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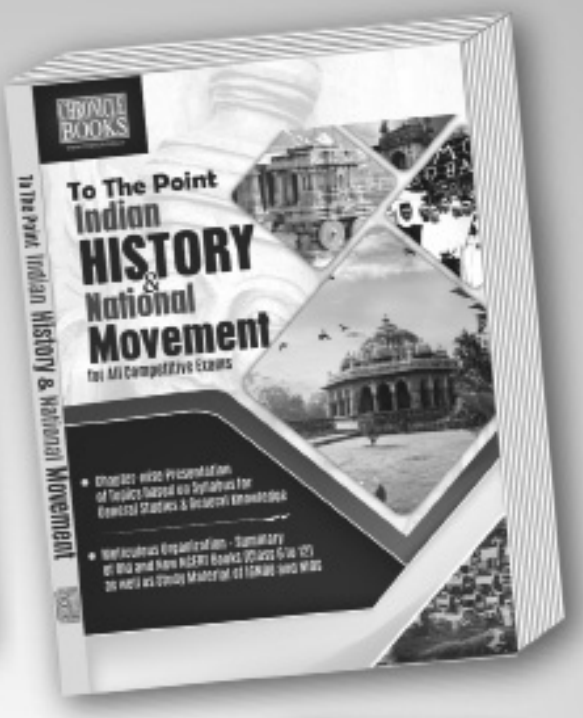

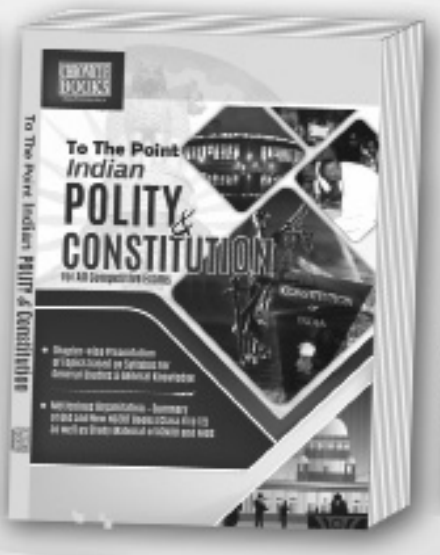

These Books are prepared in 'To the Point' format for 'General Studies' & 'General Knowledge' subjects according to the syllabus of competitive examinations. It is a compilation of important study material from NCERT (Class 6-12 New and Old), IGNOU, NIOS, and State Boards.

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PART-A

WORLD PHYSICAL GEOGRAPHY

1
CHAPTER

Our Universe, Solar System and Evolution of Earth

The Universe is all of space and time and their contents, including planets, stars, galaxies, and all other forms of matter and energy. While the spatial size of the entire Universe is unknown, it is possible to measure the size of the observable universe, which is currently estimated to be 93 billion light-years in diameter.

UNIVERSE

Evolution of Universe

The term "evolution" usually refers to the biological evolution of living things. But, the processes by which planets, stars, galaxies, and the universe form and change over time are also types of "evolution." In all of these cases there is change over time, although the processes involved are quite different.

- The **Big Bang theory** explains the origin of our universe. It was propounded by E George Lemaitre in 1927 and according to this theory, 13.7 billion years ago, cosmic matter was in a compressed state from which expansion started by a primordial explosion. The super-dense ball broke to form galaxies, which again broke to form stars and finally stars broke to form planets including Earth.
- Just two years later, an astronomer named **Edwin Hubble** noticed that other galaxies were moving away from earth and the **farthest** galaxies were moving **faster** than the closer ones.
- **Redshift** describe how light shifts toward longer wavelengths as objects in space (such as stars or galaxies) move farther away from earth. The concept is key to charting the universe's expansion. American astronomer Edwin Hubble (who the Hubble Space Telescope is named after) was the first to describe the **redshift** phenomenon and tie it to an expanding universe. His observations, revealed in 1929, showed that nearly all galaxies he observed are moving away.
- The **Hubble Space Telescope** is a spacecraft that orbits Earth and takes pictures of the universe.
- The **cosmic microwave background (CMB)** is remnant electromagnetic radiation from an early stage of the universe, also known as "relic radiation". The CMB is faint cosmic background radiation filling all space. Robert Wilson discovered the cosmic microwave background (CMB) radiation in 1964 along with Arno Penzias, putting the Big Bang theory on solid footing.

Since the outer space is limitless, conventional units for measuring distances are not suitable. Some of the units used in astronomical measurements are following:

- **Light Year:** Distance covered by light in one year in vacuum at a speed of 3x108 m/s. One light year is equal to **9.46x1012 kilometers**.
- **Astronomical Unit:** The Mean distance between the Sun and the Earth **(1.49 x 108 km)**. One light year is equal to 60,000 AU.
- **Cosmic Year:** Sun's period of revolution around the galactic centre **(250 million years)**. Also called as 'galactic year'
- **Parsec:** Distance at which the mean radius of the Earth's orbit subtends an angle of one second of an arc. It is equal to **3.26 light years**.

Theories of Origin of Earth

1. **Buffon-Hypothesis:** Based on Sun-comet collision.
2. **Kant-Gaseous Mass Theory:** Based on Newton's law of gravitation.
3. **Planetesimal Hypothesis:** Chamberlain-Moulton
4. **Tidal Hypothesis:** Jeans & Jeffery (Based on Sun-giant star attraction
5. **Electromagnetic Hypothesis:** Alfven
6. **Binary Star Hypothesis:** H. N. Russell and Littleton
7. **Fission Hypothesis:** Ross-Gun
8. **Super Nova Hypothesis:** F. Hoyle
9. **Big Bang Theory:** E. George Lemaitre

Galaxies

A galaxy is a huge collection of gas, dust, and billions of stars and their solar systems, all held together by gravity. For e.g. the Milky Way and Andromeda galaxy.

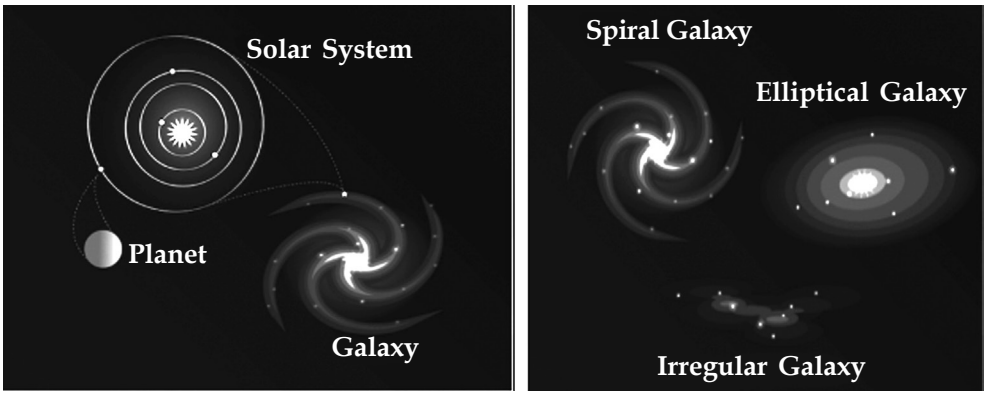

Fig: Galaxy and their shape

- **There are around** one hundred billion galaxies in the universe and each one have around 100 billion stars.
- **Shape of Galaxies:** There are three main types of galaxies: Elliptical, Spiral, and Irregular.
  - **Elliptical Galaxies:** These are shaped like a spheroid or elongated sphere.
  - **Spiral Galaxies:** Spiral galaxies consist of a flat, rotating disk containing stars, gas and dust, and a central concentration of stars known as the bulge.
  - **Irregular Galaxies:** They have no regular or symmetrical structure.

Examples of Some Galaxies

- **Milky Way Galaxy:** that contains the Solar System. The name describes the galaxy's appearance from Earth: a hazy band of light seen in the night sky formed from stars that cannot be individually distinguished by the naked eye.
- The **Andromeda Galaxy**, also known as Messier 31, is a spiral galaxy, and the nearest major galaxy to the Milky Way.
- **Bedin 1:** Astronomers using the NASA/ESA Hubble Space Telescope have discovered a new dwarf galaxy in our cosmic neighborhood in 2019.

Stars

Stars are huge celestial bodies made mostly of hydrogen and helium that produce light and heat from the churning nuclear forges inside their cores.

- Stars are self luminous bodies that account for 98 percent of the matter in a galaxy.

Life Cycle of Star

- A star's life cycle is determined by its mass. The larger its mass, the shorter its life cycle. A star's mass is determined by the amount of matter that is available in its nebula, the giant cloud of gas and dust from which it was born.
  - **Formation:** Birth takes place inside hydrogen-based dust clouds called nebulae. Over the course of thousands of years, gravity causes pockets of dense matter inside the nebula to collapse under their own weight.
  - One of these contracting masses of gas, known as a **protostar**, represents a star's nascent phase. Because the dust in the nebulae obscures them, protostars can be difficult for astronomers to detect.

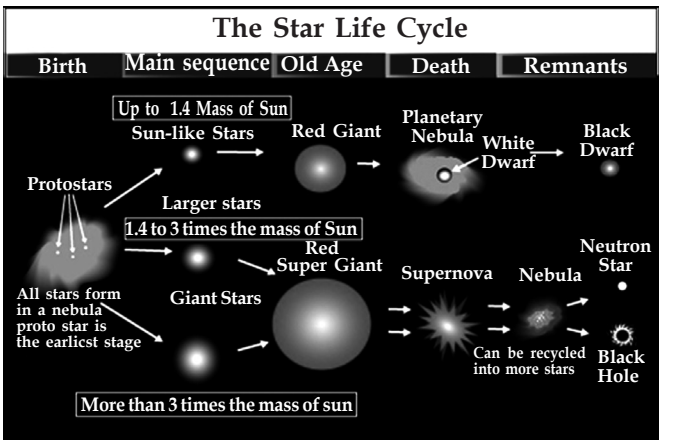

Fig: Life cycle of Star

- As the main sequence star glows, hydrogen in its core is converted into helium by nuclear fusion. When the hydrogen supply in the core begins to run out, and the star is no longer generating heat by nuclear fusion, the core becomes unstable and contracts. The outer shell of the star, which is still mostly hydrogen, starts to expand. As it expands, it cools and glows red. The star has now reached the red giant phase.
- **Red Giant:** It is red because it is cooler than it was in the main sequence star stage and it is a giant because the outer shell has expanded outward. In the core of the red giant, helium fuses into carbon. Our Sun will turn into a 'Red Giant' in 5 billion years.

3 CHAPTER

Minerals and Rocks

A rock is a naturally formed, non-living earth material, which are made of collections of mineral grains that are held together in a firm, solid mass. They are made of minerals.

A mineral is a naturally occurring organic and inorganic substance, having an orderly atomic structure and a definite chemical composition and physical properties. They are composed of two or more elements but, sometimes single element minerals like sulphur, copper, silver, gold, graphite etc. are found. The mineral grains in a rock can be so tiny that they are visible only under a microscope, or they can be as big to become visible with naked eye.

PHYSICAL CHARACTERISTICS OF MINERALS

1.	External crystal form	It is determined by internal arrangement of the molecules — cubes, octahedrons, hexagonal prisms, etc.
2.	Cleavage	Tendency to break in given directions producing relatively plane surfaces — result of internal arrangement of the molecules — may cleave in one or more directions and at any angle to each other.
3.	Fracture	Internal molecular arrangement is so complex that there are no planes of molecules; the crystal will break in an irregular manner, not along planes of cleavage.
4.	Lustre	Appearance of a material without regard to colour; each mineral has a distinctive lustre like metallic, silky, glossy etc.
5.	Colour	Some minerals have characteristic colour determined by their molecular structure — malachite, azurite, chalcopyrite etc., and some minerals are coloured by impurities. For example, because of impurities quartz may be white, green, red, yellow etc.
6.	Streak	Colour of the ground powder of any mineral. It may be of the same colour as the mineral or may differ — malachite is green and gives green streak, fluorite is purple or green but gives a white streak.
7.	Transparency	Transparent — light rays pass through so that objects can be seen plainly; Translucent — light rays pass through but will get diffused so that objects cannot be seen; Opaque — light will not pass at all.
8.	Structure	Structure is a particular arrangement of the individual crystals; fine, medium or coarse grained; fibrous — separable, divergent, radiating etc.
9.	Hardness	It is the relative resistance to being scratched; ten minerals are selected to measure the degree of hardness from 1-10. It is also called as **Mohs Scale of hardness**. They are: 1. Talc; 2. Gypsum; 3. Calcite; 4. Fluorite; 5. Apatite; 6. Feldspar; 7. Quartz; 8. Topaz; 9. Corundum; 10. Diamond.

	Specific Gravity	It is the ratio between the weight of a given object and the weight of an equal volume of water; object weighed in air and then weighed in water and divide weight in air by the difference of the two weights.

Some Major Minerals and their Characteristics

Feldspar	Silicon and oxygen are common elements in all types of feldspar and sodium, potassium, calcium, aluminium etc. are found in specific feldspar variety. Half of the Earth's crust is composed of feldspar. It has light cream to salmon pink colour. It is used in ceramics and glass making.
Quartz	It is one of the most important components of sand and granite. It consists of silica. It is a hard mineral virtually insoluble in water. It is white or colourless and used in radio and radar. It is one of the most important components of granite.
Pyroxene	Pyroxene consists of calcium, aluminum, magnesium, iron and silica. Pyroxene forms 10 per cent of the Earth's crust. It is commonly found in meteorites. It is in green or black colour.
Amphibole	Aluminium, calcium, silica, iron, magnesium are the major elements of amphiboles. They form 7 per cent of the Earth's crust. It is in green or black colour and is used in asbestos industry. Hornblende is another form of amphiboles.
Mica	It comprises of potassium, aluminium, magnesium, iron, silica etc. It forms 4 per cent of the Earth's crust. It is commonly found in igneous and metamorphic rocks. It is used in electrical instruments.
Olivine	Magnesium, iron and silica are major elements of olivine. It is used in jewellery. It is usually a greenish crystal, often found in basaltic rocks.

ROCKS

Petrology is science of rocks. A petrologist studies rocks in all their aspects viz., mineral composition, texture, structure, origin, occurrence, alteration and relationship with other rocks.

Rocks are identified primarily by the minerals they contain and by their texture. Each type of rock has a distinctive set of minerals. A rock may be made of grains of all one mineral type, such as quartzite but majority of the rocks are made of a mixture of different minerals. Texture is a description of the size, shape, and arrangement of mineral grains.

Types of Rock

The rocks are classified on the basis of mode of formation, physical and chemical properties and location. Temperature at the time of formation, the mix of minerals present and pressure all interact to create varieties of rocks. On the basis of mode of formation the rocks are divided into three categories:

- Igneous rocks
- Sedimentary rocks
- Metamorphic rocks

Igneous Rocks

- Igneous rocks are formed when molten lava cools and hardens.. If the rock is able to cool
- As igneous rocks form out of magma and lava from the interior of the Earth, they are known as primary rocks.
- Igneous rocks are characterized on the basis of texture. Texture depends upon size and arrangement of grains or other physical conditions of the materials. If molten material is cooled slowly at great depths, then larger crystals may grow producing a coarse grained rock such as granite.
- Sudden cooling (at the surface) results in small and smooth grains. For example, if the molten rock is from a volcano, then the subsequent cooled and hardened basalt rock has small crystals.

Characteristics

- Igneous rocks have low porosity and water percolates with great difficulty.
- They do not have strata and are less affected by chemical weathering.
- They don't contain fossils.
- The number of joints increases upwards.
- They are mostly associated with volcanic activity.

Classification of Igneous Rocks

- **On the Basis of Silica Content:** It is classified into two types acidic and basic igneous rock.
  - **Acidic Igneous Rocks**
    - Acidic igneous rocks are composed of 65% or more of silica. These rocks are light coloured, hard and very strong.

5
CHAPTER

Volcanism and Earthquakes

VOLCANO

A volcano is a vent or opening usually circular in form through which heated materials consisting of gases, water, liquid lava and fragments of rocks are ejected from the highly heated interior to the surface of the Earth.

- **Magma** is molten rock within the Earth's crust. When magma erupts through the Earth's surface and comes out, it is called lava. Lava can be thick and slow-moving or thin and fast-moving.
- Rock also comes from volcanoes in other forms such as **ash** (finely powdered rock that looks like dark smoke coming from the volcano), **cinders** (bits of fragmented lava), and **pumice** (light-weight rock that is full of air bubbles and is formed in explosive volcanic eruptions - this type of rock can float on water).

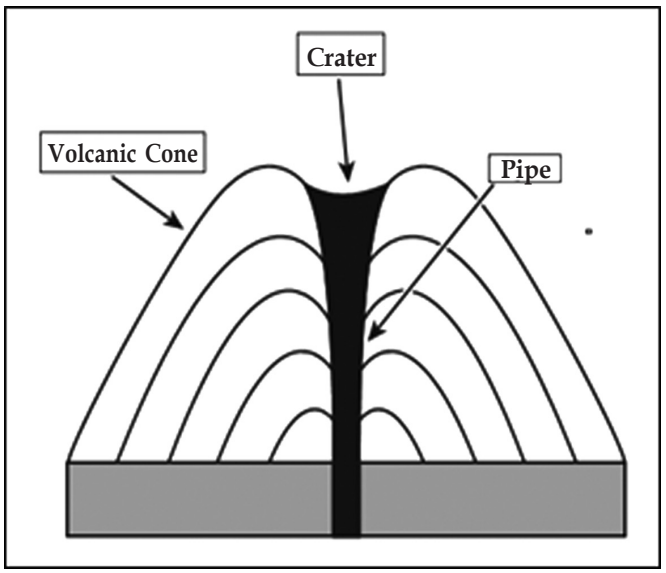

Fig: Components of a Volcano

- **Fumaroles:** It is a vent through which there is emission of gases and water vapour.

Volcanic Eruption Processes

The gradual increase in temperature with increasing depth at a rate of 1°C per 32 m due to heat generated by degeneration of radioactive elements inside the Earth.

- Origin of magma because of lowering of melting point caused by reduction in pressure of overlying rocks due to fractures caused by splitting of plates.
- Origin of gases and water vapour due to heating of water.
- Ascent of magma due to pressure from gases and vapour.
- Occurrence of volcanic eruption. These eruptions are closely associated with plate boundaries.

Classification of Volcanoes

Volcanoes are classified under different schemes:

1. On the basis of Periodicity of Eruption

On the basis of periodicity of volcanic eruption it can be classified into three types:

(a) **Active Volcano:** An active volcano is a volcano that has had at least one eruption during the past 10,000 years. An active volcano might be erupting or dormant. **For example,** Mayon (Philippines), Stromboli (Italy), Etna (Sicily, Italy), Merapi (Indonesia), Mauna Loa (Hawai) and Barren Island volcano (India).

(b) **Dormant Volcano:** It is an active volcano that is not erupting, but supposed to erupt again. **For Example, Mt. Vesuvius** (Italy), **Mauna Kea** (Hawai), **Mount Kilimanjaro**, Tanzania, and **Mount Fuji** in Japan.

(c) **Extinct Volcano:** It has not had an eruption for at least 10,000 years and is not expected to erupt

again in a comparable time scale of the future. **For example, Narcondam Island (India), Mount Thielsen (USA)** and **Mt. Slemish (Ireland).**

2. On the basis of the Mode of Eruption

On the basis of nature of volcanic eruption it can be classified into two types: Central Eruption Type and Fissure Eruption Type.

- **Central Eruption Type**: Eruption occurs through a central pipe and small opening are rapid and violent. Such volcanoes are very destructive and disastrous. It is divided into 5 sub types as follow:
  - **Hawaiian Type**: Such Volcanoes erupt quietly due to less viscous Lava and non-violent natures of gases. They emit long glossy threads of red molten Lava known as **peel's hair. For example, Mt Kilauea** and **Hawaiian Island.**
  - **Strombolian Type**: The eruptions are almost rhythmic or nearly continuous in nature but sometimes they are interrupted by long intervals. **For example,** Stromboli volcano of Lipari Island.
  - **Vulcanian Type**: Such volcanoes erupt with great force and intensity. The Lava is so viscous and pasty that these are quickly solidified. **For example,** Mt. Vulcano of Lipari Island of Mediterranean Sea.
  - **Peleean Type**: Most violent and most explosive type of volcanoes, named as **Nuee Ardente**, meaning thus by glowing cloud. **For example, Pelee** volcano of Martinique Island in the Caribbean Sea and **Krakatau** volcano between Java and Sumatra in Sunda strait.
  - **Vesuvian Type**: Extremely violent and enormous volume of gases and ashes forms which clouds like cauliflower. It is also called **Plinian type**. For example, Mt Vesuvius, Italy.

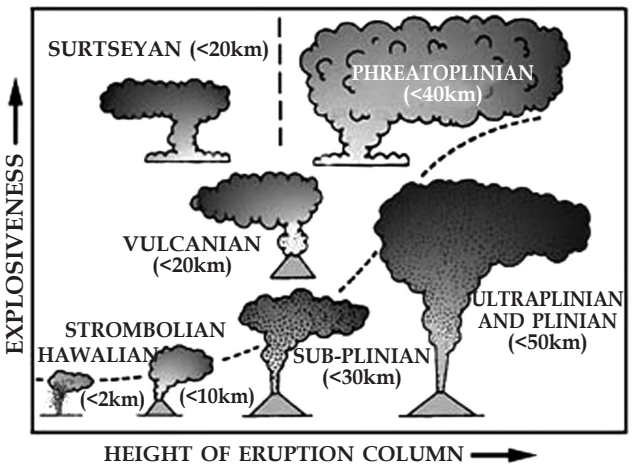

Fig: Volcanic Eruption Types

- **Fissure Type Eruption:** A fissure eruption is an "eruption that takes place from an elongate fissure. Large quantities of lava quietly well up from fissure and spread out over the surrounding countryside. Successive lava flow results in the growth of a lava platform which may be extensive to be called a plateau like Deccan Plateau of India, Columbia Snake Plateau in USA and Victoria and Kimberley districts of Australia.

Plate Tectonics & Volcanoes

Most volcanoes form at the boundaries of Earth's tectonic plates. These plates are huge slabs of the Earth's crust and upper mantle, which fit together like pieces of a puzzle. These plates are not fixed, but are constantly moving at a very slow rate. They move only a few centimeters per year. Sometimes, the plates collide with one another or move apart. Volcanoes are most common in these geologically active boundaries.

The two types of plate boundaries that are most likely to produce volcanic activity are divergent plate boundaries and convergent plate boundaries.

Divergent Plate Boundaries

- At the mid-oceanic ridges, two tectonic plates diverge from one another. New oceanic crust is being formed by hot molten rock slowly cooling and solidifying. The crust is very thin at mid-oceanic ridges due to the pull of the tectonic plates.
- The release of pressure leads to partial melting of the mantle causing volcanism and creating new oceanic crust.
- Most divergent plate boundaries are at the bottom of the oceans, therefore most volcanic activity is submarine, forming new seafloor.
- Black smokers or deep sea vents are an example of this kind of volcanic activity. Where the mid-oceanic ridge is above sea-level, volcanic islands are formed, for example, Iceland.

Convergent Plate Boundaries

Subduction zones are places where two plates, usually an oceanic plate and a continental plate, collide. In this case, the oceanic plate subducts or submerges under the continental plate forming a deep ocean trench just offshore.

Water released from the subducting plate lowers the melting temperature of the overlying mantle wedge, creating magma. This magma tends to be very viscous due to its high silica content so that it often does not reach the surface and cools at depth. When it does reach the surface, a volcano is formed.

7
CHAPTER

Erosion and Associated Landforms

EROSION

Erosion is the geological process in which earthen materials are worn away and transported by agents of erosion such as wind, running water, glaciers and sea wave. A similar process, weathering, breaks down or dissolves rock, but does not involve movement i.e., transportation. Erosion is the opposite of deposition, the geological process in which earthen materials are deposited, or built up, on a landform.

Most erosion is performed by liquid water, wind, or ice (usually in the form of a glacier). If the wind is dusty, or water or glacial ice is muddy, erosion is taking place. The brown color indicates that bits of rock and soil are suspended in the fluid (air or water) and being transported from one place to another. This transported material is called sediment.

Evolution of Landforms

- Each landform has its own physical shape, size, materials and is a result of the action of certain geomorphic processes and agents. Actions of most of the geomorphic processes and agents are slow, and hence the results take a long time to take shape. Every landform has a beginning and once formed may change in their shape, size and nature slowly or fast due to continued action of geomorphic processes and agents.
- Due to changes in climatic conditions and vertical or horizontal movements of landmasses, either the intensity of processes or the processes themselves might change leading to new modifications in the landforms.
- A landmass passes through stages of development somewhat comparable to the stages of life — youth, mature and old age.
- Running water, ground-water, glaciers, wind and waves are powerful erosional and depositional agents shaping and changing the surface of the earth aided by weathering and mass wasting processes.
- **Cycle of Erosion**: The sequence of changes in a landscape from the start of its erosion by running water, waves and currents, or glaciers until it has been reduced to the base level of erosion which limits the activity of the agents concerned is called as cycle of erosion. It is also called also geomorphic cycle.
- These geomorphic agents acting over long periods of time produce systematic changes leading to sequential development of landforms. Each geomorphic agent produces its own assemblage of landforms.

GEOMORPHIC AGENTS AND ASSOCIATED LANDFORMS

Running Water and Related Landforms

In humid regions, which receive heavy rainfall running water is considered the most important of the geomorphic agents in bringing about the degradation of the land surface.

- There are two components of running water. One is overland flow on general land surface as a sheet. Another is linear flow as streams and rivers in valleys.
- Most of the erosional landforms made by running water are associated with vigorous and youthful rivers flowing over steep gradients. With time, stream channels over steep gradients turn gentler due to continued erosion, and as a consequence, lose their velocity, facilitating active deposition.
- There may be depositional forms associated with streams flowing over steep slopes. But these phenomena will be on a small scale compared to

those associated with rivers flowing over medium to gentle slopes. The gentler the river channels in gradient or slope, the greater is the deposition.

- When the stream beds turn gentler due to continued erosion, downward cutting becomes less dominant and lateral erosion of banks increases and as a consequence the hills and valleys are reduced to plains.
- **Base level** is defined as the limiting level below which a stream cannot erode its channel. For streams that empty into the oceans, base level is sea level. Local base levels can occur where the stream meets a resistant body of rock, where a natural or artificial dam impedes further channel erosion, or where the stream empties into a lake.
- Three functions of a river: **erosion, transportation and deposition.**
- **Erosion**: The work of river **erosion** is accomplished in four different ways, all of which operate together. These four ways are**: Corrasion or Abrasion, Corrosion or Solutions, Hydraulic Action and Attrition**.
  - **Corrasion or Abrasion:** As the rock particles bounce, scrape and drag along the bottom and sides of the river, they break off additional rock fragments. This form of erosion is called Corrasion. Corrasion takes place in two different ways:
    - **Lateral Corrasion**: This is sideways erosion which widens the river valley.
    - **Vertical Corrasion:** This is the downward erosion which deepens the river valley.
  - **Corrosion or Solutions:** This is the chemical or solvent action of water on soluble or partly soluble rocks with which the river water comes in contact. For example, limestone or calcium carbonate, when it comes in contact with water, it is easily dissolved and removed in solution.
  - **Hydraulic Action**: This is the mechanical loosening and sweeping away of material by the sheer force of river water itself. No load or material is involved in this process.
  - **Attrition:** This is the wear and tear of the transported materials themselves when they roll and collide with one another. In the process the coarser boulders are broken down into smaller pieces. The angular edges are smoothened and rounded to form pebbles.
- **Transportation:** River carries rock particles from one place to another. This activity is known as transportation of load by a river. The load is transported in four ways viz. **traction, saltation, suspension and solution.**
  - **Traction**: The heavier and larger rock fragments like gravel; pebbles etc. are forced by the flow of river to roll along its bed. These fragments can be seen rolling, slipping, bumping and being dragged. This process is known as traction and the load is called traction load.
  - **Saltation:** Some of the fragments of the rocks move along the bed of a stream by jumping or bouncing continuously. This process is called saltation.
  - **Suspension:** The holding-up of small particles like sand, silt and mud by the water as the stream flows is called suspension.
  - **Solution**: Some parts of rock fragments are dissolved in the river water and are thus transported.
- **Deposition:** When the stream comes down from hills to plain area, its slope becomes gentle and this reduces the energy of the stream. The decrease in energy hampers transportation; as a result part of its load starts settling down. This activity is known as deposition and it takes place either due to decrease in slope or due to fall in the volume or velocity of river water. It usually occurs in plains and low lying areas, when the river joins a lake or sea, the whole of its load is deposited.

Stages of Erosion

- **Youth:** Streams are few during this stage with poor integration and flow over original slopes showing shallow V-shaped valleys with no floodplains or with very narrow floodplains along trunk streams. Streams divides are broad and flat with marshes, swamp and lakes. Meanders if present develop over these broad upland surfaces. These meanders may eventually entrench themselves into the uplands. Waterfalls and rapids may exist where local hard rock bodies are exposed.
- **Mature:** During this stage streams are plenty with good integration. The valleys are still V-shaped but deep; trunk streams are broad enough to have wider floodplains within which streams may flow in meanders confined within the valley. The flat and broad inter stream areas and swamps and marshes of youth disappear and the stream divides turn sharp. Waterfalls and rapids disappear.
- **Old:** Smaller tributaries during old age are few with gentle gradients. Streams meander freely over vast floodplains showing natural levees, oxbow lakes, etc. Divides are broad and flat with lakes, swamps and marshes. Most of the landscape is at or slightly above sea level.

9
CHAPTER

Atmosphere and Weather

An atmosphere is a layer or a set of layers of gases surrounding a planet or other material body that is held in place by the gravity of that body. Earth is the only planet in the solar system with an atmosphere that can sustain life. The blanket of gases not only contains the air that we breathe but also protects us from the blasts of heat and radiation emanating from the sun. It warms the planet by day and cools it at night.

Atmosphere is a mixture of different gases and it contains life-giving gases like oxygen for humans and animals and carbon dioxide for plants. The air is an integral part of the earth's mass and 99 per cent of the total mass of the atmosphere is confined to the height of 32 km from the earth's surface. The air is colourless and odourless and can be felt only when it blows as wind.

Composition of Atmosphere

The atmosphere is made up of different types of gases, water vapour and dust particles. The composition of the atmosphere is not static. It changes according to the time and place. Pure dry air consists mainly of **Nitrogen (78%), Oxygen (21%), Argon (0.93%), Carbon dioxide (0.03%)**, Hydrogen, Helium and Ozone.

Composition of Atmosphere

Gases	Volume	Height	Characteristics and Functions
Nitrogen	78.084%	upto 100 km	Not very active chemically, dilutant for oxygen, regulates combustion, enters protein molecules via soil, plants
Oxygen	20.946%	upto 100 km	Chemically active, combines readily with other elements, released by plants in photosynthesis, taken up by plants and animals in respiration.
Argon	0.934%	—	Chemically inactive, present in tiny portion
Carbon-Dioxide	0.039%	upto 50 km	Absorbs heat radiation from the Earth in the atmosphere
Neon	0.001818%		Colourless and odourless, chemically inert
Helium	0.000524%		Second lightest, used in hot air balloons
Methane	0.000179%		Main constituent of natural gas
Krypton	0.000114%		Colourless, odourless; used in lighting and photography
Hydrogen	0.000055%		Used in Fossil Fuel Processing
Nitrous Oxide	0.00003%		Surgery & Dentistry
Carbon Monoxide	0.00001%		Toxic
Xenon	0.0000087%	30 to 50 km	Used in flash lamps & arc lamps
Ozone	0.000004%	20 to 45 km	Absorbs Ultraviolet rays of Sun
Nitrogen Dioxide	0.000002%		Used in producing Nitric Acid
Water Vapour	0.4% over full atmosphere, Typically 1-4% at surface	upto 8 km	Recycles in evaporation – condensation
Dust particles	—	Lower layers	Gives the colour to sky (blue) by scattering, decides the intensity of Sunrays, acts as hygroscopic nuclei

- Besides, water vapour, dust particles, smoke, salts are also present in air in varying quantities. As a result, the composition of air is never constant and varies from time to time and place to place.
- Some of the gases behave like permanent atmospheric components as they remain in fix proportion of the total gas volume.
- Two gases, **nitrogen and oxygen constitute about 99% of the clean dry air**.
- Gaseous form of water present in the atmosphere is called **water vapour,** which reaches in the atmosphere through evaporation and transpiration. Its maximum amount in the atmosphere could be upto 4 percent.
- Maximum amount of water vapour is found in hot-wet regions and its least amount is found in the dry regions. Generally, the amount of water vapour goes on decreasing from low latitudes to high latitudes. In the same way, its amount goes on decreasing with increasing altitude.
- **Dust particles** are generally found in the lower layers of the atmosphere. These particles are found in the form of sand, smoke and oceanic salt. Sand particle have important place in the atmosphere. These dust particles help in the **condensation of water vapour**. During condensation water vapour gets condensed in the form of droplets around these dust particles. Due to this process the clouds are formed and precipitation is made possible.
- **Homosphere:** The deep layer through which the gaseous composition of the atmosphere is generally homogeneous is called the "homosphere".
- **Heterosphere:** At higher altitude, the chemical constituents of air changes considerably and this layer is known as "heterosphere".

Structure of the Atmosphere

Earth's atmosphere has a series of layers, each with its own specific traits such as varying density and temperature. Generally it extends upto about 1600 kilometers from the Earth's surface.

- 97 percent of the total amount of weight of the atmosphere is limited upto the height of about 30 kilometers.
- Moving upward from ground level, atmosphere can be divided into five layers according to the diversity of temperature and density these layers are named the troposphere, stratosphere, mesosphere, thermosphere/ionosphere and exosphere.
- The exosphere gradually fades away into the realm of interplanetary space.

Troposphere

It is the lowest layer of the atmosphere extending to an average altitude of 13 km, varying between 18 km above the equator and 8 km above poles.

- It is a region of clouds, water vapour and weather. Troposphere literally means the **region of mixing**.
- Thickness of the troposphere is greatest at the equator because heat is transported to great heights by strong convectional currents.
- The temperature in this layer decreases at the rate of 1° C for every 165m of height or 6°C per km. This is the most important layer for all biological activity.
- The temperature at the end of the troposphere is around -80°C.
- **Tropopause:** The zone separating the troposphere from stratosphere is known as the tropopause. The air temperature at the tropopause is about minus 80C over the equator and about minus 45°C over the poles. The temperature here is nearly constant, and hence, it is called the tropopause.

Stratosphere

The region above the tropopause extending up to 50 km above the Earth is known as Stratosphere. Temperature increases with height in this layer.

- In the lower part of the stratosphere i.e., upto height of 20 km, temperature remains constant.
- Afterwards it gradually increases upto a height of 50 km because of the presence of ozone layer.

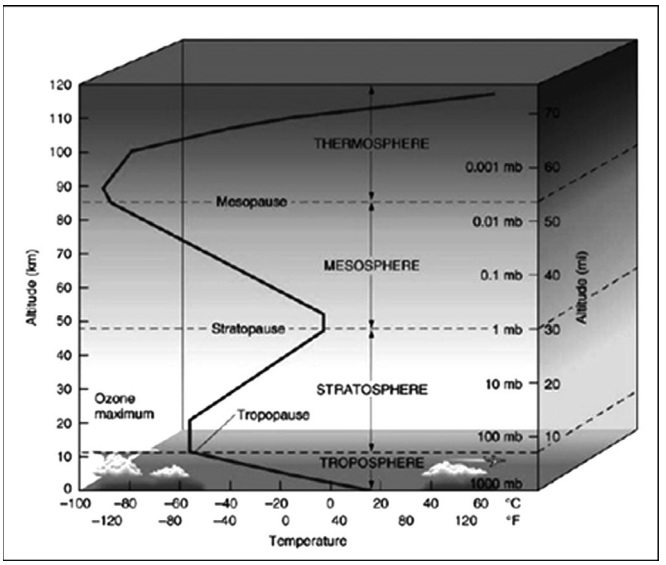

Fig: Structure of atmosphere

- Clouds are almost absent and there is little dust or water vapour. The air movements are almost horizontal.

11
CHAPTER

Oceanography

Water is an essential component of all life forms that exist over the surface of the earth. It is required for all life processes, such as, cell growth, protein formation, photosynthesis and, absorption of material by plants and animals. There are some living organisms, which can survive without air but none can survive without water. Water is a rare commodity in our solar system and Earth fortunately has an abundant supply of water on its surface. Hence, our planet is called the '**Blue Planet**'.

All the water present on the Earth makes up the **hydrosphere**. The water in its liquid state as in rivers, lakes, wells, springs, seas and oceans; in its solid state, in the form of ice and snow, though in its gaseous state the water vapour is a constituent of atmosphere yet it also forms a part of the hydrosphere. Oceans are the largest water bodies in the hydrosphere.

Distribution of Water on the Earth's Surface

About 71 % of the earth's surface is covered by water and they contain 97.2 percent of the world's total water. The remaining is held as freshwater in glaciers and icecaps, groundwater sources, lakes, soil moisture, atmosphere, streams and within life. Nearly 59 per cent of the water that falls on land returns to the atmosphere through evaporation from over the oceans as well as from other places. The remainder runs-off on the surface, infiltrates into the ground or a part of it becomes glacier.

Reservoir	Volume(Million Cubic km)	Percentage of the Total
Oceans	1370	97.25
Ice Caps and Glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil Moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and Rivers	0.0017	0.0001
Biosphere	0.0006	0.00004

Ocean Basin

Oceans form a single, large, continuous body of water encircling all the landmass of the earth. They account for four- fifth of the Southern Hemisphere and three fifth of the Northern Hemisphere. The ocean basins are partially bounded by the continents, but they are interconnected; this is why marine scientists refer to a single "**World Ocean.**"

The world ocean is divided into the North and South Pacific, Atlantic and Indian oceans, and the Arctic Ocean. Oceanographers also recognize the Southern Ocean, which encircles Antarctica and includes the southern most parts of the Pacific, Atlantic and Indian oceans.

Major Relief of Ocean Basins

The ocean water conceals a considerable variety of landscape very similar to its counterpart on the continents. There are mountains, basins, plateaus, ridges, canyons and trenches beneath the ocean water too. These relief features found on the ocean floor are called submarine relief. The ocean floors can be divided into four **major divisions or relief feature**:

1. **Continental Shelf:** The continental shelf is the extended margin of each continent occupied by relatively shallow seas and gulfs. It is the shallowest part of the ocean showing an average gradient of 1° or even less. Generally the isobath of 100 fathoms (around 200m) demarcates the continental shelf. The shelf typically ends at a very steep slope, called the **shelf break**.

- The width of the continental shelves varies from one ocean to another and the average width of continental shelves is about 80 km. The shelves are almost absent or very narrow along some of the margins like the coasts of Chile and the west coast of Sumatra. On the contrary, the **Siberian shelf** in the Arctic Ocean, the **largest** in the world, stretches to 1,500 km in width.
- The depth of the shelves also varies. It may be as shallow as 30 m in some areas while in some areas it is as deep as 600 m.
- Most of the continental shelves represent land which has been inundated by a **rise in sea level**. Many regard their formation due to the **erosional work of waves** or due to the extension of land by the deposition of river borne material on the off-shore terraces. Off the coast regions which were once covered by ice sheets, they may have developed due to glacial deposits.
- The continental shelves are covered with variable thicknesses of sediments brought down by rivers, glaciers, wind, from the land and distributed by waves and currents. Massive sedimentary deposits received over a long time by the continental shelves, become the source of fossil fuels. For example, Gulf of Cambay, Persian Gulf etc.

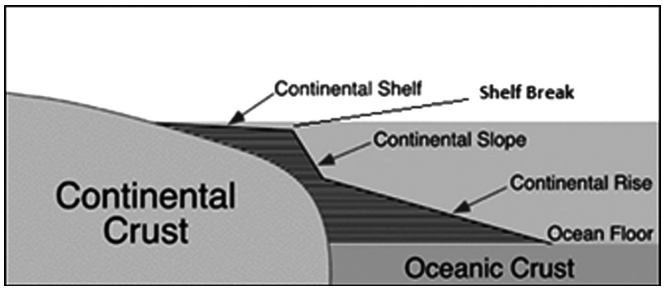

Fig: Continental Margin Relief Features

- **Isobath**: It is an imaginary line or a line on a map or chart that connects all points having the same depth below a water surface (as of an ocean, sea, or lake).
- **Fathom**: It is a unit of length in the imperial and the U.S. customary systems which is equal to 6 feet (1.8288 m). It is used for measuring the depth of water.

2. **Continental Slope:** The continental slope connects the continental shelf break and the ocean basins. It begins where the bottom of the continental shelf sharply drops off into a steep slope. The gradient of the slope region varies between 2-5°. The depth of the slope region varies between 200 and 3,000 m. The slope boundary indicates the end of the continents. **Canyons** and **trenches** are observed in this region.
- Continental slopes, mainly due to their steepness and increasing distance from the land have very little deposits of sediments on them. Sea life is also far less here than on the shelf.
- Along the base of the continental slope is a deposit of sediments. This belt of sedimentary deposits forms the **continental rise**. In some regions the rise is very narrow but in others it may extend up to 600 km in width.

3. **Deep Sea Plain or Abyssal Plain:** Deep sea plains are gently sloping areas of the ocean basins. These are the flattest and smoothest regions of the world. The depths vary between 3,000 and 6,000m.
- These plains are covered with fine-grained sediments like clay and silt. **Red clay** is a type of sediment which is of volcanic origin or made up of tiny particles brought by wind and rivers. Those seas which favour, an abundant growth of organisms have a thick layer of sediments, formed from the remains of living things called **ooze**.
- In spite of their flatness they have extensive submarine features like **submarine plateaus, hills, guyots and seamounts.**

4. **Oceanic Deeps or Trenches:** The ocean deeps are the deepest part of the ocean. They are long, narrow, steep sided and flat-floored depressions on the ocean floor. They are generally called **submarine trenches**. They are some 3-5 km deeper than the surrounding ocean floor.
- They occur at the bases of continental slopes and along island arcs and are associated with active volcanoes and strong earthquakes. That is why they are very significant in the study of plate movements.

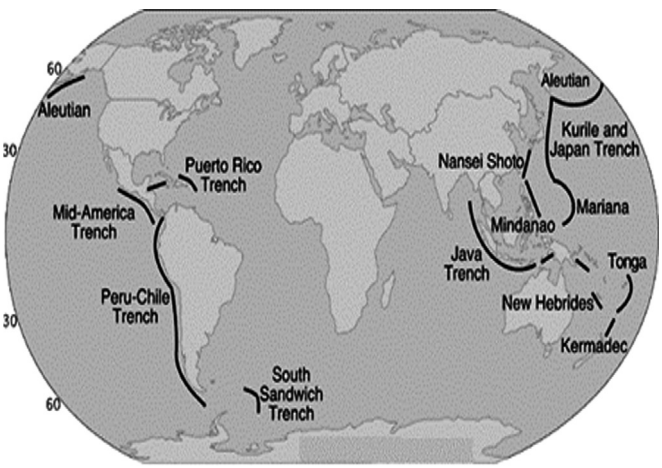

Fig: Major Trenches of the world

13
CHAPTER

Environmental Geography

Environmental geography is the branch of geography that describes the spatial aspects of interactions between humans and the natural world. It represents a critically important set of analytical tools for assessing the impact of human presence on the environment by measuring the result of human activity on natural landforms and cycles.

Ecology

The term ecology is derived from the Greek word 'oikos' meaning 'house', combined with the word 'logy' meaning the 'science of' or 'the study of '. Literally, ecology is the study of the earth as a 'household', of plants, human beings, animals and micro-organisms. They all live together as interdependent components.

- A German zoologist **Ernst Haeckel,** who used the term as 'oekologie' in 1869, became the first person to use the term 'ecology'. The study of interactions between life forms (biotic) and the physical environment (abiotic) is the science of ecology. Hence, ecology can be defined as a scientific study of the interactions of organisms with their physical environment and with each other.
- Ecology includes the study of plant and animal populations, plant and animal communities and ecosystems. Ecosystems describe the web or network of relations among organisms at different scales of organization.
- Since ecology refers to any form of biodiversity, ecologists research everything from tiny bacteria's role in nutrient recycling to the effects of tropical rain forest on the Earth's atmosphere.

Levels of organisation in Ecology

Ecology is organised at different levels for the ease of study. According to ecologist **E P Odum**, levels of organisation in ecology include: **Individual->Population->Community->Ecosystem->Biome->Biosphere.**

- **Individual/Species:** It is the individual organism which is capable of functioning independently.
- **Population:** It is a group of organisms usually of same species, occupying a defined areas during a specific time
- **Community:** It is a group of different species of plants and animals i.e. populations occupying a given area.
- **Ecosystem:** It is the basic functional unit and structural unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them.
- **Biome:** It refers to a large regional or sub-continental ecosystem characterised by similarity in vegetation and climate.
- **Biosphere**: The biosphere, (from Greek bios = life, sphaira, sphere) is the life zone of the earth. The development of the term is attributed to the English geologist **Eduard Suess** (1831-1914) and the Russian physicist **Vladimir I. Vernadsky** (1863-1945). The biosphere is one of the four layers that surround the Earth along with the lithosphere (rock), hydrosphere (water) and atmosphere (air) and it is the sum of all the ecosystems. In other words it is that part of the earth's terrestrial system including air, land, and water in which life develops and where life process in turn get transformed.

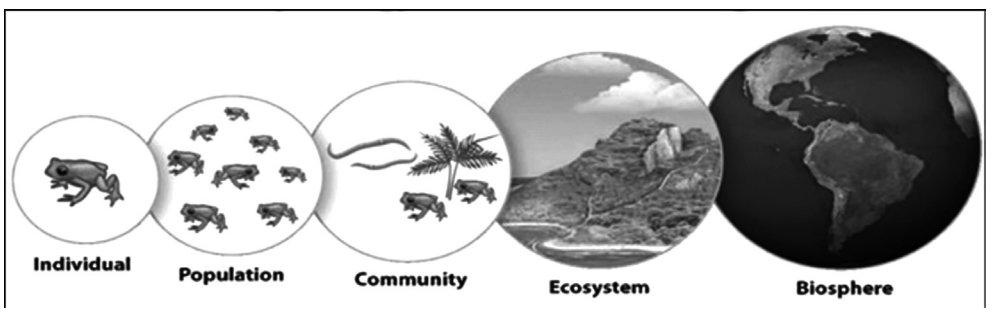

Fig: Levels of Organisation in Ecology

Population Interactions

Inter-species interactions arise from the interaction of populations of two different species. They could be **beneficial** (+), **detrimental** (-) or **neutral** (neither harm nor benefit {0}) to one of the species or both.

Population Interactions

Species A	Species B	Name of Interaction	Examples
+	+	Mutualism	• **Lichens:** Fungus+ Algae, • **Mycorrhizae**: Fungus+ roots of higher plants, • **Interaction of plants and pollinators** like bees and fig tree and wasps.
-	-	Competition	Consumption of nitrogen by a plant makes it unavailable for other competing plants.
+	-	Predation	• Wolves(Predator)- Rabbits (Prey) • Venus Fly Plant (Predator)- Insects (Prey)
+	–	Parasitism	• **Ecto parasites:** Feed on the external surface of the host organism. For e.g., lice on humans and ticks on dogs, ; ectoparasitic copepods affecting marine fish; **Cuscuta**, a parasitic plant commonly found growing on hedge plants, has lost its chlorophyll and leaves and derives its nutrition from the host plant. • **Endo parasites:** Live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.). • **Koel practises brood parasitism** by laying its eggs in the nest of the crow to allow them to incubate.
+	0	Commensalism	• An **orchid** growing as an epiphyte on a mango branch. • The **cattle egret** and grazing cattle. • **Sea anemone** that has stinging tentacles and the clown fish that lives among them.
–	0	Amensalism	**Black walnut** secretes harmful chemical which affects plants in its vicinity.

- **Invasive Species:** When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators.

Biological Communities and Succession

Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing and in this process the structure of a biological community evolves over time.

- The entire sequence of communities that successively change in a given area are called **sere(s).** The individual transitional communities are termed **seral stages** or seral communities. In the successive seral stages there is a change in the diversity of species of organisms, increase in the number of species and organisms as well as an increase in the total biomass.
- Each successive stage modifies the habitat by altering the amount of shade and the composition of the soil. The final stage of succession is a **climax community**, which is a very stable stage that can endure for hundreds of years.
- **Phases or Mechanism of Succession**: In 1916, **Frederic Clements published a descriptive theory of succession and advanced it as a general ecological concept.** According to Clements, succession is a process involving several phases:
  - **Nudation**: Succession begins with the development of a bare site, called Nudation (disturbance).
  - **Migration**: It refers to arrival of propagules. The species that invade a bare area are called **pioneer species**.
  - **Ecesis**: It involves establishment and initial growth of vegetation.
  - **Competition**: As vegetation becomes well established, grows, and spreads, various species begin to compete for space, light and nutrients.
  - **Reaction**: During this phase autogenic changes such as the buildup of humus affect the habitat, and one plant community replaces another.
  - **Stabilization**: This phase refers to formation of stable climax community.
- **Types of Succession:** There are two main types of succession, primary and secondary succession.

2
CHAPTER

Human Settlement

The concept of a human settlement is both social and physical, and it can be defined as having two components: a human group, and the habitat of this group. This important distinction makes it clear that settlements are not just roads, houses and other infrastructure: they are also sets of social relationships. So, **human settlement** can be defined as cluster of dwellings of any type or size where human beings live.

Classification of Human Settlements

Settlements are classified on the basis of size and function into two categories: **Urban and Rural settlements.**

Rural Settlements

The rural settlements derive their life support or basic economic needs from land based primary economic activities.

Rural people are less mobile and therefore, social relations among them are intimate.

Rural settlements derive a range of goods and services from urban areas and the functional relationship between the urban and rural settlements takes place through transport and communication network.

Classification of Rural Settlements

There are various factors and conditions responsible for having different types of rural settlements in India. These include:

- **Physical Features:** Nature of terrain, altitude, climate and availability of water.
- **Cultural and Ethnic Factors**: Social structure, caste and religion.
- **Security Factors:** Defence against thefts and robberies. For example due to defence from dacoits, wild animals or fear settlements may cluster and form compact settlements.

Compact or Nucleated Settlements: Nucleated settlements are ones where the houses are grouped closely together, often around a central feature like a church, pub or village green. New settlements that are planned often have a nucleated pattern.

Dispersed Settlements: In these settlements, houses are spaced far apart and often interspersed with fields. A cultural feature such as a place of worship or a market, binds the settlement together.

Planned Settlements: Sites that are not spontaneously chosen by villagers themselves, planned settlements are constructed by governments by providing shelter, water and other infrastructures on acquired lands. The scheme of villagisation in **Ethiopia** and the canal colonies in **Indira Gandhi canal command area** in **India** are some good examples.

Pattern of Rural Settlements

A **settlement pattern** refers to **the shape of the settlement as seen from above.** It also reflects the way the houses are sited in relation to each other. The shapes of settlements are influenced by the surrounding landscape and terrain. They are also shaped by other factors such as who owned the land and whether the land was good for building on or not.

- **Linear Pattern:** Linear settlements are settlements where the buildings are constructed in lines, often next to a geographical feature like a lake shore, a river or following a road. Where linear settlements follow a road, the road often predates the settlement.
- **Rectangular Pattern:** This is a very common type which develops around the rectangular shape of agricultural fields as it is common to find a system of land measurement based on square units.
- **Square Pattern:** This is basically a variant of rectangular type. Such a pattern is associated with villages lying at the crossing of cart tracks or roads and also related to features restricting the extension of the village outside a square space. These features may include an old boundary wall, thick orchards, a road or a pond.

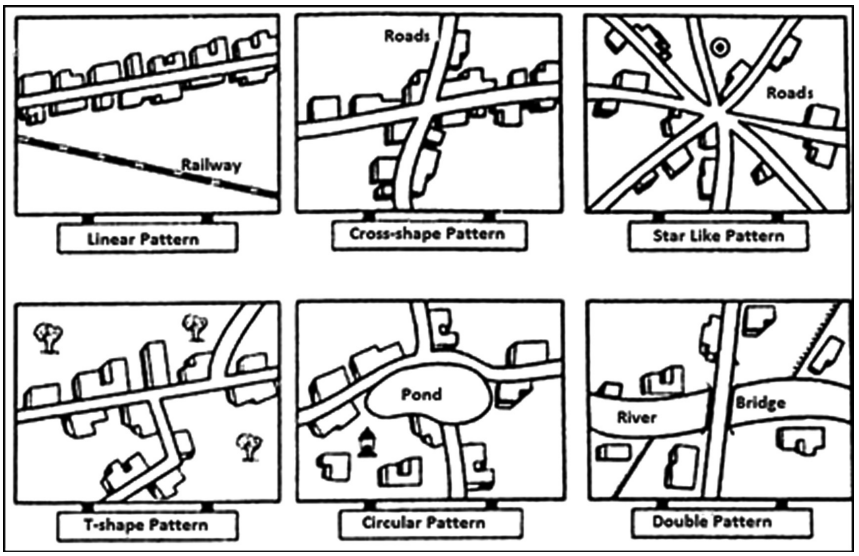

Fig: Pattern of Rural Settlements

- **Circular Pattern:** Circular villages develop around lakes, tanks and sometimes the village is planned in such a way that the central part remains open and is used for keeping the animals to protect them from wild animals. For example, Masai villages in Africa.
- **Cross-shape Pattern:** Where two roads converge, cross-shaped settlements develop by the houses built along the roads.
- **Star like pattern:** Where several roads converge, star shaped settlements develop by the houses built along the roads.
- **T-shape Pattern:** T-shaped settlements develop at the tri-junction of three roads.
- **Double village:** These settlements extend on both sides of a river where there is a bridge or a ferry.

Major Problems of Rural Settlements

Poor Infrastructure Facilities: Rural settlements in the developing countries have poor infrastructure facilities.

Supply of Water: to rural settlements in developing countries is not adequate. People in villages, particularly in mountainous and arid areas have to walk long distances to fetch drinking water. **Water borne diseases** such as cholera and jaundice are common problem because of lack of safe drinking water and unhygienic conditions.

Lack of Sanitation: The absence of toilet and garbage disposal facilities cause health related problems.

Climatic Veracity: Villages are adversely affected by the conditions of drought and flood. This in turn affects the crop cultivation.

Poor Housing Infrastructure: The houses in rural settlements are made up of mud, wood and thatch, which get damaged during heavy rains and floods. Most houses have no proper ventilation.

Lack of Transportation: Unmetalled roads and lack of modern communication network causes difficulties in providing emergency services during floods.

Health and Education: It is also difficult to provide adequate health and educational infrastructure for large rural population. The problem is particularly serious where houses are scattered over a large area.

Urban Settlements

The definition of urban areas varies from one country to another. Some of the common criteria of classification are size of **population, occupational structure and administrative setup.**

- According to the Census of India, urban areas are those which satisfy the conditions given below.
  (a) All places with a municipality corporation, cantonment board or notified town area committee etc.
  (b) All other places which satisfy the following criteria:
    - A minimum population of 5,000,
    - At least 75 percent of male working population engaged in non-agricultural sector, and
    - A density of population of at least 400 persons per square kilometer.

Types of Urban Settlements

Depending on the size and the services available and functions rendered, urban centres are designated as town, city, million city, conurbation, and megalopolis.

- **Town:** Population size in town is higher than the village. Functions such as, manufacturing, retail and wholesale trade, and professional services exist in towns.
- **City:** A city may be regarded as a leading town. Cities are much larger than towns and have a greater number of economic functions. They tend to have transport terminals, major financial institutions and regional administrative offices. When the population crosses the one million mark it is designated as a **million city.**

4
CHAPTER

Mining, Minerals and Industries

MINING

Mining is the process of extracting useful minerals from the surface of the Earth, including the seas. There are four main mining methods: **underground, open surface (pit), placer, and in-situ mining.**

- **Underground mining**: Underground mines are more expensive and are often used to reach **deeper deposits**.
- **Open surface (pit) mining:** Open surface mines are typically used for more **shallow** and less valuable deposits.
- **Strip mining** is a sub-type of pit mining in which a seam of mineral is mined by first removing a long strip of overlying soil and rock (the overburden).
- **Placer Mining:** Placer mining is used to sift out valuable metals from **sediments** in river channels, beach sands, or other environments.
- **In-situ mining:** It is primarily used in **mining uranium**, involves dissolving the mineral resource in place then processing it at the surface without moving rock from the ground.
- The method used depends on the type of mineral resource that is mined, its location at or beneath the surface, and whether the resource is worth enough money to justify extracting it i.e., economic viability.
- Each mining method also has varying degrees of impact on the surrounding landscape and environment. For example pit mining completely **destroys the landscape** of the mining area.

MINERALS

A mineral, with a few exceptions, is an inorganic substance occurring in nature that has a definite chemical composition and distinctive physical properties or molecular structure.

- Minerals are not evenly distributed over space. They are concentrated in a particular area or rock formations. Some minerals are found in areas which are not easily accessible such as the Arctic Ocean bed and Antarctica.
- Minerals are formed in different types of geological environments, under varying conditions. They are created by natural processes without any human interference.
- They can be identified on the basis of their physical properties such as colour, density, hardness and chemical property such as solubility.
- **Ore** is a metalliferous mineral, or an aggregate of metalliferous minerals and gangue (associated rock of no economic value), that can be mined at a profit.

Classification of Minerals

- On the basis of composition, minerals are classified mainly as **metallic** and **non-metallic minerals.**
- **Metallic minerals** are the sources of metals. Iron ore, copper, gold produce metal and are included in this category. Metallic minerals are further divided into ferrous and non-ferrous metallic minerals.
- **Ferrous minerals** like iron ore, manganese and chromites contain iron. A **non-ferrous mineral** does not contain iron but may contain some other metal such as gold, silver, copper or lead.
- **Non-metallic minerals** do not contain metals. Limestone, mica and gypsum are examples of such minerals. The mineral fuels like coal and petroleum are also non-metallic minerals and sometimes referred as **energy minerals**.

Mineral Deposits in the World

Name of Mineral	Primary	Secondary	Tertiary
Ferrous Minerals			
Iron Ore	Australia	Brazil	Russia
Manganese	South Africa	Ukraine	Brazil
Nickel	Indonesia	Australia	Brazil
Cobalt	Congo	Australia	Cuba
Non Ferrous Minerals			
Bauxite	Guinea	Australia	Vietnam
Copper	Chile	Australia	Peru
Lead	Australia	China	Russia
Zinc	Australia	China	Peru
Tin	China	Indonesia	Brazil
Tungsten	China	Russia	Vietnam
Cadmium	China	Peru	Mexico
Antimony	China	Russia	Bolivia
Uranium	Australia	Kazakhstan	Canada
Rare Earth Metals	China	Brazil	Vietnam
Precious Metals			
Gold	Australia	South Africa	Russia
Silver	Peru	Australia and Poland	Russia
Platinum	South Africa	Russia	Zimbabwe
Non Metallic Minerals			
Diamond	Russia	DR Congo	Australia
Graphite	Turkey	China	Brazil
Energy Minerals			
Coal	USA	Russia	Australia
Petroleum Crude	Venezuela	Saudi Arabia	Canada
Natural Gas	Russia	Iran	Qatar

Major Mineral Producers of the World

Name of Mineral	Primary	Secondary	Tertiary
Ferrous Minerals			
Iron Ore	China	Australia	Brazil
Manganese	South Africa	China	Australia
Nickel	Canada	Australia	China
Cobalt	DR Congo	New Caledonia	China
Non Ferrous Minerals			
Bauxite	Australia	China	Guyana
Copper	Chile	Peru	China
Lead	China	Australia	Peru
Zinc	China	Peru	Australia
Cadmium	China	South Korea	Japan
Tungsten	China	Vietnam	Russia
Tin	China	Indonesia	Myanmar

PART-C

WORLD REGIONAL GEOGRAPHY

1. **World: Continents and Ocean Basins**
2. **Asia**
   - West Asia
   - South Asia
   - South East Asia
   - East Asia
   - Central Asia
   - North Asia
3. **Europe**
   - Northern Europe
   - Benelux Countries
   - British Isles
   - Alpine States
   - Iberian Countries
   - East-Central Europe
   - South Europe
4. **Africa**
5. **Oceania**
6. **North America and South America**
   - **North America**
   - **South America**
   - **Middle America**
7. **Antarctica**
8. **World Miscellaneous Facts**

1 CHAPTER

World: Continents and Ocean Basins

The solid portion of the earth on which we live is called the **lithosphere**. It comprises of the rocks of earth's crust and the thin layers of soil that contain nutrient elements which sustain the life of vegetation and organisms of earth. It also contains vast depressions which are filled with life sustaining water. So there are two main divisions of the earth's surface: the large landmasses which are known as the **continents** and huge water bodies which are called the **Ocean basins**. There are seven major continents which are separated by large water bodies. These continents are – **Asia, Europe, Africa, North America, South America, Australia and Antarctica**. At the other hand five major ocean basins of the world are the **Pacific Ocean, the Atlantic Ocean, the Indian Ocean, the Southern Ocean** and **the Arctic Ocean**. Both continents and ocean basins are depicted in the Fig 1.1 given below.

In depth coverage of the continents and ocean basins are provided in the subsequent chapters and some important facts regarding the continents and ocean basins are mentioned below in Fig 1.2, Fig 1.3 and Fig 1.4.

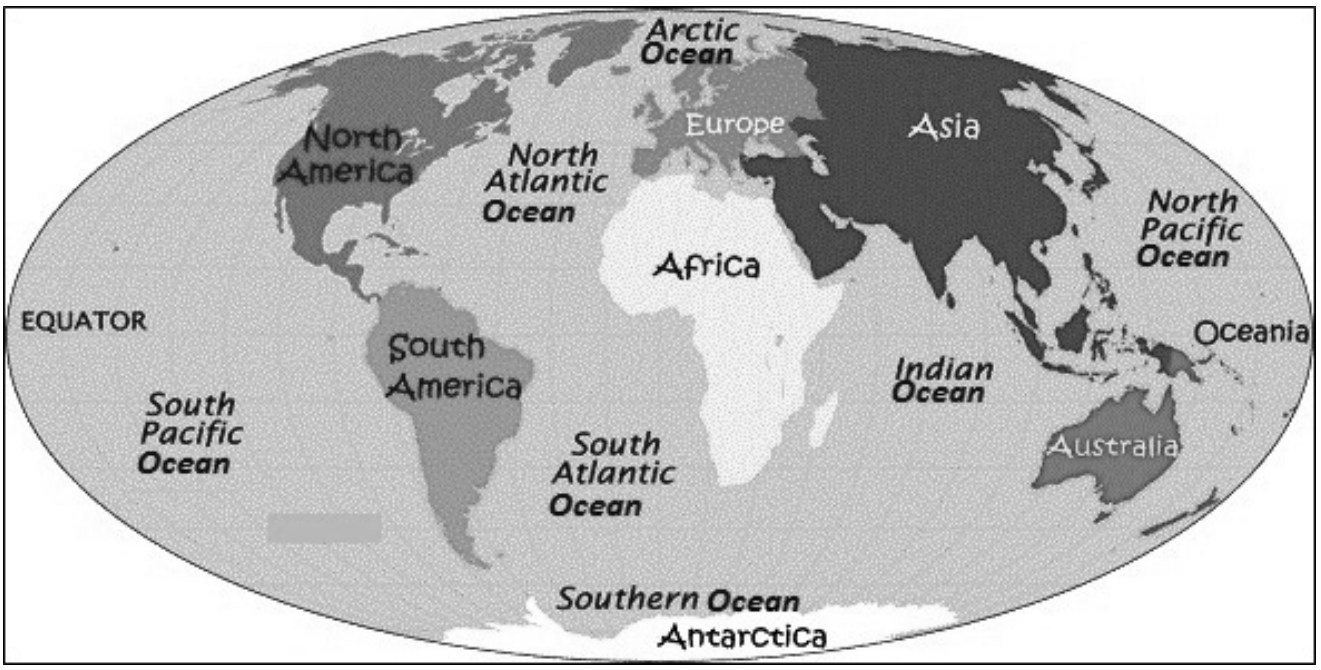

Fig 1.1 Continents and Ocean Basins

World continents in the order of size	Continent with Most Countries
1. Asia - (44,579,000 sq km)	1. Africa - (54)
2. Africa - (30,221,532 sq km)	2. Europe - (47)
3. North America - (24,709,000 sq km)	3. Asia - (44)
4. South America - (17,840,000 sq km)	4. North America - (23)
5. Antarctica - (14,000,000 sq km)	5. Oceania - (14)
6. Europe - (10,180,000 sq km)	6. South America - (12)
7. Australia/Oceania - (8,525,989 sq km)	7. Antarctica - (0)

Fig 1.2 Sizes of Continents

3
CHAPTER

Europe

Europe is the world's second smallest continent occupying the western tip of Eurasian landmass. It is a land of variety and contains huge rivers, tall mountains, and vast coastlines.

Europe extends from the island nation of Iceland in the west to the Ural Mountains of Russia in the east. Europe's northernmost point is the Svalbard archipelago of Norway, and it reaches as far south as the islands of Greece and Malta as shown in figure 3.1 given below.

Physical Geography

Landscape

The North European plain lie in northern and western part of Europe and high peaks of Alps are situated in the southern part of Europe.

- Europe's northern coastline stretches deep into the Arctic Circle. Here in Norway icebergs drift into the deep wide bottomed fjords (a fjord is a long, narrow inlet with steep sides or cliffs,

Fig 3.1: Europe Political

created by a glaciers during past glaciations.).

- The north European plain has low rolling-hills and plains. Much of the area is cultivated and used for growing crops like wheat and sugar beet.
- Some of the world's oldest rocks are found in northwest Europe. Erosion by glaciers in the last ice age created smoothed hills such as the mountains of Wales and Scotland in Britain.
- The Alps are Europe's major mountain chain. They were formed about 65 million years ago. The highest peak in Europe is Mt. Elbrus (5633 m) located in the Caucasus Mountains and Mont Blanc (4807 m) is the highest peak of Alps as shown in figure 3.2.
- Other main mountains of the Europe are the Pyrenees, Apennines, Carpathians, the Balkans, and the Caucasus.
- Pyrenees Mountain is situated on the border of Spain and France.
- The two longest rivers of Europe are the Volga, which is found in Russia and is approximately 2300 miles long, and the Danube, which runs through 10 countries including Germany and Austria, and is around 1800 miles long.
- Turkey is surrounded on **three sides by water**— the **Aegean, Black and Mediterranean Seas**. The European portion of Turkey is known as **Thrace**, while the Asian is called **Anatolia or Asia Minor** and **Istanbul** straddles both as the world's only city located on two continents.

Climate

Europe's climate is temperate with few climatic extremes. In the far north, Europe extends into the Arctic Circle and the climate is so cold that in the winter the Baltic Sea freezes over.

- Towards the Atlantic coast in the west, the climate becomes wetter and warmer because of a warm ocean current known as the 'Gulf Stream'. The countries such as Italy and Spain, which borders the Mediterranean Sea, have long hot summers and low rainfalls.
- Winter rainfall in Mediterranean are is associated shifting of pressure belts and Mediterranean climate is characterized by hot, dry summers and cool, wet winters and located between about 30° and 45° latitude north and south of the Equator and on the western sides of the continents.

Fig 3.2: Europe Physical

5 CHAPTER

Oceania

The term Oceania is used to denote the widely scattered islands of the central-south Pacific, Australia, and New Zealand. Regionally it is classified:

- Australia and New Zealand,
- Melanesia,
- Micronesia, and
- Polynesia.

Australia is the smallest continent of the world and it is located south of Asia, sitting in between the Pacific Ocean, the Indian Ocean, and the Southern Ocean. It is also the lowest, the flattest and the driest continent of the world after Antarctica.

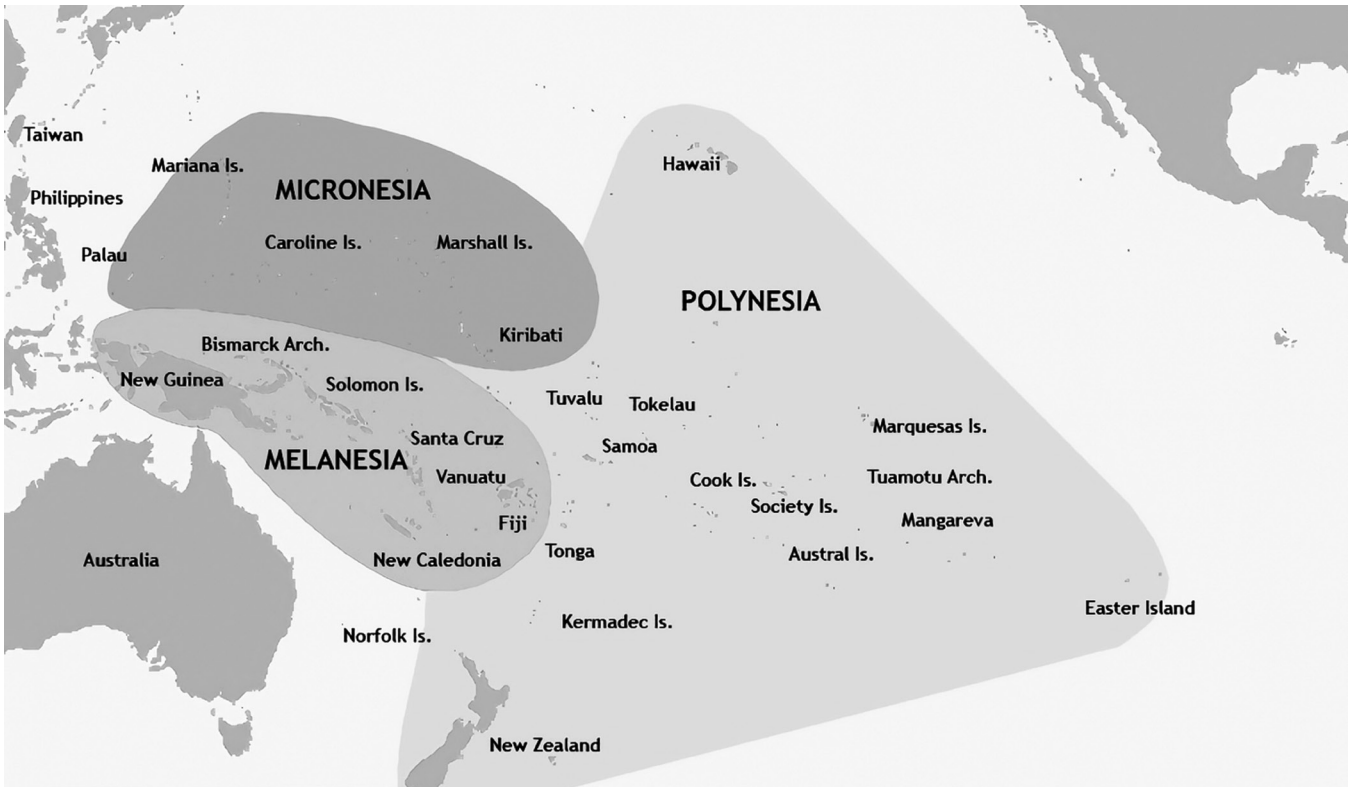

Fig 5.1: Australia

Physical Geography

Landscape

Australia

- Australia is the sixth largest country after Russia, Canada, China, the United States of America and Brazil. It is also the largest nation that is completely surrounded by water.
- The **Torres Strait** separates **Australia** and the Melanesian island of **New Guinea**.
- **Torres Strait**, **Arafura Sea** and **East Timor Sea** form the maritime border between Australia and Indonesia.
- **Bass Strait** separates province of Tasmania from the Australian mainland and more specifically the state of Victoria.

- **The Tasman Sea** is a marginal water body of the South Pacific Ocean which is situated between Australia and New Zealand.
- Australia has diverse physical features which range from lofty Great Dividing Range to vast Central Deserts, Western Plateaux, Northern lowland forests and temperate grasslands (Downs).
- The **Eastern Highlands region** is the highest part of Australia which consists of series of hills, mountains and plateaux. For example, **Great Dividing Range** is part of Eastern Highlands which

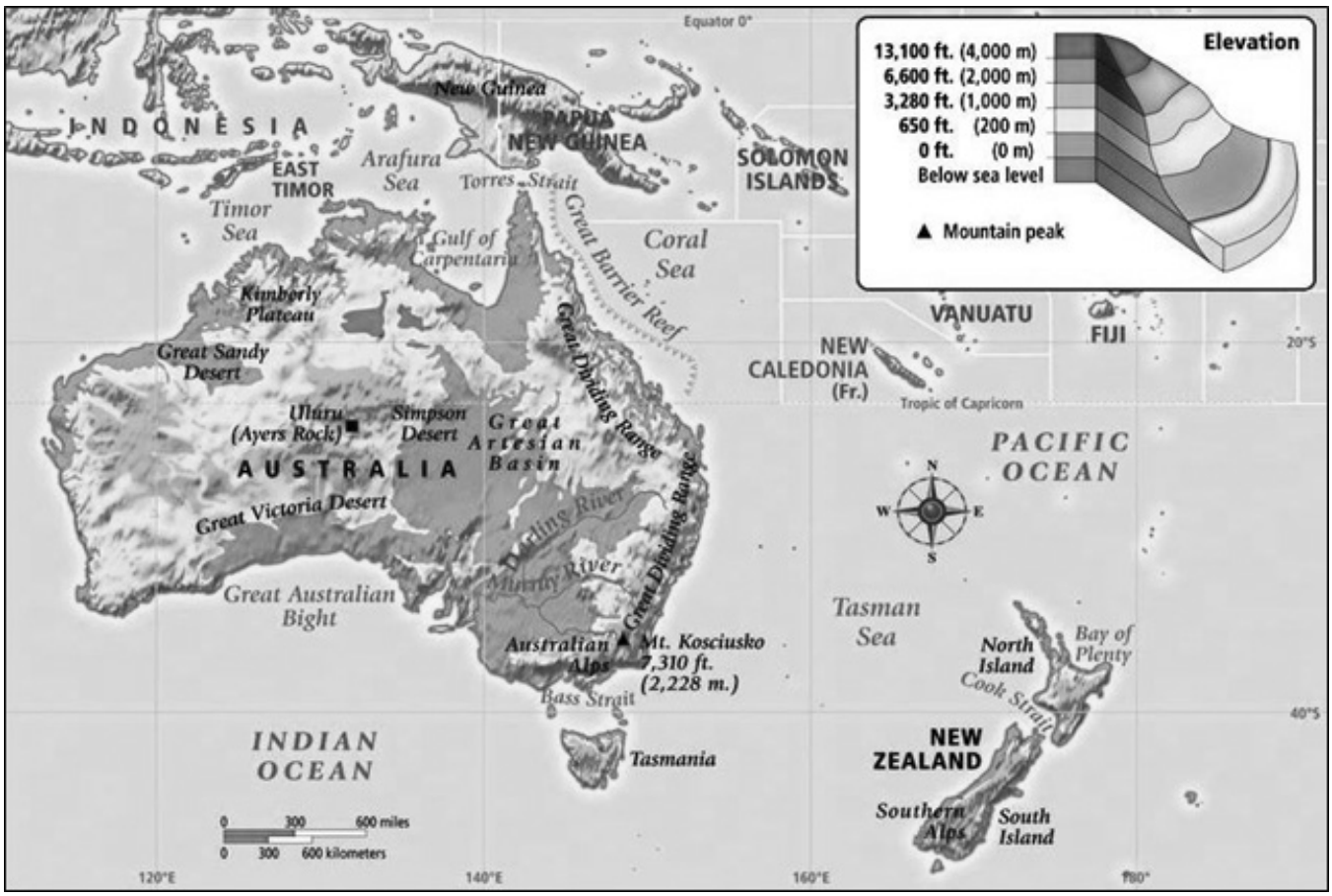

Fig 5.2: Australia Physical

is further subdivided into smaller ranges such as **New England Plateau**, the **Australian Alps**, the **Snowy Mountains**, the **Blue Mountains** and the **Grampian Mountains**.

- **Mount Kosciusko** is the high point of the **Great Dividing Range**, a long mountain range that runs along the entire eastern part of Australia from Queensland to Victoria. It is situated in New South Wales.
- The **Western Plateau** or **Australian Shield** is the largest region of Australia that covers around two thirds of the continent and is composed of the remains of the ancient Gondwanaland. **Monoliths,** or large, freestanding rocks are found throughout this area and the most famous example is **Uluru Rocks**, formerly called **Ayers Rock,** which is around 9.4 kilometers (km) in diameter and rises over 340 m above the plain.
- Lying between the **Western plateau** and **Eastern Highlands** are the **central lowlands** which also include **Carpentaria lowland basin** in the north. Lake Eyre basin lies in the middle and Darling basin in the south.
- **Great Artesian Basin** or **Great Australian Basin** is the largest areas of artesian water in the world. It consists of 1/5th of Australia and includes most of the Darling and Lake Eyre basin and extends northward to the Gulf of Carpentaria.
- The two most important rivers of Australia are "**Murray" and "Darling."**
- The lowest point in Australia is the dry bed of **Lake Eyre**, South Australia, which is 15 metres below sea level and situated in the **middle of Simpson deserts**.
- The **Outback** refers to a remote and dry region of Australia. The important deserts of Australia

7
CHAPTER

Antarctica

The continent of Antarctica was chiefly discovered in the 20th century. It is the 5th largest of the seven continents and larger than Europe and Australia. It is also the coldest and windiest continent of the world and due to the perennial frigid conditions; it is also called as **Ice continent**.

Physical Geography

Antarctica has a number of mountain summits, including the **Trans-Antarctic Mountains**, which divide the continent into eastern and western regions. These mountains hold back the ice plateau of East Antarctica like a massive dam and are deeply penetrated at places by glaciers that flow into the ice shelves.

- **Vinson Massif** at 5140 m above sea-level is the highest peak in Antarctica.
- While the ice comprises about 98% of the surface area in Antarctica, there are some areas of bare rock. Bunger Hills and the Vestfold Hills near Davis bay are the exposed rocky areas of Antarctica.
- Antarctica has the **largest reserve of freshwater**. Nearly 11 per cent of the Antarctica's ice sheets consist of **ice-shelves** which are massive floating slabs of permanent ice fringing the continent.
- **Glaciers** are made up of fallen snow that over a period of time compresses into large, thickened ice masses which flow like very slow rivers. These glaciers flow either into the ice shelves or directly out of the edge of the continent, where they break up and form **icebergs**.

Climate

The climate of Antarctica is not uniform. The high plateau region of East Antarctica yields the lowest year round temperature while the West Antarctica has a milder climate. The interior experiences almost continuous daylight during summer and darkness during winter.

- In the northward direction, there are fewer days of continuous daylight and darkness. The average annual rainfall is 5 cm making the continent one of the driest deserts.
- Antarctica experiences several unique optical phenomena including the **Aurora Australis, Ice Mirage, Parhelion and Parselene**.
- **Aurora Australis** also known as **polar lights** are

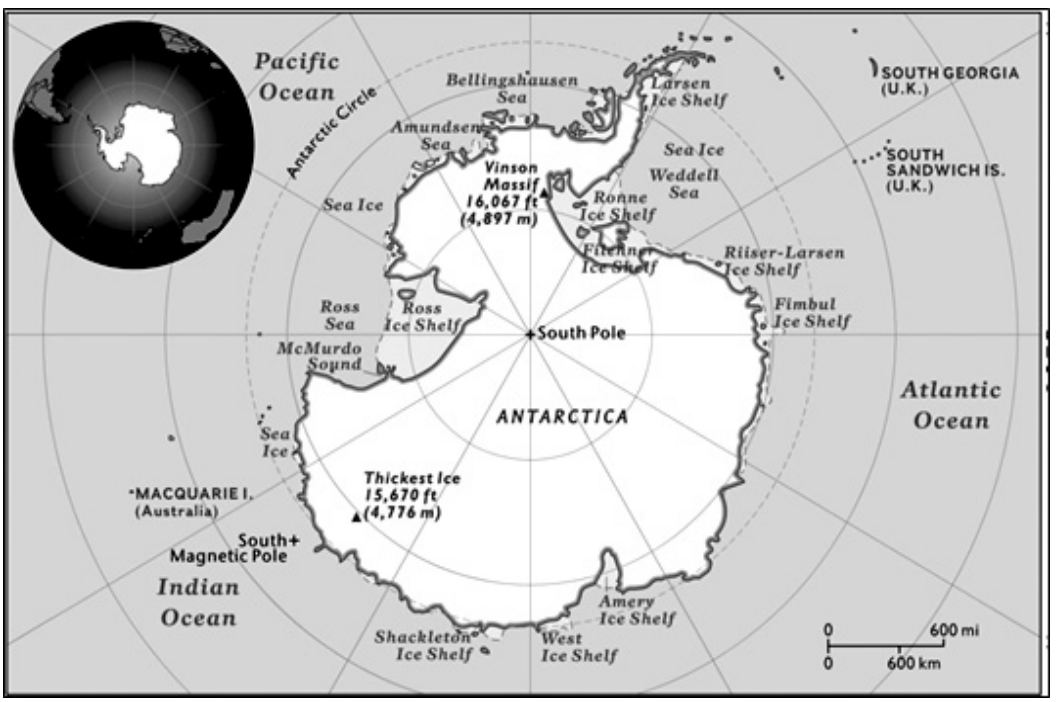

Fig 7.1: Antarctica

a natural light display in the Earth's sky and are typically located in high-latitude regions of earth. Auroras are the result of disturbances in the magnetosphere of earth caused by solar winds. It is the fantastic display of light in characteristic colour, bands and rings of various hues. A more or less similar phenomenon in the northern hemisphere is called **Aurora Borealis**.

- **Ice Mirage** is an optical phenomenon that occurs due to temperature inversion and results into several inverted (upside down) and erect (right side up) images that are stacked on top of one another.
- **Parhelion** also called as Sun Dog is a bright, sunlike optical illusion caused by sunlight passing through ice crystals in the upper atmosphere of Antarctica.
- **Parselene** is a bright spot in the sky similar to a parhelion but formed by moonlight

Social Geography

Antarctica is the only continent with no permanent human habitation. However, there are scientific research bases where scientists and support staff live for a part of the year on rotation basis.

- **Dakshin Gangotri** was the first **Indian** scientific research **base station** established in **Antarctica**, as a part of the **Indian Antarctic Program**. Now it is defunct and chiefly used as a supply base.
- **Maitri and Bharati** are the 2nd and 3rd **Antarctic research facility** of India respectively and currently both are functioning.

Economic Geography

Mineral Resources

- A wide spectrum of mineral resources is found in Antarctica. It consists of coal, copper, lead, iron, molybdenum and others. The deposit of oil and natural gas is found in the continental shelf region.
- According to the **Madrid Agreement of 1991**, the use of these mineral resources was banned for 50 years. It has been done to save the ecology and environment of the Antarctica.

Antarctica Treaty System (ATS)

- The **Antarctic Treaty System** (**ATS**) is an agreement that regulate international relations with respect to Antarctica.
- For the purposes of the treaty system, Antarctica is defined as all of the land and ice shelves **south of 60°S latitude**.
- The treaty entered into force in 1961 and currently has 54 parties.
- The treaty sets aside Antarctica as a scientific preserve, establishes freedom of scientific investigation, and bans military activity on the continent.
- The treaty was the first arms control agreement established during the Cold War.
- Since September 2004, the Antarctic Treaty Secretariat headquarters has been located in **Buenos Aires, Argentina**.

Miscellaneous Facts on Antarctica

Discovery of Antarctica: It was **James Cook** who first crossed the Antarctic Circle but unable to discover anything. Later **Sir James Clark Ross** discovered the Ross Sea, Victoria Island and the Magnetic Pole. **Roald Amundsen** (1872 - 1928) was an explorer of the North and South Poles. He led the first expedition to reach the South Pole and was the first person to visit both the North and South Pole.

Amundsen-Scott South Pole Station: This southern most post office which is located in Antarctica.

Ozone Hole: It is the ozone - layer over the continent of Antarctica which was discovered in mid 1970s. Its corresponding annual hole was identified over the Arctic Ocean in 1986. This hole is more prominent during winters due to Polar Stratospheric Clouds.

Land of Ice: The entire Antarctica is covered with the ice sheet which is as thick as 1800 metres. If all the ice of it melts, the sea would rise by 60 metres.

Cold - Pole: It refers to the point with lowest-mean annual temperature in each hemisphere. In the northern hemisphere, this is at "**Verkhoyansk**" in north-east Siberia, Russia. In the south hemisphere, the lowest recorded temperature has been at the "Soviet Research Station" of **Vostok** on the Antarctic ice plateau. "**Vostok**" and "**Verkhoyansk**" are together known as the "**Cold Poles of the Earth**".

Southern Ocean: It includes southern portion of Indian, Atlantic and Pacific Ocean and is considered as a separate ocean due to its uniform lower temperature and salt concentration.

Ross - Ice - Shelf: It is the largest ice-shelf in the world which is as large as France.

Mt. Erebus: It is an active volcano which, along with many other volcanoes, dots the coastal and island regions of Antarctica.

❖❖❖❖❖

PART-A

INDIA: PHYSICAL GEOGRAPHY

1. India: An Introduction
2. India: Geological Structure
3. Physiographic Divisions of India
    - The Northern Mountains
    - The North Indian Plains
    - The Peninsular Plateau
    - The Coastal Plains and Islands
4. Drainage System of India
5. Climate of India
6. Soils of India
7. Flora and Fauna

1 CHAPTER

India: An Introduction

India is an ancient country which is also known as **Bharatvarsh**. It is surrounded by the sea on three sides and separated from the rest of Asia by a lofty mountain chain i.e. the Himalayan mountain system. With time, due to its insular location, it has become an independent entity: **Indian sub-continent.** This sub-continent is shared by India, Pakistan, Bangladesh, Nepal and Bhutan and form the well-defined realm of **South Asia.**

- India with its area of 3.28 million sq. km accounts for 2.4 per cent of the world's land surface area and stands as the seventh largest country in the world.
- It is also the **second most populous** country of the world behind China and its population is around 17.5% of the total world population.
- The mainland of India extends, from Kashmir in the north to Kanniyakumari in the south and Arunachal Pradesh in the east to Gujarat in the west. India's territorial limit further extends towards the sea upto 12nautical miles (about 21.9 km) from the coast.
- Lying entirely in the northern hemisphere (tropical zone), the Indian mainland extends between the latitude - 8°4′N to 37°6′N and longitude - 68°7′ E to 97°25′E.
- The southernmost point of the Indian i.e., **Indira Point**, is situated at 6°30′ north in the Andaman and Nicobar Islands. Similarly **Indira Col**, which is located in the eastern Karakoram Range of the Himalayas, is the northernmost point of India.

Gulf of Mannar

- The Gulf of Mannar lies between the west coast of Sri Lanka and the southeastern tip of India in the Coromandel Coast region.
- The dugong (sea cow), a 'Vulnerable' species as per IUCN is found here.

- Expanse of India is about 3,214 km from north to south and about 2,933 km east to west.
- The total length of the **mainland coastline is nearly 6,100 km** and land frontier about 15,200 km. Length of entire coastline of India including the **mainland and island territories is around 7,517 km.**
- India is officially known as Republic of India and is comprised of total of 28 states and 8 Union territories. Recently, Jammu and Kashmir got reorganized into two union territories i.e Jammu and Kashmir and Ladakh. Merging of Dadra and Nagar Haveli and Daman and Diu as one union territory.
- The Andaman and Nicobar Islands in the Bay of Bengal and the Lakshadweep islands in the Arabian Sea are parts of the Indian Territory.

Fig: Physical Map of India

3
CHAPTER

Physiographic Divisions of India

'**Physiography**' of an area is the outcome of structure, process and the stage of development.

- The land of India is characterised by great diversity in its physical features. The north has a vast expanse of rugged topography consisting of a series of mountain ranges with varied peaks, beautiful valleys and deep gorges.The south consists of stable table land with highly dissected plateaus, denuded rocks and developed series of scarps. In between these two lies the vast North Indian Plains.
- According to one estimate, 29.3 per cent of area of India is occupied by mountains and hills, 27.7 per cent by plateaus and 43 per cent by plains.

From a physiographical point of view, India can be divided into following four regions:

1. Northern Mountain System,
2. Indian Plateaus,
3. Northern Plains and,
4. Coastal Plains and Islands.

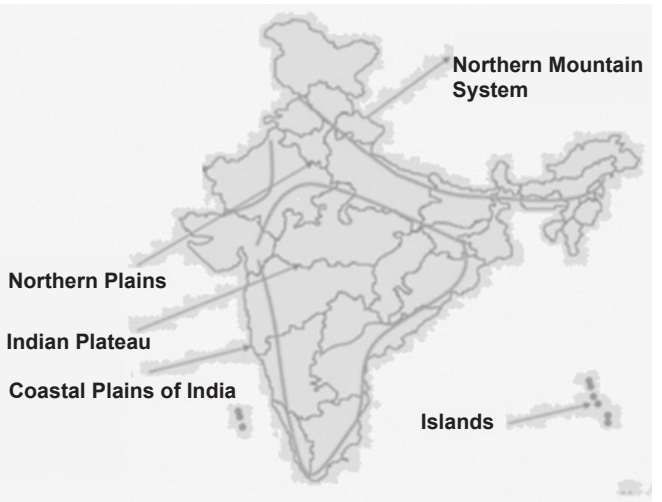

Fig: Physiographic Divisions of India

Northern Mountain System

Northern Mountain System is located all along the northern boundary of India and contains **the youngest and loftiest mountain chains of the world** i.e., the Himalayas.

- Apart from the Himalayas, it also contains **Trans-Himalayan mountain ranges** and **North-eastern mountain hills**.
- They are known as one of the **loftiest** mountain chains because more than 14 peaks of the Himalayas are more than about 8000 meters above sea level.
- They are also known as one of the **youngest mountain chain** because it belongs to tertiary orogeny. Himalayan orogeny started only 65 million years ago and it is still undergoeing.

Fact Point

The **Indian plate** is still moving toward Eurasia at a rate of 5 cm per year and pushing Tibet upward. The Himalayas continue to rise by an average of 2 cm each year.

Orogeny of Himalayan System

Mountain building process is a complex geographical phenomenon. Many theories have been put forward to explain the orogeny of mountains, but none of them fully explained the diverse mountain systems of the world.

Geosyncline theory: The **geosyncline concept** was first developed by the American geologists **James Hall** and **James Dana**. Geosyncline is a linear trough of subsidence of the earth's crust within which vast amounts of sediment accumulate and provide the materials for orogeny. For example, upliftment of Himalaya has been facilitated by Tethys geosynclines.

Plate Tectonics: It is a scientific and most widely accepted recent theory to explain the formation of different geographical features of earth such as orogeny of young fold mountain like Himalayan.

Breaking of Pangea & Northward Drift

- About 225 million years ago **Pangaea** broke into two new supercontinents Laurasia and Gondwanaland, which were separarted by Tethys Sea.
- The **Gondwanaland** began to break up during late Paleozoic era and Indian platefinally broke away around 100 million year ago and started drifting northward towards Eurasia.

- Northern movement of the Indian plate led to the collision with Eurasian plate. The resultant compression, buckling and subduction led to the formation of different mountain ranges of the Himalayas.
- Although Himalan orogeny is still undergoing, the main upheaval period is classified from mid Eocene to mid Pliestocene period.
- Folding was **phase wise** and **Prof Wadia** has classified the upliftment into 3 parts:
  1. Mid Eocene to Oligocene period related to Central or Inner Himalaya.
  2. Mid Miocene period related to Inner and Outer Himalayas.
  3. Pliocene to Mid Pleistocene period related to outer Himalaya and Shivaliks.

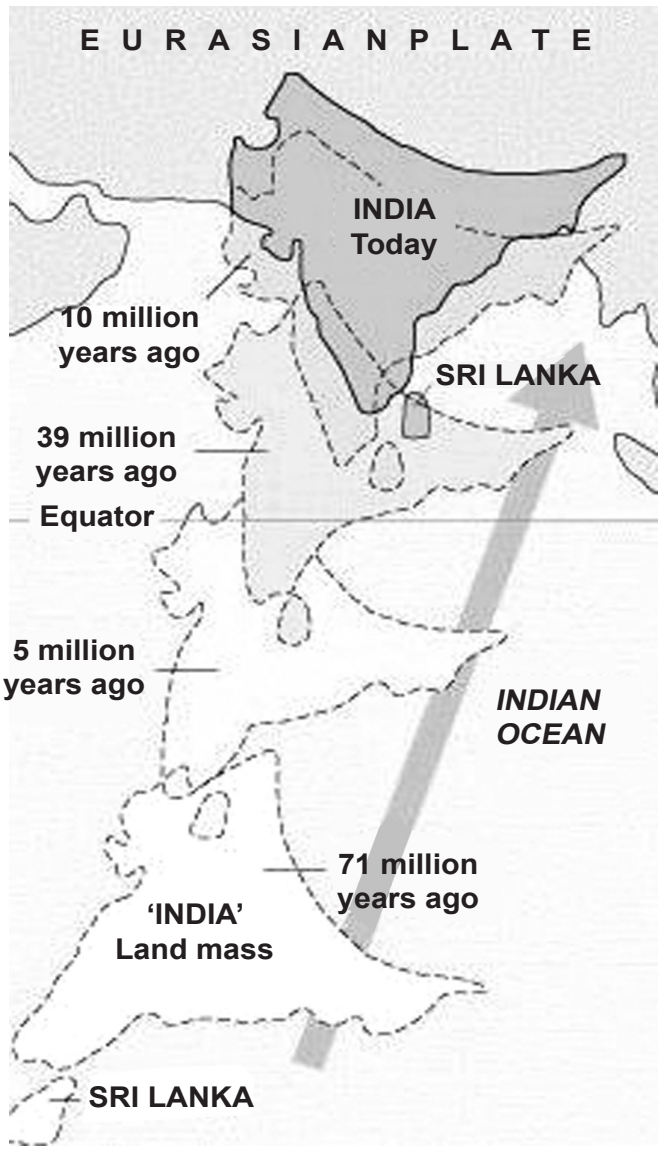

Figure: The Formation of the Himalays

Extent of Himalayas

Himalayas stretches 2400 km from west to east that is from the gorge of Indus around Nanga Parvat to the gorge of Brahmaputra Riveraround Namcha Barwa.

North-South Division of Himalayan System

Vertically the lofty Himalayas can be divided into the following **three parallel divisions** as has been shown in the below figure:

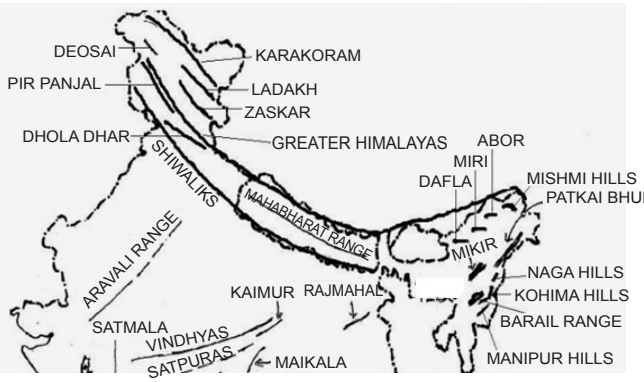

Figure: Himalayan System

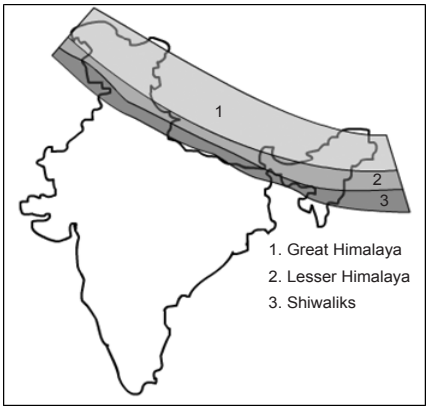

Fig: Parallel ranges of Himalaya

1. The Great Himalayas/Himadri/Inner Himalayas

- They are the **highest and the most continuous** mountain chain of the world and are separated from Trans Himalayas by suture zone.They comprise the northern most ranges having an average height of 6100 m above mean sea level and with an average breadth of about 25 km.

Syntaxial Bends of the Himalayas

At the extreme ends of west and east, the Himalayas take southward turn in deep knee bend flexures which are called syntaxial bends.

Western Syntaxial Bend: The western syntaxial bend is near Nanga Parwat where Indus has cut a deep gorge.

Eastern Syntaxial Bend: It is at Namcha Barwa where mountains take south turn just after the Brahmaputra river enters into India after taking a great bend.

5
CHAPTER

Climate of India

Climate is the statistics of weather over long periods of time. It is measured by assessing the patterns of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. The climate of a location is affected by its latitude, terrain, and altitude, as well as nearby water bodies and their currents.

The Climate of India comprises a wide range of weather conditions across a vast geographic scale and varied topography. The India Meteorological Department (IMD) divides the year into four distinct seasons:

(a) Dry Winter Season (Mid December, January and February),

(b) Dry Summer Season (March to May),

(c) Wet(Rainy) season (June to September), and

(d) Retreating Monsoon Season (October to Mid December).

Tropic of Cancer passes through eight Indian states:

1. Gujarat	2. Rajasthan	3. Madhaya Pradesh	4. Chattisgarh
5. Jharkhand	6. West Bengal	7. Tripura	8. Mizoram

Factors Affecting Climate of India

The Tropic of Cancer—the boundary between the tropics and subtropics—passes through the middle of India, so the bulk of the country can be regarded as tropical country. The following are the factors that affect the climate of India:

- **Geographical Location and Latitudinal Extent:**
  (a) The mainland of India extends roughly from 8°N to 37°N and the Tropic of Cancer and passes through the middle of the country. Areas south of the Tropic of Cancer are closer to the equator and experience high temperature throughout the year.
  (b) The northern parts on the other hand lie in the warm temperature zone. Hence they experience comparatively low temperatures.
  (c) Water bodies comprising the Arabian Sea and the Bay of Bengal surround the peninsular India and make climatic conditions mild along the coastal areas.
- **Distance from the Sea**
  (a) Areas near the coast have equitable or maritime climate.
  (b) On the contrary, interior locations are deprived of the moderating influence of the sea and experience extreme or continental climate.
- **The Himalayas**
  (a) India is separated from the rest of Asia by the impenetrable wall of the Himalayan mountain ranges. These ranges **protect India from the**

bitterly cold and dry winds of Central Asia during winter.

(b) Further, these mountain ranges act as an effective physical barrier for rain bearing south-west monsoon winds to cross the northern frontiers of India. Thus, the Himalayan mountain ranges act as a **climatic divide** between the Indian Sub-continent and Central Asia.

- **Physiography of India**:
  (a) The south-west monsoon winds from the Arabian sea **strike almost perpendicular at the Western Ghats** and cause copious rainfall in the Western Coastal plain and the western slopes of the Western Ghats.
  (b) On the contrary, vast areas of Maharashtra, Karnataka, Andhra Pradesh and Tamil Nadu lie in rain-shadow or **leeward side** of the Western Ghats and receive scanty rainfall.
- **Monsoon Winds:**
  (a) The word monsoon literally means '**reversal of winds'** and complete reversal of the monsoon winds brings about a sudden change in the seasons—the harsh summer season suddenly giving way to eagerly awaited monsoon or rainy season.
  (b) The south-west summer monsoonhas two branches **the Arabian Sea** and **the Bay of Bengal** branch.
  (c) The **north-eastern winter monsoon** travel from land to sea and do not cause much rainfall except along the Coromandel Coast after getting moisture from the Bay of Bengal.
- **Jet Streams: Westerly and Easterly Jet:**
  (a) **Westerly jet stream** blows at a very high speed during winter over the sub-tropical zone. Meteorologists believe that this branch of jet stream exercises a significant influence on the winter weather conditions in India.
  (b) This jet stream is responsible for bringing **western disturbances** from the Mediterranean region in to the Indian subcontinent.
  (c) Reversal in upper air circulation takes place in summer due to the apparent shift of the Sun's vertical rays in the northern hemisphere.
  (d) The westerly jet stream as replaced by the **easterly jet stream** which owes its origin to the **heating of the Tibet plateau**. This help in the sudden onset of the south-west monsoons.
- **Tropical Cyclones:**
  (a) Tropical cyclones originate in the Bay of Bengal and Arabian Sea and the influence large parts of the peninsular India.
  (b) Majority of the cyclones originate in the Bay of Bengal and influence the weather conditions during the south-west monsoon season.
  (c) Some cyclones are born during the retreating monsoon season, i.e., in October and November and influence the weather conditions along the eastern coast of India.
- **El-Nino Effect:**
  (a) El-Nino is the **replacement of cold Humbolt (Peru) current by narrow warm current** which occasionally appears off the coast of Peru in December. It is a temporary replacement and is responsible for wide spread floods and droughts in the tropical regions of the world.
  (b) Sometimes it becomes more intense and increases the surface water temperatures of the sea by 10°C. This warming of tropical Pacific waters affects the global pattern of pressure and wind systems including the monsoon winds in the Indian Ocean.
- **La-Nina:**
  (a) After an El-Nino, weather conditions return to normal. However, sometimes trade winds become so strong that they cause **abnormal accumulation of cold water in the central and eastern Pacific region**. This event is called La Nina, which in effect is the complete opposition of El Nino.
  (b) In India, the presence of La Nina portends exceptionally good news. It is the harbinger of heavy monsoon showers in India.
- **Southern Oscillation:**
  (a) There is a strange linkage of meteorological changes often observed between the Indian and the Pacific Oceans. It has been noticed that whenever the surface level pressure is high over the Pacific Ocean, there is low pressure over theIndian Ocean and vice-versa. This interrelation of high and low pressure over the Pacific and the Indian Ocean is called **Southern Oscillation**.
  (b) **Intensity of Southern oscillation** or **Southern Oscillation Index (SOI)** is measured by pressure difference of **Tahiti** in Pacific Ocean and **Port Darwin** in Indian Ocean.
  (c) When the winter pressure is high over the Pacific Ocean and low over the Indian Ocean i.e., **Positive SOI**, the south-west monsoons in India tend to be stronger. In the reverse case, the monsoons are most likely to be weaker.

7
CHAPTER

Flora and Fauna

India is bestowed with a wide range of flora and fauna. The natural vegetation is the endowments of nature. They grow naturally by following the climatic variables. Due to a diverse geographical and climatic condition, an extensive range of natural vegetation grows in India. The types of natural vegetation differ according to precipitation, soil, climate and topography. The cultivated crops and fruits, orchards form part of vegetation, but not natural vegetation. Extensive flora supports diverse range of fauna in India.

Flora: Plants of a particular region listed by species and considered as a group.

Vegetation: Assemblage of plant species living together in a particular environmental setup.

Natural Vegetation: Vegetation community that has been left undisturbed over a long time.

Forest: Large tract of land covered by trees and shrubs.

Forests in India

It is estimated that about 24.39 percent of India's area is covered by the forest and trees. That is about 7.08 lakh Sq. Kmareas is inder forest and 0.98 lakh Sq Km under trees.

- India is among the top ten countries which are forest rich. These top ten countries are host of the 60% of forest of world.
- Besides wood forest, India has large amount of non wood forests. These non wood forests are the source of Latex, gum, aroma chemicals, medicines etc.
- The top state of India having the largest area under forests is Madhya Pradesh followed by Arunachal Pradesh, Chhattisgarh and Odisha.

Amendment of Indian Forest Act-1927

The government of India recently amended the Indian Forest Act, 1927, and the new changes can transform the bamboo sector. Before, bamboo was categorised as a tree. After amending Section 2(7) of Indian Forest Act, 1927, bamboo is no longer a tree and felled bamboo too is not timber. So any bamboo grown in private or homestead land by millions of farmers does not require a felling permission or transit permission from any state forest department.

- Indian forests are the home of many animals and birds. About 90000 animal species are found in India and about 1300 species of birds are living in these forests.
- India ranks first in consuming fuel wood. But most of the fuel wood comes from the agricultural waste. Otherwise no forests would have remained.

Classification of Forests in India

Forests in India are classified on a number of bases:

1. On the basis of Administration (India Forest Act 1927)
   (a) Reserverd Forest (53% Area) Public activity prohibited.
   (b) Protected Forest (29% Area) Public activity regulated.
   (c) Unclassified Forest (18% Area) No restriction.
2. On the basis of ownership
   (a) State Forst i.e., state ownership.
   (b) Community Forest i.e., Community ownership.
   (c) Private Forest i.e., Individual ownership.
3. On the basis of tree composition
   (a) Tropical Forest i.e., Evergreen broad leave.
   (b) Sub Tropical Forest i.e., Broad leave deciduous.
   (c) Coniferous Forest i.e., Evergreen conifers with needle.
4. Geographical classification

Classification of **Champion and Seth** is the most accepted geographical classification of Indian forest and it classifies it into 16 types and 136 sub-types based on vegetation and climate.

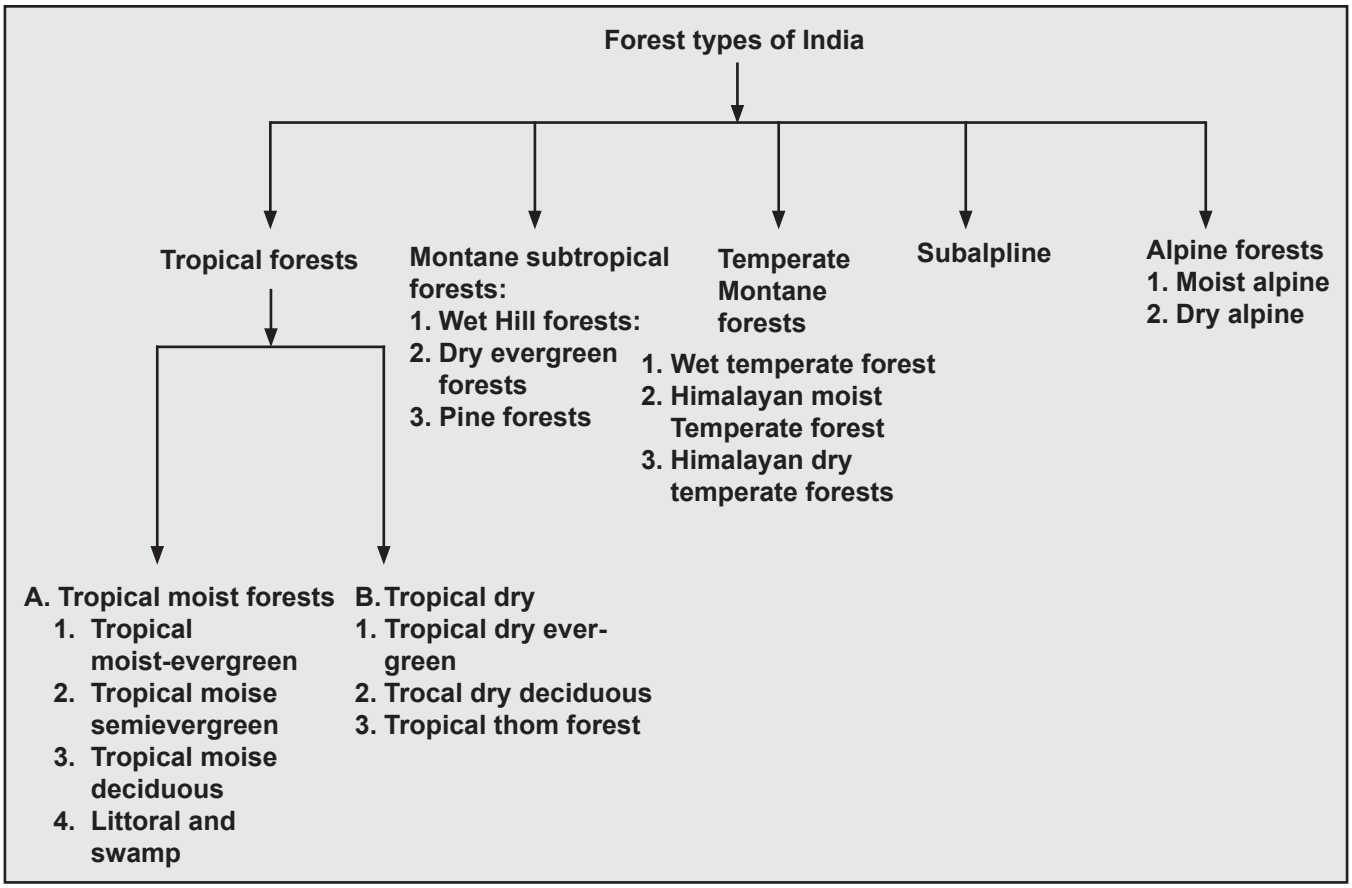

Fig: Forest types of India

Tropical Moist Forest

1. Tropical Moist Wet Evergreen

- **Location:** Tropical Moist wet evergreen forests are found in the south along the Western Ghats and the Nicobar and Andaman Islands and all along the north-eastern region.
- The true evergreen forests are found along the western side of the Western Ghats, **Tamil Nadu, Kerala and Karnataka** in a strip running from north-east to south-west direction across **Arunachal Pradesh, Upper Assam, Nagaland, Manipur, Mizoram and Tripura** upto a height of 1070 metres and in the **Andaman and Nicobar Islands**.
- **Characteristics:** It is characterized by tall, straight evergreen trees that have a buttressed trunk or root on three sides like a tripod that helps to keep a tree upright during a storm. These trees often rise to a great height before they open out like a cauliflower. The trees in this forest form a tier pattern: shrubs cover the layer closer to the ground, followed by the short structured trees and then the tall variety.
- **Common Tress Found:** The more common trees that are found here are the jackfruit, betel nut palm, jamun, mango, and hollock. Beautiful fern of various colours and different varieties of orchids grow on the trunks of the trees.

2. Tropical moist Semi-Evergreen Forests

- **Location:** Semi-evergreen forests are found in the Western Ghats, Andaman and Nicobar Islands, and the Eastern Himalayas.
- **Characteristics:** Such forests have a mixture of the wet evergreen trees and the moist deciduous trees. The forest is dense and is filled with a large variety of trees of both types.

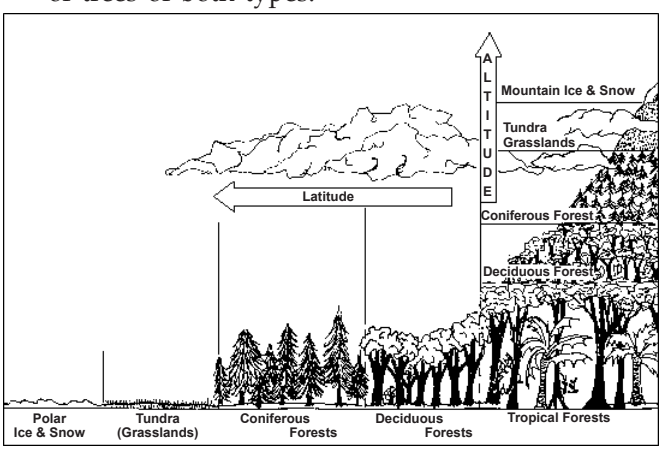

Fig: Altitunal and Latitudinal variation of Forest

2
CHAPTER

Agriculture

Agriculture is a primary activity. It includes growing crops, fruits, vegetables, flowers and rearing of livestock. In the world, 50 per cent of persons are engaged in agricultural activity. Two-thirds of India's population is still dependent on agriculture. It also plays a vital role in India's economy. 54.6% of the total workforce is engaged in agricultural and allied sector activites (Census 2011) and accounts for 19.9% of the country's Gross Domestic Produced for the year 2020-21.

Salient Features of Indian Agriculture

Subsistence Agriculture: Most parts of India practice subsistence agriculture. This type of agriculture has been practised in India for several hundreds of years and still prevails in a larger part of India in spite of the large scale change in agricultural practices after independence.

- **Pressure of population on Agriculture**: Despite increase in urbanization and industrialization, about 55% of population is still directly or indirectly dependent on agriculture.
- **Low Productivity:** The average productivity of crops is very low in comparison to several other agriculturally well developed countries of the world.
- **Small Holdings**: The average size of agricultural holdings is still very small and uneconomical to cultivate the national average being around 1.69 hectares. Because of these uneconomic holdings, there is a great hindrance to the developmental programme of agriculture.
- **Dependence on Monsoon:** Agriculture in India depends on the monsoon rains, which are uncertain, irregular and inequitably distributed. Artificial irrigation is very essential for growing various crops.
- **Large Rainfed Areas:** India has the largest irrigated area of the cultivated land. Still the facilities of irrigation are available only on 49 percent area of our cultivated land and 51 percent of the cropped area being rainfed.
- **Dominance of Food Crops**: Indian farmers grow a wide variety of crops both food crops and commercial or cash crops. Yet a very large portion of our crops consist of food grains.
- **Crop Seasons:** There are three crop-seasons in India Rabi (November to April) and Kharif (June to October). An extra-crop known as "Zayad" is also grown after the kharif crop in the months of April May and June.
- **Skewed Land Distribution:** Distribution of agricultural land in India is unjust and unfair. There is a considerable degree of concentration of land holdings among the rich landlords, farmers and money-lenders throughout the country. The vast majority of farmers own very small and uneconomic size of holdings leading to higher cost per unit.
- **Mechanization of farming**: Green Revolution took place in India in the late sixties and early seventies. After more than forty years of Green Revolution and revolution in agricultural machinery and equipments, complete mechanization is still a distant dream.

Types of Farming in India

Based on nature and purpose of farming, major types of farming practiced in India are following:

(a) Subsistence and commercial farming

- Majority of farmers in India practises subsistence farming. This means farming for own consumption. In other words, the entire production is largely consumed by the farmers and their family and they do not have any surplus to sell in the market.
- In this type of farming, landholdings are small and fragmented. Cultivation techniques are primitive and simple. In other words there is a total absence of modern equipments like tractors and farm inputs like chemical fertilizers, insecticides and pesticides.

- In this farming, farmers mostly cultivate cereals along with oil seeds, pulses, vegetables and sugarcane.
- Commercial farming is just the opposite of subsistence farming. In this case, most of the produce is sold in the market for earning money. In this system, farmers use inputs like irrigation, chemical fertilizers, insecticides, pesticides and High Yielding Varieties of seeds.
- Some of the major commercial crops grown in different parts of India are cotton, jute, sugarcane, groundnut etc. Rice farming in Harayana is mainly for commercial purpose as people of this area are predominantly wheat eaters. However in East and North-Eastern states of India, rice cultivation would be largely of subsistence type.

(b) Intensive and Extensive Farming

- The basic difference between these two types of farming is the amount of production per unit of land.
- In comparison with temperate areas of USA, Canada, and former USSR, India does not practise extensive cultivation.
- When large patch of land is used for cultivation then it is called as extensive farming. Here, total production may be high due to larger area but per unit are production is low.
- Intensive Farming records high production per unit of land. Best example of intensive cultivation is in Japan where availability of land for cultivation is very limited. Similar kind of situation can be observed in the state of Kerala in India.

(c) Plantation Farming

- It is an estate where a single cash crop is grown for sale. This type of agriculture involves growing and processing of a single cash crop purely meant for sale.
- Tea, coffee, rubber, banana and spices are all examples of plantation crops. Most of these crops were introduced in India by the Britishers in the 19th Century.

(d) Mixed Farming

- It is a situation in which both raising crops and rearing animals are carried on simultaneously. Here farmers engaged in mixed farming are economically better of than others.
- All classifications are. It may overlap. For example, Banana is a plantation type of farming. It can also be classified as commerical farming.

Land-use pattern in India

Land-use records are maintained by land revenue department. The land use categories add up to reporting area, which is somewhat different from the geographical area. The Survey of India is responsible for measuring geographical area of administrative units in India.

- The land-use categories as maintained in the Land Revenue Records are as follows:
- **Forests**: It is important to note that area under actual forest cover is different from area classified as forest.The latter is the area which the Government has identified and demarcated for forest growth. The land revenue records are consistent with the latter definition. Thus, there may be an increase in this category without any increase in the actual forest cover.
- **Barren and Wastelands**: The land which may be classified as a wasteland such as barren hilly terrains, desert lands, ravines, etc. normally cannot be brought under cultivation with the available technology.
- **Land put to Non-agricultural Uses**: Land under settlements (rural and urban), infrastructure (roads, canals, etc.), industries, shops, etc., are included in this category. An expansion in the secondary and tertiary activities would lead to an increase in this category of land-use.
- **Area under Permanent Pastures and Grazing Lands**: Most of this type land is owned by the village 'Panchayat' or the Government. Only a small proportion of this land is privately owned. The land owned by the village panchayat comes under 'Common Property Resources'.
- **Area under Miscellaneous Tree Crops and Groves (Not included in Net sown Area)** : The land under orchards and fruit trees are included in this category. Much of this land is privately owned.
- **Culturable Wasteland**: Any land which is left fallow (uncultivated) for more than five years is included in this category. It can be brought under cultivation after improving it through reclamation practices.
- **Current Fallow:** This is the land which is left without cultivation for one or less than one agricultural year. Fallowing is a cultural practice adopted for giving the land rest. The land recoups the lost fertility through natural processes.
- **Fallow other than Current Fallow**: This is also a cultivable land which is left uncultivated for more than a year but less than five years. If the land is left uncultivated for more than five years, it would be categorised as culturable wasteland.

4
CHAPTER

Minerals in India

Minerals

A mineral is a naturally occurring chemical compound usually of crystalline form and abiogenic in origin (not produced by life processes). A mineral has one specific chemical composition, whereas a rock can be an aggregate of different minerals or mineraloids. Minerals are distinguished by various chemical and physical properties.

Differences in chemical composition and crystal structure distinguish the various species, which were determined by the mineral›s geological environment when formed. Changes in the temperature, pressure, or bulk composition of a rock mass cause changes in its minerals.

Minerals can be described by their various physical properties, which are related to their chemical structure and composition. Common distinguishing characteristics include crystal structure and habit, hardness, lusture, diaphaneity, colour, streak, tenacity, cleavage, fracture, parting, specific gravity, magnetism, taste or smell, radioactivity, and reaction to acid.

Classification of Minerals

Based on physical and chemical properties minerals are divided into two groups – Metallic and Non-Metallic and. Metallic minerals are further subdivided into ferrous and non-ferrous minerals based on the iron content. Energy minerals form a special sub category under non-metallic minerals based on their energy value.

Mineral Belts in India

The distribution of mineral and energy resources is uneven. It's because occurrence of mineral resources is associated with certain types of geological formation. For example:

- Coal deposits are mostly associated with Gondwana system (97% of the total coal reserves of India).

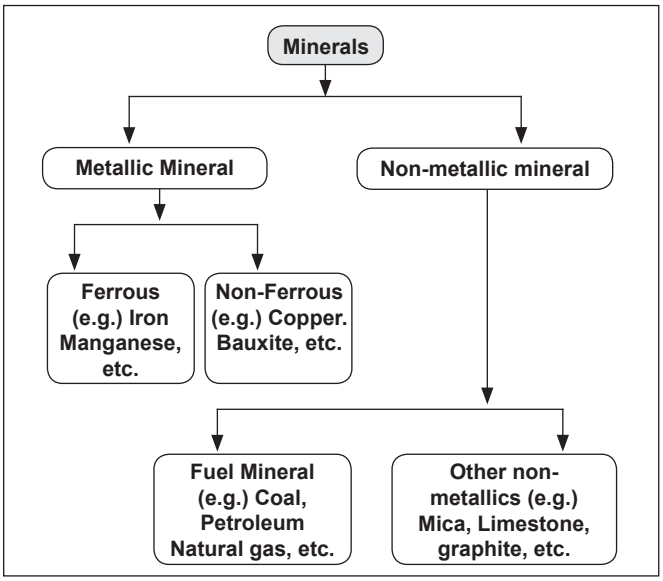

Fig: Classification of Minerals

- Petroleum reserves are located in the sedimentary basins of Assam, Gujarat and Mumbai High i.e., off-shore region in the Arabian Sea.
- Dharwar and Cuddapah systems contain resources of major metallic minerals like copper, lead and zinc.
- Major non-metallic minerals like limestone, dolomite, gypsum, calcium and sulphate are found in cuddapah and upper vindhyan system.
- In India most of the major mineral resources occur to the east of a line linking Mangaluru and Kanpur and are generally concentrated in three broad belts. These belts are:

1. **North eastern plateaus:** It covers chhotanagpur plateau, Orissa plateau and eastern Andhra plateau. This belt contains rich deposits of a variety of minerals, speacially used for metallurgical industries. Prominent minerals that are large and widely distributed are iron ore, manganese, mica, bauxite, limestone and dolomite. This region has also rich deposits coal, along the river valleys of Damodar, Mahanadi and Son. This region has also substantial amount deposit of copper, uranium, thorium and phosphate.

2. **South-western plateaus:** This region extends over Karnataka plateau and adjoining Tamil Nadu plateau and is rich in metallic minerals particularly in iron ore, manganese and bauxite and in some non-metallic minerals. All the three gold mines of India are found in this region. However, coal is not found in this plateau region.
3. **North-western region**: This belt extends from gulf of Khambhat in Gujarat to the Aravalli range in Rajasthan. Petroleum and natural gas are principal resources of this belt. Deposits of other minerals are small and scatterred. However, it is known for reserves and production of several non-ferrous metals particularly copper, silver, lead, and Zinc.
4. Outside of these mineral belts, upper Brahmaputra valley is a significant petroleum producing area whereas Kerala possesses enormous concentration of heavy mineral sands. Outside these above mentioned areas minerals deposits are very poor, scatterred and reserves are inconsistent.

Metallic Minerals

Ferrous Minerals

Ferrous minerals are the minerals having iron (Fe) as an element in the composition. For e.g., Iron ore, Manganese and Chromium. They provide a strong base for the development of metallurgical industries. India is well endowed with ferrous minerals both in terms of reserves and production.

1. Iron-ore

- India is endowed with vast reserves of good quality of iron ore. It has largest reserve in Asia and possesses over 20 percent of the world's total reserves.
- The quality of Indian ore is very high with iron content of above 60 percent. Haematite and magnetite are the two main iron ores of India.
- Magnetite is the superior quality iron ore and contains upto 72 percent pure iron. It is dark brown to blackish in colour, and is often referred as 'black ores'. It is found in southeastern Singhbum (Jharkhand), Bellary-Hospet (Karnataka), Barajamda (Odisha) and Bailadila (Chattishgarh).
- Haematite is the chief ore of India and contains 60-70% percent of iron. It is red in color and is often referred as 'red ore' and is found in Andhra Pradesh, Jharkhand, Odisha, Chhattisgarh, Goa, Karnataka, Maharashtra and Rajasthan.
- The resources of very high grade ore are limited and are restricted mainly in Bailadila sector of Chhattisgarh and to a lesser extent in Bellary-Hospet area of Karnataka and in Jharkhand and Odisha.
- Only six states i.e., Jharkhand, Odisha, Madhya Pradesh, Chhattisgarh, Karnataka and Goa account for over 95 per cent of the total reserves of India.
- Karnataka has the largest reserves of iron ore in India. This is followed by Odisha, Jharkhand and Chattishgarh.
- Odisha is the largest producer of iron ore in India and is followed by Chattishgarh, Karnataka and Jharkhand.

Fig: Distribution of Iron ore in India

Important iron ore mines in India	
Gurumahisani,Sulaipet and Badampahar	Mayurbhaj, Odisha
Kiruburu	Kendujhar, Odisha
Bonai	Sundergarh, Odisha
Noamundi	Poorbi Singhbhum, Jharkhand
Gua	Pashchimi Singhbhum, Jharkhand
Dalli and Rajhara	Durg, Chattishgarh

Manganese

- It is an important raw material for smelting of iron ore and also used for manufacturing ferro alloys. Its deposits are mainly associated with Dharwar system.
- Odisha has the largest Manganese reserves in India. Major mines in Odisha are located in the central

6 CHAPTER Industries in India

Industry

Industry implies the transformation of existent materials into something new, into goods that are used as end-products themselves, or are utilized to manufacture more goods.

Industries can be classified into several groups. A brief account is given below:

1. **On the basis of Strength of Labour**
- Large-scale Industries
- Medium-scale Industries
- Small-scale Industries

2. **On the basis of Raw Material and Finished Goods**
- **Heavy Industries**: Industries, which use heavy and bulky raw materials and produce products of the same category, are called heavy industries. Iron and steel industry presents a good example of heavy industries.
- **Light Industries:** The light industries use light raw materials and produce similar finished products. Textile industry, electronics, fans and sewing machines are light industries.

3. **On the basis of Ownership:** Since the beginning of the planned development of Indian economy in 1951, industries are divided into the following three classes:
   - **(i) Private Sector Industries:** Industries owned by individuals or firms such as Bajaj Auto or TISCO situated at Jamshedpur are called private sector industries.
   - **(ii) Public Sector Industries:** Industries owned by the state and its agencies, like Bharat heavy Electricals Ltd. or Bhilai Steel Plant or Durgapur Steel Plant and Integral Coach Factory at Kapurthala are public sector industries.
   - **(iii) Joint Sector Industries:** Industries owned jointly by the private firms and the state or its agencies, such as Gujarat Alkalies Ltd. or Oil India Ltd. fall in the group of joint sector industries.

4. **On the basis of Source of Raw Material**
   - **(i) Agro-based Industries:** Agro-based industries are those industries which obtain raw material from agriculture. Cotton textile, jute textile, silk, sugar, vegetable oil and paper industry are representative industries of agro-based group of industries.
   - **(ii) Mineral-based Industries:** The industries that receive raw material primarily from minerals such as iron and steel, aluminium and cement industries fall into this category.
   - **(iii) Pastoral-based Industries:** These industries depend upon animals for their raw material. Hide, skin, bone, horn, shoes and dairy are some of the pastoral-based industries.
   - **(iv) Forest-based Industries:** The industries which use forest products as their raw materials are known as forest-based industries. Paper, card-board, lac, rayon, resin, and cane basket are examples of forest based industries.

5. **On the basis of manufactured products industries are classified in eight classes. These are:**
   - **Metallurgical Industries,**
   - **Mechanical Engineering Industries,**
   - **Chemical and Allied Industries,**
   - **Textile Industries,**
   - **Food Processing Industries,**
   - **Electricity Generation,**
   - **Electronics Industries, and**
   - **Communication Industries.**

6. **Miscellaneous Industries**
   - **(i) Village industries:** Village industries are located in villages and primarily cater to the needs of the rural people. They usually employ local machinery such as oil extractor, flour-grinding and agricultural implements.
   - **(ii) Cottage Industries:** Industries which artisans set up in their own houses, work with wood, cane, brass, stone, etc., are called cottage industries.

Handloom Khadi and leather work at the artisans' house fall in this category.

(iii) Consumer Industries: Consumer industries convert raw materials or primary products into commodities directly used by the people. Textile industry, bakeries, etc., are some of the consumer industries.

(iv) Basic Industries: Industries, on which depend many other industries for their manufacturing processes, are called basic industries. Iron and steel industry and power generating industry are included in this category.

(v) Capital-intensive Industries: Industries requiring huge investments are called capital-intensive industries. Iron and steel, cement and aluminium are capital-intensive industries.

(vi) Labour-intensive Industries: Such industries which require huge labour force for running them are called labour-intensive industries. In these industries, labour is more important than capital. Shoe- manufacturing and bidi making, etc. are included in these industries.

Factors that affect Location of Industries

Location of industries is influenced by several factors like access to raw materials, power, market, capital, transport and labour. Relative significance of these factors varies with time and place. There is strong relationship between raw material and type of industry. It is economical to locate the manufacturing industries at a place where cost of production and delivery cost of manufactured goods to consumers are the least. Transport costs, to a great extent, depend on the nature of raw materials and manufactured products.

- **Raw Materials:** Industries using weight-losing raw materials are located in the regions where raw materials are located. For example, sugar mills in India are located in sugarcane growing areas such as Uttar Pradesh, Maharashtra and Karnataka.
- **Power:** Power provides the motive force for machines, and therefore, its supply has to be ensured before the location of any industry. However, certain industries, like aluminium and synthetic nitrogen manufacturing industries tend to be located near sources of power because they are power intensive and require huge quantum of electricity.
- **Market:** Markets provide the outlets for manufactured products. Heavy machine, machine tools, heavy chemicals are located near the high demand areas as these are market orientated. Cotton textile industry uses a non-weight-losing raw material and is generally located in large urban centre, e.g., Mumbai, Ahmedabad and Surat.
- **Transport:** Industries are located close to the nodal point having transport links. The industries shifted to interior locations, only when railway lines were laid. All major industrial plants are located on the trunk rail routes.
- **Labour:** Labour is an important factor of production and labour intensive industries prefer the location with cheap labour**.** For e.g., Textile and Leather industry.
- **Historical Factors:** British promoted few industries in selected areas. They utilised this initial edge to flourish in post indenpendence period. For e.g., Mumbai, Ahmedabad, Delhi etc.
- **Industrial Policy:** India, being a democratic country aims at bringing about economic growth with balanced regional development**.** In this wake industries were set up at Bhilai, Durgapur and Bokaro as part of industrial policy of government.

Major Industries in India

The Industrial sector of India is very well-developed. The major industries are Iron and Steel, Cement, Jute, Automobiles, Food processing, Steel, Cotton and Textiles, Rubber, Silk and many more.

Mineral Based Industries

Industries which use minerals as the raw material are called mineral based industries.

Iron and Steel Industry

- The development of the iron and steel industry opened the doors to rapid industrial development in India. Today, India is the second-largest steel producer of world with production standing at 111 MT (2019).
- The growth in the Indian steel sector has been driven by domestic availability of raw materials such as iron ore and coal along with cost-effective labour. In India, there is a crescent shaped region comprising parts of Chhattisgarh, Northern Odisha, Jharkhand and western West Bengal, which is extremely rich in high grade iron ore, good quality coking coal and other supplementing raw materials.