UNIT ONE
FORMATION OF THE CONTINENTS

Introduction

Students, do you remember the lessons on the "Geological History of Ethiopia" and "Landforms of Africa" from your Grade Nine and Ten Geography classes? If so, can you explain what geological history is and how the landforms of Africa have developed over time? In this first unit of Grade 11 Geography, you will explore the timescale of Earth's geological processes, the development stages of Earth's continents, and the relative position (distribution) of Earth's oceans and continental landmasses. By understanding these topics, you will gain an appreciation of Earth's geologic timescales, the formation of continents, and the distribution of oceans and landmasses.

1.1. Formation of Continents

This section will guide you through the evolution of Earth and its continents, providing insight into the scientific theories about the origin of the Earth and its continents.

Key Terms:

- **Big Bang**: The theory that explains the origin of the universe through a massive explosion.
- **Continental Drift**: The gradual movement of continents across Earth's surface.
- **Pangaea**: A supercontinent that existed during the late Paleozoic and early Mesozoic eras.
- **Rodinia**: An earlier supercontinent that existed before Pangaea.
- **Sea-floor Spreading**: The process by which new oceanic crust is formed through volcanic activity and gradually moves away from the mid-ocean ridges.

Formation of Earth and Continents:

The Earth, along with other planets and their moons, is part of the planetary system, and together with the Sun, they form the Solar System. The Earth was created in a process similar to other planets, within the context of the development of the Solar System. To understand Earth's origin, it's essential to understand the origin of the Solar System.

Various theories have been proposed about the formation of the Universe and Earth. Among them, the **Big Bang Theory** is the most widely accepted. According to this theory, the Universe originated around 10–20 billion years ago from a cosmic explosion. This explosion led to the formation of space objects like the Sun, planets, stars, meteors, and comets through material collision, cooling, and gravitational attraction. Earth was formed from a mixture of gas and dust particles moving in space around the Sun approximately 4.5 billion years ago.

Early Continents:

- **Rodinia**: The first major landmass, Rodinia, formed around 750 million years ago (Ma).
- **Gondwana and Laurasia**: Around 514 Ma, Gondwana evolved near the South Pole. Later, Gondwana, Baltica, Siberia, and Laurasia were the four major continents formed around 458 Ma. Laurasia collided with Baltica, closing the Iapetus Sea, forming pre-Pangaea around 390 Ma.
- **Pangaea**: This supercontinent came into existence around 255-210 Ma. By 210-180 Ma, Pangaea began to break apart. This breakup led to the formation of separate continents, oceans, and other landforms.

Continental Drift and the Formation of Modern Continents:

Pangaea eventually divided into two major landmasses, **Gondwanaland** and **Laurasia**, due to continental drift. As these landmasses moved apart, the continents took their present positions, and the Atlantic Ocean opened up. For example, the Indian subcontinent separated from Gondwanaland and collided with Eurasia, forming the Himalayas.

1.2. Geologic Timescale

The geologic timescale is a timeline that outlines Earth's history, highlighting significant geological processes, the formation of landforms, and the emergence of life. It is developed through the study of Earth's rocks and is divided into relative and absolute ages.

1.2.1. Meaning of Geologic Timescale

The geologic timescale provides a framework for understanding Earth's history and the major changes that occurred over time. It is constructed by studying Earth's rocks and determining the relative and absolute ages of geological events.

1.2.2. Relative and Absolute Age of Rocks

- **Relative Age**: This method focuses on determining the sequence of geological events without specifying their exact age. It is based on three principles:
    - **Original Horizontality**: Layers of sediments are originally deposited horizontally.
    - **Superposition**: In an undisturbed sequence, the overlying bed is younger than the underlying one.
    - **Cross-Cutting Relationships**: A rock layer that cuts across others is younger than the layers it cuts.
- **Absolute Age**: This method gives the actual age of rocks in numerical terms, determined by the decay of radioactive isotopes. For example, Uranium-238 decays into Lead-206 with a half-life of 4.5 billion years.

Geologic Eras:

The geologic timescale is divided into Eons, Eras, Periods, and Epochs. The major Eons are Hadean, Archean, Proterozoic, and Phanerozoic, with the latter being the most recent and subdivided into three Eras: Paleozoic, Mesozoic, and Cenozoic. The study of rocks and fossils helps to establish these divisions, giving us a detailed timeline of Earth's geological history.

Geologic Eras

Overview of Geologic Eras The history of Earth is divided into different geologic eras, each representing significant periods of time during which major events and life forms evolved. The four main geologic eras are:

1. **Precambrian Era**
2. **Paleozoic Era**
3. **Mesozoic Era**
4. **Cenozoic Era**

Each era marks important changes in Earth's geology, climate, and biological life.

1. Precambrian Era (4.5 Billion to 600 Million Years Ago)

- **Oldest Era**: The Precambrian is the longest and oldest era, covering about 85% of Earth's geological history.
- **Formation of Earth and Rocks**: This era saw the solidification of the Earth and the formation of its oldest rocks. The rocks formed during this time are

rich in base metallic minerals and are often referred to as the crystalline basement complex rocks.

- **Major Eons within Precambrian**:
  - **Hadean (4600 – 3900 Ma)**: Very little is known about this early period.
  - **Archean (3900 – 2500 Ma)**: Spanning 1400 million years, this eon saw the formation of the Earth's first stable continental crusts.
  - **Proterozoic (2500 – 570 Ma)**: This period witnessed the buildup of oxygen in the atmosphere, which was crucial for the development of complex life.

2. Paleozoic Era (600 to 250 Million Years Ago)

- **Beginning of Life**: The Paleozoic era is known as the "Age of Ancient Life" because it marks the beginning of complex life forms like trilobites and shelled animals.
- **Significant Events**:
  - **Age of Fish**: The Devonian period within the Paleozoic is particularly notable for the diversity of fish species.
  - **Formation of Pangaea**: By the end of this era, all Earth's continents merged into a supercontinent called Pangaea, which led to extreme seasonal weather and a massive extinction event where about 75% of amphibian species disappeared.

3. Mesozoic Era (250 to 70 Million Years Ago)

- **Era of Dinosaurs**: The Mesozoic is often called the "Age of Dinosaurs" due to their dominance during this time.
- **Significant Events**:
  - **Splitting of Pangaea**: Pangaea began to break apart into smaller continents, forming Laurasia and Gondwanaland.
  - **Emergence of Land Mammals**: The end of the Mesozoic era saw the emergence of land mammals and the extinction of dinosaurs, paving the way for the evolution of mammals.

4. Cenozoic Era (70 Million Years Ago to Present)

- **Age of Mammals**: The Cenozoic era is known as the "Age of Mammals" because mammals became the dominant life form.
- **Modern Geography**:
  - **Continental Drift**: The continents moved into their current positions.
  - **Formation of Modern Landforms**: Volcanism and tectonic activity led to the creation of various mountain ranges, and glaciations shaped the climate and geography of high-latitude regions.

- **Climate Changes**: This era experienced significant climate changes, including periods of glaciation and global warming.

Key Concepts

- **Geologic Time Scale**: Earth's history is classified into Eons, Eras, Periods, and Epochs, with each division marking significant geological and biological changes.
- **Continental Drift**: The movement of Earth's tectonic plates caused continents to drift to their current positions, leading to the formation and breakup of supercontinents like Pangaea.

By understanding these eras, students can appreciate the dynamic and ever-changing nature of Earth's geology and the evolution of life over billions of years.