UNIT ONE

GEOLOGICAL HISTORY AND TOPOGRAPHY OF ETHIOPIA

Introduction to Grade 9 Geography

Welcome to Grade 9 Geography! Last year, you explored the Earth's physical characteristics, people and their socioeconomic activities, natural resources, Ethiopia's modern history, and contemporary global issues. This year, we will focus on the geography of Ethiopia, examining its physical, human, and economic environments. You will learn about Ethiopia's location, size, shape, geological history, topography, drainage systems, climate, vegetation, wildlife, soil, mineral resources, major economic activities, and the interactions between humans and the natural environment. Additionally, we will cover geographic enquiry, skills, and techniques. Before diving into these topics, we will start with some basic concepts related to geography, including its meaning, scope, and branches.

Main Contents

1. **Geography: Meaning, Scope, and Branches**
2. **Location, Size, and Shape of Ethiopia**
3. **Geological History of Ethiopia**

1.1 Geography: Meaning, Scope, and Branches

Meaning of Geography

Geography comes from the Greek words "Geo" (earth) and "Graphos" (writing), meaning "writing about the earth." The term was first defined by Eratosthenes, a Greek philosopher, who described geography as "the description of the earth." Over time, the definition has evolved to reflect the discipline's expanding scope.

Key Definitions:

- **Eratosthenes (276-196 BC):** Geography is the description of the earth.

- **Alexander von Humboldt (1769-1859):** Geography connects the general with the particular through measurement, mapping, and regional emphasis.
- **Concise Oxford Dictionary (1964):** Geography is the science of the earth's surfaces.
- **Hartshorne, R. (1899-1992):** Geography provides an accurate, orderly description of distributions on the earth's surface.
- **Yeates, M. (1968):** Geography develops and tests theories to explain and predict spatial distributions on earth's surface.

Modern Definition: Geography is the scientific study of the Earth, describing and analyzing the spatial and temporal variations of physical, biological, and human phenomena, and their interrelationships over the Earth's surface.

Scope of Geography

The scope of geography refers to the range of topics and areas it covers. Geography is a broad field that includes both physical and human features and their interactions.

Key Areas Covered:

- **Hydrosphere:** All water bodies, including oceans, rivers, and lakes.
- **Biosphere:** All living organisms.
- **Atmosphere:** Air composition surrounding the Earth.
- **Lithosphere:** Solid rock layer covering the planet.
- **Anthroposphere:** Human-made and modified environments.

Geography also addresses economic, social, political, and ecological issues, utilizing modern technologies like computers, GPS, and GIS for accurate analysis.

Major Focus Areas:

- **Earth's Position and Movements:** Understanding the Earth's place in the universe and its movements.
- **Physical Features:** Studying landforms, climate, vegetation, and their changes over time.
- **Human-Environment Relationships:** Examining how humans interact with and impact their natural environment.
- **Weather and Climate:** Analyzing weather patterns and climatic conditions and their spatial distribution.
- **Earth Materials and Landforms:** Investigating the materials that make up the Earth and the formation of various landforms.

- **Economic Activities:** Exploring major economic activities and their effects on the environment.

Despite its wide scope, geography focuses on specific areas, making it a comprehensive and interconnected discipline.

Branches of Geography

Geography is divided into two main branches: Physical Geography and Human Geography.

A. Physical Geography Physical Geography studies natural features and processes of the Earth, including:

- **Geomorphology:** Landforms and their formation.
- **Climatology:** Climate and weather patterns.
- **Biogeography:** Distribution of living organisms.
- **Oceanography:** Ocean structures and processes.
- **Soil Geography:** Soil types and distribution.
- **Phytogeography:** Distribution of plant species.
- **Zoogeography:** Distribution of animal species.

B. Human Geography Human Geography examines human activities and their impacts, including:

- **Cultural Geography:** Cultures and cultural landscapes.
- **Population Geography:** Population distribution and dynamics.
- **Economic Geography:** Economic activities and their spatial distribution.
- **Political Geography:** Political systems and boundaries.
- **Urban Geography:** Urban areas and city development.
- **Historical Geography:** Historical changes in geographic phenomena.

Key Terms

- **Geography:** The study of the Earth and its features, inhabitants, and phenomena.
- **Physical Geography:** The branch of geography dealing with natural features and processes.
- **Human Geography:** The branch of geography dealing with human activities and their impacts.
- **Spatial:** Relating to the position, area, and size of things on the Earth's surface.

1.2 Location, Size, and Shape of Ethiopia

Learning Objectives

- Describe the absolute and relative location of Ethiopia.
- Discuss the effects of the size and shape of Ethiopia on its sociocultural, political, and economic conditions.

1.2.1 Location of Ethiopia

Why is location important in geography? The location of a place determines its interactions with surrounding areas and its role in global or regional contexts. Ethiopia's location in the Horn of Africa and near the Red Sea is strategically significant, influencing its historical, economic, and political importance.

A. Relative Location of Ethiopia

Relative location refers to where a place is in relation to other geographic features. This can be described through:

1. **Vicinal Location**:
    - Ethiopia is a landlocked country surrounded by six neighboring countries: Djibouti, Eritrea, Kenya, Somalia, Sudan, and South Sudan.
    - The total boundary length of Ethiopia is 5,260 km, with Somalia sharing the longest boundary and Djibouti the shortest.
2. **Strategic Location**:
    - Ethiopia is located in the northeastern part of Africa (Horn of Africa), southwest of the Asian continent, within the Nile Basin, and to the northwest of the Indian Ocean.
    - Its proximity to the Red Sea and the Mediterranean Sea enhances its strategic importance.

B. Absolute Location of Ethiopia

Absolute location is the precise geographical position of a place, expressed in latitudes and longitudes:

- Ethiopia lies between 3°N to 15°N latitudes and 33°E to 48°E longitudes.
- The extreme points of Ethiopia include the Northern tip of Tigray, Moyale in the south, Akobo in the west, and the tip of Ogaden in the east.

1.2.2 Size of Ethiopia

Ethiopia is the 10th largest country in Africa, covering 1,106,000 square kilometers. This large size provides both advantages and disadvantages:

Advantages:

- **Diverse Agro-Ecological Zones**: The vast area includes various climates and ecosystems, supporting a wide range of fauna and flora.
- **Arable Land**: Ethiopia possesses a significant amount of cultivable land, essential for agriculture.
- **Mineral Resources**: The country has a variety of mineral deposits.
- **Cultural Diversity**: The large area is home to numerous ethnic groups, enriching the country's cultural heritage.

Disadvantages:

- **Administrative Challenges**: The large size requires significant resources for effective governance and infrastructure development.
- **Defense Needs**: A large country requires a substantial military to protect its borders.
- **Socio-Economic Integration**: Managing socio-economic integration across a vast territory can be challenging.

1.2.3 Shape of Ethiopia

The shape of a country affects its administration, defense, and economic integration. Countries can have different shapes, such as compact (circular), elongated (linear), or truncated (shortened).

Ethiopia's Shape:

- Ethiopia has a more or less compact (circular) shape, with the north-south and east-west distances being relatively similar.
- The compact shape of Ethiopia offers certain advantages, particularly in terms of defense, as it allows for easier control and protection of the interior regions.

Measuring Compactness:

- The compactness of Ethiopia can be assessed using various ratios, such as the boundary-circumference ratio (B/C), which measures how closely the country's shape resembles a circle.

- Ethiopia's B/C ratio is 1.411, indicating a 41% deviation from a perfect circular shape. This compactness helps in defense and administrative efficiency.

1.3.1 The Geological Processes in Ethiopia

The geological history of Ethiopia spans millions of years and is a result of various geological processes that have shaped the current landscape. Understanding this history helps in grasping how the country's landforms, such as mountains, plateaus, and valleys, came into existence.

Geological Eras

The geological time scale divides Earth's history into four major eras:

1. **Precambrian Era** (4.5 billion to 600 million years ago)
2. **Paleozoic Era** (600 million to 250 million years ago)
3. **Mesozoic Era** (250 million to 70 million years ago)
4. **Cenozoic Era** (70 million years to present)

Each era is characterized by:

- **The position of continents**
- **The prevailing climate**
- **The dominant life forms**

Precambrian Era (4.5 Billion to 600 Million Years Ago)

The Precambrian is the oldest and longest era, covering about 5/6 of Earth's history. During this time:

- **Orogenic movements** (mountain-building processes) were frequent.
- **Volcanic activities** were intense.
- **Denudation** (erosion and weathering) led to the formation of folded mountains.
- The **first life forms** appeared, including one-celled organisms like amoebas.
- **Old crystalline basement rocks** formed, which can still be seen in parts of Ethiopia, such as central and northern Tigray, and other regions like Mettekel and the Abbay Gorge.

Paleozoic Era (600 Million to 250 Million Years Ago)

The Paleozoic Era in Ethiopia was marked by:

- Extensive **denudation** and **peneplanation** (flattening of land).
- The formation of **inselbergs** (isolated hills), but no significant structural changes.
- A gap in rock formation, as no major geological structures were created during this era.

This era is known for the dominance of **invertebrates**.

Mesozoic Era (250 Million to 70 Million Years Ago)

The Mesozoic Era was significant for:

- **Epeirogenesis**: Slow sinking and uplifting of the landmass.
- Formation of **sedimentary rocks** in Ethiopia, divided into three periods:
    1. **Triassic Period**: Landmass sank, leading to the formation of **Adigrat Sandstone**.
    2. **Jurassic Period**: Continued transgression of the sea, forming **Hintalo Limestone**.
    3. **Cretaceous Period**: Landmass uplifted, sea regressed, and **Upper Sandstone** was formed.
- The era was dominated by **reptiles** like dinosaurs. Toward its end, dinosaurs disappeared, and mammals, birds, and flowering plants emerged.

Cenozoic Era (70 Million Years to Present)

The Cenozoic Era saw significant geological activities:

- **Tertiary Period** (70 million - 2 million years ago):
    - Continued uplifting led to the formation of the **Northwestern and Southeastern Highlands** and the **Somali Plateaus**.
    - The **Great East African Rift Valley** began to form, extending from Palestine to Mozambique, including the Ethiopian Rift Valley.
- **Quaternary Period** (2 million years ago - present):
    - Continued volcanic activities formed structures like:
        - **Afar Horst**
        - **Ertalle Volcano** in Afar
        - **Fentalle Volcano** in Eastern Oromia
        - **Metahara Lava Fields**
    - This period also saw the evolution of **modern humans**.

Landforms of Ethiopia:

Introduction to Landforms

- **Landforms** are individual features of the earth's surface, shaped by natural processes. Ethiopia, with its diverse and dramatic landscape, offers a variety of landforms, including highlands, plateaus, mountains, river gorges, and lowlands. These features result from tectonic and volcanic activities during the Cenozoic era, and they give Ethiopia a unique topography.

Altitude Extremes

- Ethiopia's landscape ranges from 116 meters below sea level at the Dallol depression (Kobar sink) to 4620 meters above sea level at Ras Dashen in the Semein Mountains. This wide altitude range creates a variety of climates and habitats across the country.

Formation of Landforms

- Ethiopia's landforms are shaped by two main forces:
    1. **Endogenic Forces:** These originate from within the earth, such as volcanic activity and tectonic movements.
    2. **Exogenic Forces:** These originate at the earth's surface, including denudation (erosion) and peneplanation (flattening of land).

Main Physiographic Divisions

- Ethiopia's topography can be divided into three major regions:

1. **Western Highlands and Associated Lowlands**
    - **Western Highlands:**
        - This is Ethiopia's largest physiographic region, extending from Tigray in the north to Gamo and Goffa in the southwest. The highlands are the source of major rivers like the Abbay (Blue Nile), Baro, and Tekezze.
        - **Sub-divisions:**
            - **Tigrean Plateau:** Known for its high mountains, such as Mount Tsibet (3988 m), Mount Ambalage (3291 m), and Mount Assimba (3248 m).
            - **North Central Massif:** Includes rugged and dissected highlands like Ras Dashen (4620 m) and other peaks.
            - **Shewan Plateau:** A dome-shaped plateau serving as a watershed for major rivers like the Awash and Abbay.

        - **Southwestern Highlands:** Known for its high rainfall and agricultural productivity, this area includes high points like Mount Gughe (4200 m).
    - **Western Lowlands:**
        - Extending from Tigray in the north to Gamo and Goffa in the south, these lowlands border Sudan and South Sudan. The lowlands are characterized by arid and semi-arid climates, with notable rivers like the Baro providing regular water flow.
2. **Southeastern Highlands and Associated Lowlands**
    - **Southeastern Highlands:**
        - These highlands, located southeast of the Rift Valley, include:
            - **Hararghe Plateaus:** Known for coffee and chat production, with peaks like Mount Gara Muletta (3381 m).
            - **Arsi Plateau:** Noted for wheat production, with high points like Mount Kaka (4180 m).
            - **Bale Massif:** Featuring peaks like Mount Tulu Dimtu (4377 m) and known for barley production.
            - **Sidama Highlands:** Separated from the Bale Highlands by the Genale River, this region slopes gently to the south.
    - **Southeastern Lowlands:**
        - These lowlands extend along the Ethiopian borders with Somalia and Kenya. They are characterized by harsh climates and are predominantly inhabited by pastoralist communities.
3. **Rift Valley**
    - **Ethiopian Rift Valley System:**
        - Part of the Great East African Rift Valley, this narrow strip of land runs diagonally from northeast to southwest, dividing the Ethiopian Highlands into two. It covers 1700 km and includes three main parts:
            - **Afar Triangle (Northern Part):** The largest part, with elevations ranging from 116 meters below sea level to 900 meters above.
            - **Main Ethiopian Rift (Central Part):** Known for its lakes and active volcanoes.
            - **Chew-Bahir Rift (Southern Part):** Extends towards the Kenya-Ethiopia border.