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Geography



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Geography as a discipline

Geography has transitioned from a component of Social Science in secondary school to an **independent, scientific discipline** at the higher secondary level. It serves as a bridge between the physical environment and human activity, offering a holistic perspective on the Earth as our home.

1. Defining Geography

The term **Geography** was first coined by the Greek scholar **Eratosthenese (276-194 BC)**. It is derived from two Greek roots: **‘geo’ (earth)** and **‘graphos’ (description)**.

- **Core Meaning:** Simply put, geography is the "description of the earth."
- **The Abode of Humans:** Beyond mere description, it is defined as the "description of the earth as the abode of human beings."
- **A Multi-dimensional Reality:** Since the Earth is complex, geography synthesizes knowledge from natural sciences (geology, meteorology, zoology, etc.) and social sciences (economics, sociology, history, etc.). While it derives its database from these subjects, its unique **methodology**—which focuses on **areal differentiation**—distinguishes it from other sciences.

2. The Scope of Geographical Study

Geography is concerned with the **dynamic relationship** between Nature and Humans.

- **Nature vs. Human Interaction:** Initially, humans were entirely dependent on "natural means of subsistence" (edible plants/animals). Over time, through technological advancement, humans began to modify their environment (land, soil, water) to produce food and improve living standards.
- **The "Drama" of Human Development:** The physical environment provides the "stage," while human societies enact the "drama" of their creative skills using tools and technology.
- **Key Concepts:**
 - **Naturalised Humans:** Humans adapting their food, clothing, and shelter to prevailing weather conditions.
 - **Humanised Nature:** Humans modifying the landscape (building roads, gardens, cities) to create new possibilities.
- **Spatial Organization:** Geography studies how space is organized through **nodes** (settlements) and **links** (transportation and communication networks), leading to **spatial integration**.

3. The Three Fundamental Questions

Geography is organized around three sets of questions to move from simple inventory to scientific explanation:

1. **What?** Identification of patterns of natural and cultural features on the Earth's surface.
2. **Where?** Distribution of these features (locational aspects).
3. **Why?** The **causal relationship** between features, processes, and phenomena.

Note: The "Why" question transforms geography into a true scientific discipline. It allows geographers to interpret present patterns and **foresee future phenomena** through cause-and-effect analysis.

4. Geography as an Integrating Discipline

Geography is a **discipline of synthesis**. While history attempts **temporal synthesis** (studying changes over time), geography attempts **spatial synthesis** (studying how different phenomena relate in space).

- **Geography as a Fourth Dimension:** Time is an integral part of geography. Geographical phenomena are dynamic and undergo changes that follow a historical course. For example, distance can be expressed in time (e.g., a place is 1,500 km away OR two hours away by plane).
- **Linkages:**
 - **Historical Geography:** Geography influences history. For instance, the Himalayas acted as barriers to invaders but also provided routes; the vast oceanic expanse protected the "New World" from traditional land-based warfare.
 - **Societal Impact:** Changes in landforms, climate, and vegetation dictate human economic activities and cultural development.

5. Branches of Geography

Geography is an interdisciplinary field, and its study is conducted through two major approaches: **Systematic** and **Regional**.

A. The Two Major Approaches

1. **Systematic Approach (General Geography):** Introduced by the German geographer **Alexander Von Humboldt (1769-1859)**. In this approach, a specific phenomenon is studied globally as a whole, and its typologies or spatial patterns are identified. For example, studying "Natural Vegetation" involves identifying types like equatorial rainforests or monsoon forests on a world scale.
2. **Regional Approach:** Developed by **Karl Ritter (1779-1859)**. Here, the world is divided into hierarchical regions (natural, political, or designated), and all geographical phenomena within that specific region are studied holistically, searching for "unity in diversity."

B. Classification based on Systematic Approach

The branches of geography are categorized into three main pillars:

1. Physical Geography:

- ☞ **Geomorphology:** Study of landforms, their evolution, and related processes.
- ☞ **Climatology:** Study of atmospheric structure, weather elements, climatic types, and regions.
- ☞ **Hydrology:** Study of the realm of water (oceans, lakes, rivers) and its impact on life forms.
- ☞ **Soil Geography:** Study of soil formation (pedogenesis), types, fertility, distribution, and utilization.

2. Human Geography:

- ☞ **Social/Cultural Geography:** Study of society, its spatial dynamics, and cultural elements.
- ☞ **Population and Settlement Geography:** Study of growth, distribution, density, migration, and sex ratio, alongside the characteristics of rural and urban settlements.
- ☞ **Economic Geography:** Study of agriculture, industry, trade, transport, tourism, and services.
- ☞ **Historical Geography:** Study of historical processes and how space has been organized over time.
- ☞ **Political Geography:** Study of boundaries, space relations between political units, election scenarios, and political behavior.

3. **Biogeography:** The interface between physical and human geography.

☞ **Plant Geography:** Spatial patterns of natural vegetation.

☞ **Zoo Geography:** Spatial patterns and characteristics of animals and their habitats.

☞ **Ecology/Ecosystem:** Scientific study of the habitats of species.

☞ **Environmental Geography:** Focuses on environmental problems like pollution, land degradation, and conservation.

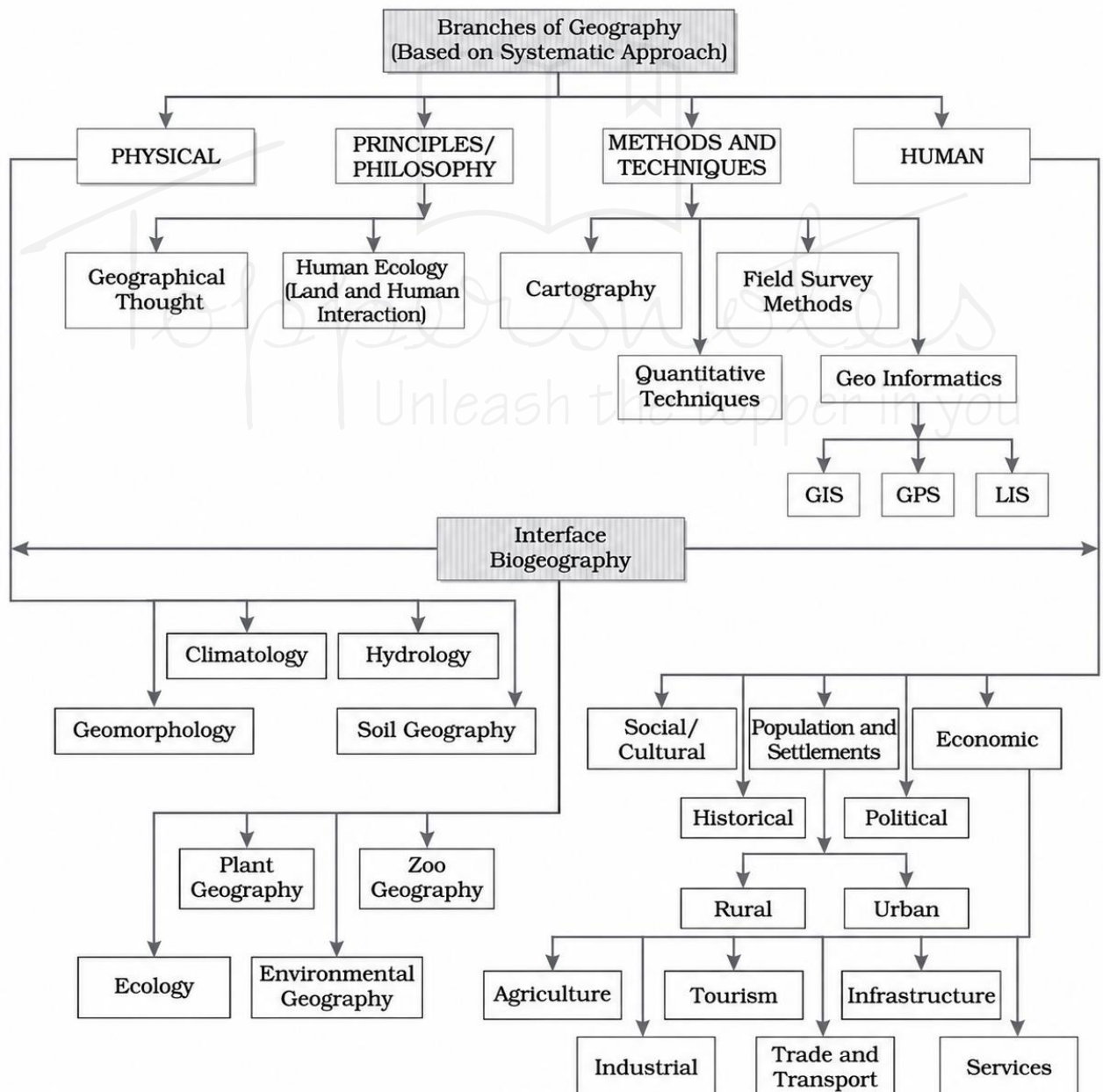
C. Classification based on Regional Approach

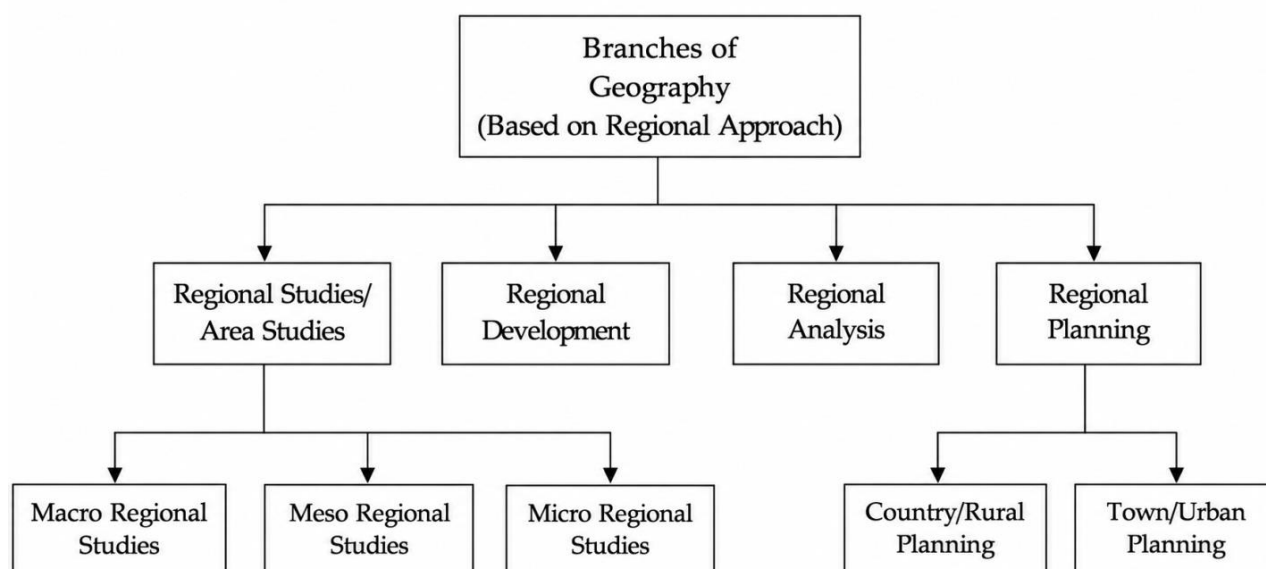
- **Regional Studies/Area Studies:** Focusing on Macro, Meso, and Micro levels.
- **Regional Planning:** Covering town, urban, and rural planning.
- **Regional Development and Analysis.**

D. Common Foundations

Every branch of geography relies on two common pillars:

- **Philosophy:** Geographical thought and Human Ecology (the study of land and human interaction).
- **Methods and Techniques:** Cartography (including computer cartography), Quantitative/Statistical techniques, Field survey methods, and **Geo-informatics** (Remote Sensing, GIS, GPS).





6. Physical Geography and Its Importance

Physical Geography examines the four realms of the Earth:

1. **Lithosphere:** Landforms, relief, and physiography.
2. **Atmosphere:** Composition, weather, and climate (temperature, pressure, winds, precipitation).
3. **Hydrosphere:** Water bodies and oceanic resources (e.g., mineral resources like manganese nodules).
4. **Biosphere:** Life forms and the sustaining mechanism (food chain, ecological balance).

Why is it important for a student?

- **Resource Management:** Landforms (plains for agriculture, plateaus for minerals, mountains for water/tourism) are the base for all human activity.
- **Human Adaptation:** Climate directly influences our house types, clothing, and food habits.
- **Sustainable Development:** While modern technology allows humans to modify the environment (e.g., using air conditioners or tapping into groundwater), it has also led to **ecological imbalance**. Understanding the intricate relationship between the physical environment and human activities is, therefore, essential to achieving sustainable development in a rapidly changing world.

7. The Evolution of Geographical Techniques

The discipline of geography is not static; it evolves alongside new ideas, problems, and technological advancements.

- **Transition in Techniques:** What was once strictly **manual cartography** has transformed into **computer cartography**.
- **Capacity Enhancement:** Modern technology—including the **internet**, **GIS (Geographic Information Systems)**, and **GPS (Global Positioning System)**—enables scholars to manage massive amounts of data, improve the accuracy of locations, and perform complex spatial analyses.
- **Scientific Contribution:** These modern techniques equip students to contribute meaningfully to national development efforts, providing the tools necessary for synthesis and sound theoretical understanding.

8. Defining the "Fourth Dimension" and Spatial Synthesis

Geography utilizes a holistic approach to comprehend the reality of the world as a system of interdependencies.

- **Spatial vs. Temporal Synthesis:** While **geography attempts spatial synthesis**, **history attempts temporal synthesis**.

-
- **Time as the Fourth Dimension:** Every geographical phenomenon changes over time and can be explained temporally. Because space can be converted into terms of time (e.g., distance via travel mode), time is integrated as the fourth dimension.

Note: The source text prompts a reflection on the "other three dimensions," which in a physical/spatial context typically refer to **length, width, and height/depth** (the three dimensions of space).

9. Conceptual Frameworks: Summary Quotes

To ground your understanding of "What is Geography?", consider these classic academic definitions:

- **Richard Hartshorne:** "Geography is concerned with the description and explanation of the **areal differentiation** of the earth's surface."
- **Hettner:** "Geography studies the differences of phenomena usually related in different parts of the earth's surface."

10. The Dualism in Geography

A fundamental characteristic of geography is its **dualism**, which stems from the focus of study:

- **Physical Emphasis:** Early scholars focused primarily on physical geography—the study of landforms, atmosphere, hydrosphere, and biosphere.
- **Human Emphasis:** As human beings are an integral part of the Earth, scholars developed **human geography**, emphasizing human activities, cultural development, and the human-nature interaction.
- **Synthesis:** Modern geography bridges this dualism. It recognizes that "human" is an integral part of "nature," and "nature" bears the imprints of "human" activity. This interaction has moved humanity from a "stage of necessity" (primitive dependence) to a "stage of freedom" (utilizing technology to create new possibilities).

Key Takeaway for Aspirants

Geography is a **discipline of synthesis**. Whether you are studying the impact of the **Himalayan passes** on Indian history, the role of **monsoonal rainfall** in agricultural rhythms, or the **technological appropriation** of natural resources, geography provides the spatial perspective required to understand reality in its totality.

The origin and evolution of the earth

The study of the Earth's origin provides a fascinating journey from the birth of the universe to the emergence of life. This chapter integrates early philosophical theories, modern scientific models, and the geological evolution of our planet.

1. Early Theories of Origin

Before modern cosmology, several hypotheses attempted to explain how the Earth and planets were formed:

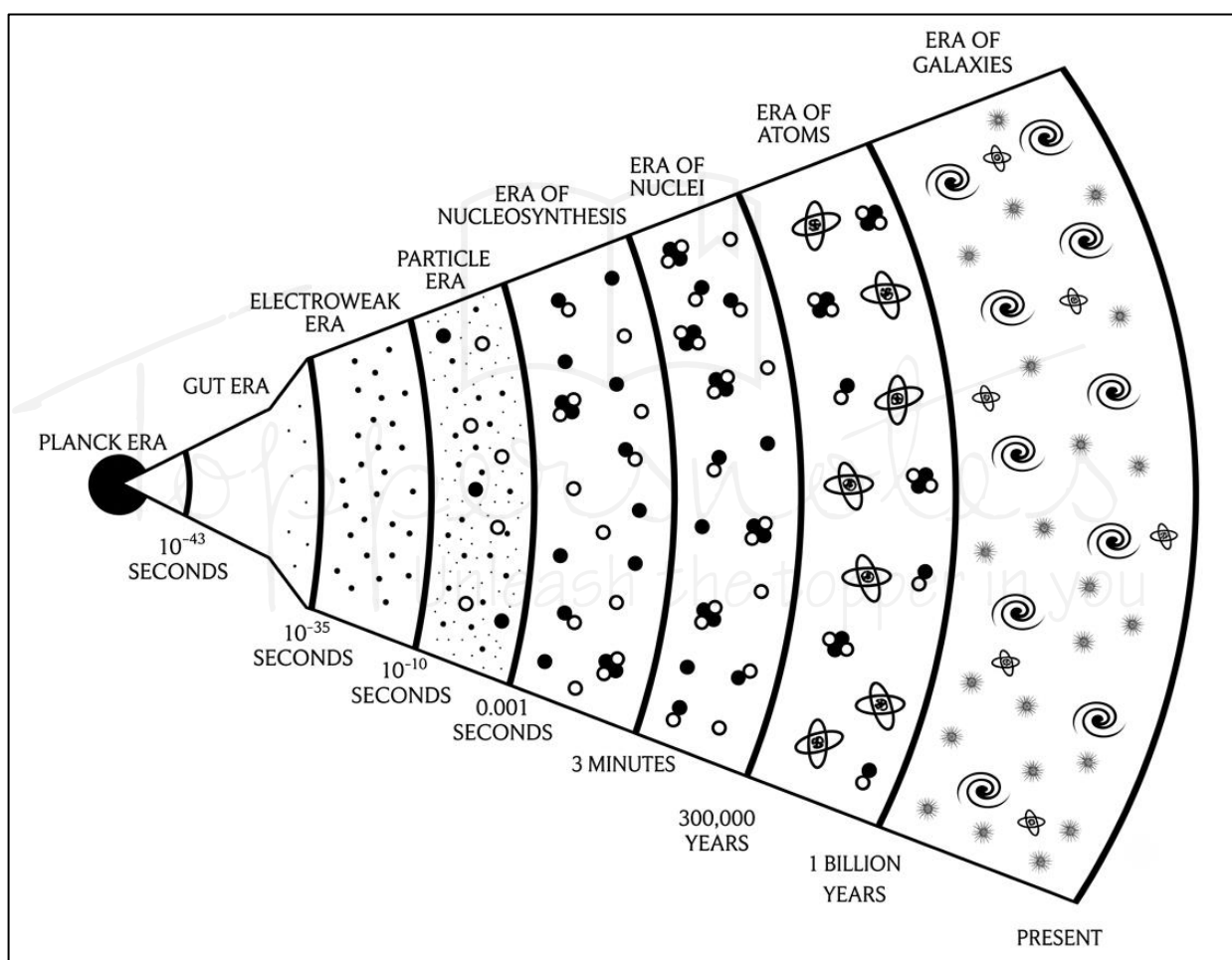
- **Nebular Hypothesis:**
 - Proposed by **Immanuel Kant** and later revised by **Laplace (1796)**, it suggested that planets formed from a cloud of material associated with a youthful, slowly rotating sun.
 - **Modern Revision (1950): Otto Schmidt and Carl Weizsacker** proposed that the sun was surrounded by a **solar nebula** consisting of hydrogen, helium, and dust. Friction and collision of these particles formed a disk-shaped cloud, leading to the formation of planets through **accretion**.

2. Modern Theory: The Big Bang

The **Big Bang Theory** (also called the **Expanding Universe Hypothesis**) is the most widely accepted explanation for the origin of the universe.

The Mechanism of Expansion

- **Evidence:** In 1920, **Edwin Hubble** provided evidence that galaxies are moving further apart, indicating that the universe is expanding.
- **The "Tiny Ball":** Initially, all matter existed in a **singular atom** (a "tiny ball") with an unimaginably small volume, infinite temperature, and infinite density.
- **The Event:** The "tiny ball" exploded violently **13.7 billion years ago**.
- **Timeline of Development:**
 - **Immediate aftermath:** Rapid expansion occurred within fractions of a second. Energy began converting into matter.
 - **First 3 Minutes:** The first atom began to form.
 - **300,000 Years Later:** The temperature dropped to **4,500 Kelvin**, giving rise to atomic matter and making the universe transparent.
- **Status of Galaxies:** While the space *between* galaxies is increasing, individual galaxies themselves are not expanding.



3. The Birth of Stars and Planets

Star Formation

- **Density Differences:** Initial differences in matter and energy distribution created variations in **gravitational forces**, causing matter to clump together.
- **Nebula to Stars:** Galaxies began as **nebulae** (large clouds of hydrogen gas). Within these, localized gas clumps grew into dense gaseous bodies, forming stars approximately **5–6 billion years ago**.
- **Note:** A **light-year** is a measure of distance (9.461×10^{12} km), not time. Light travels at 300,000 km/s.

Planet Formation

1. **Core Development:** Gravitational force within gaseous nebula lumps created a core surrounded by a rotating disk of gas and dust.
2. **Planetesimals:** The gas cloud condensed into small, rounded objects that joined through **cohesion** to form **planetesimals** (smaller, solid bodies).
3. **Accretion:** Collisions and gravitational attraction caused these planetesimals to stick together, eventually accreting into fewer, larger bodies—the **planets**.

4. Evolution of the Earth

The Earth transitioned from a barren, hot, rocky object to a life-sustaining planet over **4,600 million years**.

Evolution of the Lithosphere (Layered Structure)

- **Differentiation:** During its primordial stage, the Earth was volatile. As density increased, the interior temperature rose, causing material to separate based on density.
- **Layering:** Heavier materials (like **iron**) sank toward the center, while lighter materials moved toward the surface. This process formed the distinct layers: **crust, mantle, outer core, and inner core**.
- **Solidification:** As the Earth cooled and condensed, the outer surface solidified into the crust.

5. Evolution of Atmosphere and Hydrosphere

The Earth's atmosphere evolved in three distinct stages, transforming from a volatile, hot environment to one containing oxygen.

- **Stage I: Loss of Primordial Atmosphere:** The early atmosphere, composed of hydrogen and helium, was stripped away by **solar winds**. This loss affected all terrestrial planets.
- **Stage II: Degassing:** As the Earth cooled, gases and water vapour were released from the interior through **volcanic eruptions**, a process known as **degassing**. This early atmosphere consisted of water vapour, nitrogen, carbon dioxide, methane, ammonia, and very little free oxygen.
- **Stage III: Modification through Photosynthesis:**
 - **Formation of Oceans:** As the Earth cooled, water vapour condensed. Carbon dioxide dissolved in rainwater, further cooling the planet and causing more rain. This rainwater collected in surface depressions, forming oceans. The Earth's oceans are approximately **4,000 million years old**.
 - **Evolution of Life:** Life began to evolve around **3,800 million years ago**.
 - **Photosynthesis:** Around **2,500–3,000 million years ago**, the process of photosynthesis evolved. Oceans became saturated with oxygen produced by this process.
 - **Oxygenation:** Finally, **2,000 million years ago**, oxygen began to flood the atmosphere, establishing the modern composition.

6. Origin of Life

The final phase of Earth's evolution involves the emergence of biological life.

- **Chemical Reaction:** Scientists define the origin of life as a series of chemical reactions that generated complex organic molecules. These molecules assembled in a way that allowed them to duplicate themselves, transforming inanimate matter into living substances.
- **Fossil Record:** Evidence of early life is preserved in rocks as **fossils**. Microscopic structures similar to modern **blue algae** have been discovered in geological formations dated older than **3,000 million years**.
- **Timeline:** While life likely began 3,800 million years ago, the journey from unicellular bacteria to modern man is a continuous evolutionary process spanning geological time.

Summary Checklist of Key Terms for Aspirants

- **Nebular Hypothesis:** Planets formed from a cloud of material (sun + nebula).
- **Accretion:** The process of particles sticking together due to gravity to form planets.
- **Big Bang:** The event 13.7 billion years ago that caused the rapid expansion of the universe from a "tiny ball" (singularity).
- **Singularity:** A point of infinite temperature and infinite density.
- **Steady State Theory:** Hoyle's concept that the universe remains roughly the same at any point in time (an alternative, though now less favored, to the Big Bang).
- **Nebula:** A large cloud of hydrogen gas where stars are born.
- **Light Year:** 9.461×10^{12} km; the distance light travels in one year.
- **Differentiation:** The process of separating Earth's interior into layers (crust, mantle, core) based on density.
- **Degassing:** The release of gases from the Earth's interior through volcanic activity.
- **Photosynthesis:** The process that modified the atmosphere by increasing free oxygen.

The earth in the solar system

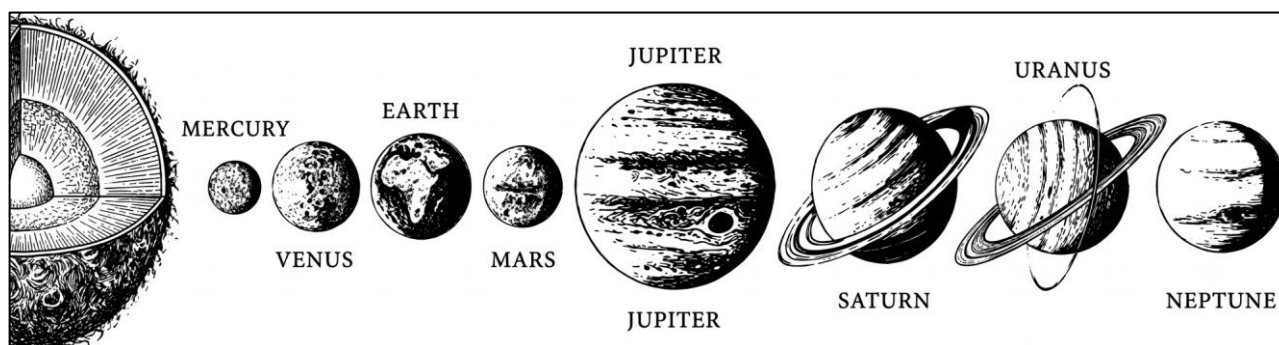
The study of our celestial neighborhood provides the foundation for understanding our place in the cosmos. From the observation of the night sky to the complexities of the solar system, this chapter explores the structure of our universe.

1. Celestial Bodies and the Night Sky

The night sky serves as a map of the universe. When we observe the sky after sunset, we see various **celestial bodies**—the sun, moon, stars, and planets.

- **Stars:** These are massive, hot celestial bodies made of gases. They possess their own **heat and light**, which they emit in large quantities. The Sun is a star. The countless other stars appear tiny and non-flickering (in contrast to planets) only because they are at an immense distance from Earth.
- **Constellations:** These are various patterns formed by different groups of stars.
 - **Ursa Major (Big Bear):** A major constellation.
 - **Saptarishi:** A group of seven stars that forms part of the Ursa Major. It is used to locate the **Pole Star (North Star)**.
 - **Pole Star:** It indicates the north direction and remains in the same position in the sky. An imaginary line joining the "pointer stars" of the Saptarishi leads directly to the Pole Star.
- **The Moon:** A **satellite** that acts as a companion to the Earth, moving around it. It changes shape and position daily.
 - **Full Moon (Poornima):** Occurs once a month.
 - **New Moon (Amavasya):** A fortnight later, when the moon is not visible, allowing for the best viewing of the night sky.
- **Daytime Visibility:** We cannot see stars or the moon during the day because the sun's extremely bright light obscures them.

2. The Solar System (The Solar Family)



The solar system consists of the **Sun**, eight **planets**, their **satellites**, and other celestial bodies like **asteroids** and **meteoroids**.

The Sun: The Head of the Family

The Sun is at the center of the solar system. It is composed of extremely hot gases and provides the **gravitational pulling force** that binds the entire system together. It is the ultimate source of heat and light.

- **Distance:** It is approximately **150 million km** away from Earth.
- **Light Speed:** Light travels at about 300,000 km/second; it takes approximately **eight minutes** for sunlight to reach Earth.

The Eight Planets

The term "planet" originates from the Greek word "**Planetai**", meaning "wanderers." Planets do not have their own heat and light; they are lit by the light of the stars they orbit.

- **Order of Distance from the Sun:** Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. (Mnemonic: *My Very Efficient Mother Just Served Us Nuts*).
- **Orbits:** All planets move around the Sun in fixed, **elongated paths** called **orbits**.
- **Classification:**
 - **Inner Planets:** Mercury, Venus, Earth, Mars. They are very close to the Sun and are composed primarily of **rocks**.
 - **Outer Planets:** Jupiter, Saturn, Uranus, Neptune. They are located very far from the Sun and are huge, composed mainly of **gases and liquids**.
- **Unique Features:**
 - **Venus:** Often called "Earth's Twin" because its size and shape are similar to Earth.
 - **Pluto:** Reclassified as a "**dwarf planet**" in August 2006 by the International Astronomical Union.
 - **Rings:** Jupiter, Saturn, and Uranus possess rings (belts of small debris) that can be seen with powerful telescopes.

3. The Earth: A Unique Planet

The Earth is the **third nearest planet** to the Sun and the **fifth largest** in size.

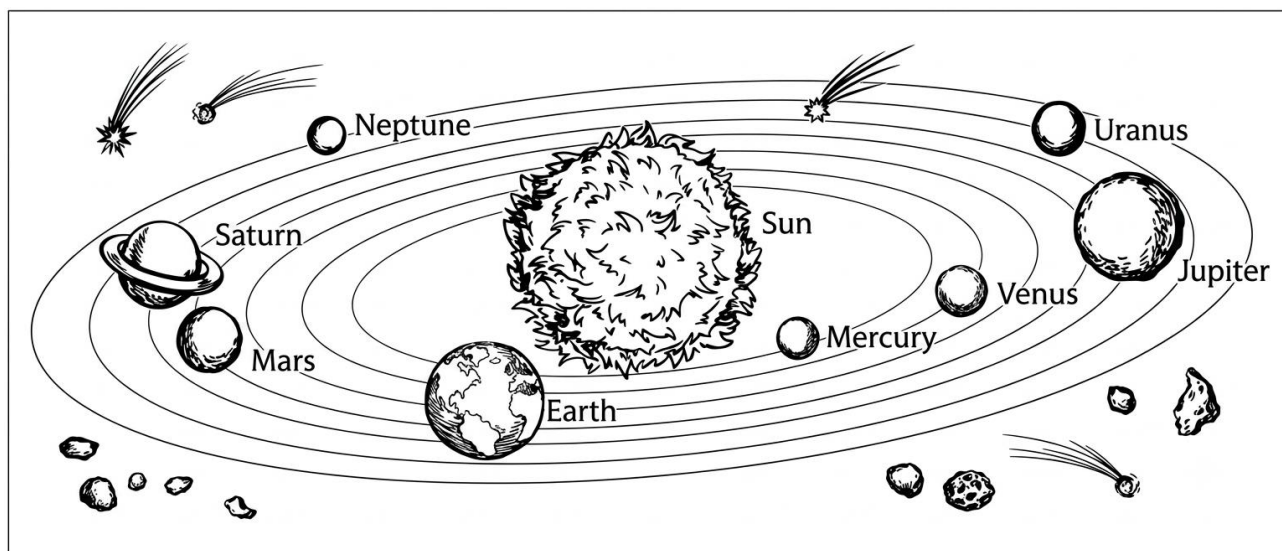
- **Shape:** It is slightly flattened at the poles, and its shape is described as a **Geoid**, which means an "earth-like shape."
- **Conditions for Life:** Earth is unique because it is neither too hot nor too cold. It contains **water and air** (containing life-supporting oxygen), which are essential for survival.
- **The Blue Planet:** From outer space, the Earth appears blue because two-thirds of its surface is covered by water.

4. The Moon and Satellites

A **satellite** is a celestial body that moves around planets just as planets move around the Sun.

- **The Moon:** Earth's only natural satellite, located about **3,84,400 km** away. Its diameter is one-quarter of the Earth's. It appears large only because it is nearer to us than other celestial bodies.
- **Orbital/Spin Dynamics:** The moon moves around the Earth in about 27 days and takes exactly the same time to complete one spin on its axis. Consequently, only **one side** of the moon is visible from Earth.
- **Surface Features:** It has no atmosphere or conditions for life. Its surface is marked by **mountains, plains, and depressions**, which cast shadows.
- **Human-made Satellites:** These are artificial bodies designed by scientists to gather information about the universe or for communication. They are placed in orbit by rockets. Examples of Indian satellites include **INSAT, IRS, and EDUSAT**.

5. Asteroids, Meteoroids, and the Galaxy



Beyond the planets and satellites, the solar system contains other significant celestial matter:

- **Asteroids:** These are numerous tiny bodies found between the orbits of **Mars and Jupiter**. Scientists believe they are fragments of a planet that exploded long ago.
- **Meteoroids:** Small pieces of rock moving around the Sun. When they enter Earth's atmosphere, friction with the air causes them to heat up and burn, creating a **flash of light** (a meteor). If they fall to Earth without burning completely, they create a **hollow**.
- **Galaxies:** A **galaxy** is a huge system of billions of stars and clouds of dust and gases.
 - **Milky Way (Akash Ganga):** The galaxy we belong to. It appears as a broad, white, glowing band across the sky on a clear night.
- **The Universe:** The universe is composed of millions of such galaxies. While we do not know its exact size, we know that all celestial bodies and humanity belong to this vast, interconnected system.

Key Historical & Scientific Facts for Aspirants

- **Ancient Astronomy:** Ancient Indians, including the famous astronomer **Aryabhatta**, understood that the moon and planets shine due to **reflected sunlight**.
- **Lunar Exploration:** **Neil Armstrong** was the first man to step on the moon's surface on **20 July 1969**.
- **Word Origin:**
 - **Geography:** Derived from Greek words *ge* (earth) and *graphia* (writing).
 - **Planet:** Derived from the Greek word *planetai* (wanderers).
 - **Solar:** Derived from the Roman sun god *Sol*.
- **Note on Observation:** Remember the "**Torch/Perforation**" experiment mentioned in the text: this illustrates why stars are invisible during the day—the overpowering, bright light of the Sun masks the fainter light of distant stars, just as turning on room lights makes dots of light from a torch invisible on a wall.

6. Technical Data Table: The Planets of the Solar System

Understanding the specific metrics for each planet is vital for competitive preparation.

Planet	Orbit Period (Sun)	Spin Period (Axis)	Number of Moons	Key Characteristic
Mercury	88 Days	59 Days	0	Nearest to Sun
Venus	255 Days	243 Days	0	Earth's Twin
Earth	365 Days	1 Day	1	Supports life
Mars	687 Days	1 Day	2	Inner planet

Jupiter	~12 Years	9h 56m	~53	Outer, gas giant
Saturn	~29.5 Years	10h 40m	~53	Outer, gas giant
Uranus	84 Years	17h 14m	~27	Outer, gas giant
Neptune	164 Years	16h 7m	13	Outer, gas giant

- **Note:** Inner planets are very close to the sun and made of **rocks**. Outer planets are very, very far from the sun and are huge planets made of **gases and liquids**.

7. Supplementary Definitions & Concepts

To provide full conceptual clarity as per the text:

- **The "Torch" Experiment (Analytical Understanding):** This activity explains the disappearance of stars during the day. By perforating a paper, placing it over a torch, and flashing it on a wall in a dark room, you see "stars." When you switch on all lights in the room, the dots become invisible. This proves that the bright light of the Sun masks the presence of celestial bodies in the daytime.
- **Size Perception:** Objects always look smaller when viewed from a distance (e.g., an airplane at a great height appears tiny). This explains why the massive sun and stars appear small to us.
- **The "Sol" Connection:** The word 'Solar' is derived from 'Sol' in Roman mythology, which means 'Sungod'. The solar system is the family of the sun.
- **Scientific Uncertainty:** Scientists are currently uncertain about the total size of the **Universe**, but they continue to explore the millions of galaxies that comprise it.

8. Unique Dimensions

- **Full Moon (Poornima):** Occurs once in about a month's time.
- **New Moon (Amavasya):** A fortnight after Poornima, the night sky is best for watching.
- **Pole Star:** It remains in the same position in the sky at all times.
- **Dwarf Planets:** Objects like **Ceres** and **2003 UB313** are officially categorized as dwarf planets along with Pluto.
- **Moon Shadows:** The mountains, plains, and depressions on the moon's surface cast shadows; looking at the full moon allows one to observe these.
- **Galaxy Components:** A galaxy is a huge system of billions of stars and clouds of dust and gases.
- **Ancient Naming:** In ancient India, the Milky Way was imagined to be a **river of light** flowing in the sky, hence the name **Akash Ganga**.
- **Human Fascination:** Astronomers, including the ancient Indian scholar **Aryabhatta**, were driven by the fascination of gazing at the night sky.

Globe: latitudes and longitudes

To understand the Earth's geography, we use a **globe**, which is a true miniature model of the Earth. While the Earth is not a perfect sphere—it is slightly flattened at the poles and bulges in the middle—the globe accurately represents the relative size of continents, oceans, and countries.

1. Defining Reference Points

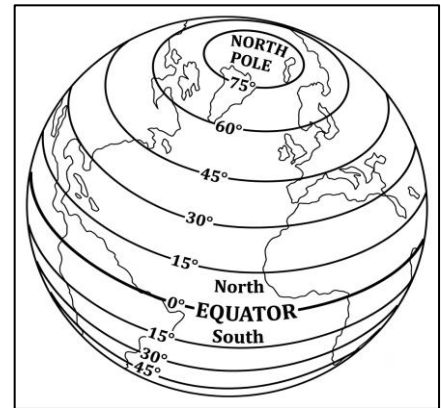
Because the Earth is a sphere, locating a specific point requires reference lines:

- **The Axis:** An imaginary line passing through the North and South Poles, around which the Earth rotates.
- **The Equator (0° Latitude):** An imaginary circular line that divides the Earth into two equal halves: the **Northern Hemisphere** and the **Southern Hemisphere**. It is the most critical reference point for latitude.

2. Parallels of Latitude

Latitudes are parallel circles running from the Equator to the poles.

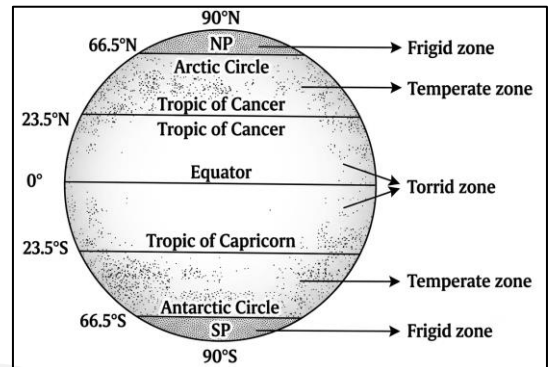
- **Measurement:** Measured in degrees. The Equator is 0° , while the North and South Poles are 90°N and 90°S , respectively.
- **Northern vs. Southern:** Parallels north of the Equator are "North Latitudes" (N), and those south are "South Latitudes" (S).
- **Key Characteristics:** As we move away from the Equator toward the poles, the **size of the parallels of latitude decreases**.
- **Important Parallels:**
 - **Tropic of Cancer:** $23\frac{1}{2}^\circ\text{N}$
 - **Tropic of Capricorn:** $23\frac{1}{2}^\circ\text{S}$
 - **Arctic Circle:** $66\frac{1}{2}^\circ\text{N}$
 - **Antarctic Circle:** $66\frac{1}{2}^\circ\text{S}$



Heat Zones of the Earth

The angle of the Sun's rays determines the heat zones:

1. **Torrid Zone:** Located between the Tropic of Cancer and Tropic of Capricorn. The mid-day sun is overhead at least once a year, receiving maximum heat.
2. **Temperate Zones:** Located between the Tropics and the Polar Circles (Arctic/Antarctic). They experience moderate temperatures because the sun's rays are not overhead.
3. **Frigid Zones:** Located between the Polar Circles and the Poles. These are very cold because the sun never rises much above the horizon, resulting in **slanting rays** that provide little heat.



3. Meridians of Longitude

To fix a precise location, latitude is not enough; we need **meridians of longitude**.

- **Definition:** These are semi-circles running from the North Pole to the South Pole.
- **Measurement:** The distance between them is measured in degrees, minutes, and seconds. Unlike latitudes, **all meridians are of equal length**.
- **Convergence:** The distance between meridians decreases steadily polewards until they meet at the poles (distance becomes zero).
- **Prime Meridian:** The 0° longitude line passing through **Greenwich** (where the British Royal Observatory is located). It divides the Earth into the **Eastern Hemisphere** and **Western Hemisphere**.
 - The count extends 180° Eastward and 180° Westward.
 - Note: The 180° East and 180° West meridians are on the same line.

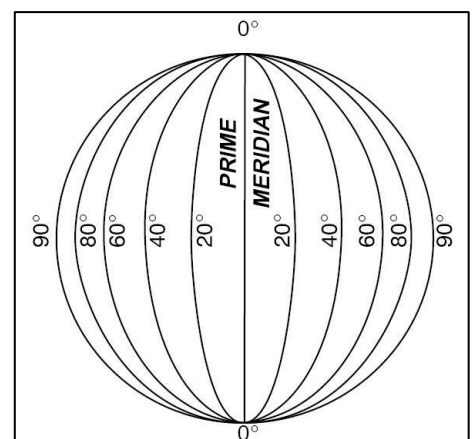
4. Locating Places: The Grid

By superimposing latitudes and longitudes, we create a **grid**. If the latitude and longitude of a place are known, the point of intersection provides the exact location.

- **Example: Dhubri (Assam)** is located at 26°N latitude and 90°E longitude.

5. Longitude and Time

The measurement of time is intrinsically linked to the movement of the Earth, the moon, and the planets. The sun is the most reliable time-keeper globally.



- **Local Time:** This is determined by the shadow cast by the sun, which is at its **shortest at noon** (when the sun is at the highest point in the sky) and longest at sunrise and sunset.
- **The Greenwich Reference:** When the Prime Meridian of Greenwich has the sun at the highest point, all places along that meridian experience mid-day or noon.
- **Calculation of Time Difference:**
 - The Earth rotates **360° in 24 hours**, which equates to **15° per hour** or **1° every 4 minutes**.
 - **East vs. West:** Since the Earth rotates from west to east, places east of Greenwich are ahead of Greenwich time, and those west are behind.
 - **Example:** At 15° East, the time is 1 hour ahead (1 p.m.); at 15° West, it is 1 hour behind (11 a.m.).

6. Standard Time and Why It Is Necessary

Local times differ significantly across various meridians, making it impractical for activities like rail travel to follow local time everywhere.

- **The Indian Context:** In India, the longitudinal difference between Dwarka (Gujarat) and Dibrugarh (Assam) is about **1 hour and 45 minutes**.
- **Indian Standard Time (IST):** To maintain uniformity, countries adopt a central meridian's local time as the standard. India uses **82½° E (82° 30' E)** longitude as the standard meridian.
- **Time Difference:** India is located east of Greenwich at 82°30'E, making it **5 hours and 30 minutes ahead of GMT**. Thus, when it is 2 p.m. in London, it is 7:30 p.m. in India.

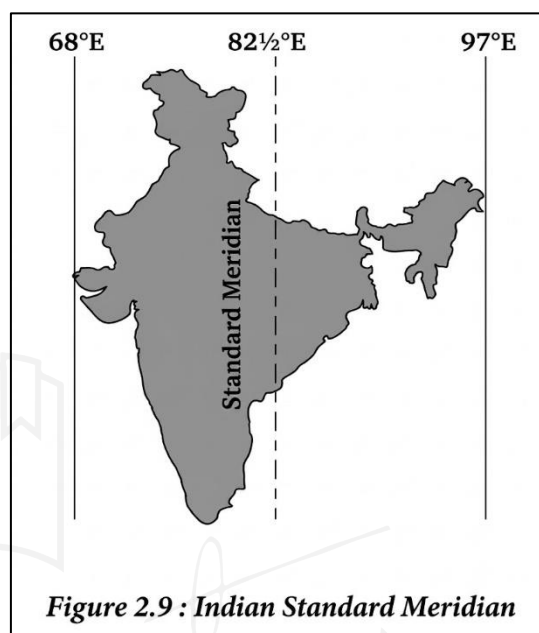
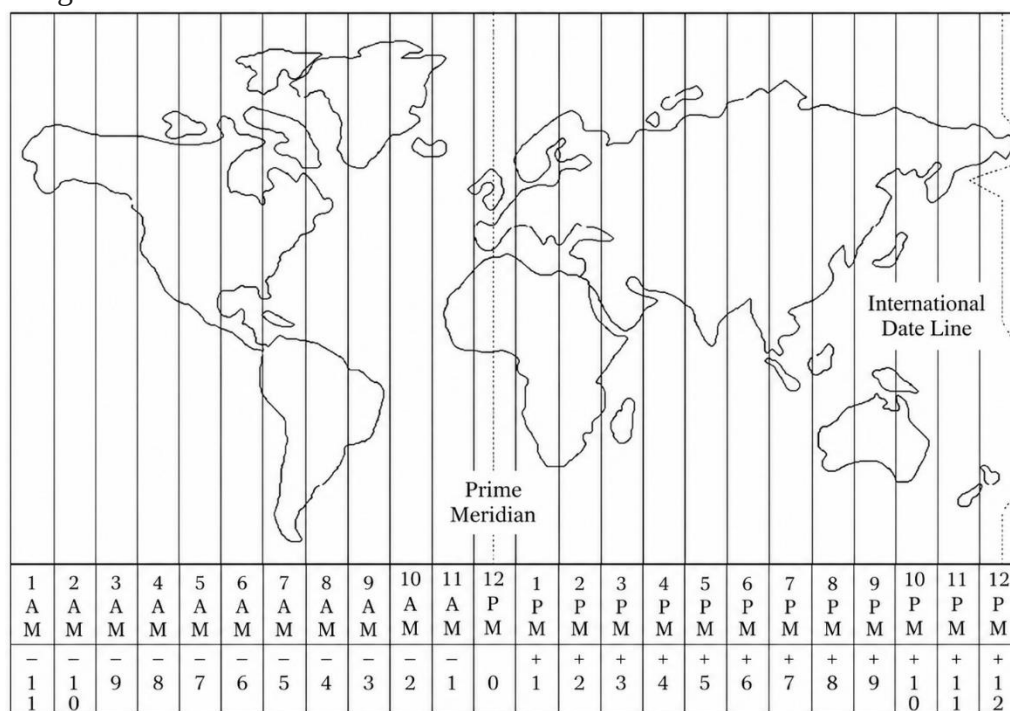


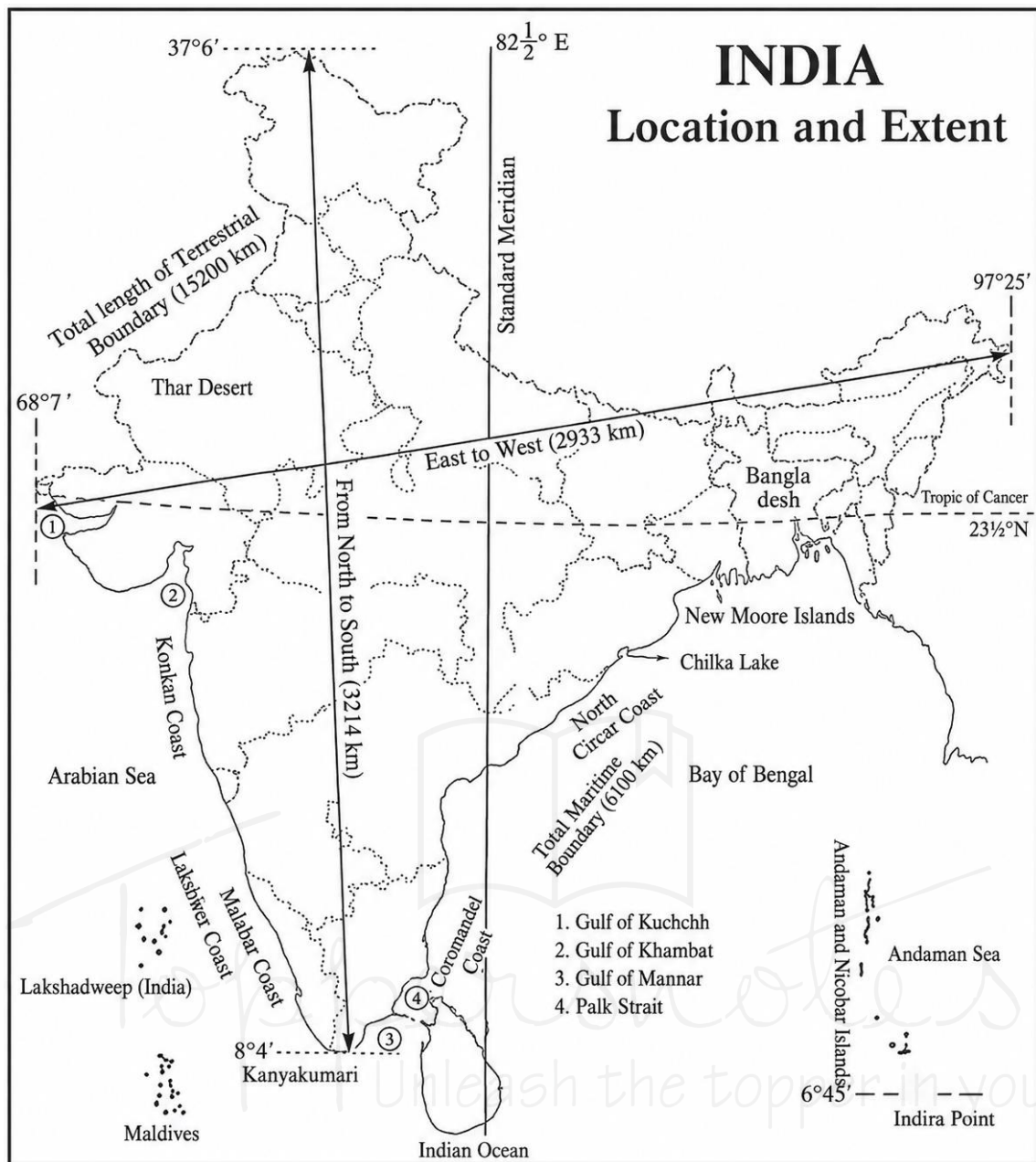
Figure 2.9 : Indian Standard Meridian

Global Time Zones

- Large countries with extensive longitudinal spread require multiple time zones. **Russia**, for example, has **eleven standard times**.
- The Earth is divided into **twenty-four time zones**, each covering **15° of longitude** and representing one hour.



GMT, Greenwich Mean Time, London (Zulu)



Summary

- **Axis:** The tilted, imaginary line passing through the poles around which the Earth rotates.
- **Globe Rotation:** Unlike a top or potter's wheel, the real Earth does not have a physical needle; it rotates on an **imaginary axis**.
- **Hemispheres:** The Equator creates Northern/Southern hemispheres; the Prime Meridian creates Eastern/Western hemispheres.
- **Latitude Facts:**
 - Distance from Equator to Pole = 90° (one-fourth of a circle).
 - Size of parallels decreases as one moves away from the Equator.
 - **Pole Star method:** You can determine your latitude by measuring the angle of the Pole Star.
- **Longitude Facts:**
 - Meridians are semi-circles of equal length.
 - They converge at the poles.
 - Each degree is divided into minutes, and minutes into seconds.
- **Grid:** The intersection of latitude and longitude identifies exact locations (e.g., Dhubri, Assam).
- **Standard Time:** A necessity for coordinating national activities and transportation across vast longitudinal extents.

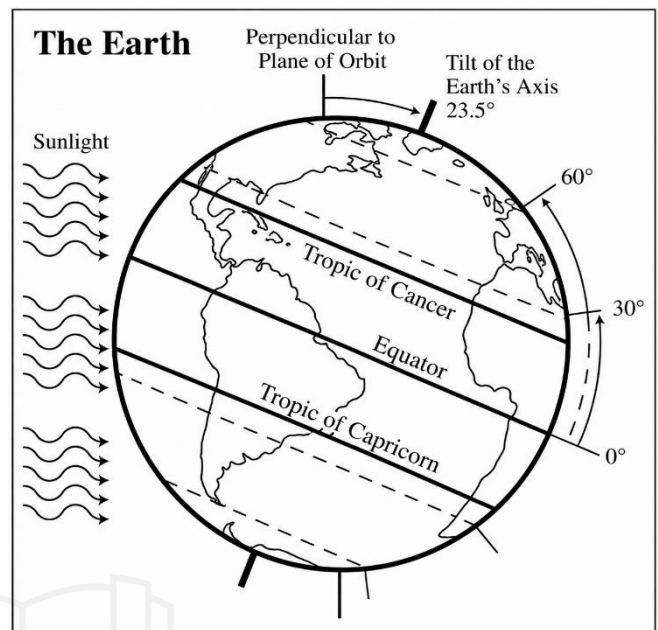
Motions of the earth

The Earth is in constant motion, performing two primary movements: **Rotation** (spinning on its axis) and **Revolution** (orbiting the Sun). These motions are responsible for the phenomena of day and night and the changing seasons.

1. Rotation: The Daily Motion

Rotation is the movement of the Earth on its axis.

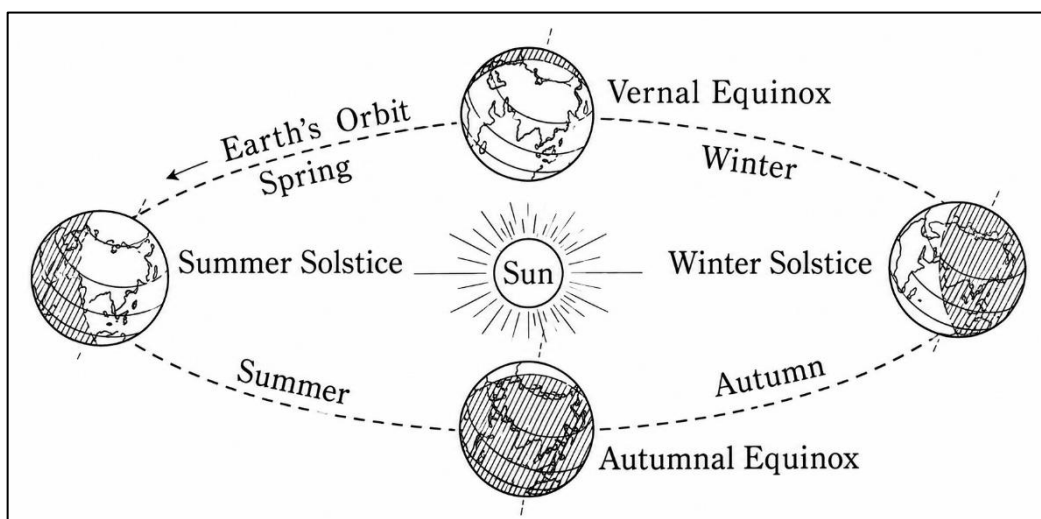
- **Axis and Plane:** The Earth's axis is an imaginary line that makes an angle of $66\frac{1}{2}^\circ$ with its **orbital plane** (the plane formed by the orbit).
- **Day and Night:** Because the Earth is spherical, the Sun illuminates only half of it at any given time. The side facing the Sun experiences **day**, while the side away from the Sun experiences **night**.
- **Circle of Illumination:** This is the imaginary circle that divides the day from the night on the globe. Crucially, this circle **does not coincide with the axis**.
- **Earthday:** The Earth takes approximately **24 hours** to complete one rotation. This 24-hour cycle is known as the earthday.
- **Consequences of No Rotation:** If the Earth did not rotate, one-half would face the Sun continuously (bringing extreme warmth), and the other half would remain in perpetual darkness and freezing cold. Life, as we know it, would be impossible.
- **Historical Context:** Ancient Indian astronomer **Aryabhata** correctly stated that the "earth is round and rotates on its own axis."



2. Revolution: The Seasonal Motion

Revolution is the movement of the Earth around the Sun in a fixed **elliptical orbit**.

- **Time Period:** It takes **365 $\frac{1}{4}$ days** (one year) to complete one revolution.
- **The Leap Year:** For convenience, we count a year as 365 days, ignoring the six hours. Over four years, these six hours accumulate into one full day (24 hours). This extra day is added to February every four years, creating a **leap year** (366 days).
- **Axis Inclination:** Throughout its entire orbit, the Earth's axis remains inclined in the **same fixed direction**. This permanent inclination, combined with the Earth's revolution, is the cause of **seasons**.



3. The Solstices and Equinoxes

The Earth's position relative to the Sun determines the changing seasons and the variation in the length of days and nights.

Summer Solstice (21st June)

- **Tilt:** The Northern Hemisphere is tilted towards the Sun.
- **Direct Rays:** Sun rays fall directly on the **Tropic of Cancer**.
- **Consequences:** These areas receive more heat. Regions north of the equator experience summer, with the **longest day and shortest night** occurring on 21st June.
- **Polar Effect:** Places beyond the Arctic Circle experience **continuous daylight** for about six months.
- **Southern Hemisphere:** All conditions are reversed; it is winter, and nights are longer than days.

Winter Solstice (22nd December)

- **Tilt:** The South Pole tilts towards the Sun.
- **Direct Rays:** Sun rays fall vertically at the **Tropic of Capricorn (23½° S)**.
- **Consequences:** A larger portion of the Southern Hemisphere receives light, leading to summer with longer days and shorter nights. (Example: Australia celebrates Christmas in summer).
- **Northern Hemisphere:** The reverse occurs; it experiences winter.

Equinoxes (21st March and 23rd September)

- **Direct Rays:** Sunlight falls directly on the **Equator**.
- **Position:** Neither pole is tilted towards the Sun.
- **Consequences:** The entire Earth experiences **equal days and equal nights**.
- **Seasonal Variation:**
 - **23rd September:** Autumn in the Northern Hemisphere; Spring in the Southern Hemisphere.
 - **21st March:** Spring in the Northern Hemisphere; Autumn in the Southern Hemisphere.

Summary Checklist for Aspirants

- **Rotation:** Causes Day and Night.
- **Revolution + Inclination:** Causes Seasons.
- **Orbital Plane:** The plane formed by the Earth's orbit around the Sun.
- **Ellipse:** The shape of the Earth's path around the Sun.
- **Circle of Illumination:** The line separating the illuminated (day) half from the dark (night) half.

4. Technical Activities: Visualizing Earth's Motions

The NCERT text highlights specific activities to help visualize Earth's complex movements:

- **Drawing an Ellipse:** To understand Earth's path, take two pins, a loop of thread, and a pencil. Fix the pins on paper, place the loop around them, and keep the thread tight while moving the pencil. The resulting figure is an **ellipse**.
- **Inclination Simulation:** By moving along an elliptical path on the ground while keeping a flag pointing toward a fixed point (like a tree-top), one can visualize how the Earth's axis remains **permanently inclined** in the same position throughout its revolution.

5. Definitive Summary of Earth's Motion Impacts

- **Rotation (Daily Motion):**
 - **Definition:** Movement of the Earth on its axis.
 - **Duration:** Takes about 24 hours (Earthday).
 - **Effect:** Creates the daily cycle of Day and Night.
 - **The Circle of Illumination:** It is important to note that this circle does **not** coincide with the axis.
- **Revolution (Annual Motion):**
 - **Definition:** Movement of the Earth around the Sun in a fixed elliptical orbit.

- **Duration:** 365¼ days.
- **Effect:** Seasonal changes (Summer, Winter, Spring, Autumn).
- **The Leap Year Logic:** Because we count 365 days for the calendar year, the 6-hour surplus per year equals 24 hours over four years. This results in an extra day in February (29 days instead of 28), forming a **leap year** of 366 days.

6. Key Conceptual Facts Table

For rapid revision, the following table summarizes the Solstice and Equinox conditions:

Event	Date	Sun's Direct Rays	Seasonal Impact
Summer Solstice	21st June	Tropic of Cancer	Summer in North; Winter in South
Winter Solstice	22nd Dec	Tropic of Capricorn	Summer in South; Winter in North
Equinox	21st March	Equator	Equal days & nights everywhere
Equinox	23rd Sept	Equator	Equal days & nights everywhere

7. Core Scientific Principles

- **Insolation Dynamics:**
 - On 21st June, the Northern Hemisphere is tilted towards the Sun, receiving direct rays at the Tropic of Cancer. The North Pole is inclined toward the Sun, resulting in **six months of continuous daylight** for areas beyond the Arctic Circle.
 - At the poles, Sun rays are always **slanting**, which is why these regions receive less heat compared to the tropics.
- **The Seasonal "Reverse":**
 - When it is summer in the Northern Hemisphere, it is winter in the Southern Hemisphere, and vice versa.
 - On 23rd September, the Northern Hemisphere experiences autumn, while the Southern Hemisphere experiences spring. On 21st March, this is reversed (Spring in North, Autumn in South).

Locating places on the earth

1. Maps: Representation and Components

A **map** is a representation or drawing of the Earth's surface, or a part of it, on a flat surface as if viewed from above. While a **globe** is a true miniature model of the Earth and superior for global study, it has limitations in portability and detail.

- **Distortion:** Representing a sphere on a flat surface causes distortion; an orange-peeling analogy demonstrates that a spherical surface cannot be flattened without tearing at the edges.
- **Types of Maps:**
 - **Physical (Relief) Maps:** Show natural features (mountains, plateaus, plains, rivers, oceans).
 - **Political Maps:** Show administrative boundaries (countries, states, cities, villages).
 - **Thematic Maps:** Focus on specific data (rainfall, road networks, forest distribution, industries).
 - **Atlas:** A book/collection of maps of varying scales.

2. The Three Components of Maps

Maps reduce the world to fit on paper using three fundamental components:

- **Distance (Scale):** The ratio between the distance on the map and the actual distance on the ground (e.g., 1 cm = 500 m).
 - **Small Scale Maps:** Used for large areas (continents/countries).
 - **Large Scale Maps:** Used for small areas (villages/towns); these provide more detail.
- **Direction:** The **North line** (arrow marked 'N') indicates the North. The four **Cardinal Points** are North, South, East, and West. **Intermediate Directions** (NE, SE, SW, NW) allow for more accurate location. A **magnetic compass** is used to find these directions.