boundary or limit around the map. It gives or shows the reader and interpreter the end of the map.
5. **Publisher and date publication**; this shows when the map was produced and a publisher.
6. **Latitude and Longitude / Grid reference**: used to locate the actual location of place on the map. For example the map of Tanzania is located at latitude 6°00' south of the equator and longitude 35°00' east of Greenwich meridian.
7. **A scale**; It shows the relationship between map distance and the actual ground distance for example 1cm to 10km means one centimeter on the map represents ten kilometers on the ground map scale is the relationship or ratio between map distance and actual ground distance.

Types of maps

There are many types of maps. Most of these maps are grouped into two major types:

1. Topographic maps.
2. Statistical or Distribution maps.

Topographic maps

The word topography is derived from the Greek word topos, which means place. Topography is a term used to describe all physical features of a given area. Topographic maps are small-scale drawings of a part of the earth's surface. These maps show:

(a) **Location**

The geographic location in a map may be shown by using:

1. Compass bearing.
2. Grid reference.
3. Latitude and longitude.
4. Political and administrative boundaries.
5. Use of place names.

(b) **Landscape**

Some of the landscape features shown on a topographic map are, mountains, hills, plateaus, plains, lakes, rivers, seas, oceans and shape of coast lines.

(c) **Cultural features**

Some of the cultural features or artificial features are roads, railways, cities, towns, dams and other structures built by man. Most of the topographic maps in South Sudan are produced by the Lands and

Survey Department. To make these maps, airplanes are used to take pictures for an area for the first survey. Late, only certain points on land need to be measured and surveyed by surveyors. When all the necessary data has been compiled it is then used to print and produce map.

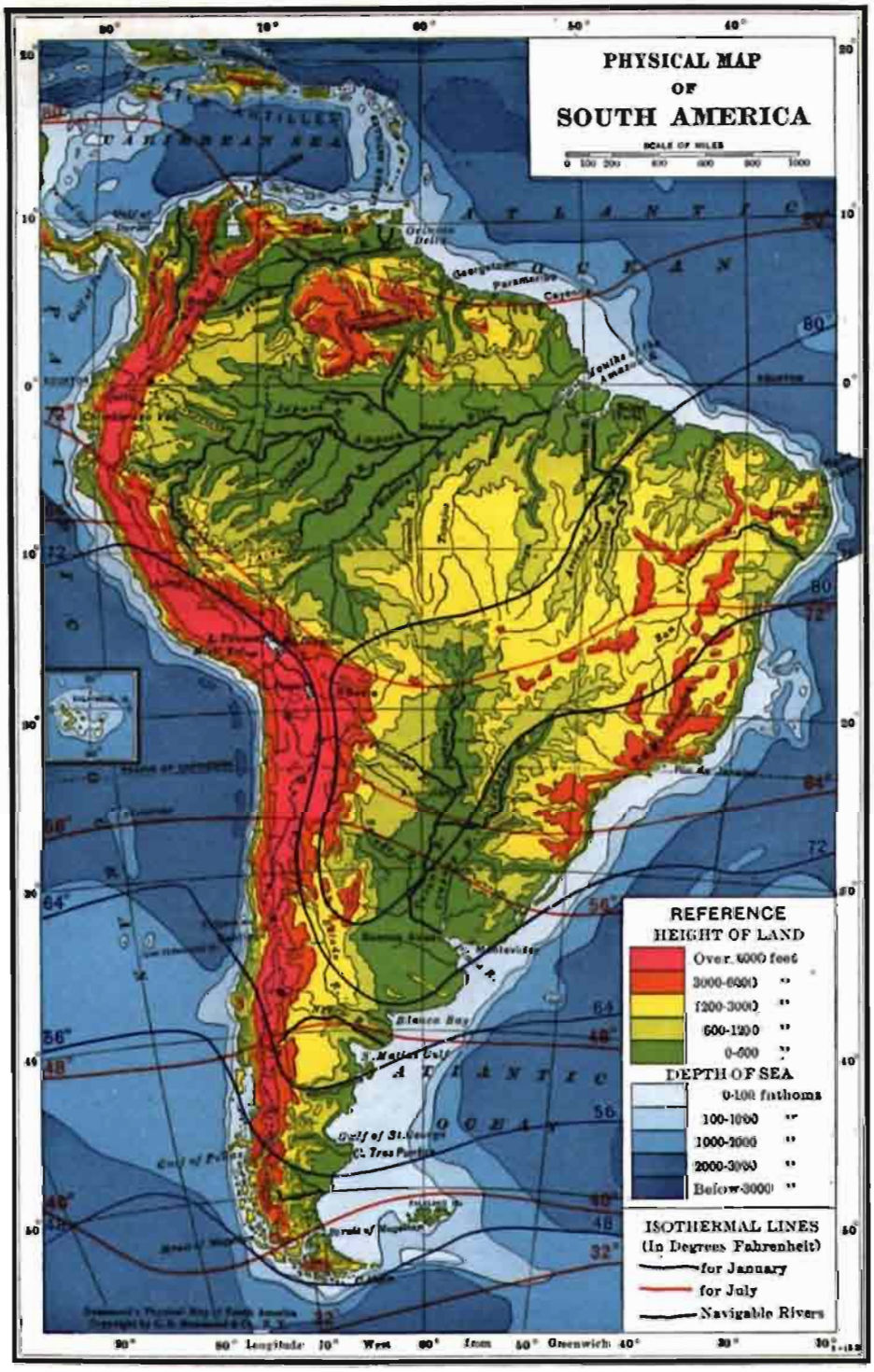


Figure 137. A detailed topographic map of South America

Uses of topographic maps

1. Topographic maps are useful for describing features of the earth's surface.
2. People use maps to reach their direction. That is the direction where to go and how far to go.
3. Builders use maps to plan the best use of land.
4. Road constructors use maps to design new roads.
5. Farmers use maps to plan the best use of their farmlands.

Statistical and Distribution maps

The statistical or distribution maps are the type of maps which have been made with the help of exact statistics. These maps show such things as distribution of rainfall, temperature, pressure, vegetation, crops, minerals and many other things. The commonly used Statistical or Distribution maps are the Atlas maps.

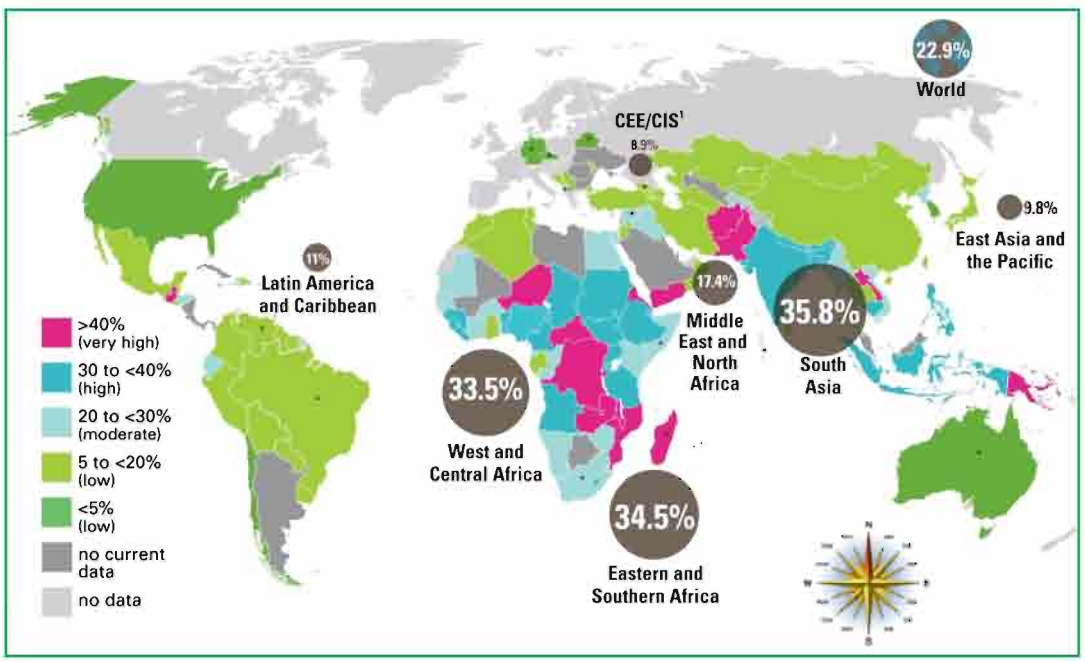


Figure 138. Global malnutrition statistical map

Uses of Statistical and Distribution Maps

1. They are useful for describing the distribution of many things found on the earth's surface or showing certain selected features such as physical, political, historical or economic features.
2. They are useful for showing generalized information on large or small areas.

Some examples of the uses of the statistical or distribution maps.

a) **Physical maps** show the arrangement or the distribution of mountains, hills, uplands, lowlands, rivers and so on.
b) **Political maps** show areas with their political and administrative boundaries.
c) **Climatic maps** show the distribution of temperatures, rainfall, pressure, winds, climatic regions, etc.
d) Historical empires and historical sites, for example. The Fort Jesus in Kenya.
e) **Economic maps** show the distribution of chief crops, animals, industries, roads, mines, etc.

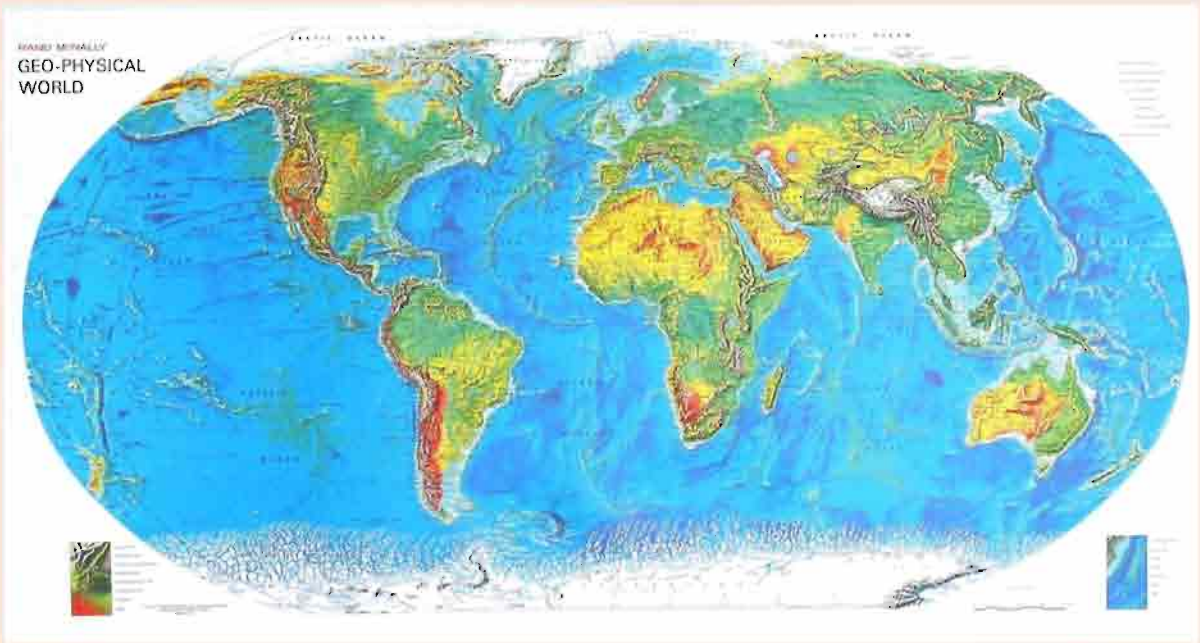
Characteristics of Atlas maps

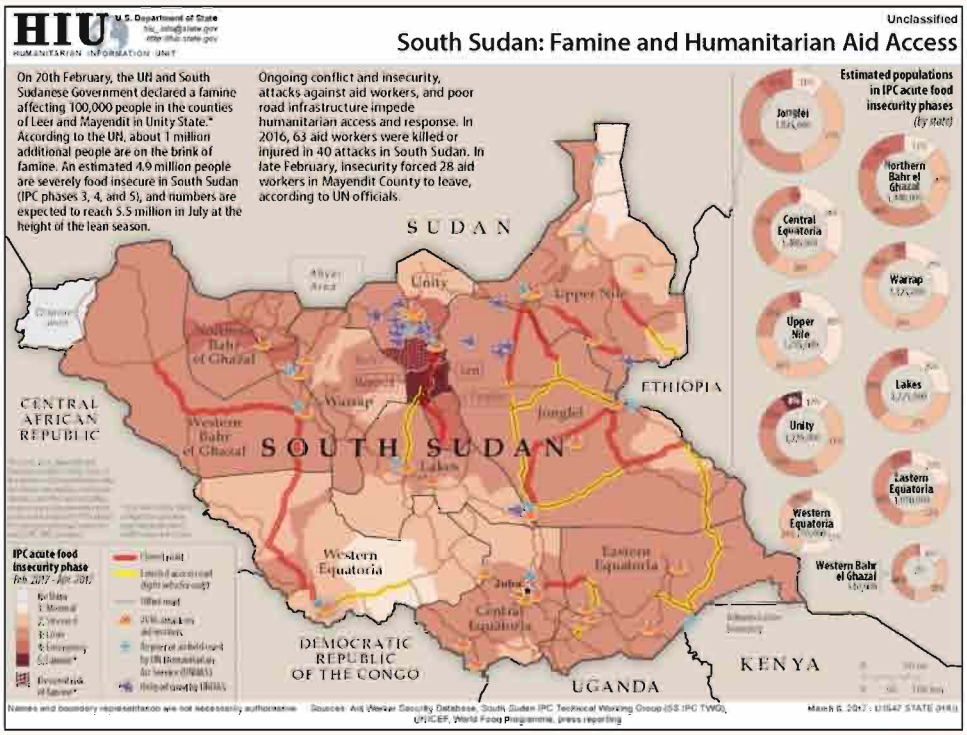
1. They are maps drawn on small scales.
2. They show whole countries, continents or even the world on a single sheet of paper or page.
3. They show generalized information. They do not include or show a great amount of detail as shown in topographic maps.
4. Atlas maps may be drawn on one map and include and show the distribution of many things such as crops, minerals, roads, railways, towns, relief, vegetation and many others. Such details may be shown by the use of colors, signs and symbols.
5. Atlas maps are simple, easy to read and interpret. They are easy to draw or to reproduce.

An example of an Atlas Map

Progress Check: Differentiating maps

Observe the maps below; what are the major differences in these maps?





Finding distance and bearing in a map

Finding distance on a map

Maps aren't just useful for directions, they can also help you determine the distance between two (or more) places. Here's a quick guide on how to measure distances on a map.

1. Find the scale of the map you're going to use (it might be a ruler bar scale or a written scale, in words or numbers).
2. Use a ruler to measure the distance between the two places. If the line is quite curved, use a string to determine the distance and then measure the string.

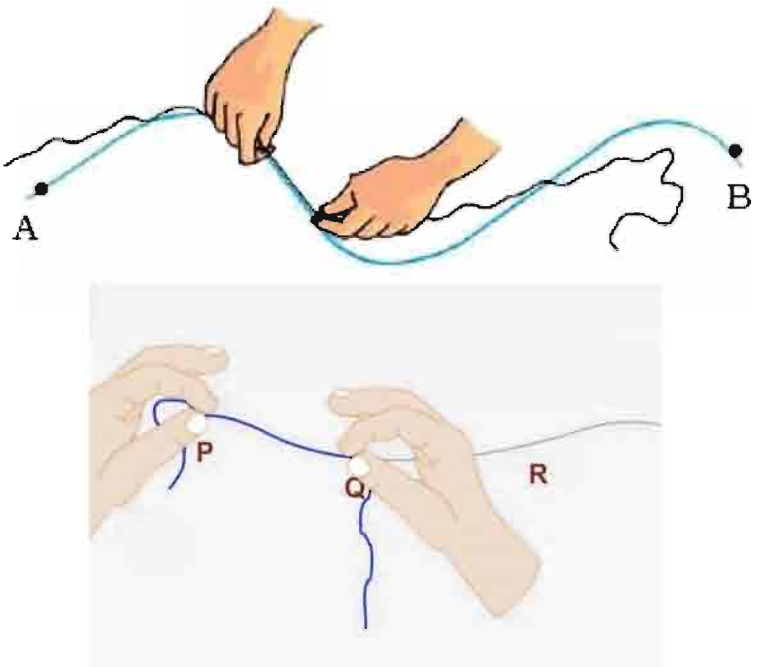


Figure 139. Measuring distance using a piece of string.

You can as well use a divider to point on the start location and the end location, then transfer your measurements to the ruler (*on instances where the distance between the two points is longer than 15cm, you can measure the distance in bits.*)

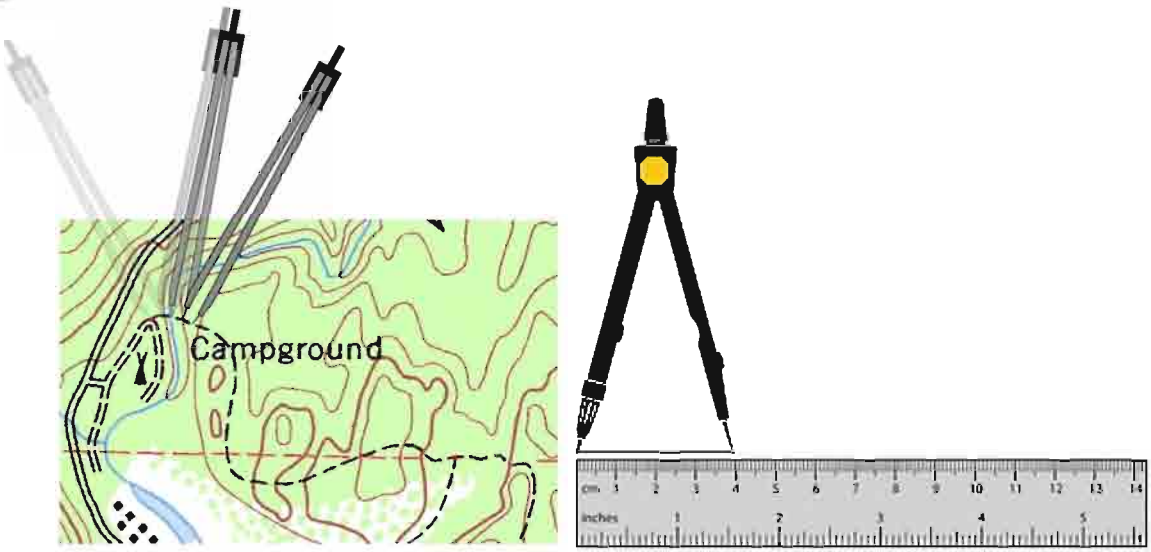


Figure 140. Using a divider and a ruler to measure distance on maps

On the other hand you can use a strip paper by laying it along a given length then break your lengths into short sections. Transfer the obtained measurements to the linear scale for measuring and calculation.

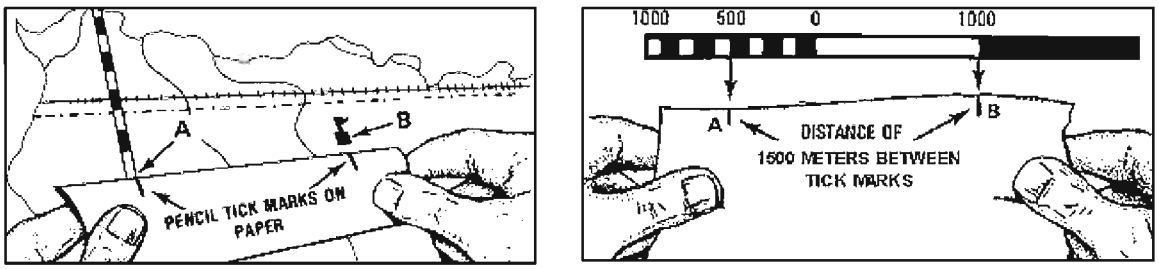


Figure 141. Measuring distance using a piece of paper

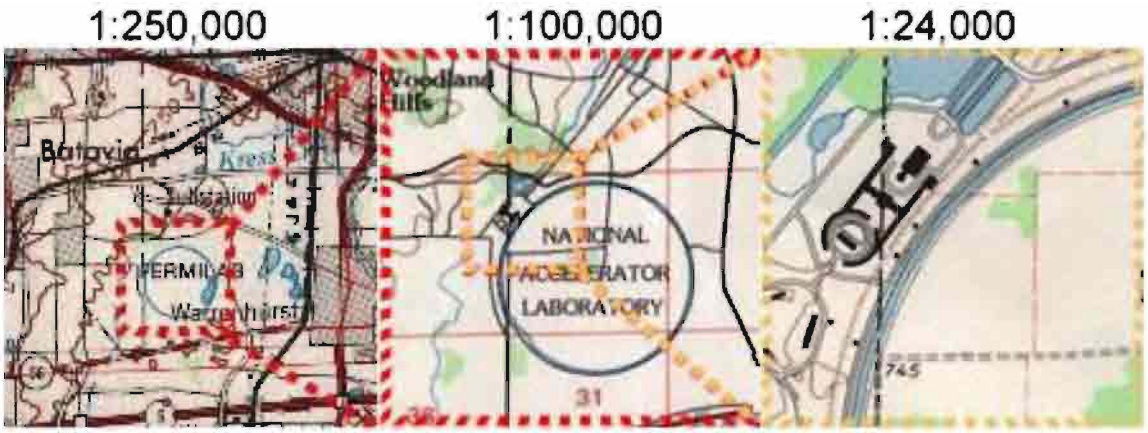
3. If the scale is a representative fraction (and looks like 1/100,000 or 1:100,000), multiply the distance of the ruler by the denominator, giving distance in the ruler units.
4. If the scale is a word statement (i.e. "One centimeter equals one kilometer") then determine the distance.
5. For a graphic scale, you'll need to measure the graphic and divide the scale into the measured units on the ruler.
6. Convert your units of measurement into the most convenient units for you (i.e. convert 63,360 inches to one mile).

Note: Watch out for maps that have been reproduced and have had their scale changed. A graphic scale will change with the reduction or enlargement but the other scales become wrong.

Types of scales

There are three major types of scales;

1. **Large scale:** They are used to present information on small areas for example a map of village buildings and farms. The map size involves all numbers less than 1:25000 I.e. 1:10000 and 1:5000. The following are characteristics of large scale.
    a) It has smaller numbers in the denominator.
    b) It shows features clearly.
    c) It contains geographical details.
2. **Medium scale**: They are used to represent medium details shown on the map. i.e. 1:50,000 and 1:100,000. Example of a map that can be drawn using medium scale is a map of a district, region, city etc.
3. **Small scale.** They are used to present information that is long. This type of scale covers a big area with less detail. For example a map of a country, continent or world. May involve numbers between 1: 500,000 to 1: 1000,000.



A small scale | A medium scale | A large scale

Figure 142. Different types of scales.

Ways used to express map scale.

1. **Statement scale:** Refers to the scale which is expressed in terms of words or explanation. For example one centimeter on a map is equivalent to 10 centimeters on the ground.
2. **Linear scale:** Also is called plain or graphic scale. This is a line which is divided into two parts. The primary division and secondary division. The secondary are expressed in meters and placed on the left side from zero and primaries are expressed in kilometers and placed on the right side from zero.
3. **Representative fraction (RF) scale:** is written as a fraction or ratio e.g. 1:50,000 50,000. The distance on a map is expressed as fraction of the actual distance on the ground. Therefore, RF scale = map distance Ground distance. The top number (numerator) represents the map distance on the ground and is usually more than 1.

Scale conversion

Example: Change the following statement to a representative fraction scale:

1cm represents 60km

Solution:

1km is equivalent to 100,000cm

What about 60 kilometers?

60 Km is equivalent to = $[\frac{60}{1}$ X 100000 cm] = 600000cm

Therefore R.F scale = 1:6000000

Progress Check

Now convert the following statement scales to representative fraction scales:

a) 1cm represents 500km.
b) 1cm represents 2500km.

Finding the location and position of a point in a map (compass bearing and direction)

Using Grid lines

You might have noticed by now that maps are covered in a series of interconnecting lines that make square patterns. These lines are known as **grid lines** and they help you to pinpoint an exact location anywhere on the map. The vertical lines are called **'eastings'**, as they increase in value as you travel east on the map. The horizontal lines are called **'northings'** as they increase in value as you travel north on the map.

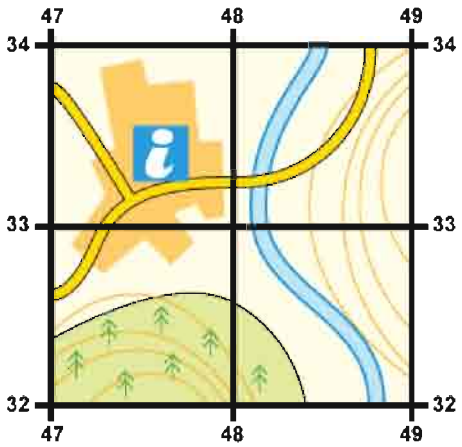
Figure 143. A map with grid lines

Remember...

- On an Ordinance Survey map **each grid square** is 1 km x 1 km or **1 sq. km**.
- When you give a grid reference, always give the easting first... "**Along the corridor and up the stairs**".

Practical activity: Reading grid lines

Four-figure grid references can be used to pinpoint a location to within a square measuring 1 sq. km.

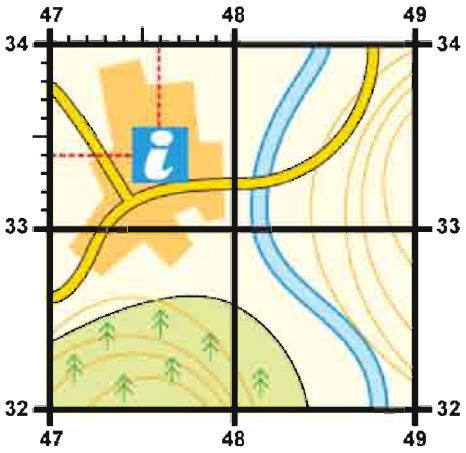


To find the grid reference of the tourist information office within the map represented with the symbol {i}:

1. Start at the left-hand side of the map and go east until you get to the easting crossing through the bottom-left-hand corner of the square you want. Write this number down.
2. Move north until you get to the northing crossing the bottom-left-hand corner of the square you want. Look at the number of this grid line and add it to the two-digit number you already have. This is your four-figure grid reference. In this case, the tourist information office is in grid square 4733.

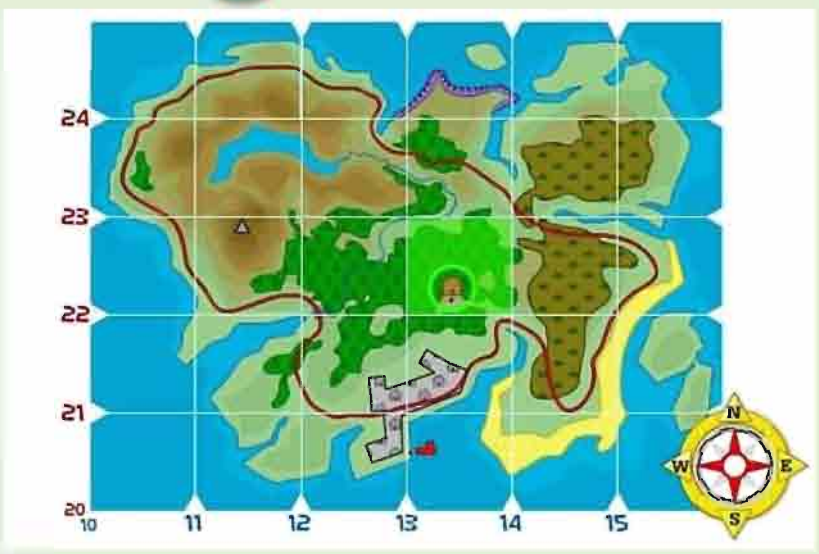
Sometimes it is necessary to be even more accurate. In this case you can imagine that each grid is divided into 100 tiny squares. The distance between one grid line and the next is divided into tenths.

1. First, find the four-figure grid reference but leave a space after the first two digits. When you get to the easting at the left-hand side of the grid square you want, keep moving east and estimate or measure how many tenths across your symbol lies. Write this number after the first two digits.



2. Next, move north from the bottom-left-hand corner of your grid square and estimate how many tenths your symbol is from this point. Put them together to create a six figure grid reference. In this instance, the tourist information office is located at 476334.

Progress Check



Now that you know how to read grid lines on maps, find:

1. The four-figure grid reference of the church shaded in green from the map above.
2. The six-figure grid reference of the church.

Finding compass bearings on maps

Compass Bearing are directions which measure degrees clockwise from north. They are written in three figures i.e. 090, 045. Here are guidelines in finding compass bearing of a given location on a map:

a) Identify the grid reference points given on the maps. Draw a straight line connecting the two points.
b) Draw the major four cardinal lines at the starting now look at the question asked use a protector to measure degree clockwise from north up to the line joining the two points.
c) Then provide your answer in degrees bearings. There are basically two types of bearings i.e.:
   i. **Forward bearing:** this is the bearing into a subject. Procedures to calculate forward bearing are as follows:
      a) Identify the two points.
      b) Join them with a straight lines
      c) Draw north direction on a second point.
      d) Measure the angle by using a protractor.
      e) State the bearing in terms of degrees of the direction.

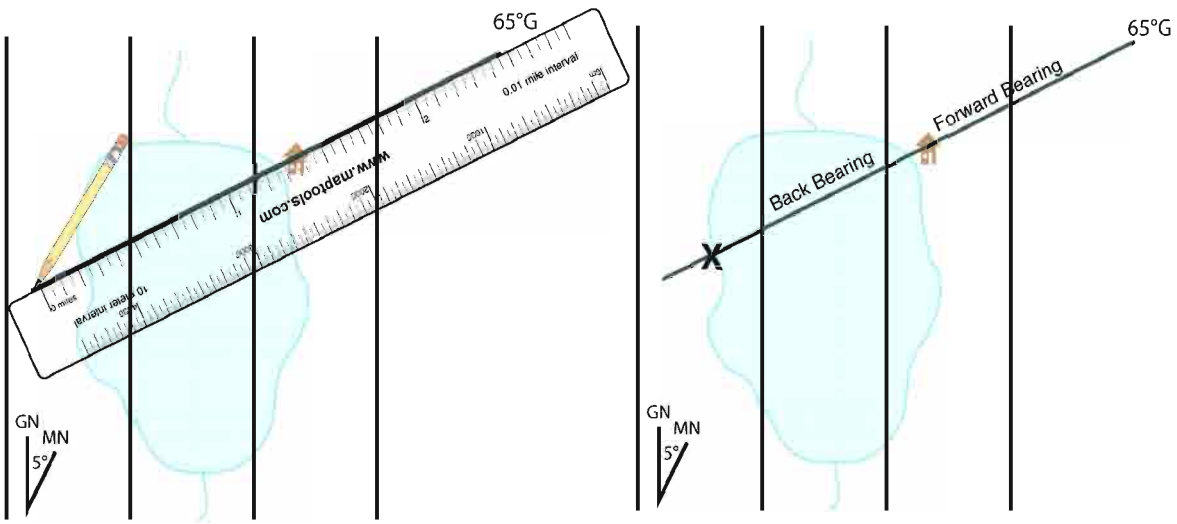


Figure 144. Finding the forward and backward bearing of a region on a map.

ii. **Backward bearing**: this is the opposite of forward bearing, it's taken from the object to the observer while forward bearing is taken from observer to the object. Here is how to determine the backward bearing.
Find forward bearing.

a) Mark the cardinal point north direction of the opposite point.
b) Find the bearing of the observer along the straight line.

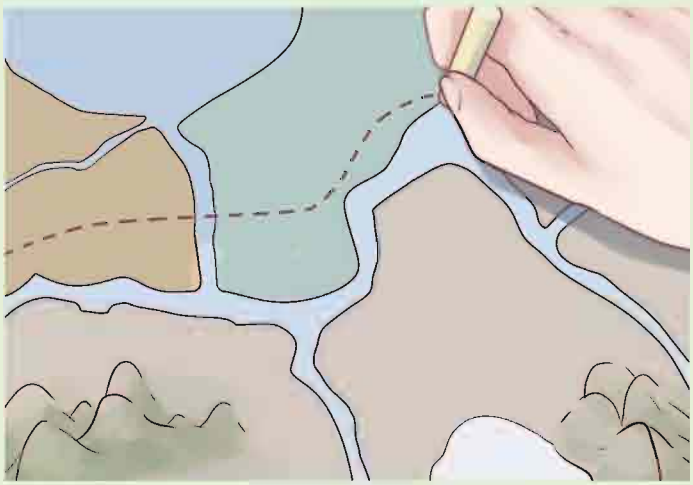
Comprehensive Activity 12

In pairs choose points in any map from your atlases and try to measure the following:

a) Distance between two points using a piece of paper, a piece of thread and a divider.
b) The forward and backward bearing of a point in any map.

Exercise 14

1. Describe the qualities of a good map.
2. Differentiate between topographic maps and statistical and distribution maps.
3. Hamisi is drawing a sketched map of his home town.



a) In pairs draw a sketched map describing your hometown.
b) Place all the features of a good map in your sketch map.

Describing the relationship between physical geography and human geography in maps

Understanding the differences between human geography and physical geography

Physical and human geography are two main branches of geography.

Physical geography looks at the natural processes of the Earth, such as climate and plate tectonics. Areas of physical geography include:

- Geomorphology: the shape of the Earth's surface and how it came about
- Hydrology: the Earth's water
- Glaciology: glaciers and ice sheets
- Biogeography: species, how they are distributed and why
- Climatology: the climate
- Pedology: soils
- Paleogeography: how the continents have moved over time
- Coastal geography: how the ocean and land affect each other
- Oceanography: the study of oceans and seas
- Quaternary science: the geography of the last 2.6 million years, including the last ice age
- Landscape ecology: how the landscape affects things like the distribution of plants and animals
- Geomatics: gathering, storing and processing geographic information – for example, making maps

Human geography looks at the impact and behavior of people and how they relate to the physical world. However, it is important to remember that all areas of geography are interconnected: for example, the way human CO_2 emissions affect the climate is part of both physical and human geography Areas of human geography include:

- Cultural geography: how things like religion, language and government vary across the world
- Development geography: standards of living and quality of life across the world
- Historical geography: how people have studied and thought about geography in the past

- Population geography: how populations grow in different places and people migrate
- Urban geography: cities and built-up areas of human settlement.

The main area of geography that looks at the connection between physical and human geography is called environmental geography.

Features of Physical/ Topographical Maps

Contour Lines

The defining feature of a two-dimensional topographical map is its contour lines. A **contour line** is a line joining points of equal elevation on a surface. An easy way to imagine a contour line is to imagine walking around the shore of a lake. As you walk, you will always remain at the same elevation, and eventually you will return to your starting point.

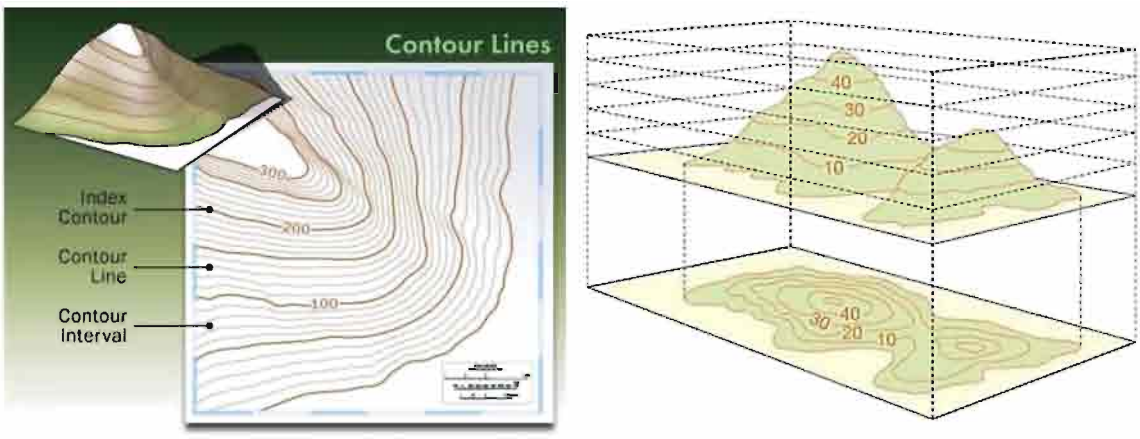


Figure 145. Understanding contour lines

There are three rules for contour lines:

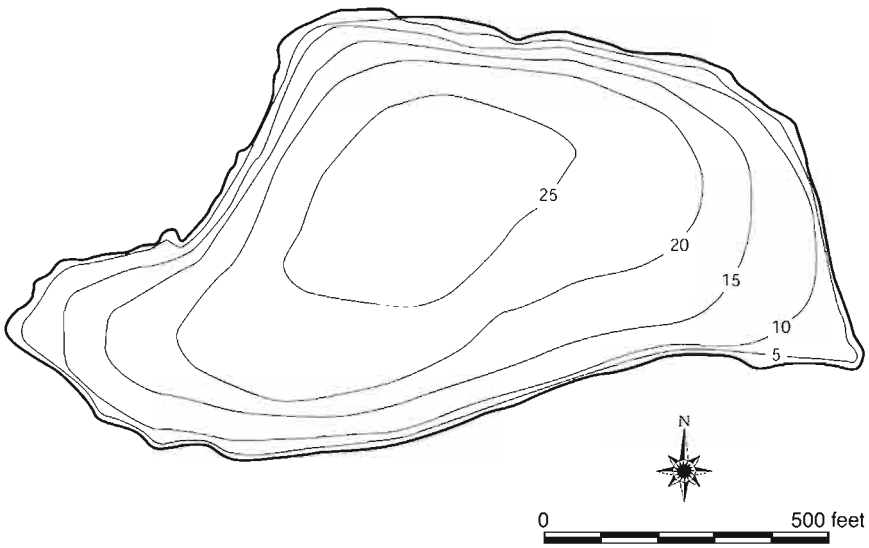
1. Every point along a contour line is the exact same elevation
2. Contour lines can never cross each other
3. A contour line must close on itself

Some contour lines will have their elevation marked next to them, but not all. In order to calculate the height of any contour line, you need to know the contour interval.

Contour Interval

A topographical map will contain many contour lines, but the change in elevation between each line will remain the same; this is called a **contour interval**. By making the change in elevation between the lines equal, it is easy to calculate height by using multiplication.

For example, this image shows contour lines that we can use to calculate contour intervals:

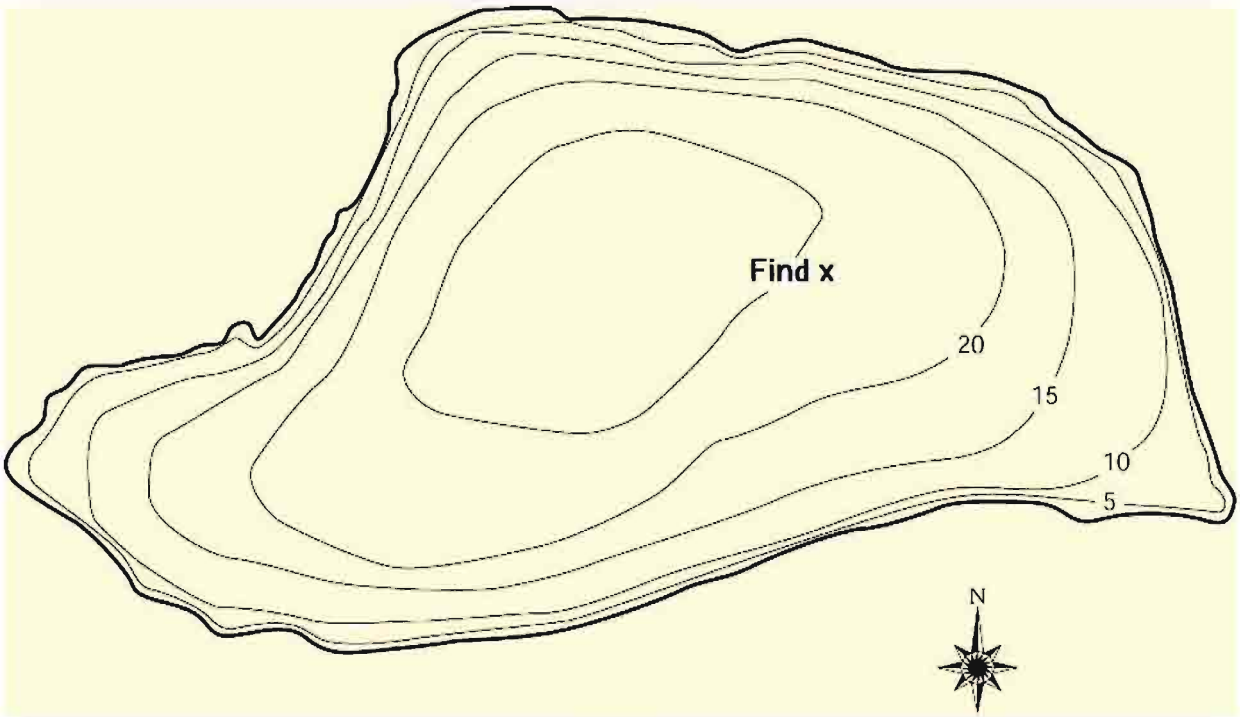


For this map, the contour interval is **5**. This can be calculated by the difference between the two known elevations. While the horizontal distance varies between the lines, it is important to remember that contour lines are there to show elevation. In addition to calculating the contour interval, it is also usually labeled on the map near the legend.

An easy way to think about topographic maps is the distance between the lines is horizontal distance, while the values of the lines are the elevation. If the distance between the lines is very far apart, that indicates a gradual increase in elevation. If the lines are close together, the change in elevation happens very quickly, indicating a steep terrain.

Comprehensive Activity 13

1. Calculate the **contour interval** of the region represented in the map.
2. With reference from your answer **in question 1 above**, find the altitude of the region in the map. Draw a cross-sectional representation of the region.



Relief Maps

A relief map is a specific type of topographic map that uses colors and shading to show heights and features on the map. If you have ever felt bumps on a map or globe, you have used a topographic relief map. Shading on a topographic map is used to give it a more realistic view. You can see that on this map, the mountains actually look like mountains instead of just contour line

Figure 146. Left, a shaded relief map and left, a raised relief map

Colors are used to show depths of oceans and vegetation cover within a region.

a) In mountains, white can be used to show ice or glacier cover.
b) Green can be used to show the density of vegetation in a region that is the more greener a region is the denser the vegetation cover. Brown and red colors are used to show deserts and other areas with sparse vegetation.
c) Blue can be used to indicate prescience of waterbodies. Similarly, the bluer a point is in the water body, the deeper it is.

Features of Statistical and Distribution Maps

Usage of symbols

Since a map is a reduced representation of the real world, map symbols are used to represent real objects. Without symbols, we wouldn't have maps. Since a map is a reduced

representation of the real world, map symbols are used to represent real objects. Without symbols, we wouldn't have maps.

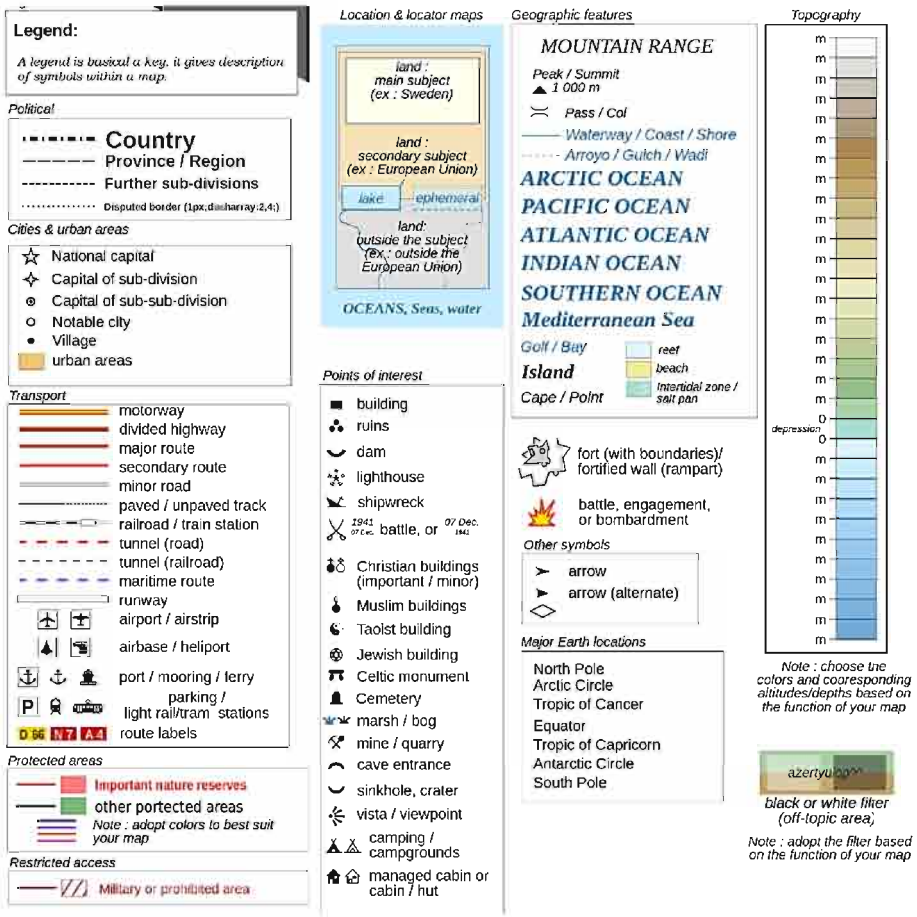


Figure 147. Symbols in a map

Both shapes and colours can be used for symbols on maps. A small circle may mean a point of interest, with a brown circle meaning recreation, red circle meaning services, and green circle meaning rest stop. Colors may cover larger areas of a map, such as green representing forested land and blue representing waterways. To ensure that a person can correctly read a map, a Map Legend is a key to all the symbols used on a map. It is like a dictionary so you can understand the meaning of what the map represents.

Symbols are used to show:

a) The distribution of roads, rails and infrastructure in a region
b) Human settlement within a location.
c) Human activity such as fishing, tourism, agriculture, mining, trade etc.
d) Distribution of animal species, ethnical groups and other related feature of both animals and humans.
e) Political boundaries of a state, country or region.

Usage of numbers and data

Statistical maps are used for research. They contain important information about a particular research. Some of the research may include the following:

1. Demographics of a country.
2. Statistics on human economic activity including mining, agriculture, transportation etc.
3. Statistics on plant animal migration and distribution.
4. Statistics on rainfall distribution etc.
5. Problematic information such as internet connectivity in a region, spread of a contagious disease etc.

Just like distribution maps, statistical maps use symbols and colors to present their information. Graphs, and pie charts may be included to supplement information in the maps.

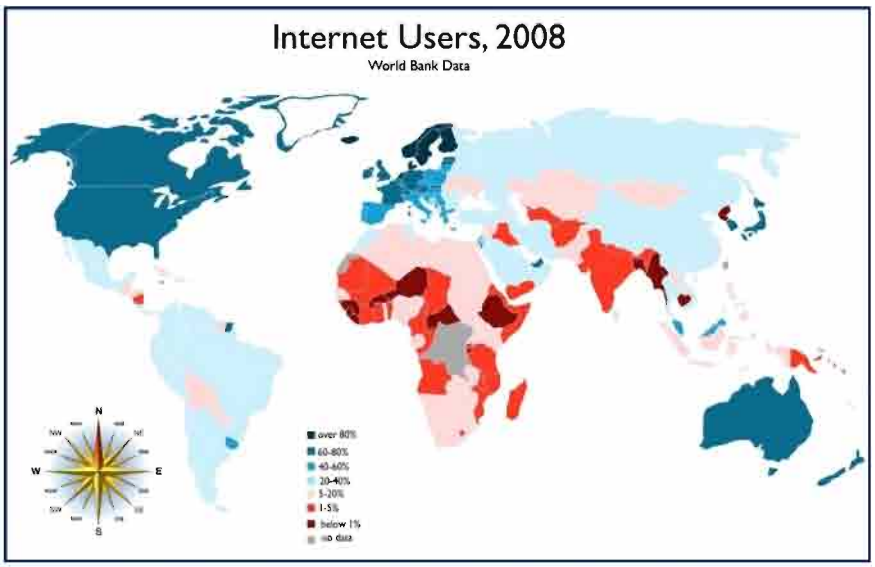


Figure 148. An example of a problematic statistical map

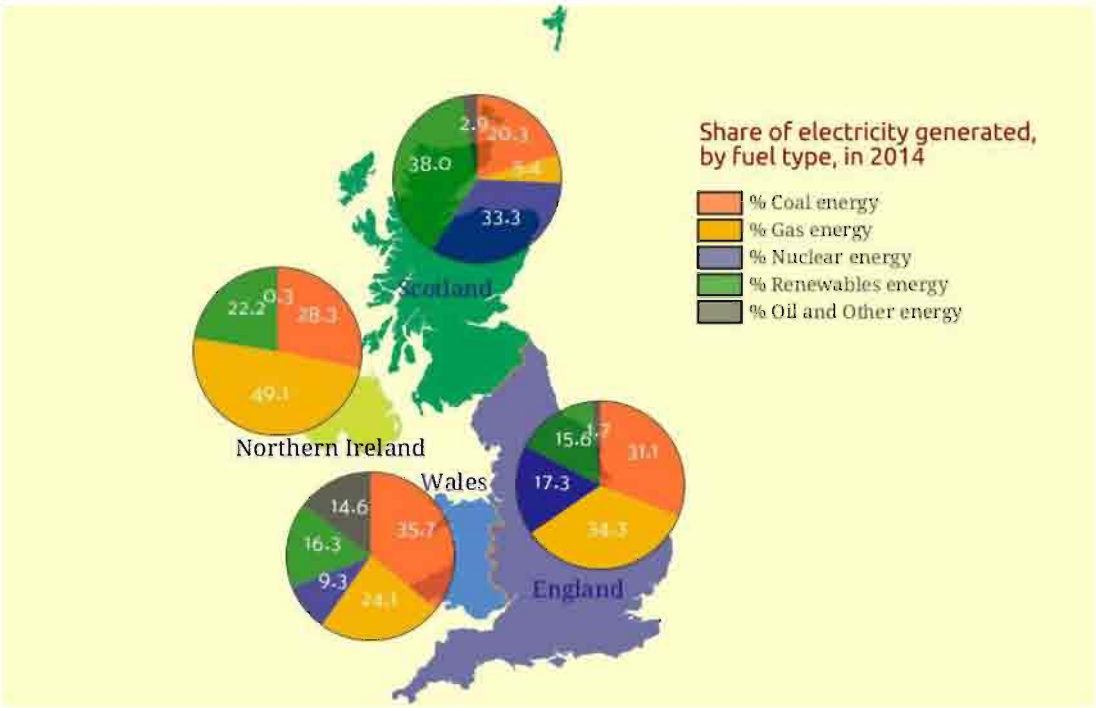


Figure 149. Pie charts in statistical maps.

Practical activity: Drawing sketch maps

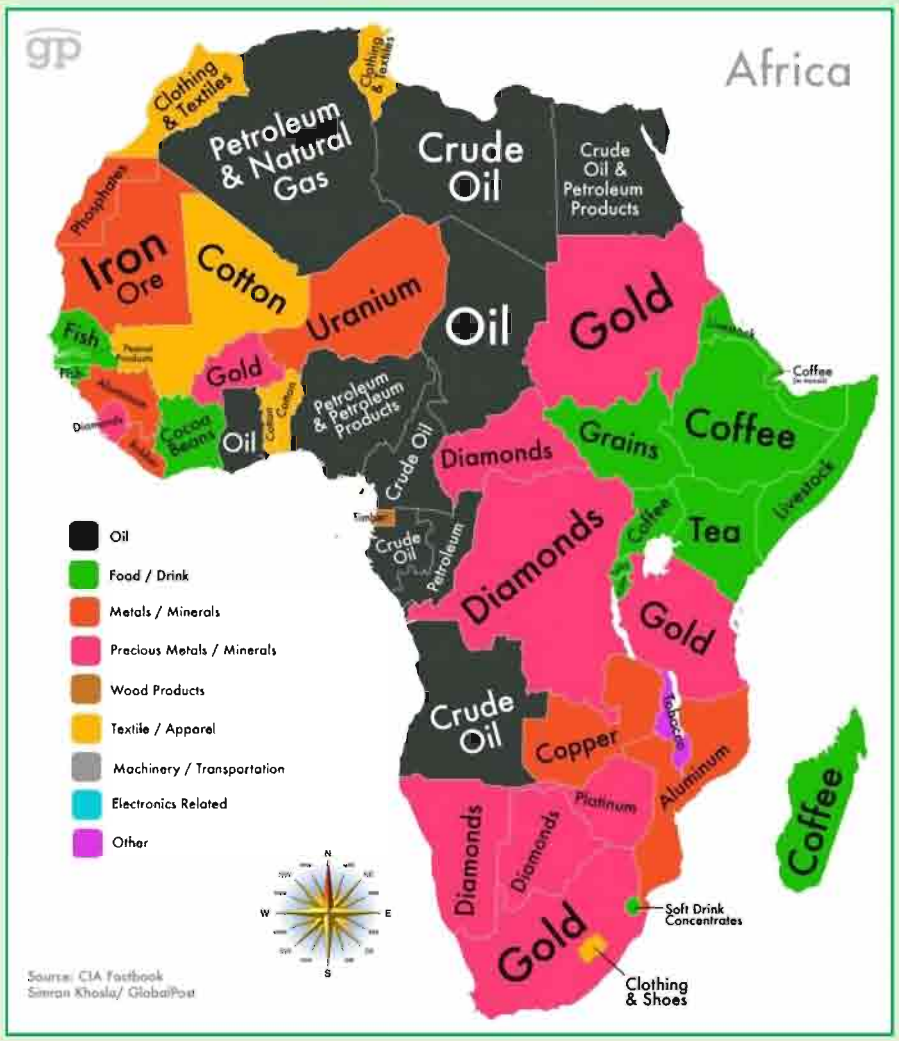
Draw a sketch maps to show:

a) Distribution of roads in your locality.
b) Distribution of physical features within your hometown.
c) A map of your school.

Note: place symbols and use colours to clearly show vegetation cover, relief, buildings roads, and public facilities. **Compose a key or map legend for this.**

Exercise 15

1. Differentiate between human and physical geography.
2. How can we describe the relationship between physical and human geography as far as maps and atlases are concerned?
3. Look at the map below and answer the following questions.



a) What type of map is this? *Justify your statement.*

b) Why is it important to use symbols and colors in a map?

4. Use the map below to answer the questions that follow.

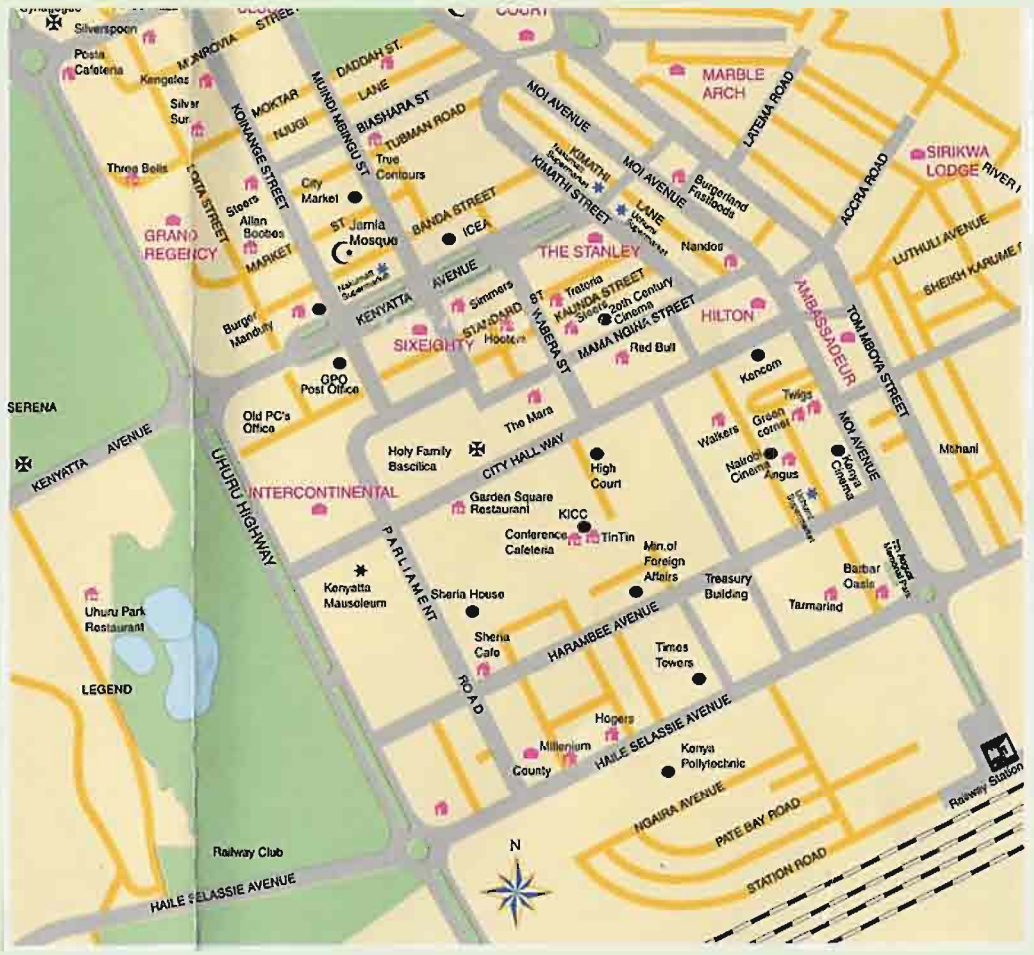


Figure 150. A map of City.

a) Measure the distance between Marble arch and Intercontinental Hotel Use the scale of 1:25000

b) Determine the compass bearing of Marble arch from the intercontinental hotel.

c) Is the map above a topographical map? Use appropriate examples to justify your statement.

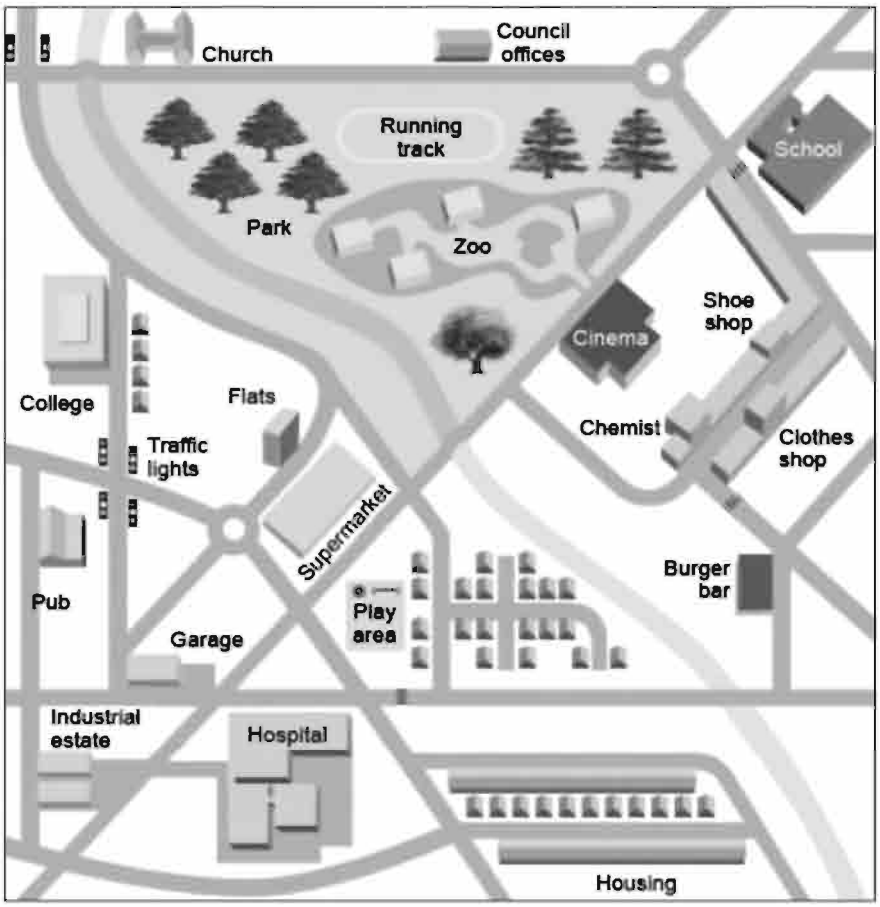
d) What additional data could be presented to further explain features of this locality? Choose one of your ideas and present it inform of a bar or pie chart.

Progress Check: Reading and interpretation of maps and photographs

1. Observe the photographs provided and answer the questions that follows:

a) Classify the photographs provided.
b) Identify the economic activity depicted in the photographs provided.
c) From your own understanding identify the time when the photographs were taken. Justify your answer.
d) Give an appropriate title for each of the photograph provided.

2. Look at the map below and answer the questions that follows:



a) What type of map is this? Justify your answer.
b) What elements of a map are missing in the map provided?
c) Find the distance between the hospital and the church. Use the scale of 1: 100000.
d) Find the compass bearing of the clothes shop from the college.
e) Measure the bearing of the shoe shop from the supermarket.
f) According to your judgement what are the major economic activities in the area within the map?

Unit 8

THE ENVIRONMENT AND DEVELOPMENT

Understanding the relationship between the Environment and Development

Environment

Environment means the surrounding and everything that affect an organism during its lifetime. In another words "Environment is sum total of water, air and land interrelationships among themselves and also with the human being, other living organisms and property".

Development

Development is the gradual growth of something so that it becomes more advanced. Development depends on the utilization of the resources that are available in a particular environment. An environment that is endowed with resources may be well developed if the resources available are utilized. However increase in population has led to pressure on the environment leading to over exploitation of the resources in the environment. Exploitation of natural resources in the quest for economic development has led to environmental degradation.

Figure 151. The city of Dubai, United Arab Emirates, is an example of a developed environment.

What is Environmental Degradation?

Environmental degradation is the disintegration of the earth or deterioration of the environment through consumption of assets, for example, air, water and soil; the destruction of environments and the eradication of wildlife. It is characterized as any changes on nature, seen to be undesirable.

Causes of Environmental Degradation

Pollution

Pollution, in whatever form, whether it is air, water, land or noise is harmful for the environment. Air pollution pollutes the air that we breathe which causes health problems. Water pollution destroys the quality of water that we use for drinking purposes. Land pollution results in destruction of earth's surface as a result of human activities. Noise pollution can cause irreversible damage to our ears when exposed to endless loud sounds like honking of vehicles on a busy road or machines producing very loud noises in a factory or a mill.

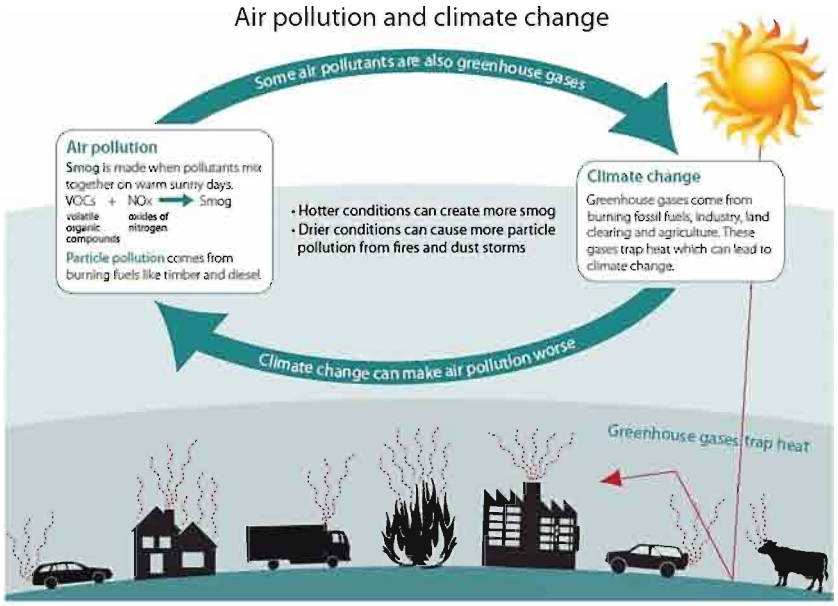


Figure 152. The effects of air pollution.

Overpopulation and Overexploitation of Natural Resources

Rapid population growth puts pressure on natural resources which results in degradation of our environment. More population simple means more demand for food, clothes and shelter. You need more space to grow food and provide homes to millions of people. This often causes over-exploitation of the natural resources and contributes to environmental erosion. Overpopulation simply means more pollution and fast extraction of natural resources compared to how they are being replaced.

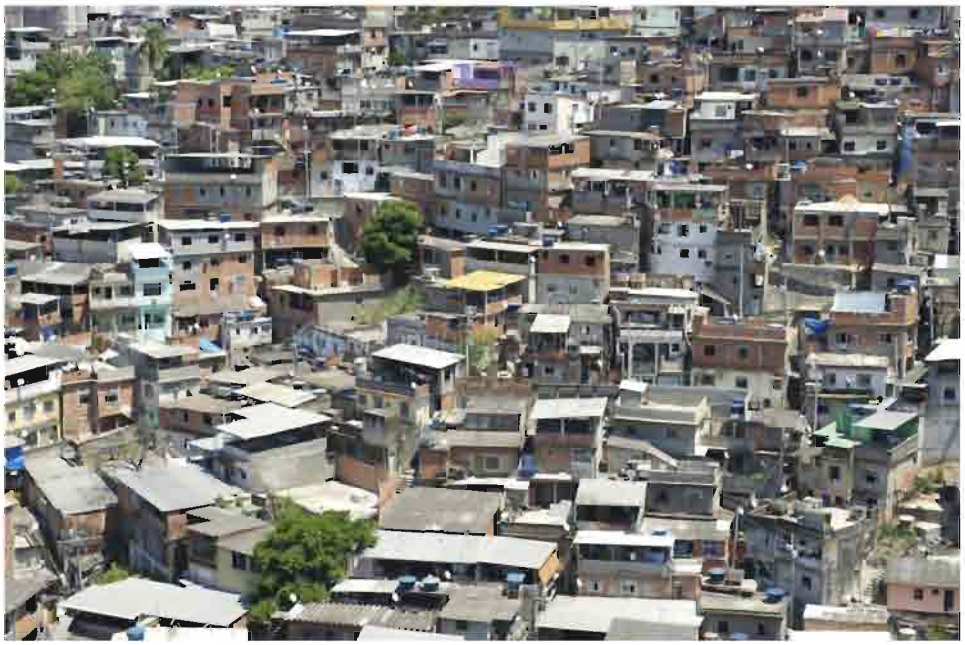


Figure 153. A crowded hillside favela of a shanty town in Rio de Janeiro, Brazil

Poor waste disposal

Heaps of wastes disposed poorly, pollute the environment and destroy the beauty of the city. The large heaps of waste disposed outside of major towns are known as **Landfills.** Landfills come within the city due the large amount of waste that gets generated by households, industries, factories and hospitals. Landfills pose a great risk to the health of the environment and the people who live there. Landfills produce foul smell when burned and cause huge environmental degradation.

Figure 154. Left, a truck, disposing waste on a landfill and right, the threats posed by landfills.

Deforestation

Deforestation is the cutting down of trees, without replacing them, to make way for more homes and industries. Rapid growth in population and rural development are two of the major causes of deforestation. Apart from that, the use of forest land for agriculture, animal grazing, harvest for fuel wood and logging are some of the other causes of deforestation. Deforestation contributes to global warming as decreased forest size puts carbon back into the environment.

Figure 155. Deforestation

Natural causes

Things like avalanches, quakes, tidal waves, storms, and wildfires can totally crush nearby animal and plant groups to the point where they can no longer survive in those areas. This can either happen through physical demolition as the result of a specific disaster, or by the long term degradation of assets by the presentation of foreign animal species to the environment. Degradation frequently happens after tidal waves, when reptiles and bugs are washed ashore.

Figure 156. The aftermath of an earthquake in Japan

Ruinous agricultural practices

Intensive agricultural practices have led to the decline in quality of most of our natural environments. Majority of farmers resort to converting forests and grasslands to croplands which reduces the quality of natural forests and vegetation cover. The pressure to convert lands into resource areas for producing priced foods, crops, and livestock rearing has increasingly led to the depreciation of natural environments such as forests, wildlife and fertile lands.

Improper Land use, planning and development

The unplanned conversion of lands into urban settings, mining areas, housing development projects, office spaces, shopping malls, industrial sites, parking areas, road networks, and so on leads to environmental pollution and destruction of natural habitats and ecosystems. Mining and oil exploration, for instance, makes land to become inhabitable and causes other forms of environmental destruction by releasing toxic materials into the environment. Improper land leads to the loss and destruction of millions of acre of natural environments across the globe.

Effects of Environmental Degradation

Impact on Human Health

Human health might be at the receiving end as a result of the environmental degradation. Areas exposed to toxic air pollutants can cause respiratory problems like pneumonia and asthma. Millions of people are known to have died of due to indirect effects of air pollution.

Figure 157. Emission of toxic fumes from industries

Poverty

In the majority of developing countries, poverty is attributed to poor crop harvests and lack of quality natural resources that are needed to satisfy basic survival needs. The inadequacy basic survival resources and lack of quality of food is the direct result of environmental degradation in the regions. Most vulnerability situations brought about by water shortages, climate change, and poor crop yields in developing countries are tied to environmental degradation. Hence, the lack of access to adequate basic needs such as water and food directly induce poverty.

Atmospheric Changes

Environmental degradation can alter some of the natural process such as the water cycle and the normal processes of animal and plant activities. Also, environmental degradation aspects such as deforestation and mining destroy the natural land cover. This, together with air, water, and land pollution pose several atmospheric alteration threats. The alterations include global warming and climate change which can increase the risks of climatic natural disasters, and ozone layer depletion which increases the risk of skin cancer, eye disease, and crop failure.

Loss of Biodiversity

Degradation of the environment has recorded a continued destruction of wild forests and the damage of natural ecosystems that has greatly contributed to the mass extinction of species. The number of extinct species persists to multiply worldwide whereas some have completely gone extinct. This is because of the human activities such as acidifying water systems, over-exploitation of natural resources, overpopulation, and the deliberate and indirect destruction of natural systems necessary for the survival of different species. These activities alter the natural process combined, thus, destroying the natural ecosystems supporting biodiversity.

Scarcity of Natural Resources

Environmental degradation through aspects such as over-exploitation of natural resources, pollution, and deforestation can contributes to the scarcity of resources particularly arable land, water, genetic resources, medicinal plants, and food crops.

Figure 158. An example of a dried up waterfall.

Ozone Layer Depletion

Ozone layer is responsible for protecting earth from harmful ultraviolet rays. The presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere is causing the ozone layer to deplete. As it will deplete, it will emit harmful radiations back to the Earth. This problem is one that the world is beginning to solve thanks to legislation banning the use of these harmful gases, although it may take decades for the ozone layer to fully recover.

Loss for Tourism Industry

The destruction of environment can be a huge hindrance for the tourism industry which relies on tourists for their daily livelihood. Environmental damage in the form of loss of green cover, loss of biodiversity, huge landfills, increased air and water pollution can be a big turn off for most of the tourists.

Figure 159. A herd of endangered African elephants.

Economic Impacts of Environmental Degradation

The huge cost that a country may have to suffer due to environmental degradation can have big economic impact in terms of restoration of green cover, cleaning up of landfills and protection of endangered species. The economic impact can also be in terms of loss of tourism industry.

What is environmental protection?

Environmental protection means that human beings consciously protect and reasonably make use of natural resources, and at the same time, they prevent natural environment from pollution and destruction. Meanwhile, environment protection has the meaning of the general terms of all kinds of actions taken by humans in order to solve the practical or potential environmental issues: coordinate the relationship between humans and environment, and ensure a sustainable economic and social development.

Preventing environmental damage caused by the construction and developmental activities includes prevention of environmental pollution and destruction caused by large-scale water conservancy, railways, highways, major ports, airports, large industrial projects and other projects.

Protection of natural environment includes:

- Protecting rare species and their living environment,
- The natural history of specific sites, geological phenomena and landscape.
- Urban and rural planning, control of water and soil loss as well as desertification, forest planting, control of population growth and distribution, rational distribution of productive forces.

Environmental protection has become the world's governments and people's common action and the main tasks. Countries have formulated and promulgated a series of environ mental protection laws and regulations to ensure its implementation.

Figure 160. Planting trees is a way of protecting the environment

Environmental conservation

Environmental conservation works in two ways. It is meant to protect nature by protecting important resources, and it is also a way of living that works against the irresponsible practices of businesses and large corporations. Green living takes away the power from those who have no interest in using their influence to promote the greater good of our world.

Progress Check: Creating a poster on environment conservation

Look at the posters below. In groups, design a **creative poster** to advertise the importance of conserving the environment.

Case study 18

The effects of environmental degradation on tourism

In groups, look at the pictures below and tackle the questions that follow:

Figure 161. Wild animals grazing at Nairobi National park, Kenya.

- The national park pictured above is located near a city in Africa. Discuss some of the possible threats posed on the ecosystem of the park.
- Imagine that you are the governor of Nairobi County, formulate an action plan that would protect the environment. **(Your teacher will help you with this.)**

What is Sustainable development?

This is development which meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development involves preserving the environment for other species as well as for people.

Sustainable Development is a pattern of economic growth in which the use of resources aims to meet human needs while preserving the environment, so that those needs can be met not only in the present, but also for generations to come.

The present generation has the responsibility to improve the future generation's life by restoring the previous ecosystem damaged and reducing environmental pollution.

Figure 162. The goals of global sustainable development by the year 2030

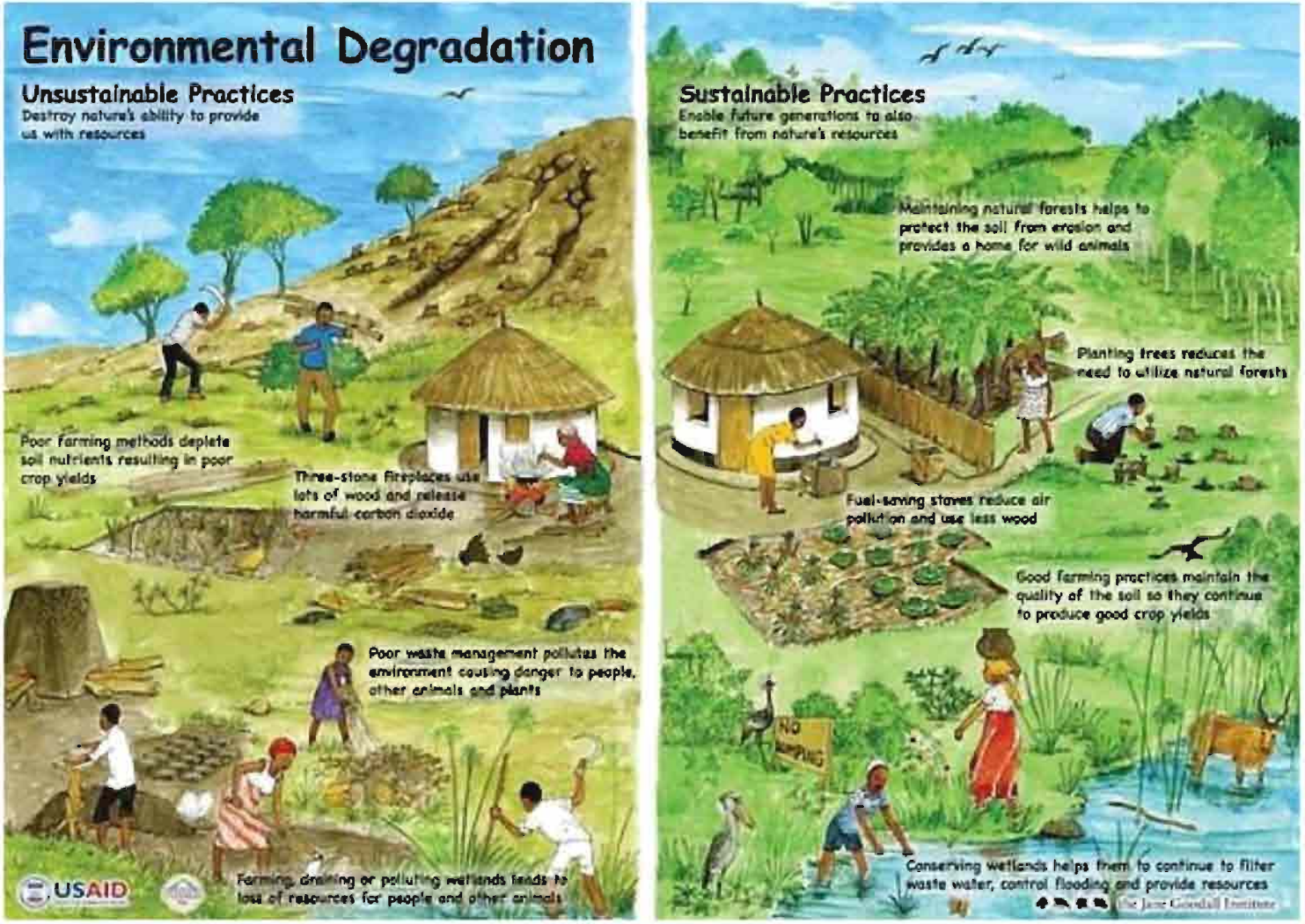


Figure 163. Examples of sustainable and unsustainable practices (Illustration courtesy of USAID)

Figure 164. An artistic impression on the differences between an environment that is developed sustainably and an environment that is developed without the interest of the future generation.

Comprehensive Activity 14

1. **Class Debate:**

   "Development and globalization has led to poverty in some parts of the world". As a class, debate on this.

2. **Group discussion**

   Discuss ways that we can conserve and protect the environment.

Field Observation 1

Observing the environment near your school

Figure 165. Merol market, Bor Town, Jonglei state, South Sudan.

In groups take a walk in a neighboring town or market near your school. And record your observations in the table below:

What is the name of the market/ town you are visiting?
Are there any poorly disposed waste around the place you are visiting?
Are there any tree plantations near the market/ town?
Are there any industries nearby?
Are there any signs of environmental degradation within your place of visit? If yes, what are they?
What are some of the ways or methods that the community living in your place of visit can use to eliminate non- biodegradable waste disposal?

Exercise 16

1. What do you understand by the following terms?
    a) Environment.
    b) Sustainable development.
    c) Environmental conservation.
2. What are the effects of urban development and population growth on the towns and cities?
3. What are the effects of industrialized economic development on the environment?
4. How can the present environment be preserved for the benefit of the future generation?
5. Look at the images below. What are the effects of the actions in the pictures to the environment?

Glossary

1. Vulcanicity: This is the processes by which molten materials from the mantle (magma) are intruded into the Earth's crust but also extruded from the Crust.
2. Volcanicity: Refers to the ways by which magma is intruded into the earth's crust.
3. A fault, in geographical/geological terms, is a fracture or rupture in the rock strata due to strain in which displacement is observable.
4. Faulting is the movement responsible for the formation of a fault may operate in vertical, horizontal or any other direction.
5. The source or headwaters of a river or stream is the furthest place in that river or stream from its estuary or confluence with another river, as measured along the course of the river.
6. Tributary or affluent is a stream or river that flows into a larger stream or main stem (or parent) river or a lake.
7. A confluence, where two or more bodies of water meet together, usually refers to the joining of tributaries.
8. A meander is one of a series of regular sinuous curves, bends, loops, turns, or windings in the channel of a river, stream, or other watercourse
9. Levee: an embankment alongside a river, produced naturally by sedimentation or constructed by man to prevent flooding.
10. An oxbow lake is a U shaped body of water that forms when a wide meander from the main stem of a river is cut off, creating a free-standing body of water.
11. A river delta is a landform that forms from deposition of sediment carried by a river as the flow leaves its mouth and enters slower-moving or standing water.
12. An estuary is the tidal mouth of a large river, where the tide meets the stream.
13. A butte is like a plateau but its top is a bit more rounded.
14. A mesa is a plateau with quite a flat top.
15. An ecosystem is comprised of all the non-living elements and living species in a specific local environment.
16. Tundra: a vast, flat, treeless Arctic region of Europe, Asia, and North America in which the subsoil is permanently frozen.
17. Infant mortality rate: The number of death from 0-2 years.

18. Child mortality rate: Number of death of children aged between 1-5 years per 1000 live birth.
19. Adult mortality rate: Number of adults dying per 1000 of the total population.
20. The Central Business District (CBD): This is in the center and contains the: shops, offices and public buildings (like museums and hospitals) because it is the most accessible point.
21. The Inner-City: In some settlements this area contains abandoned factories and old terraced houses, whilst in others it has been redeveloped by converting empty warehouses into flats and waste land into parks.
22. The Suburbs: These are the residential areas where people who commute into the CBD for work live on housing estates.
23. Climate change: is a change in the statistical distribution of weather patterns that lasts for an extended period of time (i.e., decades to millions of years).
24. Topography is a term used to describe all physical features of a given area.
25. Physical geography: a branch of geography that looks at the natural processes of the Earth, such as climate and plate tectonics.
26. Human geography: a branch of geography that looks at the impact and behaviour of people and how they relate to the physical world.
27. Environmental geography. The main area of geography that looks at the connection between physical and human geography.
28. A Map Legend is a key to all the symbols used on a map.
29. A contour line is a line joining points of equal elevation on a surface.
30. Environmental degradation is the disintegration of the earth or deterioration of the environment through consumption of assets, for example, air, water and soil.
31. Landfills: The large heaps of waste disposed outside of major towns.
32. Sustainable development: This is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.

References

Benaiah Yongo-Bure (2010), Economic Development of Southern Sudan, University Press of America, New York.

Dr. Terry Marsh (2015) Map reading skills, Pathfinder guides.

Emma Griffin (2010) A short History of British Industrial Revolution, Palgrave Macmillan, New York.

Edward Aguardo and James .E .Burt (1999) Understanding weather and climate 4th Edition, Prentice Hall, New Jersey, United States of America.

Francisco Gutierrez and Mateo Gutierrez (2016) Landforms of the Earth, an Illustrated Guide, Springer International, Switzerland.

Gordon Dickinson and Kevin Murphy (1998), Ecosystems, Routledge, New York.

Jose Goldemberg and Oswaldo Lucon (2010) Environment and Development, Earthscan, United Kingdom.

M.H. Fulekar, Bhawana Pathak, R. K Kale (2013) Environment and Sustainable Development, Springer, India.

Robert Davidson (2008), Reading Topographic Maps, Retrieved on 28th November 2017 from www.mapreading.com

Sophie and Max Lovell-Hoare (2013), South Sudan, 1st Edition, The Bradt Travel Guides, United Kingdom and Globe Pequot Press, United States of America.