

**CONDENSED GEOGRAPHY CURRICULUM
FROM GRADE 9-12
DESIGNED FOR GRADE 12 TUTORIAL
PROGRAM**

**October 2025
Addis Ababa, Ethiopia**

Preface

The program is designed to support Grade 12 students for the 2025/2026 academic year. The primary goal is to help students maximize their scores in the Ethiopian Secondary School Leaving Certificate Examination (ESLCE), particularly at the level of the Addis Ababa City Government Education Bureau. The content of the new module is derived from textbooks used in Grades 9 (old curriculum) and 10 to 12 (New curriculum). These materials have been carefully selected and organized to address and bridge gaps in students' academic achievements through a weekend tutorial program.

The selection and integration of the content were carried out by a team of geography experts from the Addis Ababa City Government Education Bureau, in collaboration with a group of experienced high school teachers who have many years of service in teaching and educational material development. The program is structured by lessons, each with a specific time allocation. Each lesson includes clearly defined competencies, key concepts, examples, and activities that aim to reinforce the material.

Teachers participating in the program are expected to identify and address gaps in students' understanding during lessons, while also making individual efforts to meet the program's objectives. Additionally, teachers are encouraged to incorporate more activities, update content with recent information, and adjust the material to reflect dynamic changes in the subject matter. Feedback from all stakeholders, including teachers, students, and education administrators, is crucial for evaluating the progress of the program and ensuring its future success.

Lesson One

1. Major Landforms of Africa

1.1 Physical regions of Africa (Atlas Mountain, Sahara desert and Sahel)

At the end of this lesson, students will be able to:

Explain the spatial variations and distributions of the major landforms in Africa.

Key concepts

Table 1: Major Landform Regions in Africa

Major Landform Regions	Physical Regions
African Alpine System - cover small area	Atlas Mountains
African Massif -cover very large area	The Sahara
	The Sahel
	The Savannah
	The Tropical rainforest
East African Highlands & Rift System	Ethiopian & Eritrean Highlands
	Rift Valley and African Great Lakes
Southern Africa Platform	Mountains & Desert systems of Southern Africa

A. African Alpine System

i. Atlas Mountain

- It is located between the Mediterranean Sea in the north and The Sahara desert in the south.
- It covers the Maghreb region of Morocco, Algeria, and Tunisia 2000km.
- It forms a series of mountain ranges: the Anti-Atlas, High Atlas, Middle Atlas, Rif Mountains, Tell Atlas, and Sahara Atlas.

B. African Massifs

i. The Sahara desert

- It is located between the Mediterranean Sea and the Atlas Mountains in the north, and the Sahel region in south.
- It is the largest hot desert in the world with an area of 9,200,000 km².
- It covers the largest part of North Africa, from the Atlantic coast in the west to the Red Sea in the east.
- It encompasses whole or large parts of 10 countries in North Africa, such Morocco, Algeria, Tunisia, Libya, Egypt, Mauritania, Mali, Niger, Chad, and Sudan.
- Its landscape is covered by **reg-** large mass of sand dunes and **erg-** desert pavement of pebbles on top of vast flat surfaced sheet of sand.

ii. Sahel Region

- Sahel is an Arabic word (sahil) meaning “shore”.
- It is a transitional zone between the Sahara on the north and the savanna (drier savanna) region to the south.
- It is an extremely drought-affected area.
- It extends from Mauritania and Senegal in the west to Sudan and Eritrea in the east, 5000km.
- It encompasses whole or large parts of 9 countries, such as Senegal, Nigeria, Burkina Faso, Mauritania, Mali, Niger, Chad, Sudan and Eritrea.
- The Sahel lands are Savanna grasslands with Scrub to the north alternating areas of trees mainly **Acacia** in the south.
- The semiarid grassland of the Sahel has natural pasture, with low-growing grass and tall herbaceous perennials.
- Its landscape is similar to the drier savanna type. However, it tends to merge into desert because of human activity & climate change.

Activity1: Give short answer for the following questions.

1. List the four major landform regions of Africa.
2. Describe the locational extent of Atlas Mountain.
3. Write countries incorporated by Sahara desert and Sahel region.
4. Explain the main features of the Sahara desert region.
5. List the Africa's landform regions that cover very large area and the small area respectively.
6. Why the Sahel region is tend to merge in to desert?

Activity 2: Choose the correct answer from the given options.

- Which country has the largest portion of the Atlas Mountains?
A. Morocco B. Tunisia C. Algeria D. Libya
- The Sahara Desert is primarily characterized by which of the following?
A. High rainfall and dense forests
B. Rolling hills and fertile soil
C. Vast sand dunes and arid climate
D. Wetlands and swamps
- The Sahel region is best described as:
A. A tropical rainforest
B. A semi-arid transitional zone between the Sahara and Savanna
C. A mountain range
D. A coastal wetland

4. Which of the following statements best describes the Atlas Mountains?
- A. They are young fold mountains formed by the collision of the African and Eurasian plates.
 - B. They are low, ancient fold mountains formed by the separation of tectonic plates.
 - C. They are volcanic mountains located along the Great Rift Valley.
 - D. They are Block Mountains formed through faulting.
5. The Sahel region is best described as:
- A. A humid equatorial zone with dense forests.
 - B. A rift valley area with many volcanic lakes.
 - C. A mountainous zone with high plateaus.
 - D. A transitional zone between the Sahara Desert and the Savanna.

1.2 Physical regions of Africa (Savanna and Tropical rainforest regions)

At the end of this lesson, students will be able to:

- Explain the spatial variations and distributions of the major landforms in Africa.

Key concepts

iii. The Savanna Region

- It is transitional region between Rainforest and the Sahel grassland.
- It is tropical grassland with few trees and shrubs (Shrub is a woody plant smaller than a tree and has very short stem with branches near the ground).
- The trees are drought resistant; usually shed their leaves during the dry season due to reduce water loss from the plants.
- It has two vegetation types: Woodland & Thorn Tree Tall Grass Savanna.
- Savanna woodland trees are widely spaced because of less soil moisture during the dry season to support full tree cover.
- The open spacing lets a dense lower layer grasses develop. The woodland has an open Park-like appearance.
- Savanna woodland of Africa trees has medium height.
- Some species of trees in dry Savanna are xerophytic forms while others species of trees are broad-leaved deciduous species-shed their leaves in the dry season.
- It contains the most world's national parks of Africa.

iv. The Tropical Rainforest

- It lies both north and south of the Equator.

- The rainforests near the equator are known as Equatorial Rainforests.
- They are very diverse and contain large number of flora and fauna species.
- Broadleaf evergreen trees dominate the vegetation cover.
- It covers six Congo Basin African countries, such as Cameroon, Central African Republic, Republic of Congo, DRC, Gabon, and Equatorial Guinea and also Ghana, Ivory Coast and eastern Madagascar.
- The various trees are closely spaced together and form thick continuous canopy some 25 to 35 meters tall.
- The major plant species of the Tropical Rainforest include:
 - ✓ Epiphytic—are plants grow on other plants surfaces,
 - ✓ Herbaceous—are non-woody plants,
 - ✓ Lianas (Vines)- are tree climbing plants,
 - ✓ Ferns- are non-flowering plants.
- Its climate is wet all the year round.
- Temperature and humidity are high throughout the year.
- Decomposition is rapid because of high temperature and high moisture.
- Due to frequent and heavy rainfall, soils are subject to extreme chemical weathering and Leaching.
- **Chemical weathering** is rainwater reacts with minerals in rocks or soil, causing the minerals to break down and change chemically.
- **Leaching** is water percolates through the soil and dissolves and carries away dissolved minerals and nutrients.
- The environment also make tropical soils acidic and poor nutrient.

Activity1: Give short answer for the following questions.

1. What is the location of savanna region?
2. Explain the main features of tropical rainforest region.
3. List six African countries that make the Congo basin.
4. Describe the difference between leaching and chemical weathering.
5. Why savanna region trees usually shed their leaves?

Activity 2: Choose the correct answer from the given options.

1. Which feature is typical of the African Savanna?
 - A. Broad-leaved evergreen forests
 - B. Grasslands with scattered trees
 - C. Permanent ice caps
 - D. Mangrove swamps
2. The Equatorial region of Africa is mainly associated with:
 - A. Plateau landscapes with low temperatures.
 - B. Short rainy seasons and long dry seasons.
 - C. Sparse vegetation and low humidity.
 - D. Heavy rainfall throughout the year and dense evergreen forests.
3. The Savanna region differs from the Equatorial region mainly because:
 - A. It has colder temperatures all year round.
 - B. It experiences seasonal rainfall with alternating wet and dry seasons.
 - C. It has higher annual rainfall and denser forests.
 - D. It is located near the equator.
4. Which sequence correctly arranges the following African regions from north to south?
 - A. Atlas → Sahara → Sahel → Savanna → South African Plateau
 - B. Savanna → Sahel → Sahara → Atlas
 - C. Sahara → Atlas → Sahel → Savanna
 - D. Sahel → Sahara → Savanna → Atlas

Lesson Two

2. East African Rift System and Southern African Plat form

At the end of this lesson, students will be able to:

- Explain the spatial variations and distributions of the major landforms in Africa.

Key concepts

2.1 The East Africa Rift Valley and African Great Lakes

2.1.1 The East Africa Rift Valley

- It was formed by normal faulting in the Tertiary period.
- Normal fault occur when land between two blocks *sank down* by tension force.
- The Rift valley was formed when the land stretched by forces moving to opposite direction (Tension force) creating rupture and splitting apart between them.
- It extends from the Red Sea to Mozambique.
- Its total length is 5,600 km in Africa, touching 15 countries in the continent.
- The average width of the Rift Valley ranges 32 km and 80 km.

2.1.2 African Great Lakes

- The lakes are divided into two types-natural and artificial (anthropogenic).
- Natural lakes are formed by tectonic, volcanic and/or denudation processes.
- Natural are lakes that are formed under natural conditions.
- Based on location, natural African lakes are divided into two groups: Rift valley and Non-Rift Valley lakes.
- Rift valley lakes are the lakes that occupy the floor of the East African Rift Valley such as Lake Turkana, Tanganyika, Kivu, Albert, Malawi, Edward and the numerous Rift Valley lakes in Ethiopia (Lake Abbaya, Chamo, Shala, Abijatta, Langano, Ziway, Hawassa).
- Non-Rift Valley lakes are found outside the East African Rift Valley such as Lake Victoria, Chad and Tana.
- Lake Victoria is the largest lake in Africa lies at an elevation of 1,134m above sea level, with an area of 69,000km².
- Artificial lakes are formed when water is accumulated at the backs of dams that are constructed across rivers for various purposes.
- The major anthropogenic lakes in Africa are Nasser, Koka, Volta, Kaindji and Kariba.

Southern African Plat form

2.1.3 Mountains and Desert Systems of Southern Africa

- It is found to the south of the Congo and Tanzania.
- It is crossed by the Tropic of Capricorn in the middle, indicating that the southern portion is a temperate part.
- It has very diverse landscape such as escarpment, mountains, grassland, and desert landscapes.
- The UKhahlamba (Drakensberg) Mountain is the most recognizable landscape in the region with the average altitude of 3,000 m above sea level.
- Two large deserts of southern Africa: Kalahari & Namib.
- The **Kalahari Desert** lies mainly in Botswana. It is an extensive desert region with arid mixture of grasslands and sand. It is home to game reserves and national parks.
- The **Namib Desert**, found along the west coast of Namibia. It is affected by Benguela cold ocean current border of the area. Hence, the Namib Desert was formed partly because of the nearby cold ocean current.
- The **Highveld** is the portion of the South African inland plateau. It is home to the South Africa's most important commercial farming areas, and largest concentration of metropolitan centers, especially the Gauteng conurbation, which accommodates one-third of South Africa's population.

Activity 1: Give short answer for the following questions.

1. What is the cause for the formation of East African Rift Valley?
2. List the fifteen countries crossed by East African Rift Valley.
3. What is the major difference between Artificial and Natural lakes?
4. What is the deepest lake in Africa?
5. Why Kalahari Desert is not under the influence of Benguela Cold Ocean current?

Activity 2: Choose the correct answer from the given alternatives

1. The East African Rift Valley was mainly formed through:
 - A. Folding of the Earth's crust.
 - B. Faulting due to tension forces in the crust.
 - C. Deposition by rivers.
 - D. Volcanic eruption alone

2. Which of the following is the largest lake by area in Africa?

A. Lake Victoria	C. Lake Malawi
B. Lake Tanganyika	D. Lake Chad
3. Which of the following is the deepest lake by depth in Africa?

A. Lake Victoria	C. Lake Edward
B. Lake Tanganyika	D. Lake Kivu
4. Which mountain is the highest peak in Africa?

A. Mount Kenya	C. Atlas Mountains
B. Mount Kilimanjaro	D. Drakensberg Mountains
5. Which desert is under the influence of Benguela cold ocean current?

A. Namib Desert	C. Sahara Desert
B. Kalahari Desert	D. Libyan Desert
6. The South African Plateau is mainly characterized by:

A. Coastal plains and mangroves	C. Mountainous terrain only
B. High elevation with flat terrain and some hills	D. Desert dunes
7. Which of the following is a major challenge in the Sahel region?

A. Desertification and drought	C. Mountain landslides
B. Excessive rainfall and flooding	D. Glacial melting
8. Which of the following lakes is located in the East African Rift Valley?

A. Lake Victoria	C. Lake Chad
B. Lake Volta	D. Lake Tanganyika
9. The Drakensberg Mountains are located in which part of Africa?

A. Northern Africa	C. Southern Africa
B. Western Africa	D. Eastern Africa

2.2 The Geological Time Scale.

At the end of this lesson, students will be able to:

- *Describe the difference between relative and absolute ages of the Earth's rocks*

Key concepts

Meaning of Geologic Timescale

- It is the time-table showing the age of the Earth and its associated life-forms.
- It provides a review of Earth's history and the major changes that occurred over time.

- It is developed by Earth scientists through the study of Earth's rocks. Through the study of rocks, scientists determine the Relative and Absolute ages of rocks.

Relative and Absolute Age of Rocks

A) Relative Age

- Relative age mainly depends on the analysis of the sequence of geological occurrences without the exact time of origin.
- It focuses only on determining the sequence of formation of events. This method principally depends on the study of sedimentary rocks and often applies to local conditions interpretations.
- It does not provide a precise measurement in terms of years before the present but indicate whether the rock (sediment) is old or young.
- Geologists employ three basic principles during the study of the relative age of rocks. These are:
 - Principle of original horizontality,
 - Law of superposition and
 - Principle of cross cutting relationships
- **The principle of original horizontality** indicates that layers of sediments are originally placed horizontally under the action of gravity. This means that except for the disturbed sequences, sedimentary rocks are always deposited in nearly horizontal beds.
- **The principle of superposition** asserts that an undisturbed sequence of sedimentary rock layers, the overlying bed is younger than the underlying rock.
- **The principle of cross-cutting relationships** indicates that a rock-layer that cross-cuts another rock-layer is said to be younger than the rocks it cross-cuts. This is a condition where older rocks are cut by younger igneous intrusions.

B) Absolute age

- It refers to the actual age of rocks given in numerical values through the analysis of the spontaneous decay of radioactive isotopes.
- Isotope is a form of chemical element that has the same number of protons but a different number of neutrons in its nucleus. For example, Carbon -14 → 6 Protons and 8 neutrons.
- Radioactive decay is the conversion of unstable (Parent) elements into daughter (Stable) elements through gaining or losing of particles in their nucleus.

Table 2: Parent and Daughter isotopes and time-taken (half-life) for conversion

No	Parent isotope	Daughter isotope	Half-life
1	Uranium - 238 (^{238}U)	Lead - 206 (^{206}Pb)	4.5 billion years
2	Rubidium - 87 (^{87}Rb)	Strontium - 87 (^{87}Sr)	48.8 billion years
3	Potassium-40 (^{40}K)	Argon - 40 (^{40}Ar)	1.25 billion years
4	Uranium - 235 (^{235}U)	Lead - 207 (^{207}Pb)	704 million years
5	Carbon-14 (^{14}C)	Nitrogen - 14 (^{14}N)	5,730 years

- The time taken to convert from parent element to daughter element is commonly measured in half-lives.
- The half-life of an isotope is the time taken for half of the parent isotope to change to its daughter atoms.
- The relative proportions of the parent and daughter isotopes are used to determine the number of half-lives.

Table 3: Proportion of Parent and Daughter isotopes during radioactive decay

No	No of half-lives	Proportion (% of total isotopes)	
		Parent isotope	Daughter isotope
1	0	100	0
2	1	50	50
3	2	25	75
4	3	12.5	87.5

- Before conversion, 100% of the Parent prevails and no daughter product is formed.
- After one half-life, 50% of the parent remains while 50% of the atoms are changed to daughter atoms.
- After two half-lives, the number of parent isotopes is again halved (25%) whilst the number of daughter atoms increases by the same amount (75%).
- After three half-lives, the number of parent isotopes is again halved (12.5%) whilst the number of daughter atoms increases by the same amount (87.5%).

- Radioactive decay occurs when elements recombine to form new minerals in metamorphism process.
- Radioactive elements found in igneous and metamorphic rocks are commonly used in rock-dating studies.

Activity 1: Give short answer for the following questions.

1. What is the difference between relative and absolute ages of geological events?
2. What is the difference between the principle of original horizontality and the principle of super-position?
3. What is the order of rock layers from oldest to youngest in the figure below?

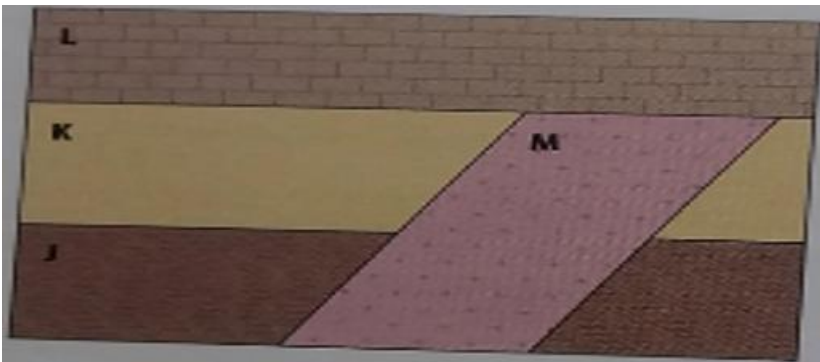
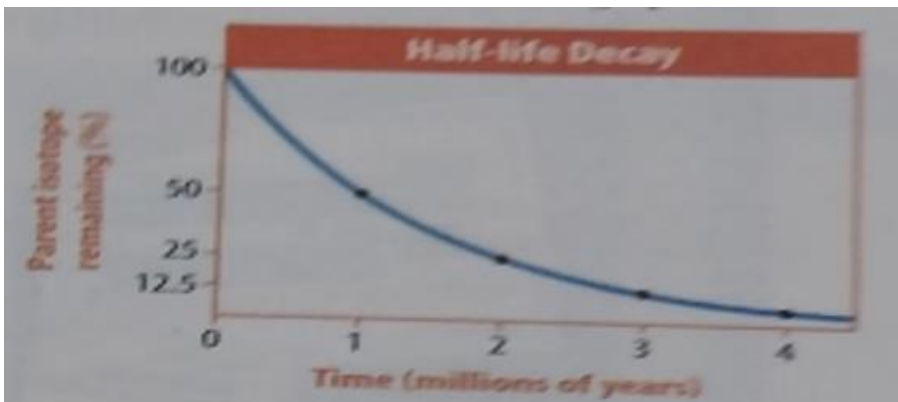


Figure 4 Relative age of rocks

4. What is the half-life on the graph below?



Graph 1: Absolute age of rocks

5. What do scientists measure when determine the absolute age of rocks?

Activity 2: Choose the correct answer from the given alternatives.

1. Which method is used to determine the relative age of rocks?

A. Radiometric dating	C. Law of Superposition
B. Carbon-14 dating	D. Potassium-argon dating

2. Absolute dating of rocks provides:
- A. The age of rocks in sequence
 - B. The exact numerical age of rocks
 - C. Only the oldest rock
 - D. Only the youngest rock
3. Which of the following is true about relative dating?
- A. Younger rocks are below older rocks
 - B. Older rocks are above younger rocks
 - C. Younger rocks are above older rocks
 - D. All rocks are the same age
4. The law stating that layers of sedimentary rock are deposited in a time sequence, with the oldest on the bottom and the youngest on top is called:
- A. Law of Original Horizontality
 - B. Law of Superposition
 - C. Law of Cross-Cutting Relationships
 - D. Principle of Fossil Succession
5. Which method would you use to find the absolute age of volcanic rocks?
- A. Radiocarbon dating
 - B. Potassium-argon dating
 - C. Fossil correlation
 - D. Law of Superposition
6. Which of the following best explains cross-cutting relationships?
- A. Sedimentary layers are always horizontal
 - B. A rock or fault that cuts through other rocks is younger than the rocks it cuts
 - C. Fossils are found only in the oldest rocks
 - D. Igneous rocks are always older than sedimentary rocks
7. Which type of fossil is most useful for relative dating?
- A. Index fossils
 - B. Dinosaur bones
 - C. Tree fossils
 - D. Ammonia
8. The absolute age of a rock can be determined using:
- A. Carbon-14 dating for rocks older than 1 million years
 - B. Radiometric dating using isotopes such as uranium-238
 - C. Observing rock color
 - D. Counting sediment layers only

9. If a fault cuts through several layers of rock, the relative age of the fault is:
- A. Older than the layers
 - B. Impossible to determine
 - C. The same age as the layers
 - D. Younger than the layers
10. Which of the following is a limitation of relative dating?
- A. It cannot provide the exact numerical age of rocks
 - B. It requires radioactive isotopes
 - C. It only works for igneous rocks
 - D. It can only be applied to fossils

Lesson Three

3. Grid Reference

At the end of this lesson, the students will be able to:

- Identify some of the marginal information given on maps.

A **map grid reference** is a set of imaginary lines that divides the earth's surface into regular grids.

It can be divided into **international (Geographic)** and a **National** Grid Systems.

Key concepts

3.1 The International (Geographic) Grid System

- It shows the absolute locations of places on the earth's surface.
- Its references are made up of **parallels or lines of latitude** and **meridians or lines of longitude**.
- It provides the position of any point/place, in degrees, minutes and seconds north and south of the equator and east and west of the prime meridian.

i. **Parallels or lines of latitude:**

- Define locations north and south of the equator.
- They are horizontal lines of the grid.
- They are parallel and are an equal distance from each other.
- Each degree of latitude is approximately 111 km apart.
- Degrees of latitude are numbered from 0° - 90° north and south.
- Its origin is 0° equator (the imaginary line which divides our planet into the northern and southern hemispheres).

- They are angular distances measured to the north and south of the equator in degrees, minutes and seconds.

ii. Meridians or lines of longitude

- Define locations east and west of the Prime Meridian (Greenwich meridian).
- They are vertical lines of the grid.
- They converge at the poles and are widest at the equator (about 111 km apart) on the globe.
- Degrees of longitude are numbered from 0° - 180° east and west.
- Its origin is 0° Prime Meridian.
- 180° east /west where they meet and form the International Date Line in the Pacific Ocean.
- They are angular distances measured to the east and west of the Greenwich meridian in degrees, minutes and seconds.

Note: When giving position of any place in geographic grid reference system latitudes are always given before longitudes.

Example 1: Find the geographic grid of point B in Figure 1. Follow the following steps.

1. Identify whether point B is North or South of the Equator.
2. Read the latitudes of B, North of the equator i.e., 20°N .
3. Read the longitude of B, East of the prime meridian i.e., 30°E .
4. The complete geographic grid of point B is 20°N , 30°E .

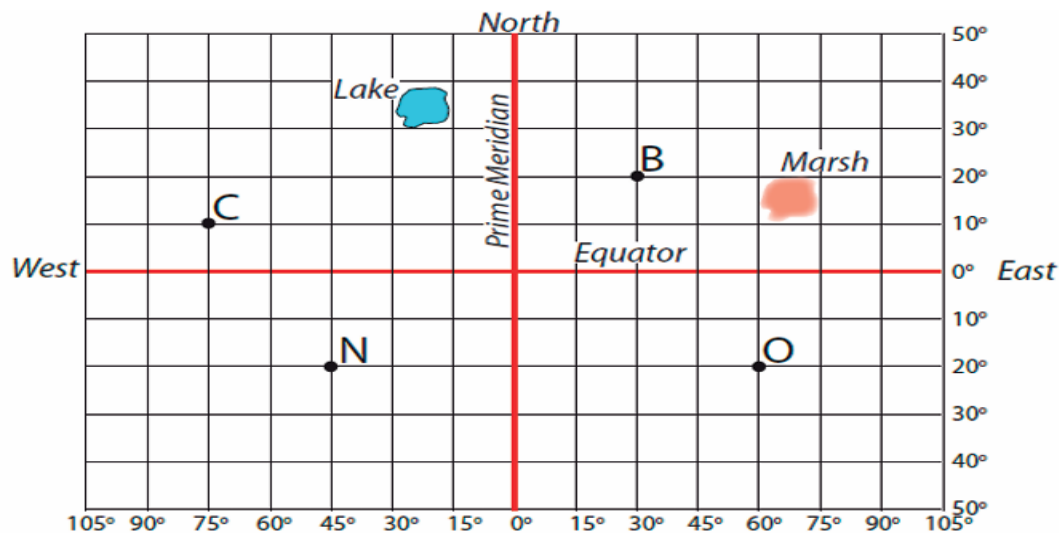


Figure 1: Geographic grid reference

Activity 1: Answer the following questions.

- a) What is geographic grid reference system?
- b) Explain the difference between the lines of latitudes and the lines of longitudes?
- C) Find the geographic grid reference of the following points and areas based on Figure 1.
1. C 2. N 3. O 4. Lake 5. Marsh

Activity 2: Choose the correct answer from the following alternatives.

- 1. The geographic grid is formed by:
 - A. Imaginary lines of latitude and longitude drawn across the globe
 - B. A network of roads and landmarks on a map
 - C. The boundaries between countries
 - D. Elevation contours on a topographic map
- 2. Which statement best describes latitude?
 - A. It runs vertically from pole to pole and measures east–west position
 - B. It changes according to seasons
 - C. It runs diagonally across continents
 - D. It runs horizontally and measures distance north or south of the Equator
- 3. Which of the following correctly identifies longitude?
 - A. Lines that meet at the poles and measure distance east or west of the Prime Meridian
 - B. Lines that are parallel to the Equator
 - C. Lines that represent elevation above sea level
 - D. Lines that cross the Equator at right angles and measure north–south distance
- 4. Which of the following coordinates is written correctly in geographic grid reference format?
 - A. 38° N, 9° E C. 38 N 09 E
 - B. 9° E, 38° N D. N 9°, E 38°
- 5. Geographic grid references are useful mainly for:
 - A. Measuring slope angle
 - B. Calculating population density
 - C. Estimating rainfall amounts
 - D. Locating absolute positions of places on the Earth’s surface.

3.2 The National Grid System

At the end of this lesson, students will be able to:

- Identify some of the marginal information given on maps.

Key concepts

- It is used on maps of individual countries and regions within them.
- Its references are made up of **Easting's** (lines that are drawn from north to south) and **Northings** (lines that are drawn from east to west).
- Eastings and northings are originated from the “False Grid Origin” that lies at the southwestern corner of the place they cover.
- The values of Easting's increase *eastwards*, while the values of northings increase *northwards*.
- Easting's and northings are measured in kilometers and fractions of kilometers east and north of the grid origin.
- Northings are lines that run **horizontally** while Eastings are lines that run **vertically**.
- In contrast to meridians, Eastings (verticals) do not indicate true north.
- The grid origin of Ethiopia lies in south-west most corner, is at the point in SW Kenya where the $34^{\circ}30'E$ meridian crosses the equator (0°).
- It never can be used to indicate an area rather stands for a point, which is the intersection of two lines.
- Easting must always be read before northings.
- There are two types of grid references:
 - A. The four digit grid reference
 - B. The Six digit grid reference

A. The four digit grid reference

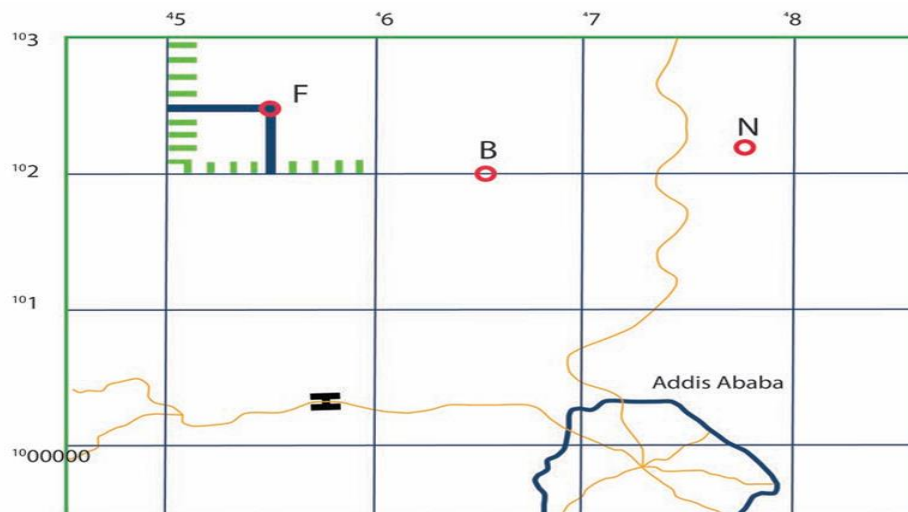
- It is common on a map drawn on a **small scale** so that a *less accuracy* in position can be obtained.
- The 10 Km sides of the square are marked with numbers that increases towards East and North.
- The Northing and Easting are numbered at every 10 Km intervals.
- Again, each side of the square is divided into 10 units (1 unit represents 1 Km).

- The two first digits in the grid reference always refer to the Easting's and the two last digits to the northings.

B. The Six digit grid reference

- It is common on a map drawn on a **large scale** so that a *greater accuracy* in position can be obtained.
- The 100 Km sides of the square are marked with numbers that increases towards East and North.
- The Northing and Easting are numbered at every 100 Km intervals.
- Again, each side of the square is divided into 100 units (10 unit represents 1 Km).
- The three first digits in the grid reference always refer to the Easting's and the three last digits to the northings.

Note: When giving position of any place in national grid reference system Eastings are always given before Northings.



Scale 1:250,000

Figure 2: Four digit grid reference

Proceedings	Easting's (Vertical)	Northings (Horizontal)
Locate the vertical grid line to the left of the point F and read the large number.	5	
Divide the square into ten equal divisions and pick the tenth of the point.	5	
Locate the horizontal grid line below the point F and read the large number.		2
Again divide the square into ten equal divisions and pick the tenth.		5
The grid references for point F:	55	25
The 4-digit grid reference for point F: 5525		

Activity 1: Answer the following questions.

- What is national grid reference system?
- Explain the difference between four digit and six digit grid reference?
- Based on Figure 2, find the four digit grid reference for the following points:
 - B
 - N
- Based on the above Figure 3, find the six digit grid reference for the following Points:
 - C
 - A

Example 3: Find the six digit grid reference for point B using Figure 3. Use the four digit grid reference procedure as a guide. The approximate six digit grid reference for Point B is 287585.

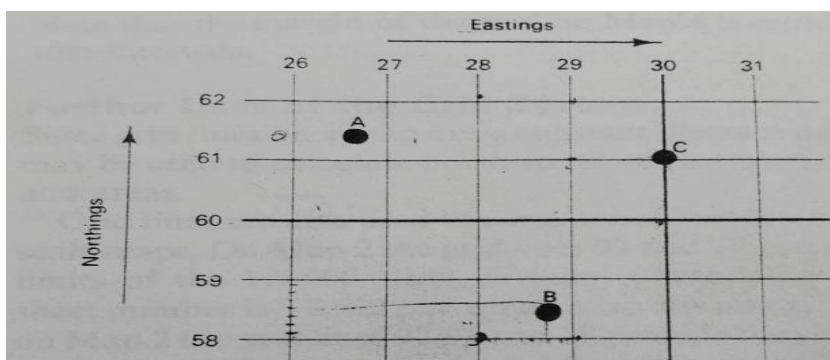


Figure 3: Six digit grid reference

Activity 2: Choose the correct answer from the given alternatives.

1. In a six-figure grid reference **462378**, what do the first three digits (462) specifically represent?
 - A. The latitude in degrees north of the Equator
 - B. The easting value, showing distance east of the origin
 - C. The northing value, showing distance north of the origin
 - D. The total distance from the Prime Meridian
2. On a topographic map, if the grid square with reference **7248** is 1 km by 1 km, which of the following locations lies approximately **southwest** of this square?
 - A. 7149 B. 7347 C. 7147 D. 7349
3. In a national grid system, what is the main advantage of using six-figure grid references instead of four-figure grid references?
 - A. They are easier to memorize.
 - B. They provide a more general location over a wider area.
 - C. They give a more precise position within a grid square (to 100 meters).
 - D. They are used only for smaller-scale maps.
4. If a point is located at Grid Reference 625435, what would be the reference of a point 2km east and 1 km north of it? A. 645425 B. 627436 C. 645445 D. 623433
5. On a map with Eastings 40–50 and northings 60–70, a school is located at **437652**. Which square should you first go to?
 - A. 43 Easting $\times$ 65 Northing
 - B. 43 Easting $\times$ 62 Northing
 - C. 437 $\times$ 652
 - D. 40 $\times$ 60
6. Which of the following correctly represents the position east of the origin and north of the baseline in a four-figure grid reference?
 - A. The first two digits indicate northings, and the last two digits indicate Easting's.
 - B. The first two digits indicate Easting's, and the last two digits indicate northings.
 - C. Both pairs of digits represent northings only.
 - D. Both pairs of digits represent Easting's only.

7. A national grid system differs from a geographic grid because it:
- A. Uses a rectangular coordinate system based on Easting's and northings within a country
 - B. Uses imaginary lines of latitude and longitude
 - C. Is used only for measuring elevation
 - D. Is drawn on globes but not maps
8. In a four-digit national grid reference, the first two digits represent:
- A. Northings
 - B. Horizontal lines
 - C. Longitudes
 - D. Easting's
9. A six-digit national grid reference provides:
- A. A general location of a region
 - B. An exact latitude and longitude
 - C. A precise point within a $100\text{ m} \times 100\text{ m}$ square
 - D. Only the vertical position of a place
10. Which of the following is an advantage of using national grid references over geographic Coordinates for map work?
- A. NGR is less accurate than latitude/longitude.
 - B. NGR uses simpler numerical coordinates, making it easier to read precise locations on topographic maps.
 - C. NGR depends on global positioning satellites only.
 - D. NGR gives climate information.

Lesson Four

4. Scale

4.1 Scale, Type and scale conversion

At the end of this lesson, students will be able to:

- Convert linear scale to areal scale

Key concepts

- Scale is the ratio or proportion of the distance and areas shown on the map to the corresponding distance and area on the earth's surface

$$\text{Scale} = \frac{\text{Map Distance (MD)}}{\text{Ground Distance (GD)}}$$

- It can be categorized in to **linear** or **areal** scale.

A. Linear Scale

- It is the ratio of map distance to ground distance.
- It is the most common scale type.
- It is the square root of areal scale.

B. Areal Scale

- It shows the relationship between map area and ground area.
- It is the square of linear scale.

Example 1: If a map has an areal scale of 8cm^2 to 68km^2 , what is the linear scale of the map?

Solution: $\sqrt{8\text{cm}^2/68\text{km}^2} = 1\text{cm to } 8\text{km}$

Example 2: If a map has a linear scale of 1 cm to 6 km, what is the areal scale of the map?

Solution: $(1\text{ cm})^2 \text{ to } (6\text{ km})^2 = 1\text{ cm}^2 \text{ to } 36\text{ km}^2$

Activity 1: Answer the following questions.

1 Find the linear scale for the following:

- a. 2 cm^2 to 200 km^2 b. 4 cm^2 to 400 m^2 c. 3 cm^2 to 9 km^2 d. 1 cm^2 to 4 km^2

2. Find the areal scale for the following:

- a. 1 cm to 5 km b. 1 : 50,000 c. 6 cm to 36 km d. 3 cm to 9 km

Activity 2: Choose the correct answer from the given alternatives

1. Which of the following correctly compares linear and areal scales?

- A. Areal scale refers to distance, while linear scale refers to area.
- B. Areal scale is derived from linear scale by squaring the representative fraction.
- C. Linear scale is used to measure area directly.
- D. Both linear and areal scales are expressed in square kilometers.

2. Which of the following best describes an areal scale?
 - A. It is used to measure direction on a map
 - B. It converts map distances to ground distances
 - C. It converts map areas to actual ground areas
 - D. It determines the elevation of land features
3. On a map, a lake measures 3 cm by 4 cm. If the scale is 1:100,000, find the real area of the Lake. A. 6 km² B. 12 km² C. 24 km² D. 36 km²
4. If the linear scale of a map is 1 cm represents 5 km, what is the areal scale of the map?
 - A. 1 cm² represents 5 km²
 - B. 1 cm² represents 10 km²
 - C. 1 cm² represents 25 km²
 - D. 1 cm² represents 50 km²
5. A lake on a map has an area of 2 cm². If the map scale is 1:40,000, what is the actual area of the lake? A. 0.16 km² B. 16 km² C. 32 km² D. 320 km²
6. Which of the following best describes linear scale?
 - A. Converts map area to ground area
 - B. Converts map distance to ground distance
 - C. shows the slope of terrain
 - D. Measures height of landforms
7. If 1 cm² on a map represents 16 km² on the ground, what is the linear scale of the map?
 - A. 1:4,000
 - B. 1:40,000
 - C. 1:400,000
 - D. 1:1,600,000
8. Which of the following best describes linear scale on a map?
 - A. It shows the relationship between map distance and ground distance using words.
 - B. It is a line divided into units representing ground distance.
 - C. It compares area on a map to area on the ground.
 - D. It is expressed as a ratio, e.g., 1:50,000.
9. To convert a linear scale to an areal scale, you should:
 - A. Multiply the linear scale by 2
 - B. Divide the linear scale by the square root
 - C. Square the denominator and numerator of the linear scale
 - D. Convert to graphic scale
10. If the areal scale of a map is 1:25,000,000, what is its linear scale?
 - A. 1:25,000
 - B. 1:5,000
 - C. 1:50,000
 - D. 1:100,000

11. A map has a linear scale of 1:100,000. What is the areal scale?

- A. 1:10,000,000 C. 1:100,000,000
B. 1:1,000,000,000 D. 1:10,000

4.2. How to Find the Scale of a Map

At the end of this lesson, students will be able to:

- Identify some of the marginal information given on maps.

Is it possible to calculate the scale of a map when it is not given? How?

Key concept

- In principle, every map should show the scale to which it has been drawn.
- If the scale is not shown, we can calculate it.
- There are two ways of finding a map scale, if it is not given:

1. By using the known distance between two points on the map.

- This method is used if the ground distance between two points or places shown on the map ^{is given}.
- Then use the following procedure to obtain the scale:
 - a. Measure the distance between the two points on the map in centimeters using ruler.
 - b. Divide the obtained distance on the map by the ground distance to obtain the ratio between the two. This gives you the scale of the map.

Example: The ground distance between two places is 100 km. If this distance is represented by 5 cm on a map, what is the scale of the map?

Solution: Scale = Distance on the Map/ Distance on the Ground
$$= 5\text{cm} / 100\text{km} = 1\text{cm to } 20\text{km or } 1:2,000,000$$

2. By using latitudes

- In this method, the scale of the map can be obtained by using the values of latitudes.

For example: Calculate the scale of the given map.

1. The degree difference between the two latitudes is 15'.
2. The distance that 15' represents is 27.75 km.
3. The distance between the two latitudes on the map is approximately 5 cm.
4. The scale of the map is, therefore:

Scale = Distance on the Map/ Ground Distance
$$5\text{cm}/27.75\text{km} = 1\text{cm to } 5.55\text{km or } 1: 555,000$$



Activity 1: If the straight-line distance between Addis Ababa and Mekele is 780 km. Using Figure 7, calculate the scale of the map?

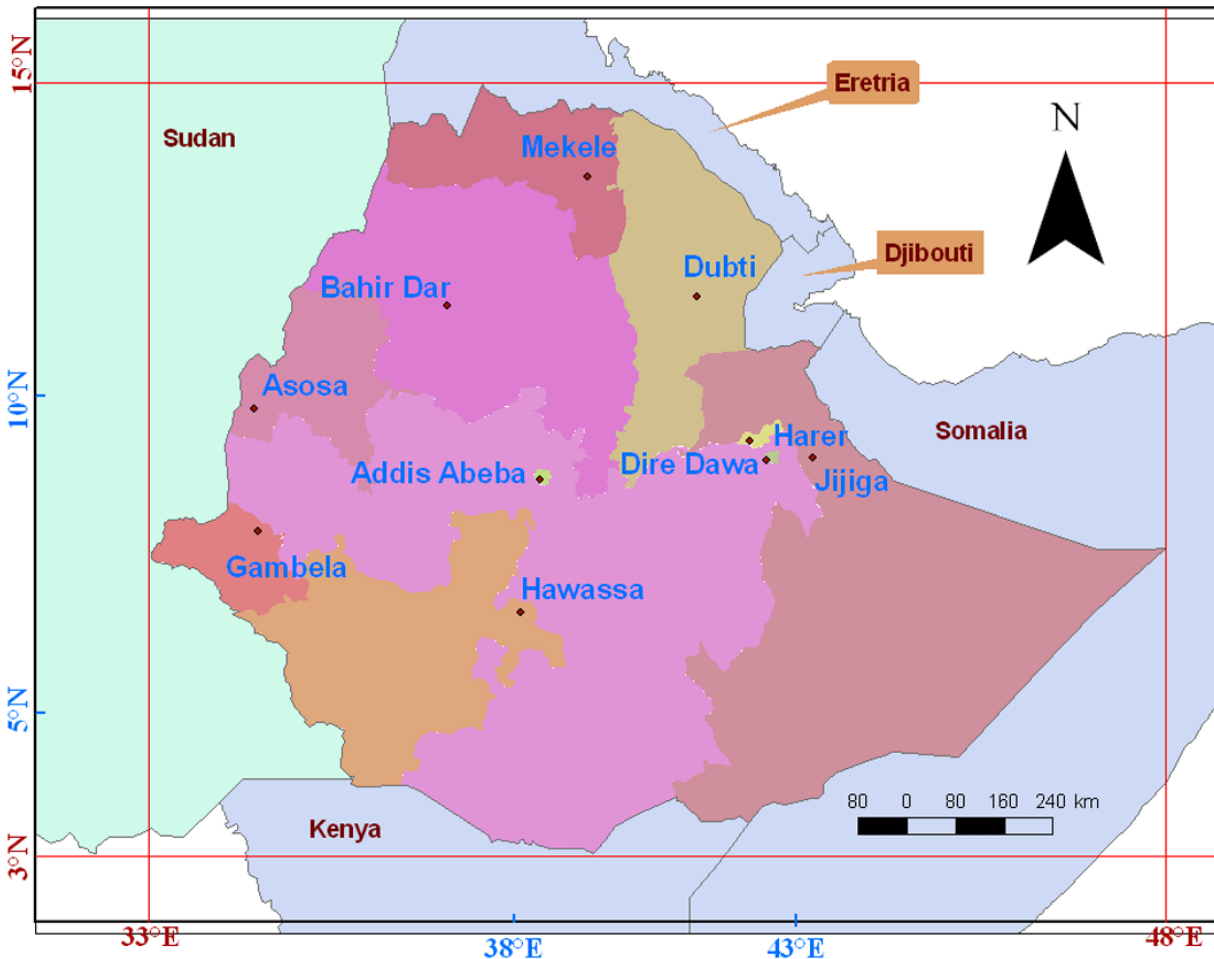


Figure 7: Map of Ethiopia

Activity 2: Choose the correct answer from the given alternatives

1. If two places on the ground that are located 5° south and 10° north are 10 cm apart on a given map, what is the scale of the map? (Hint 1° = 111km)
 A. 1:16, 650,000 B. 1:1,665,000 C. 1:166,500 D. 1:650,000

2. A river is 4 cm long on a map, while its actual length is 2 km. What is the scale of the map?
- A. 1 cm represents 0.5 km C. 1 cm represents 0.2 km
B. 1 cm represents 2 km D. 1 cm represents 5 km
3. On a map, two points on the same meridian are 6 cm apart, and their latitudinal difference is minutes. Using 1 minute of latitude ≈ 1.852 km, find the map scale.
- A. 1:37,040 B. 1:92,600 C. 1:555,600 D. 1:111,120