I PUC

GEOGRAPHY

FUNDAMENTALS OF PHYSICAL GEOGRAPHY AND PHYSICAL ENVIRONMENT OF INDIA

DEPARTMENT OF PRE-UNIVERSITY EDUCATION
Malleshwaram, Bangalore - 560 012.

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Director's Message

Dear Students,

We at the Department of Pre-university Education, Karnataka strive to empower each student to dream big and equip them with the tools that enable them to reach new heights and successfully deal with the challenges of life. As Swami Vivekananda said, "**Real education is that which enables one to stand on one's own legs".**

The course contents in this book are designed with the objective of equipping you well for the next level of study.

We wish you well on your journey and look forward to you becoming a responsible citizen of the nation and give back to the betterment of the society.

With best wishes,

Sd/-
C. Shikha, IAS
Director
Department of Pre University Education
Bengaluru

PREFACE

The Department of Pre-University Education for the first time, in its history, has constituted a Text Book Development Committee comprising of teachers belonging to Pre-University Education to frame syllabus and prepare a Text book for I PUC. This is a welcome move by the department towards promotion of standard of teaching on the one hand and content development on the other. Hence it could be termed as a reformative move because teaching is not merely injecting ideas into the learners; it is to make learning a passion and it should be an integral part of the learner. This implies that the teacher, on his part, should be a learner himself first, so that he knows what he needs to impart and how. This enables the learners to receive the best and the most.

The Text book, **'Fundamentals of Physical Geography and Physical Environment of India'** for I PUC is prepared in accordance with the NCERT guidelines and CBSE syllabus.

The framework of the Text book has been set into three parts. In **Part-A** Fundamentals of Physical Geography is discussed with the objective of giving basic information about Geography, the Earth, Interior of the Earth, Earthquakes, Volcanoes, Rocks and Minerals, Denudational agents, Atmosphere, Hydrosphere, Ecology, Biomes and Biodiversity.

In **Part-B** Physical Environment of India is discussed with a focus on Location, Extent, Physiographic divisions, River system, Inter-linking of Rivers, Climate, Soil, Forest, Natural hazards and Disasters.

In **Part-C** Cartography is included to give proficiency to students and teachers in the practical aspects of Geography. This part discusses about Maps, Essentials of a Map, Types, Map reading, Identification of Places with Latitudes and Longitudes, Representation of physical aspects through diagrams and drawing of outline map of India to mark and show various physical aspects.

Maps, Diagrams, Flow charts and Photographs are used sufficiently to illustrate and explain the concept and to make the subject interesting, lively and easy to study. Local examples have been quoted wherever possible.

In the text, Facts file and Do you know? items are included here and there to help the student to acquire more facts and update his/her knowledge. To assist the student, important terms are mentioned at the end of each chapter. A few thought provoking sample questions are also included in each chapter. To initiate better learning process a few suggested activities are also mentioned.

The committee is grateful to many Authors, Publishers and Internet sources who helped in the production of this book.

I wish to express my heartfelt thanks to Director, Department of Pre-University Education for assigning this work, Convenors and Members of the Text Book Development Committee for the preparation of syllabus and production of text book and the various Authors and Friends who have generously helped me.

13. 02. 2013

K. R. Manjunath
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CONTENT

PART-A : FUNDAMENTALS OF PHYSICAL GEOGRAPHY

PART-C : CARTOGRAPHY

PART-A : FUNDAMENTALS OF PHYSICAL GEOGRAPHY

CHAPTER 1

GEOGRAPHY AS A DISCIPLINE

1.1 MEANING AND SCOPE OF GEOGRAPHY

Meaning of Geography

Geography is defined as the 'Science of Earth' and the 'Home of Man'. It describes the Earth's surface-its physical features, climates, soils, vegetation, population, human activities etc., and their distribution.

Geography: Greek words 'Geo' and 'graphos'.
Geo - Earth and graphos - study or description

The Earth's surface includes the upper part of the Earth's crust-mountains, plateaus, plains, water bodies-lakes, rivers, seas, oceans, atmosphere and biosphere.

Earth is the home of man and man is the product of the environment. Human beings use the natural resources of the Earth such as land, water, air, forests, animals, minerals and many others for their living.

Modern Geography deals with the 'Earth and its inhabitants'. It studies the factors and processes which change these features, their mutual relationships and their spatial arrangement.

Scope of Geography

Geography is as old as mankind. It is an old field of knowledge known to the philosophers, scholars and experts in the ancient world. Geography is often called the 'Mother of all Sciences'. Earlier its field of study used to comprise mere facts and information about the Earth and its features.

During 19th and 20th centuries there was a plea for widening the scope of study of Geography, particularly, in its relation to other allied subjects. Modern geographical research, development in science and technology in the recent years helped to see a rapid change in the subject matter. Modern Geography is being developed as an inter-disciplinary subject and serves as an important link with Natural and Social Sciences. The aims and

objectives of the present study is to understand the interaction of the vast natural environment with the cultural environment.

1.2 Geography as an Integrating Discipline

Geography is a discipline of synthesis. It is considered to be a liaison subject. It recognizes the fact that the world is a system of interdependency. Geography as an integrating discipline stands midway between Natural Science and Social Science. Modern Geography focuses attention on man's physical, biological and cultural environments and thereby points out the inter-relationship between human activities and the environment.

Physical Geography has interface with Natural Sciences. The traditional Physical Geography is linked with Geology, Meteorology, Hydrology and Pedology which have very close link with Natural Sciences. Bio Geography is closely related to Botany and Zoology. Astronomical Geography is related to heavenly bodies such as Galaxy, Solar System, Stars, Planets, Satellites and Mathematical Geography helps to represent Latitudes, Longitudes, Shape of the Earth, Size, Cartographic and Quantitative Techniques.

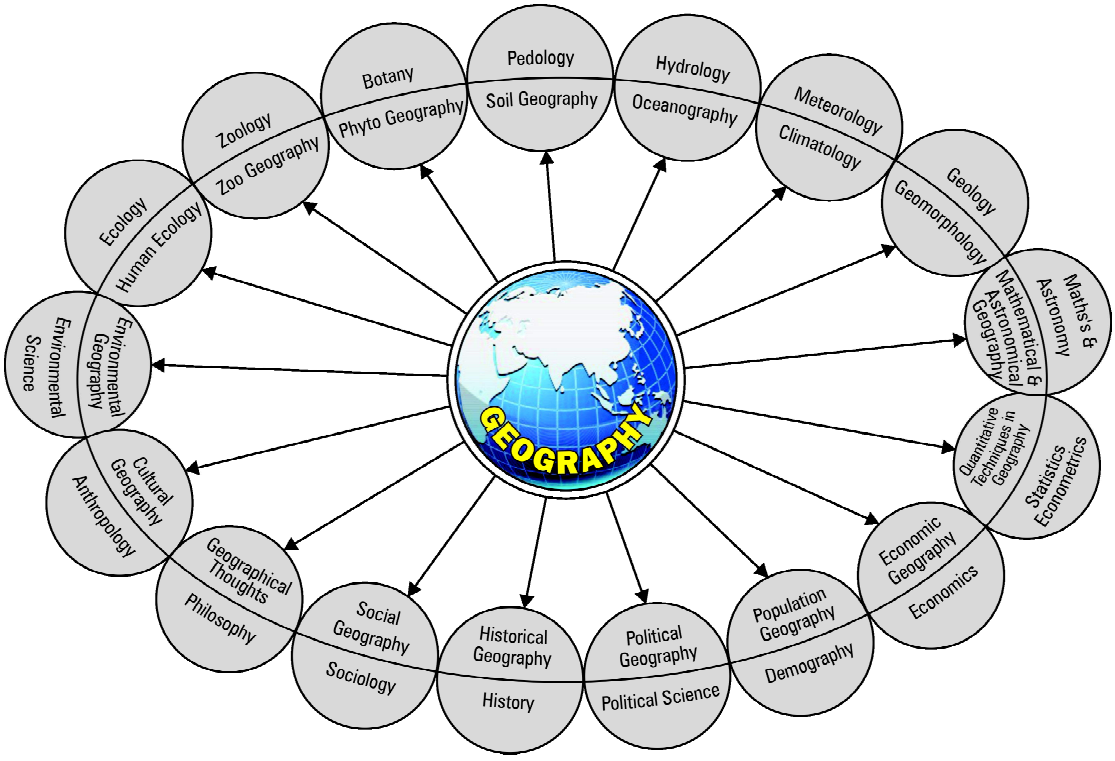


Fig. 1.1 Geography and its relation with other subjects

Geography also has interface with Social Sciences like History, Sociology, Economics, Political Science, Commerce etc., These subjects have close links with other disciplines as each one of them has spatial attributes. History is concerned with past events and studies about people of different times and Geography deals with the people of different places. The core concern of Political Science is territory, people and sovereignty. While Political Geography deals with the spatial unit, people, distribution, political behaviour, political divisions etc., Economics studies about basic attributes of the economy such as production, distribution, exchange of goods and consumption. Each of these attributes has spatial differences and implications. Economic Geography deals with the spatial aspects of production, distribution and consumption and also helps in understanding the most proper location for establishing different human activities. Commercial Geography deals with the spatial distribution of trade and commercial practices with respect to exchange of goods, balance of trade, inter and international trade practices etc., Population Geography helps to understand the distribution, growth, density, migration and various other components of population. Thus Geography behaves like an inter-related and integrating discipline to assess the spatial distribution of various natural and social aspects on the Earth and its interaction with each other.

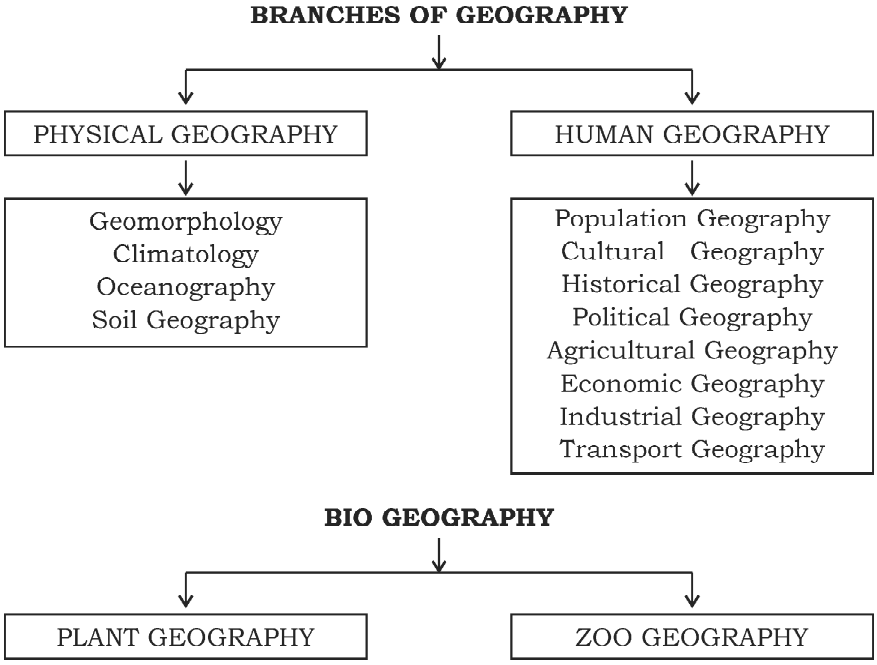
1.3 Branches of Geography

Geography is the only discipline that brings all Natural and Social Sciences on a common platform to understand the dynamics of the spatial configuration of the Earth surface. It is an inter-disciplinary science having numerous branches.

Geography is divided into two main branches on the basis of systematic approach. 1) Physical Geography 2) Human Geography

Physical Geography: It deals with the physical environment or physical aspects of the Earth that are created by nature. Important areas of study are: a) Geomorphology-Land, land features and landforms b) Climatology-Climate, atmospheric conditions and climatic change. Meteorology-Weather conditions and weather changes, C) Oceanography-Seas, oceans, relief of the ocean floor, configuration of ocean water, movements of ocean water etc., d) Soil Geography-Formation and distribution of soils on the Earth. Pedology is the study of soils in their natural environment.

Human Geography: It deals with man and his activities, particularly cultural environment factors or man made features. Important among them are culture, society, agriculture, mining, industry, transport, tourism, trade, population size etc., viz., Cultural Geography, Historical Geography, Political Geography, Agricultural Geography, Economic Geography, Industrial Geography, Geography of Transport etc.,



Bio Geography: It deals with the living organisms on the Earth. Plant Geography dealing with the distribution of natural vegetation, forest, grassland etc., and Zoo Geography dealing with distribution of animal wealth on the Earth are the additional branches in the study of Geography. Many more branches are also being introduced in recent years.

Importance of Physical Geography

Physical Geography is an important branch in Geography which deals with the physical features of the Earth, including land, air and water. It is an area of study that brings together and inter-relates the important elements of the physical environment of humans.

Physical Geography draws attention in understanding the land, landforms, layers of the Earth (Geomorphology), elements of atmosphere, composition and structure (Meteorology, Climatology), Ocean topography, movement of ocean water (Oceanography), soil formation, types (Soil Geography) etc.,

Physical Geography emphasizes spatial relationships with the systematic arrangements of environmental elements into regions over the Earth's surface, and the causes for those patterns.

The main focus of the Physical Geography is on the life layer, a zone of the lands and oceans containing most of the world of organic life, or biosphere. The major concern of physical geography is the sum of the physical factors that make the life layer habitable for all forms of plants and animals, but more particularly for humans.

IMPORTANT TERMS .....

Geomorphology	Climatology	Oceanography
Meteorology	Pedology	Zoo Geography

I Answer the following in a word or a sentence each.

1. Define Geography.
2. What is Modern Geography?
3. Which branch of Geography studies about heavenly bodies?
4. What is Bio Geography?
5. Name any one branch of Physical Geography.

II Answer the following in two or three sentences each.

1. Why is Geography called as the 'Science of Earth'?
2. How is Geography a discipline of synthesis?
3. What is Oceanography?
4. Name any two branches of Human Geography.
5. What is the main focus of Physical Geography?

III Answer the following.

1. Explain the important branches of Geography.

SUGGESTED ACTIVITIES .....

- Prepare chart to show Geography and its relation with other subjects.
- Prepare flow chart to show Geography and its branches.
- List out the main branches and sub-branches of Geography and add the latest branches.

CHAPTER 2

THE EARTH

2.1 EARTH AS A PLANET

Our Earth is a member of the Solar System. It is the third planet from the Sun and fifth largest planet in the solar system. Its age is around 4.6 billion years. The Earth is called 'Terrestrial Planet', because it has rocks and soils.

Earth is the only planet which supports various forms of life, because of the atmosphere, presence of water and suitable distance from the Sun. Our Earth is called by many names. They are 'Watery planet', 'Blue planet', 'Man made greenhouse planet', 'Biosphere planet' , 'Unique planet' etc.,

Earth has a natural satellite called Moon. The position, rotation and revolution of the Moon cause various effects on the Earth viz., eclipses, tides etc.

2.2 SHAPE AND SIZE OF THE EARTH

SHAPE OF THE EARTH

The shape of the Earth was a matter of controversy for a longer period. With the latest information and facts Sir Isaac Newton (1643-1727) asserted that the Earth was not a complete circle, but it is slightly flattened at the Poles and bulged at the Equator. This shape is called 'Oblate spheroid' or later named as **'Geoid'.** Recent pictures of the Earth taken from the space have proved that the Earth is not in circular shape, but it is spherical or Geoid in shape.

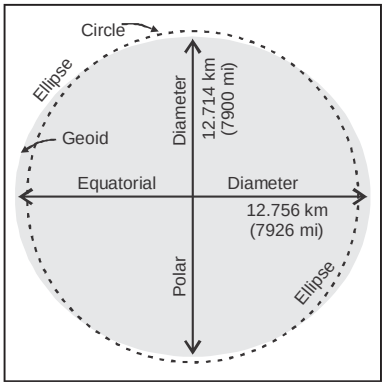


Fig. 2.1 Shape of the Earth

Proofs in support of the spherical shape of the Earth

To ascertain the Geoid shape of the Earth, several proofs are forwarded by experts. The most important among them are:

1. **Heavenly bodies appear to be spherical:** The Sun, the Moon and other heavenly bodies appear to be spherical when viewed from different position. The Earth is one of them and hence it must also be spherical in shape.

Fig. 2.2 Heavenly bodies

2. **The Lunar Eclipse:** The lunar eclipse proves that the Earth is in spherical shape. During lunar eclipse when the Earth is between the Sun and the Moon, the shadow of the Earth falls on the Moon. Aristotle was the first scholar to show this by looking at the shadow of the Earth on the lunar surface. Later, this was ascertained by Ptolemy. This is considered to be the oldest proof in respect of the shape of the Earth.

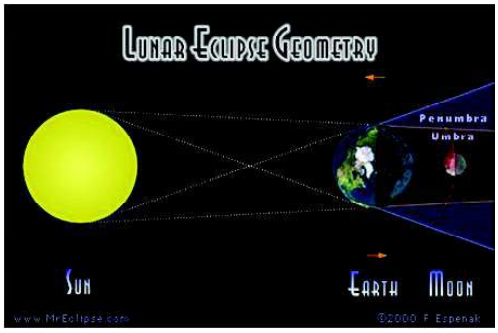


Fig. 2.3 Lunar Eclipse

3. **Sunrise and Sunset:** The time of Sunrise and Sunset is not the same everywhere in the world. This is due to spherical shape of the Earth. If the Earth were to be flat all places on the Earth would have had sunrise and sunset at the same time everywhere in the world.

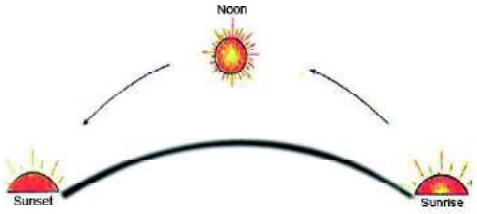


Fig. 2.4 Sunrise and Sunset

4. **Circumnavigation:** Circumnavigation of the world can only be possible when the Earth is in spherical shape. If one start on a sea voyage towards the east, by moving constantly in the same direction, he would be able to complete a circle of the world and reach the original point from where he had started.

Fig. 2.5 Circumnavigation of the Earth

Do you know?

Ferdinand Magellan (1519-1522), a Portuguese explorer is known for the circumnavigation of the world. 'Victoria' was the sole ship of his fleet to complete the circumnavigation.

5. The Bed Ford level experiment: Dr. Alfred Russel Wallace conducted an experiment in 1956, along the Bed Ford level canal area in Britain. It is the most convincing proof of the curvature of the Earth. He fixed three poles of same height at an interval of about 1mile apart and observed through a telescope. It was found that the pole in the middle was higher than the other two poles (Fig. 2.6). It is due to the curvature of the Earth. If the Earth were to be flat all the poles would have the same horizontal level.

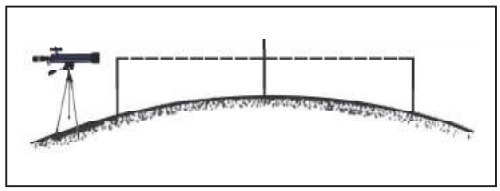


Fig. 2.6

6. Sighting a ship: A ship on the sea approaching the coast, when seen from the shore does not come into view all at once. The observer first sees the mast and then the hull and finally the whole ship. A ship moving away from the coast, disappears gradually and finally out of view (Fig. 2.7). If the Earth were to be flat the whole ship would have come into view.

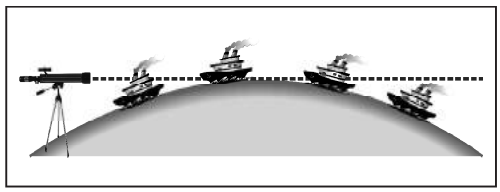


Fig. 2.7

7. Aerial and Satellite photographs: The most clinching evidence of the spherical shape of the Earth is obtained from aerial and satellite photographs taken from the space. This is considered to be the latest proof in respect of the shape of the Earth.

Fig. 2.8 Satellite image of the Earth

In addition to the above, spherical horizon, position of the Pole Star, weight of an object are also considered as some of the convincing proofs regarding the shape of the Earth.

SIZE OF THE EARTH

The ancient Philosophers, Mathematicians and Geographers made several attempts to determine the size of the Earth. The distance between places on the Earth was first calculated by a Greek Philosopher Eratosthenes (276-195 BC). He calculated the circumference of the Earth to be 2,52,000 stadia (measuring system Stades) or 46,250 km which is very close to modern calculations.

Do you know?

Eratosthenes (276 BC-195 BC): **'Father of Geography'** - was the first person to use the word **'Geography';** first to calculate the tilt of the Earth's axis; also was the first to prepare the map of the World.

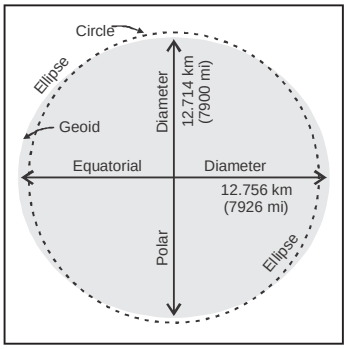


Fig. 2.9 Size of the Earth

The Equatorial circumference of the Earth is 40,076 km and the Polar circumference is 40,006 km. In the same way the Equatorial diameter of the Earth is 12,756 km and its Polar diameter is 12,714 km. The difference of 70 km in circumference and 42 km in diameter is due to Oblate spheroid or Geoid shape of the Earth.

According to size of the Planets, Earth is the fifth largest planet in the Solar System. The total geographical area of the Earth is 510 mil sq km. Of this, water bodies cover 361 mil sq km (71%) and land masses cover 149 mil sq km (29%). The ratio between land and water bodies is 1:2.43.

Distribution of land and water

The Earth's surface is made up of land and water bodies. The huge land masses are called Continents and the vast water bodies are called Oceans. The continents and oceans are unevenly distributed throughout the world.

On the basis of Equator the globe is divided into two hemispheres. The region which lies to the North of the Equator is called Northern Hemisphere and area to the South is called Southern Hemisphere.

Northern hemisphere is covered with more land than water. In this region nearly 60% of the area is covered by land and 40% is covered by water. Therefore, Northern hemisphere is called **'Land Hemisphere'.** In the same way Southern hemisphere is covered with more water than land. In this region nearly 81% is covered with water and only 19% is land masses. Therefore, Southern hemisphere is called **'Water hemisphere'.**

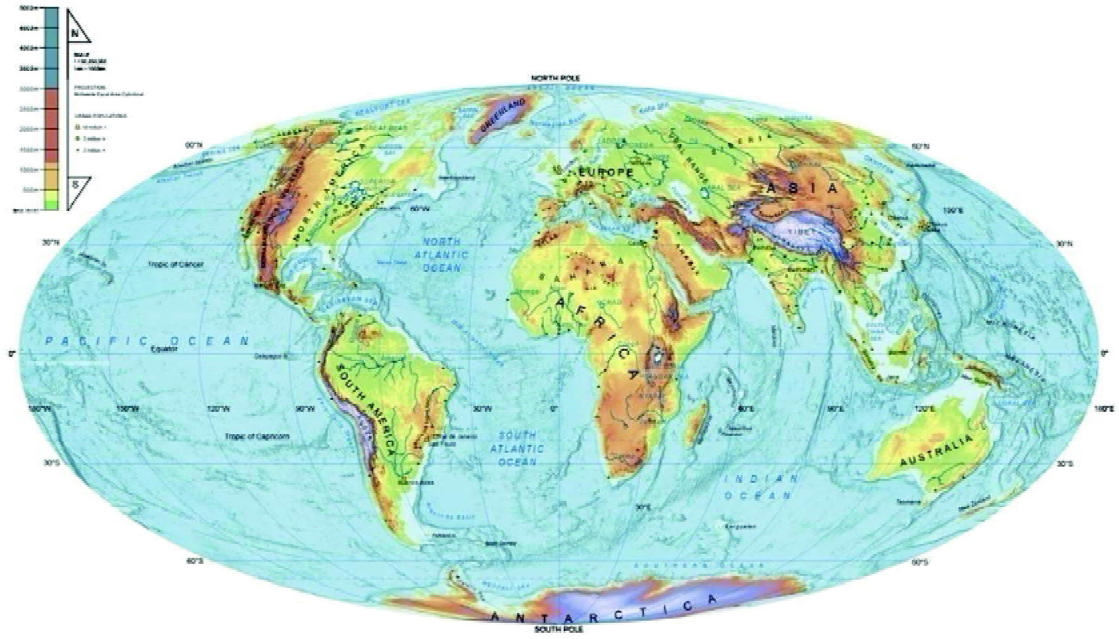


Fig. 2.10 World Physical

The arrangement of land and water bodies on the Earth is called ‘Antipodal balance’. Land on the one side of the Earth is balanced by water on the other side. eg., The Arctic ocean is opposite to the Antarctic continent.

Antipodes: Two places situated geometrically on opposite sides of the Earth. eg. North Pole and South Pole, New Zealand and Iberian Peninsula.

The average height of the land is 900 m, while the average depth of the oceans is 3800 m.

The world has seven Continents. They are 1) Asia 2) Africa 3) North America 4) South America 5) Antarctica 6) Europe and 7) Australia.

Africa is the oldest Continent and it lies in all the four directions. Asia is the largest Continent having vast geographical area and greatest population in the world. Antarctica is located entirely in the southern hemisphere covered with ice. It is popularly called 'Ice Continent', 'Southern Continent', 'White Continent' etc.,

Mt. Everest (8850 m -Nepal) is the highest peak in the world and Dead Sea (400 m below sea level-Asia) is the lowest point on the land.

The Earth surface is covered with water bodies like oceans, seas, bays, gulfs, lakes etc., There are four major oceans in the world. They are 1) The Pacific Ocean 2) The Atlantic Ocean 3) The Indian Ocean and 4) The Arctic Ocean. The Pacific Ocean is the largest and the deepest ocean in the world. The Atlantic Ocean is the busiest and the most dangerous ocean. It has the longest coastline in the world. The Indian Ocean is the only ocean in the world named after a country-India. It is surrounded by land in the north. The Arctic Ocean is the smallest and the shallowest ocean in the world. It is surrounded by land in all directions. All the oceans of the world are named by Ferdinand Magellan. Challenger deep (10,898 m or 35,755 ft) of Mariana trench in the Pacific Ocean near Philippine islands is the deepest point in the ocean floor.

2.3 Movements of the Earth: Rotation and Revolution

The origin, shape and the movements of the Earth have been a subject of speculation for a long time. Earlier philosophers and geographers were of the opinion that the Earth is a stationary body and other heavenly bodies revolve round it. According to Cladius Ptolemy (120-180 AD) Earth is the centre of the Solar System and all heavenly bodies including Sun revolves around the Earth (Geo-centric or Earth- centre theory). Nicolous Copernicus (1473-1543) a Polish astronomer disagreed with the Earth-centre theory and advanced Sun- centre (Helio-centric) theory. In this he suggested that the Sun is in the centre of the Solar System and Earth and other planets revolve around the Sun. Galileo Galieli accepted Copernicus's explanations and proved the position of Sun and other planets in the Solar System. John Kepler supported the Copernicus theory and opined that all planets have elliptical orbits.

Like the Sun and other planets the Earth also has two movements. They are Rotation and Revolution.

ROTATION OF THE EARTH

The Earth rotates or spins on its axis from west to east. This movement is called **'Rotation'** or **'Daily motion'** of the Earth.

The axis of the Earth is an imaginary line passing through the centre of the Earth and joining north and south poles. The two ends of the Earth's axis are known as the Poles.

The actual period of one Rotation is 23 hr 56 min and 4.09 sec, known as 'Sidereal day'. But one complete Rotation in respect to the Sun or average period of rotation takes 24 hr, known as 'Mean Solar Day'.

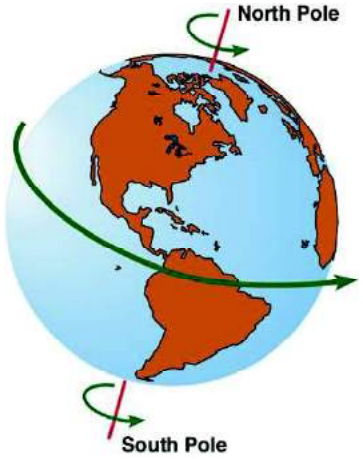


Fig. 2.11 Rotation and Axis

The average speed of the Rotation of the Earth varies from latitude to latitude. At 0º or Equator it is 1670 km/hr. While at 60º N/S latitudes it is half the speed at the Equator, at 80º N/S latitudes it is 10 km/hr, at 89º N/S it is 1 km/hr and at the Poles it is 0 km/hr respectively. This variation is due to shape of the Earth and its diameter at different latitudes.

Effects of the Earth's Rotation

Rotation of the Earth causes various effects. They are: Day and Nights, deflection of winds, sense of time, identification of directions, longitudes, influence on the shape of the Earth, magnetic attraction, ocean currents, tides etc.,

Day and Night: Day and nights are caused due to the rotation of the Earth. Our Earth is a non-luminous body and it has to depend on the Sun's light. If the Earth does not rotate there would be no day and night. The effect is one half of the Earth would always face the Sun and get illuminated and would always have day. The other half away from the Sun would remain dark and would always have night.

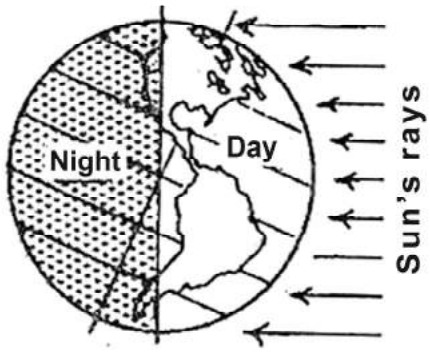


Fig. 2.12 Day and Night

Do you know?

Circle of illumination: A line that bisects areas on the Earth receiving sunlight and those areas in darkness cuts the spherical Earth into lighted and dark halves.

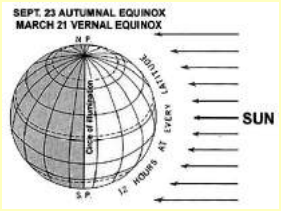


Fig. 2.13 Circle of Illumination

Deflection of winds: Rotation of the Earth from West to East cause change in the direction of winds i.e., to its right in the Northern hemisphere and to its left in the Southern hemisphere.

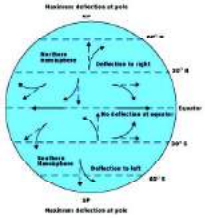


Fig. 2.14 Deflection of Winds

Facts File

- Coriolis force: It is caused by the rotation of the Earth. Coriolis force or effect (named after French scientist Gaspard-Gustave Coriolis) is noticeable on the large scale movement of air in the atmosphere or water in the ocean. This force causes moving objects on the surface of the Earth to be deflected in a clockwise direction in the Northern Hemisphere and in the anti-clockwise direction in the Southern Hemisphere.

Sense of time: Earth's rotation from West to East help us to understand and calculate the periodic change in time in a day. When the Sun rises from the horizon it is called morning, when it is overhead it is called noon and when it is setting it is said as evening and finally when there is no Sun's light or darkness the period is called night. This happens due to regular spinning of the Earth on its axis.

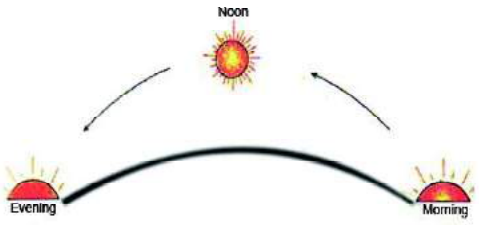


Fig. 2.15

Identification of directions: Rotation of the Earth causes apparent movement of the Sun and other heavenly bodies. The direction in which the Sun rises is called East, the direction where the Sun sets is identified as West. Based on the Pole Star (North Star) North is identified and South is recognized on the basis of Southern Cross - a group of stars found in the Southern Sky.

Longitude and time: Longitudes are the imaginary lines drawn on the globe from North Pole to South Pole. These lines are marked on the spherical shape of the globe with the help of degrees. A sphere consists of 360º and every line of longitude demarcates one degree. Rotation of the Earth influences the falling of direct Sun's light on these longitudes one after the other. The difference in the fall of Sun's light is 4 minutes from one longitude to another and every 15 longitudes receive sun's light in 60 min or 1 hr. In the same way 180 longitudes get light in 12 hr and 360 longitudes receive light in 24 hr or 1 day.

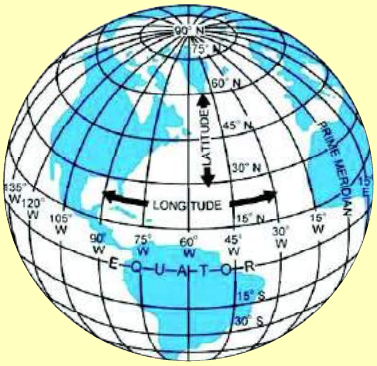


Fig. 2.16
Longitude and Time

GMT: Greenwich Meridian (Mean) Time - 0º longitude: Prime Meridian (passes on Greenwich of London)- Standard time of UK.

IST: Indian Standard Time - 82½º E longitude (+5½ of GMT): Standard time of India (passes on Allahabad (Prayag) of Uttar Pradesh).

IDL: International Date Line - 180º longitude : Zig zag line drawn on the water bodies of the Pacific Ocean - to recognize date and day difference in the East or West of IDL.

Shape of the Earth: The continuous Rotation of the Earth at high speed has its influence on the shape of the Earth. The bulging of the Equatorial region and flattening of the polar areas is due to rotation of the Earth. It is said that, when the Earth was formed it was in circular shape, now it has changed to spherical or Geoid and later may change into oval shape.

Magnetic attraction of the Earth: The Earth acts as a huge magnet. The one end of the compass needle is always pointed towards the North pole because of high magnetic attraction in that pole caused by the rotation of the Earth.

Ocean currents: Rotation of the Earth influences the movement of ocean water, particularly ocean currents. The ocean water flows continuously to its right in the northern hemisphere and to its left in the southern hemisphere from low latitudes to high latitudes due to rotation of the Earth and wind movement.

Fig. 2.17 Ocean currents

Tides: The rise and fall in the sea level is called tides. Rotation of the Earth causes the facing of water bodies to the Moon. The gravitational attraction of the Moon and position of the water bodies cause tides. This is a regular phenomenon due to Earth's rotation.

Apparent movement of the Sun, the Moon and other heavenly bodies: Earth Rotates from west to east. Therefore, we can see the Sun, Moon and other heavenly bodies appearing to be rising in the east and setting in the west.

REVOLUTION OF THE EARTH

With its rotation on its axis, the Earth also revolves around the Sun in a fixed orbit. This is called Revolution. The fixed path on which the Earth revolves round the Sun is known as **'Orbit'.** Our Earth has elliptical orbit, which is around 927 mil km long. The average speed of the revolution of the Earth in its orbit is 29.8 km/sec. or 1,07,000 km/hr. The revolution of the Earth is in anticlockwise direction and one revolution takes around one year. Therefore, this movement is also called 'yearly movement'.

The time taken by the Earth to complete one revolution is around 365 days, 6 hr, 9 min and 9.545 sec. This period is called 'Sidereal year'. The average period of one revolution is around 365 days and 6 hr. This is called 'Solar year'. However a normal year consists of 365 days. To compensate 6 hr or ¼ day, a day is added once in four years. The year having 366 days and particularly 29 days in the month of February is called **'Leap year'.** Any year divisible equally by 4 or 400 is considered as leap year.

The average distance between the Earth and the Sun is 150 mil km. Due to its elliptical orbit the distance between the Sun and the Earth do not remain the same. On January 3rd the Earth will be very close to the Sun and the position is called **'Perihelion'** (Peri-near). At this point the mean distance between the Sun and the Earth will be 147 mil km. Similarly, on July 4th the Earth is far from the Sun. This position is called **'Aphelion'** (Ap-away). At this point the average distance between the Sun and the Earth will be 152 mil km.

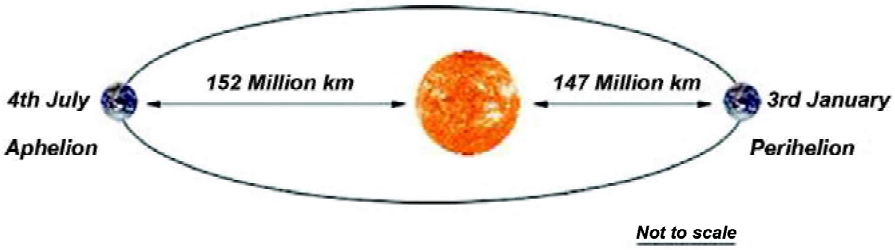


Fig. 2.18 Aphelion and Perihelion

The Earth's axis is not at right angle (perpendicular) to the plane of the elliptical orbit. The axis is inclined at an angle of 66½º to the plane of the orbit. This is known as **'Inclination of the Earth's axis'.**

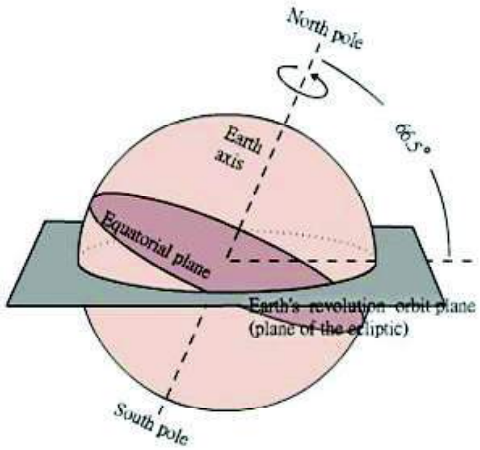


Fig. 2.19 Inclination of the Earth

Effects of Earth's Revolution

The inclination and revolution of the Earth causes many effects. They are: 1) Cycle of Seasons 2) Variations in the length of day and night and 3) Identification of special Latitudes and Temperature zones.

1. Cycle of Seasons

It is the most important effect of the inclination and revolution of the Earth. The yearly movement of the Earth on its elliptical orbit takes the Earth to be in four important positions from the Sun. This results in causing cycle of seasons. They are: a) Summer Season b) Autumn Season c) Winter Season and d) Spring Season

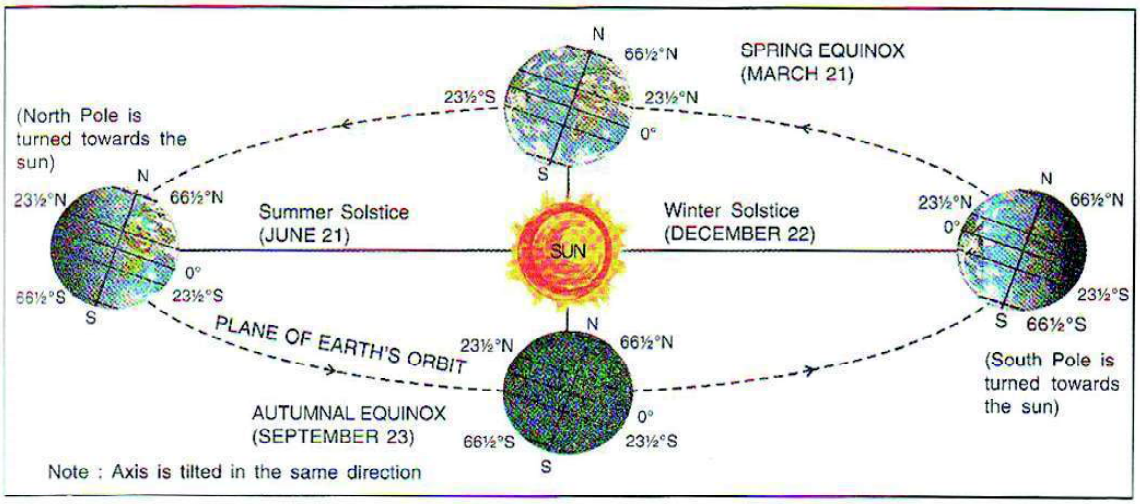


Fig. 2.20 Cycle of Seasons

Of these Seasons two are Solstices (June 21st & December 22nd) and the other two are Equinoxes (September 23rd & March 21st). During Solstices the direct rays of the Sun falls either on the Tropic of Cancer or the Tropic of Capricorn and on Equinoxes it will be on the Equator. Solstices influence on the variation in the length of day and nights (both hemispheres), while Equinoxes (Equinox: Equal nights) influence in getting equal length of days and nights (both hemispheres).

Summer Season (June 21st to September 22nd)

On June 21st, due to the Earth's inclination and revolution, vertical rays of the Sun fall on the Tropic of Cancer (23½º North) - 'Summer solstice'. This is the beginning of Summer Season in the Northern Hemisphere (Winter in SH) and continues up to September 22nd. During this season the average temperature is high and days are longer and nights are shorter in all the countries of Northern Hemisphere and vice versa in the Southern Hemisphere. At this time the length of the day increases with the increase in latitude towards the North of the Equator till north of the Arctic circle (66½º North), as the North Pole is tilted towards the Sun. There is no sun

set to the north of the Arctic circle (66½º North)during this period. Therefore, northern part of Norway (Hammerfest) lying to the north of the Arctic Circle receives Sun light for almost 24 hours and the Sun never sets below the horizon. So, Norway is called '**Land of mid-night Sun'.** In this period the North Pole faces the Sun for six months and the length of day is six months.

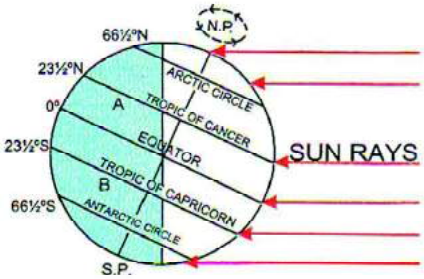


Fig. 2.21 Summer Season

Land of Mid-night Sun

Autumn Season (September 23rd to December 21st)

On September 23rd, the vertical rays of the Sun falls on the Equator- 'Autumn Equinox'. Therefore, the days and nights are equal in both the hemispheres. This is the beginning of Autumn Season in all the countries of the Northern Hemisphere and it continues up to December 21st. In this Season many plants and trees (natural vegetation) shed their leaves, known as 'Fall Season'. During this period Southern Hemisphere witnesses Spring Season. This season lasts for three months.

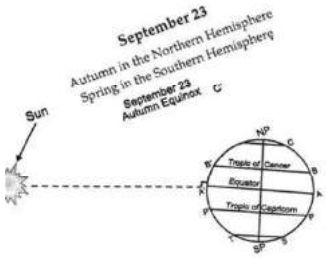


Fig. 2.22 Autumn Season

Winter Season (December 22nd to March 20th)

On December 22nd, the vertical rays of the Sun falls on the Tropic of Capricorn (23½º South) - 'Winter solstice'. This is the beginning of Winter Season in all the countries of the Northern Hemisphere and it continues till March 20th. In this period Southern Hemisphere record Summer

Season. During this season the average temperature is low and the days are shorter and nights are longer in the Northern hemisphere and it is vice versa in the Southern hemisphere. Countries situated above 50º North latitude record severe winter with high snow storms. The areas coming under the Antarctic Circle (66½º S) receive vertical sun rays as the South Pole is tilted towards the Sun. Hence, there is no sun set to the south of the Antarctic Circle. The South Pole faces the Sun for six months and the length of the days is also six months.

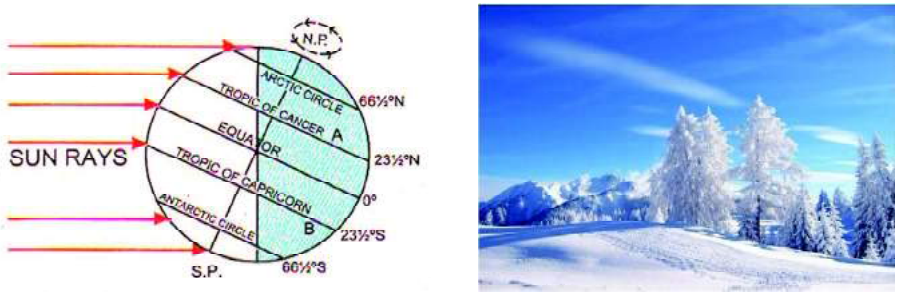


Fig. 2.23 Winter Season

Spring Season (March 21st to June 20th)

On March 21st, the vertical rays of the Sun falls on the Equator - 'Spring Equinox' or 'Vernal Equinox'. Therefore, the duration of days and nights are equal in both the hemispheres. This is the beginning of spring in the Northern hemisphere and it continues up to June 20th. At the same time in the Southern hemisphere it will be Autumn. In this season many plants and trees (natural vegetation) get new leaves and nature looks afresh with greeneries. This season lasts for three months and continues with fresh cycle of summer. In India, the beginning of the spring is considered very auspicious and is celebrated as the first day of the year.

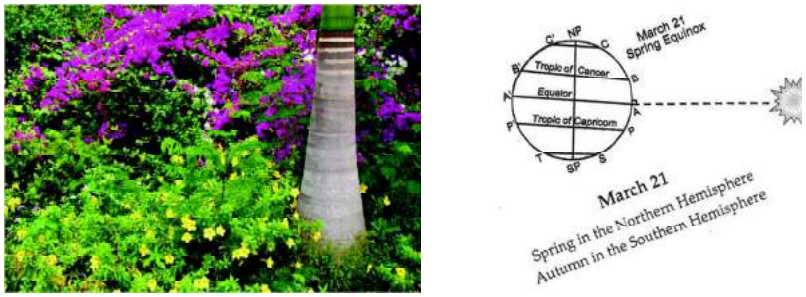
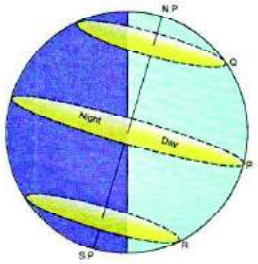


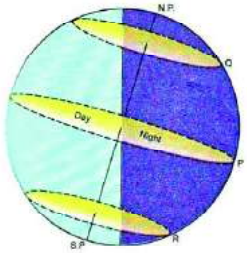
Fig. 2.24 Spring Season

2. Variation in the length of Day and Night

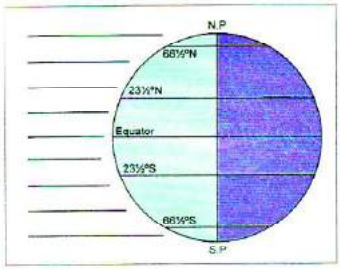
The variation in length of Day and Night is due to the inclination of the Earth's axis and revolution. As one moves from the Equator to Poles the duration of day and night is not equal; it changes from latitude to latitude. When the vertical sun rays are on the Tropic of Cancer (23 ½º N) or the Tropic of Capricorn (23½º S) the duration of day and night is longer. In the North and South poles the duration will be 6 months due to tilting of the Poles towards the Sun. When the vertical rays of the Sun is on the Equator the duration of day and night are equal (12 hr day and 12 hr night).



Varying lengths of day and night – June 21



Varying lengths of day and night – December 22



Varying angle of sun's rays – March 21 and September 22

3. Identification of Special Latitudes and Temperature zones :

Due to the Earth's inclination at 66½º (orbit) and revolution, we recognize a few special latitudes (Imaginary lines drawn on the globe from west to east) on the globe. The vertical rays of the Sun strike the Earth at different points at different times of the year. On March 21st and September 23rd it falls on the middle of the Earth i.e., **Equator** (0º). On June 21st the vertical rays fall on 23½º North - **Tropic of Cancer** and on December 22nd it falls on 23½º South - **Tropic of Capricorn.** On June 21st the Sun's rays reach 66½º North - **Arctic circle** and on December 22nd the rays reach 66½º South - **Antarctic circle.** The **North pole** (90º North)and **South pole** (90º South) are the two ends of the Earth's axis.

On the basis of special latitudes the globe may be divided into **'Temperature zones'** or **'Heat zones'.** Direct rays of the sun produce more heat than the slanting rays. The region near the equator receives more direct rays of the Sun. These rays are intense over a smaller area

and so it heats up the Earth more. As we go away from the equator, the sun's rays strike the Earth's surface with slanting rays, spreading over a larger area so, they do not heat as intensely as the direct rays. Therefore, when we go from the equator to the poles, we come across zones with varying temperatures.

The temperature zones are: a) Torrid zone b) Temperate zone and c) Frigid zone.

a. The Torrid Zone or Tropical Zone : The area between the Tropic of Cancer (23½° North) and Tropic of Capricorn (23½° South) is known as 'Torrid zone or Tropical zone'.

b. The Temperate Zone : The area between the Tropic of Cancer and Arctic circle and Tropic of Capricorn and Antarctic circle (23½° N/S to 66½° N/S) is known as 'Temperate Zone'.

c. The Frigid Zone : Between the Arctic circle to North pole (66½° N to 90° N) in the Northern Hemisphere and the Antarctic circle to South pole (66½° S to 90° S) is Known as 'Frigid Zone'. (Refer Chapter 5.2 also).

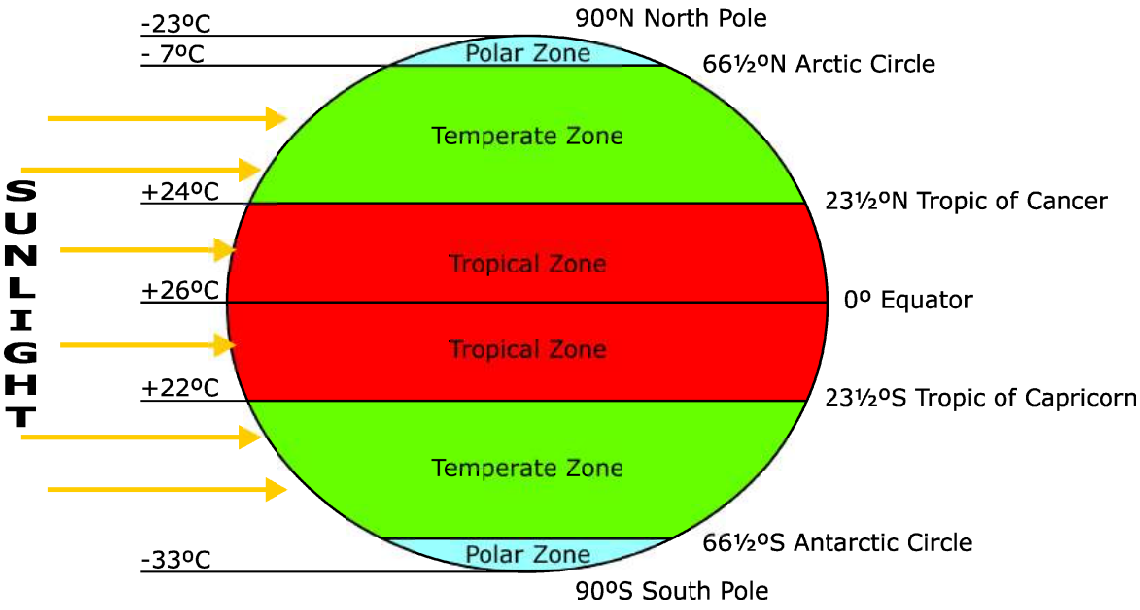


Fig. 2.25 Temperature Zones

IMPORTANT TERMS .....

Terrestrial planet	Coriolis force	Solstice
Geoid	Axis	Equinox
Lunar Eclipse	Orbit	Land of Mid-night Sun
Circumnavigation	Leap year	Equator
Satellites	Perihelion	Tropic of Cancer
Antipode	Aphelion	Tropic of Capricorn
Circle of Illumination	Inclination of the Earth	Torrid zone
		Frigid zone

I Answer the following in a word or a sentence each.

1. What is the approximate age of the Earth?
2. Name the oldest proof in respect of shape of the Earth.
3. Who conducted Bed Ford level experiment?
4. What is the total geographical area of the Earth?
5. Who was the first person to calculate the distance between places?
6. What is Earth's axis?
7. What amount of time does the Earth take to complete one rotation?
8. Define Orbit.
9. On what date does the Summer Solstice occur?
10. How many temperature zones are there on the globe?

II Answer the following in two or three sentences each.

1. What is Geoid?
2. Mention the Equatorial and Polar diameter of the Earth.
3. Why are Northern and Southern hemispheres called as Land and Water hemisphere?
4. Name the highest and lowest points on the land.
5. What is deflection of Winds?
6. What is Inclination of the Earth?

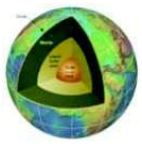
7. Distinguish between Perihelion and Aphelion.
8. State the difference between Autumn Equinox and Spring Equinox.
9. Why is Norway called 'Land of Mid-night Sun'?
10. Mention the difference between Torrid and Temperate zones.

III Answer the following.

1. Name and explain the proofs in support of the spherical shape of the Earth.
2. Describe the size of the Earth.
3. Explain the effects of the rotation of the Earth.
4. How do seasons occur? Explain with a neat diagram.
5. Describe the special latitudes and temperature zones of the globe with a neat diagram.

SUGGESTED ACTIVITIES .....

- Collect photographs of Solar system and identify the position of the Earth and the Moon.
- Draw diagrams to show the shape of the Earth and proofs in support of the shape of the Earth.
- Collect the pictures of Eclipse and identify the difference between Lunar and Solar eclipses.
- Prepare models to show the size of the Earth-distribution of land and water bodies.
- Prepare tables to show the effects of the Rotation and Revolution of the Earth.
- Prepare model to show the cycle of Seasons.
- Collect photos to show various effects of the movement of the Earth.



CHAPTER 3

INTERIOR OF THE EARTH

Understanding the interior of the Earth is very important to geographers. The study helps to know where solid, gas and also liquid materials lie. Man is not in a position to understand the Earth's interior directly, but he is in quest of knowing the information through indirect sources. Understanding the internal features of the Earth was a mystery for many years. With the development in science, technology, and modern research man started understanding the Earth's interior indirectly from the last few years.

The important direct and indirect evidences through which most of the information gathered are Temperature and Pressure in the Earth, density of rocks, seismic waves, volcanic materials, observations of natural valleys, gorges, sea shores, mining, deep oil drilling etc.

Deepest places in the World

1. Kola Super deep Borehole: Scientific drilling project of Russia (1989) near Murmansk in Kola Peninsula. Deepest artificial point on the Earth-12,262 m
2. Tau Tona mine: A Gold mine in South Africa is currently deepest mine (3.9 km) in the World.

3.1 STRUCTURE AND COMPOSITION OF THE EARTH

On the basis of velocity of seismic waves, density of material, chemical composition and physical state of matter the Earth's interior is divided into three concentric zones viz.,

1) The Crust 2) The Mantle
3) The Core

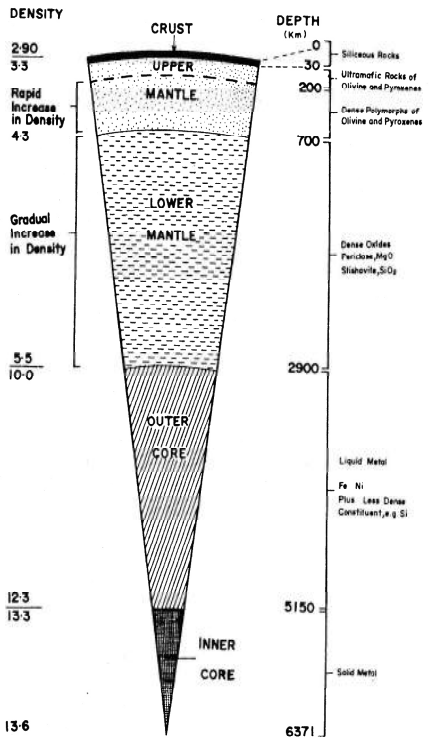


Fig. 3.1 Interior of the Earth

1) **THE CRUST:** The uppermost layer of the Earth is called the Crust. This layer comprises of continental and oceanic regions. The thickness of the crust varies under the oceanic and continental areas. The depth of the crust is 60 km.

   On the basis of its nature and features the Crust is divided into two layers. They are Continental Crust and Oceanic Crust. The Crust consists of all three major types of rocks such as Igneous, Sedimentary and Metamorphic.

   a. **Continental Crust:** This is the uppermost layer of the crust and the Earth.Continental Crust is thicker than the Oceanic Crust. The mean thickness of Continental Crust is around 30 km, whereas the Oceanic Crust is around 5 km. The Continental Crust is thicker, its maximum thickness is around 60 km beneath mountain ranges. The outer portion of the Crust is known as **Sial** [silica and aluminium]. It is the lightest layer with the density of 2.7 gm/cm^3. Continental Crust is floating on the dense Oceanic Crust.

   b. **Oceanic Crust:** The lower part of the Crust is known as Oceanic Crust. Its thickness is around 5 km. This layer is rich in silica and magnesium. Therefore, it is called **Sima**. The mean density of this layer is 2.95gm/cm^3. Sima forms the ocean floors and is heavier than Sial.

   The two important discontinuities in the Crust are: a) Conrad discontinuity - between Sial and Sima and b)Mohorovicic (Moho) discontinuity - between Crust and Mantle

2) **THE MANTLE**: The portion of the Earth's interior below the Crust is called Mantle. It extends from 60 km to 2,900 km. The density of this layer ranges from 3.3 to 5.7gm/cm^3. The materials are in semi liquid or partially molten state due to high temperature known as Magma. The mantle is a composition of dense and rigid rocks which have minerals like magnesium and iron (Olivine). The mantle has two parts:-

   a. **Upper Mantle:** This is the outer layer of the Mantle known as Asthenosphere, partially in molten condition. Most of the earthquakes and volcanoes take birth due to disorder in this layer.

   b. **Lower Mantle:** This is the lower layer of the Mantle known as Mesosphere and it is in solid form.

The important discontinuities in the Mantle are: a) Repetti discontinuity -between Asthenosphere and Mesosphere and b) Gutenberg/Oldham discontinuity - between Mantle and Core.

3. **The CORE:** The Core is the inner most layer of Earth. The depth of this layer is up to 6371 km from the surface. The most important materials of core are nickel and ferrous (iron). Therefore, it is known as **Nife**. It is the densest layer with density varying between 5.5 and 11gm/cm^3.

   a. **Outer Core:** It is the outer layer of the Core consisting of hard molten rocks. Most of the materials are in molten form. It extends from 2900km to 4980km.

   b. **Inner Core:** It is the lower layer of the Core with very high temperature and pressure. Most of the materials are in solid form. Therefore, it is called solid core. The average temperature of this layer is around 2900º C. This layer lies between the depth of 4980 and 6371km.

Lehmann/ Bullen/Transition discontinuity is found between Outer Core and Inner Core.

3.2 EARTHQUAKES

Earthquake is a natural hazard and disaster that takes place due to sudden movement and disturbance in the rocks in the interior of the Earth. It is one of the most dangerous and destructive natural calamities that causes great damage to men and material on the surface of the Earth. Earthquakes are movements within the Earth caused by natural or man-made stresses.

An Earthquake is a sudden vibration or oscillation in the Crust of the Earth. It is a form of energy of wave motion transmitted through the surface layer of the Earth. It is also defined as a shock or series of shocks due to sudden movement of crustal rocks. The place of origin of an Earthquake in the Earth's Crust is called **'Focus'**

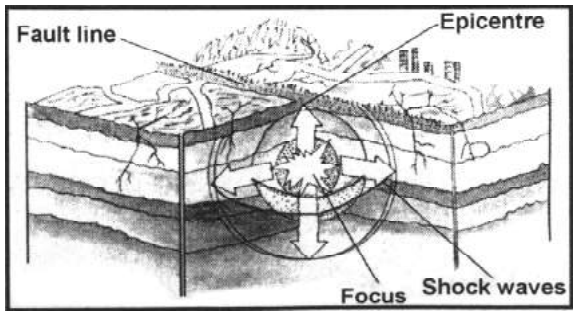


Fig. 3.2 Focus and Epicentre

or **'Hypocenter'** or '**Seismic Focus'**. The depth of the focus generally varies between 10 km and 700 km below the surface of the Earth. The point on the Earth surface which is perpendicular to the focus, receiving seismic waves is called '**Epicentre'** (Fig. 3.2). The areas affected by earthquakes are usually around this point.

The scientific study of earthquakes is called **'Seismology'**. 'The place, time, velocity and direction of seismic waves are recorded by an instrument known as **'Seismograph'**. A **Seismogram** is a graph output by a Seismograph. The people who are specialized in the study of earthquakes are called '**Seismologists'**.

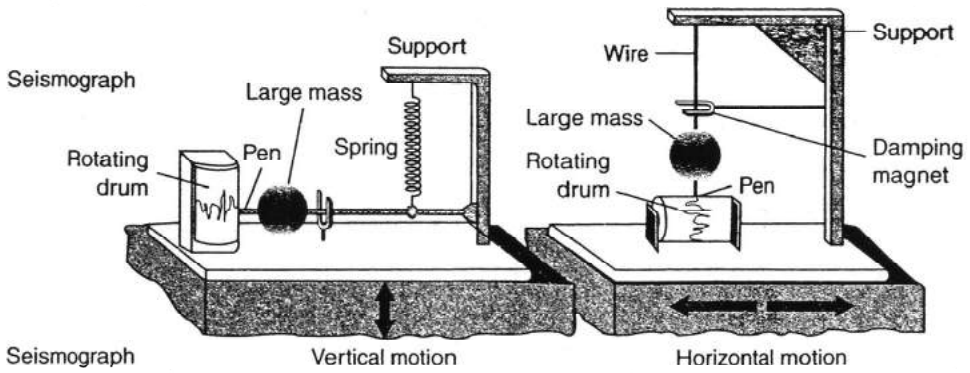


Fig. 3.3 Seismograph

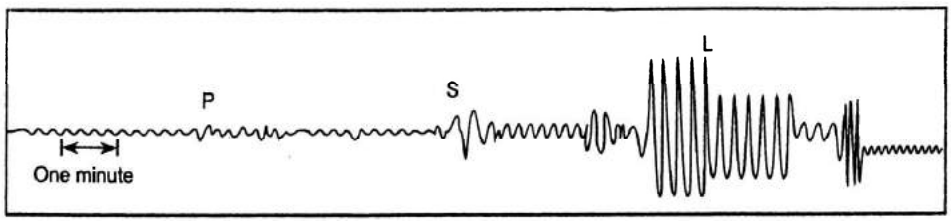
Causes of Earthquakes

On the basis of their occurrence earthquakes can be classified into three types.

1) **Tectonic Earthquakes:** These are caused due to folding, faulting and displacement of blocks of rocks in the Earth's Crust. They are highly intensive and destructive seismic activities.
2) **Volcanic Earthquakes:** These are associated with the volcanic activities and are usually caused at great depths. They are with low intensity and magnitude. The destruction and damage are slightly lesser than earthquakes caused by Tectonic Forces.
3) **Earthquakes caused by man-made factors**: Over interaction of man on nature such as construction of huge dams, reservoirs, deep mining, underground nuclear explosion etc. are causing great change in the crustal formation leading to seismic activity. eg. Koyna dam (India) - 1967, Hoover dam (U.S.A.)-1935, Mangla dam (Pakistan), Kariba dam (Zambia) etc.,

Earthquake waves:

Earthquake waves are classified into three main types based on their mode of travelling and velocity. 1) Primary waves (P.W) 2) Secondary waves (S.W) and 3) Surface waves (L.W)



1) **Primary waves**: These are the first and the fastest earthquake waves from the Seismic Focus to Epicentre. These waves travel horizontally in the land, gaseous and water bodies and make the materials to move forward and backward. These are also called 'Push' or 'Longitudinal' or 'Compressional' waves. The speed of the waves is around 4 to 13 km per sec. Even though these waves reach the Epicentre first they don't cause earthquakes, but they prepare the area for earthquakes.

2) Secondary waves: These waves are also called 'Transverse' or 'Distortional' waves. Secondary waves reach the epicentre after primary waves. These waves make the particles to move at right angles. Secondary waves cannot pass through liquid materials. The speed of these waves is around 4 to 6 km per sec.

3) Surface waves: These are the slowest waves and reach the Epicentre at the last stage. Surface waves are also called 'Long' waves or 'Long period' waves. The speed of these waves is around 3 to 4 km per sec and are confined to the upper layer of the crust. These waves cause heavy destruction and damage on the crust of the Earth. Therefore they are called destructive earthquake waves.

Tsunami: A large sea wave occasionally experienced along the sea coast caused by an underwater or sub-marine earthquake is called 'Tsunami' ("Tsu" - harbour, "nami"- wave). It is quite common in Japan and locally called 'Harbour Waves'. These waves have become common in the recent years in seismic zones of the Pacific and the Indian Ocean and are causing great havoc. Tsunami causes sudden high tidal waves leading to problems for navigation, fishing and coastal activities. In the recent years they are named as 'Killer waves'.

Greatest Tsunami of recent years

1. 26.12. 2004 - Tsunami of Indonesia (Banda Aceh).
2. 11.3.2011- Tsunami of the Pacific ocean (Sendai Daichi, Fukushima, Miyagi – Japan)

To measure the intensity and magnitude of the earthquakes two scales are used.

a) Richter Scale: Most common scale used to measure the magnitude of an earthquake. But in the recent years it is used to measure the intensity of the earthquake.

b) Mercalli Scale: Commonly used to measure the intensity of the earthquake.

The intensity and magnitude of the earthquake waves are recorded on the Seismograph in the seismic recording centres. Later these centres declare the areas of destruction, epicentre etc. Some such centres in India are Gowribidanur (Karnataka), Kodaikanal (Tamilnadu), Kolaba (Maharashtra), Hyderabad (A.P), Dehradun (Uttarakhand) etc.

To indicate the places of earthquake occurrence, intensity and time of occurance three types of lines are drawn on the maps. They are:

Iso-seismal lines: Lines drawn on the map to show the places experiencing the same intensity of earthquake.

Homo-seismal lines: Lines drawn on the map to show the places recording the same time of occurrence of earthquake.

Co-seismal lines: Lines drawn on the map to show the places experiencing same intensity and same time of occurrence of earthquake.

Earthquake Zones

Earthquakes are closely connected with certain seismic zones of the world. Most of the earthquakes occur in the areas of folded regions, zones

of faulting, active volcanic areas and zones of continental and oceanic margins.

1) **The Circum-Pacific belt:** This belt is found all along the coastal margins of the Pacific Ocean. The important areas in this belt are Philippines, Japan, Alaska, Western USA, Mexico, Central America, western part of South America. Japan and USA are the most important earthquake-prone zones in this belt. Eastern Japan and San Andrews fault of USA are the intense seismic zones. About 65 % of the earthquakes in the world are recorded in this belt.

2) **The Mid-continental belt:** It is also known as Mediterranean or Alpine belt. This is a 'Zone of fracture'. The Alpine mountains and their branches, Europe, North Africa, Iran, Afghanistan, Pakistan, Himalayan mountain ranges, China and Myanmar are in this belt. This belt records around 21% of the earthquakes in the world.

3) **The Mid-Atlantic belt:** This belt extends along the mid-oceanic ridges and in the islands of Atlantic Ocean.

4) **Siwalik belt:** This is the most important seismic zone of India in the foot hills of Himalayas: Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Assam and parts of West Bengal record earthquakes frequently.

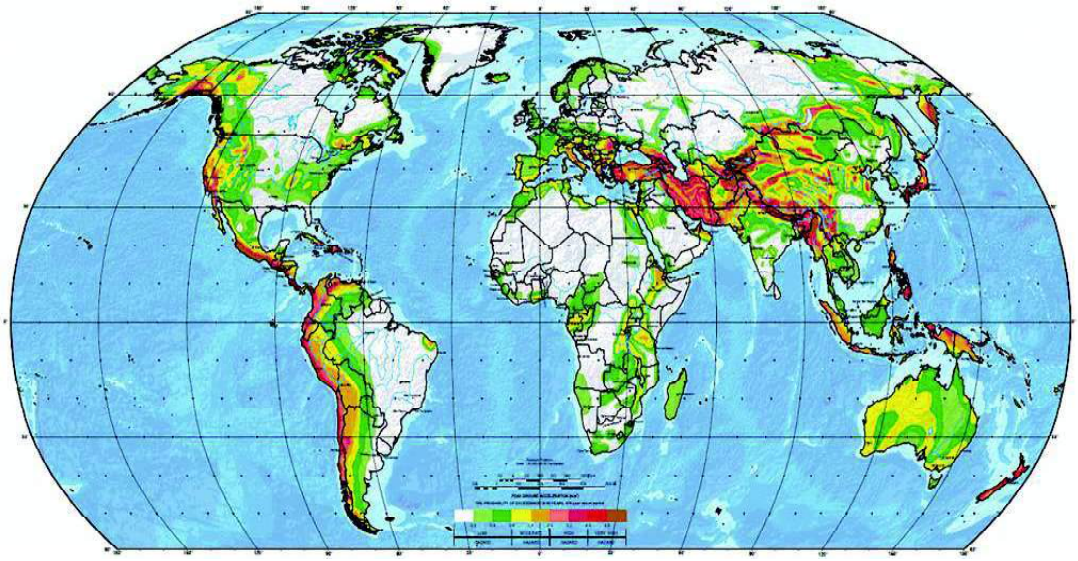


Fig. 3.4 Earthquake zones of the World

Effects of Earthquake

Earthquakes are natural hazards which cause great disaster. Their effects depend on the strength of the seismic waves, nature of the rocks, material through which they pass. Earthquakes cause damage to the topography, course of the river, structure of mountains, underground water levels and on the human life and property. The inhabitance, economic activities, transport, communication system are also affected by earthquake. Loss of human life, animal wealth and destruction of the vegetation are the most important concern to man in the recent years.

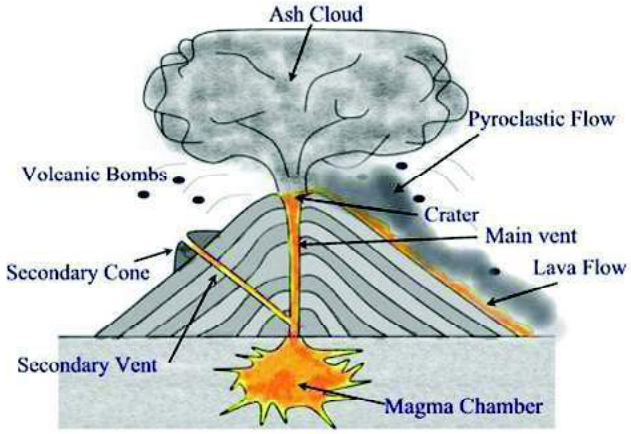
3.3 VOLCANOES

Volcano is also an important natural hazard and disaster like the Earthquake. It is an internal agent of the Earth which influence changes on the face of the Earth and cause great damage to life and property.

In ancient times, Greeks believed that volcanic eruptions were due to anger of Goddess 'Vulcan', living under the Mt. Vulcan (Lipari Islands near Sicili of Italy). People thought that Volcano was the mountain of fire ('Agni', means Fire in Sanskrit). Some volcanoes are still worshipped as Goddess of fire eg. 'Mt. Fujiyama' or Fuji of Japan.

Volcano is a vent or opening, through which heated materials consisting of gases, hot water, lava and fragments of rocks are ejected from the interior of the Earth. A passage in the earth's Crust through which magma and other volcanic materials are ejected is called **'Vent'**. The funnel shaped hollow at the top of the cone of a volcano is called **'Crater'**. A large basin shaped crater bounded by steep sides is known as **'Caldera'.**

The scientific study of volcano is known as **'Volcanology'** or **'Vulcanology'**.



Main Features of a Volcano

Causes of Volcano

The volcanic eruptions are closely associated with various causes.

a) The temperature inside the Earth increases with the increasing depth(1º C per 32 m).

b) Formation of magma because of increase in temperature and reduction in pressure.

c) Gases and water vapour formed due to heating of underground water.

d) Movement and breaking of major and minor plates of the Earth.

e) Ascent of magma forced by excess pressure.

Types of volcano

On the basis of periodicity or frequency of eruption, volcanoes are classified into three types.

1) **Active Volcanoes:** Volcanoes which constantly eject solid, liquid and gaseous materials are known as active volcanoes. Eg. Mt Etna and Stromboli of Italy, St Helens of USA, Mauna Loa and Mauna Kea of Hawaiian Islands, Pinatubo of Philippines, Cotopaxi and Chimborazo of Ecuador and Izalco of El Salvador etc.

Facts File

- Stromboli is known as 'Lighthouse of the Mediterranean'.
- Izalco is called 'Lighthouse of Central America'.

2) **Dormant Volcanoes:** Volcanoes which become quiet after eruption, show no indications of further future eruptions, but erupt again after a long period very violently are called Dormant Volcanoes. These volcanoes cause enormous damage to human life and property. Eg.Mt Vesuvius of Italy, Mt Fujiyama of Japan and Mt. Krakatau of Indonesia.

Facts File

- Mt Vesuvius, Mt Krakatau and Mt. Pelean Volcanoes are called 'Super Volcanoes'.

Fig. 3.5 Mt. Vesuvius Mt. Krakatau Mt. Pelean

3. **Extinct Volcanoes:** Those Volcanoes which have not been active for considerable period of time are called 'Extinct Volcanoes'. There are no possibilities of future eruption in these volcanoes. Sometimes these volcanoes are referred to as 'sleeping' or 'dead' volcanoes. Eg. Narcondum (Andaman & Nicobar Islands of India), Aconcagua (Argentina), Arthur Seat (Scotland) etc.

Barren island of Andaman & Nicobar islands is also an important volcano in our country.

Fig. 3.6 Barren Island Narcondum Island

Volcanic Materials

There are three types of materials ejected from the Volcanoes.

1) **Liquid materials:** Lava is the most important liquid material ejected by volcanoes. The molten rock materials found below the Earth's surface is called 'Magma'. When the molten matter reaches the surface of the Earth it is called 'Lava'.

   There are two types of lava :

   a. **Acid Lava:** It has high percentage of Silica. It is highly viscous and flows slowly. It produces steep sided cones.

   b. **Basic Lava:** It has low percentage of Silica. It is hot, highly fluid and flows faster. It forms flattened shield like landforms.

2) **Solid Materials:** Volcanic bombs, dust, pumice, scoria, volcanic ash, cinder and rock fragments.

3) **Gases:** Sulphur, Hydrogen and Carbon-dioxide.

Volcanic landforms

The landforms produced by volcanoes can be grouped into two types.

a) Extrusive landforms: These are formed by the accumulation and solidification of lava and other materials ejected by volcanoes. eg. Volcanic Cones, Crater, Caldera, Lava cone, Lava dome, Volcanic shield etc.

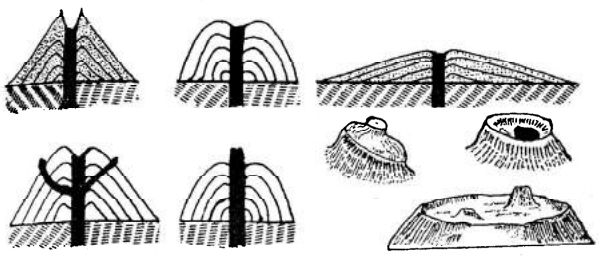


Fig. 3.7 Extrusive landforms

b) Intrusive landforms: These are formed along the bedding planes of sedimentary rocks below the Earth surface. eg. Dyke, Sill, Batholiths, Laccolith, Lapolith, Phacolith etc.

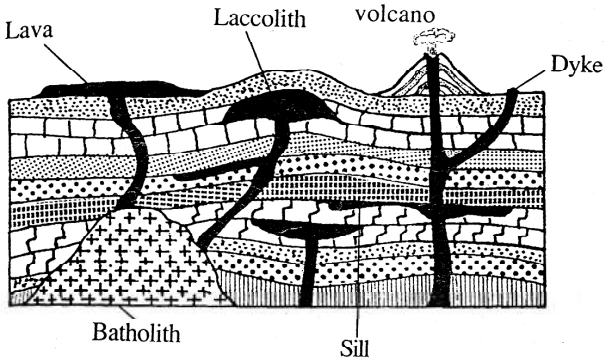


Fig. 3.8 Intrusive landforms

Distribution of Volcanoes

Volcanoes are mainly found in three belts.

1) **The Circum-Pacific belt:** This belt is also called Pacific **'Ring of Fire'**. It is found in the eastern part of New Zealand, New Guinea, Philippines, Japan, western part of Alaska, USA, Hawaiian Islands, Central America and western margins of South America etc., This belt experiences greater number of volcanoes.
2) **Mid-continental belt:** This belt is found in Alpines, Mediterranean region, Europe, North Africa etc.,
3) **Mid -Atlantic belt:** This belt is found in the Mid- Atlantic ridge, Iceland, Caribbean Islands etc.

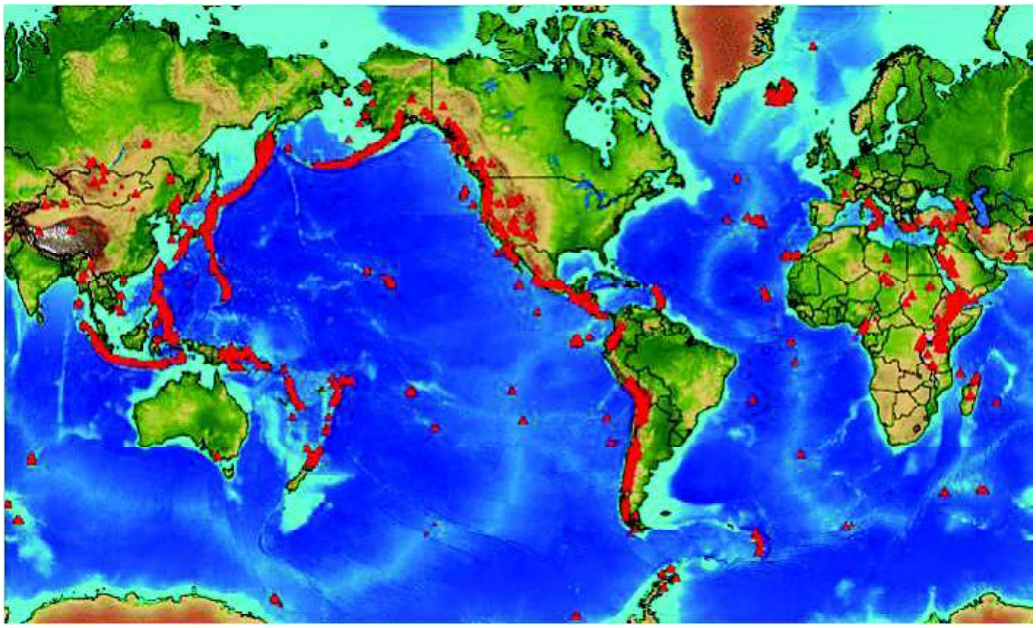


Fig. 3.9 Volcanic regions of the World

Effects of Volcanoes

i. Volcanoes are natural hazards and disaster which causes extensive damage to life and property.
ii. Volcanoes cause damage to agricultural fields, industries, dwellings, buildings, roads, railways, airports, dams, reservoirs etc.
iii. Volcanoes cause diversion of river course and flooding of water.
iv. Volcanic dust, ash and smoke cause air pollution.
v. Volcanic eruption sometimes produce seismic waves.
vi. Volcanoes form roocks and minerals.

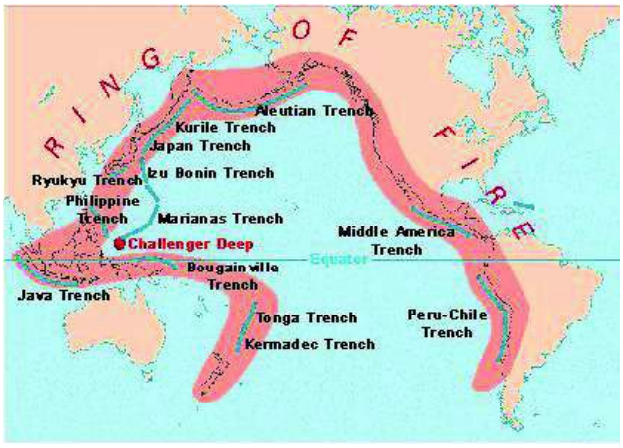


Fig. 3.10 The Pacific Ring of Fire

3.4 Rocks and Minerals

ROCKS

Earth's crust is made up of various solid substances (rocks) formed by volcano and other natural agents. The understanding of rocks is very important for students of Geography to know about different kinds of minerals, soil formation and their types, shaping of landforms etc.

Rocks are the natural solid substances that are found in the Earth's Crust. Rocks are also called aggregate of minerals. The scientific study of rocks is called 'Petrology'. Lithosphere (Litho means Rock) is the uppermost layer of the Earth formed by rocks. A Rock may be hard like granite or soft like limestone. It may be porous like sandstone or nonporous like shale.

Types of Rocks: On the basis of mode of formation, texture and features rocks are classified into three types. I) Igneous rocks II) Sedimentary rocks III) Metamorphic rocks

Rock Cycle: It is a continuous process through which old rocks are transformed into new ones.

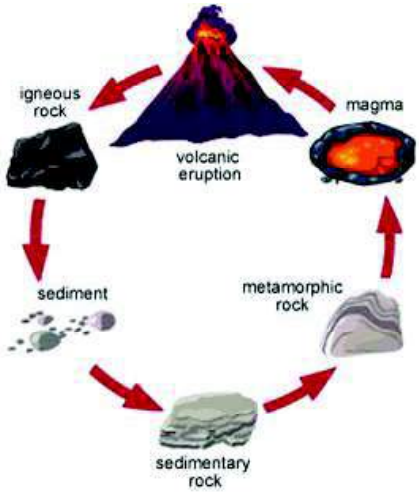


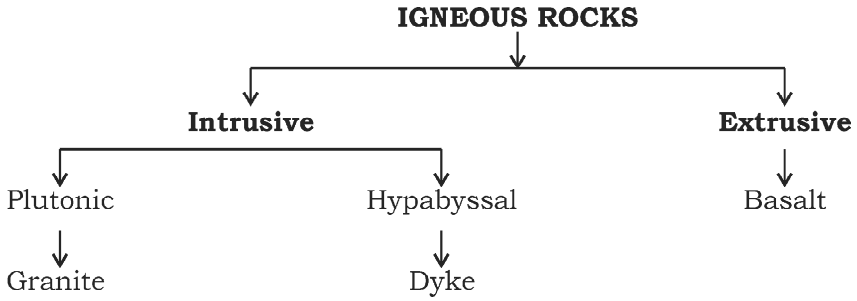
Fig. 3.11 Rock cycle

I IGNEOUS ROCKS

The term Igneous is derived from the Latin word 'Ignis', means fire. Igneous rocks are the primary (first) rocks formed by the action of Volcano. They are formed on the surface of the Earth and in the Crust by the cooling of lava and magma.

On the basis of Silica content, Igneous rocks are classified as:
a) Acid Igneous rocks - these rocks have more Silica eg. Granite
b) Basic Igneous rocks - these rocks have low Silica eg. Gabbro.

On the basis of mode of occurrence, Igneous rocks are classified into two types.



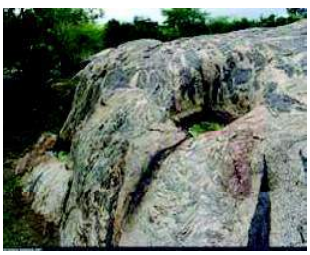
1) Intrusive Igneous rocks: Rocks formed below the Earth's surface or in the Crust of the Earth by the solidification of magma are called Intrusive Igneous rocks. Plutonic rocks and Hypabyssal rocks are two important sub-types in this category.

Plutonic rocks are deep seated, coarse grain in size, formed by slow cooling of magma at great depth. eg. Granite, Gabbro, Diorite etc.

Hypabyssal rocks are formed by fast cooling and solidification of rising magma in the intermediate regions i.e., just beneath the Earth's surface. eg. Dyke

2) Extrusive Igneous rocks: Rocks formed by cooling and solidification of lava on the surface of the Earth is called extrusive Igneous rocks. eg. Basalt.

Fig. 3.12 Granite



Dyke

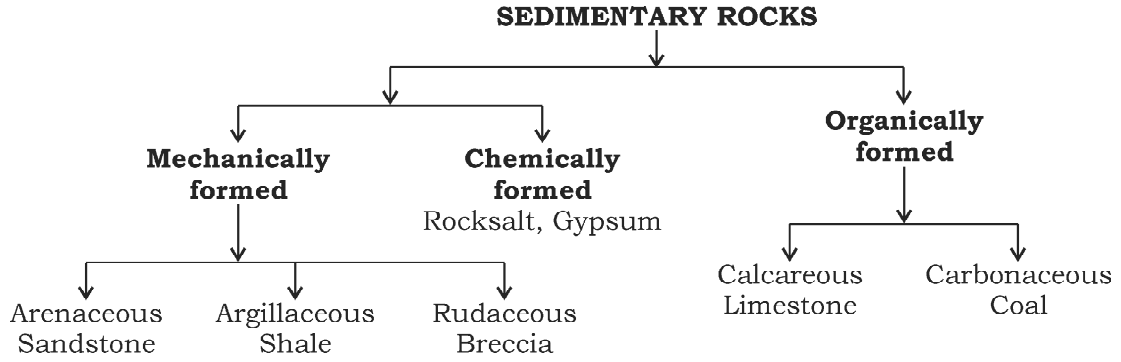
Basalt

Igneous rocks are hard, compact, massive, non-fossiliferous and crystalline in nature. They do not occur in layer or strata formation. Valuable minerals like Iron ore, Manganese ore, Copper, Tin, Bauxite, Zinc, Lead etc., are found in this rock.

II SEDIMENTARY ROCKS

The word Sedimentary is derived from the Latin word 'Sedimentum' means, setting. Sedimentary rocks are formed by the action of wind and water. The accumulation and consolidation of sediments form sedimentary rocks. These rocks are also known as Stratified rocks (Strata), Secondary rocks (formed after Igneous rock) and Aqueous rocks (formed by water).

On the basis of character of the material, composition and the process of its formation, Sedimentary rocks are classified into three major types. 1) Mechanically formed Sedimentary rocks 2) Chemically formed Sedimentary rocks 3) Organically formed Sedimentary rocks.



1) **Mechanically formed Sedimentary rocks**: The rocks which are formed by the process of weathering, erosion and accumulation of fragments from the pre-existing rocks are called mechanically formed rocks. Agents like river, wind, waves etc., transport the fragmented materials and deposit them in the bottom of the lake, sea or oceans. The consolidation and cementing of these materials form sedimentary rocks. In this process three types of rocks are formed. a) **Arenaceous rocks:** Formed by sand grains, porous in nature. eg. Sandstone. b) **Argillaceous rocks:** Formed largely by fine clay particles, non-porous

in nature. eg. Shale. c) **Rudaceous rocks:** Formed by the cementation and consolidation of pebbles and boulders. eg. Breccia and Conglomerates.



Fig. 3.13 Sandstone Shale Conglomerate

2) **Chemically formed Sedimentary rocks**: These rocks are formed by the accumulation and cementation of sediments by chemical action. eg. Gypsum, Rock salt, Quartz etc.


Fig. 3.14 Gypsum Quartz

3) **Organically formed Sedimentary rocks**: These rocks are formed by the decay and decomposition of vegetation and skeletal remains of certain animals. There are two types of organically formed sedimentary rocks. a) **Calcareous rocks:** These are formed by the skeletal remains of certain animals, which are rich in calcium eg. Limestone b) **Carbonaceous rocks:**These are formed by the decay and decomposition of plants, trees and vegetation, which are rich in carbon eg. Coal.


Fig. 3.15 Limestone Coal

Sedimentary rocks are in strata or layer form, usually porous, contain fossils, formed from the pre-existing rocks, non-crystalline in nature, found in the largest surface area of the Earth. Minerals like Coal, Petroleum, Natural gas, Sandstone, Clay, Limestone are found in this rock.

III METAMORPHIC ROCKS

The word metamorphic means 'change of form'. When the Igneous and Sedimentary rocks undergo physical and chemical changes due to the influence of temperature and pressure, it results in the formation of Metamorphic rocks. Metamorphism is the process in which original rock becomes harder and the mineral content also undergoes transformation. Generally these rocks remain in their original location and alter under the impact of internal and external forces.

The process of Metamorphism is of two types:

a) **Contact Metamorphism:** It is directly related to the volcanic activity. When the hot molten magma comes to the surface of the Earth, it passes through joints and fissures in the rocks. The rocks coming in contact with the magma or lava get baked or burnt to form Metamorphic rock. It is also known as Thermal or Local metamorphism. eg. Marble from Limestone.

b) **Regional Metamorphism:** It is associated with Earth movements and processes of mountain building. In this the masses of Igneous and Sedimentary rocks are squeezed and buried deep in the Earth. The heat and pressure causes metamorphism on these rocks. eg. Slate from Clay, Graphite from Coal etc.,

Influence of heat and pressure on the original rock (Igneous or Sedimentary) forms Metamorphic rock. eg. Granite→Gneiss, Basalt→Schist, Sandstone→Quartzite, Shale→Slate, Limestone→Marble, Coal→Graphite, Graphite→Diamond etc.,

Metamorphic rocks are compact, hard and do not contain fossils. A few precious minerals and gem stones like Diamond, Gold ore, Marble, Quartzite, Ruby, Emerald, Sapphire etc., are found in this rock.




Fig. 3.16 Gneiss Schist Marble Diamond

Uses of Rocks:

1) Rocks supply various minerals.
2) Rocks are used for constructional activities.
3) Rocks are used to make statues, idols and other art and sculpture.

MINERALS

Mineral is a natural inorganic substance which has certain chemical and physical properties. As per the estimates, 2000 minerals have been identified and named in the World. The scientific study of minerals is called **'Mineralogy'**. Minerals are used by man for various human activities. Understanding the minerals, their types and uses is very important as natural resources of the Earth.

Earth's Crust comprises of various minerals. Some of the major minerals are: **Feldspar** - it is rich in silica and oxygen, found in more than half of the Earth's Crust. **Quartz** – it is a combination of sand and granite and consists of silica. This mineral covers around 20% of the Earth's crust. **Mica** – it comprises of magnesium, potassium, aluminium, etc. which covers more than 4% of the Earth's crust. In addition to these minerals Pyroxene, Olivine, Amphibole, Calcite, Magnetite, Bauxite etc., are also present in the crust of the Earth.

Types: Minerals are classified into different types on the basis of nature, texture and uses. Important among them are 1) Metallic Minerals 2) Non-Metallic Minerals

1) **Metallic Minerals :** These are the minerals in metallic form or contain metal. Few metallic minerals are Iron ore, Manganese ore, Bauxite, Copper ore etc.

2) **Non-Metallic Minerals:** These minerals are not in metallic form and they do not contain metal. A few non-metallic minerals are Mica, Asbestos, Sulphur, Lead, Zinc, Phosphate etc.

Minerals are also classified into other types. **Ferrous minerals**- which contain Iron (ferrous) eg. Iron ore. **Non ferrous minerals** – these minerals do not contain ferrous eg. Bauxite, Mica.

A few minerals are used for making decorative, commercial and precious ornaments. They are called **Precious minerals**. eg. Platinum, Diamond, Gold and Silver.

Some minerals are used for the generation of energy. They are **Nuclear** or **Atomic minerals**. eg. Uranium, Thorium etc.

Uses: Minerals are useful in many ways. They help in the manufacturing of various structural items, commercial, domestic utensils, ornaments, decorative articles and as raw materials in agriculture, industry, automobiles, transport industry etc.

IMPORTANT TERMS .....

- Crust
- Mantle
- Core
- Sial
- Sima
- Nife
- Conrad discontinuity
- Mohorovicic discontinuity
- Asthenosphere
- Mesosphere
- Repetti discontinuity
- Gutenberg discontinuity
- Lehmann discontinuity
- Focus
- Epicentre
- Seismology
- Push waves
- Transverse waves
- Long waves
- Tsunami
- Iso-seismal lines
- Homo-seismal lines
- Co-seismal lines
- Zone of fracture
- Vent
- Crater
- Caldera
- Magma
- Lava
- Volcanology
- Lighthouse of the Mediterranean
- Lighthouse of Central America
- Acid lava
- Basic Lava
- Pacific Ring of Fire
- Petrology
- Lithosphere
- Hypabyssal rock
- Arenaceous rock
- Argillaceous rock
- Calcareous rock
- Carbonaceous rock
- Contact Metamorphism
- Regional Metamorphism
- Minerology
- Metallic minerals
- Ferrous minerals
- Nuclear minerals

I Answer the following in a word or a sentence each.

1. What is Continental Crust?
2. Name the discontinuity found between Mantle and Core.
3. Why is the inner core called 'Solid Core'?
4. Name the instrument used to record seismic waves.
5. Which is the most destructive earthquake wave?
6. Define Tsunami.
7. What is Homo-seismal line?
8. Mention the region which record more seismic activities in the world.
9. What is Volcano?
10. Name any one volcano of India.
11. Which is a famous active Volcano in USA?
12. What is 'Ring of Fire'?
13. Define Petrology.
14. Give an example for Plutonic rock.
15. Why are secondary rocks called Aqueous rocks?
16. How is Carbonaceous rock formed?
17. What is Metamorphism?
18. What is a Mineral?
19. Which mineral covers largest area of the Earth's crust?
20. Give an example for non-ferrous mineral.

II Answer the following in two or three sentences each.

1. Mention any two features of Oceanic Crust.
2. Why is Mantle very important in the Earth's interior?
3. State the difference between Focus and Epicentre.
4. Name any two causes for earthquakes.
5. Distinguish between Iso-seismal and Co-seismal lines.
6. Which scales are used to measure the intensity of an earthquake?
7. Mention any two causes of a Volcano.

8. Distinguish between Active and Extinct volcanoes.
9. Name any two active volcanoes of the World.
10. Name any two countries which come under the Circum- Pacific belt.
11. How are Igneous rock formed? Give examples.
12. Distinguish between Arenaceous and Argillaceous rocks.
13. How is contact metamorphism different from regional metamorphism?
14. Give four examples of Metamorphic rock.
15. What are metallic and non-metallic minerals?

III Answer the following.

1. Explain the structure and composition of the Earth with a neat diagram.
2. What is an Earthquake? Describe the causes and effects of earthquake.
3. How does a Volcano erupt? Explain the types of Volcanoes.
4. What is a rock? Describe the different types of rocks.
5. What is a mineral? Explain the types of minerals.

SUGGESTED ACTIVITIES .....

- Prepare model to show the interior of the Earth.
- List out the deepest mines and places of India and the World.
- Collect photos of recent earthquakes and tsunamis of the world.
- Draw outline maps of India and the World and show the important earthquake and volcanic prone zones.
- Prepare a list of greatest earthquakes and volcanoes of the world.
- Visit a nearby seismic recording centre and understand how they work.
- List out the important volcanic landforms.
- Prepare chart to show the different types of Rock.
- Collect a few rock samples and understand its texture and features.
- List out the important minerals found in the World.

CHAPTER 4

LANDFORMS

A landform is any natural formation of rock and dirt, found on the Earth. A landform can be as large as a mountain range or as small as a hill. Landforms are natural features of the landscape, natural physical features of the earth's surface. eg., Valleys, Plateaus, Mountains, Plains, Hills, Loess Plains etc.,

The major landforms of the Earth are i) Mountains ii) Plateaus and iii) Plains. The minor landforms include hills, ridges, valleys, basins etc., According to Geo-scientists the landforms are formed by the forces acting from the interior and on the surface of the Earth.

4.1 GEOMORPHIC PROCESSES

The surface of the Earth is facing continuous changes because of the influnce of some natural agents. The agents that influence on the surface of the Earth are called External agents or Exogenic agents, while the agents which bring the change inside the Earth are called Internal agents or Endogenic agents. The processes carried out by Endogenic and Exogenic forces are called Geomorphic processes.

Endogenic Forces: The internal forces are also known as Endogenic forces. These are mainly the land building forces. Diastrophism includes all these processes that move, elevate or build portions of the Earth's Crust. It includes Orogenic or Mountain building processes and Epeirogenic or Continental building processes. Volcanoes and Earthquakes are the most important internal forces which involve in the Crustal disturbances.

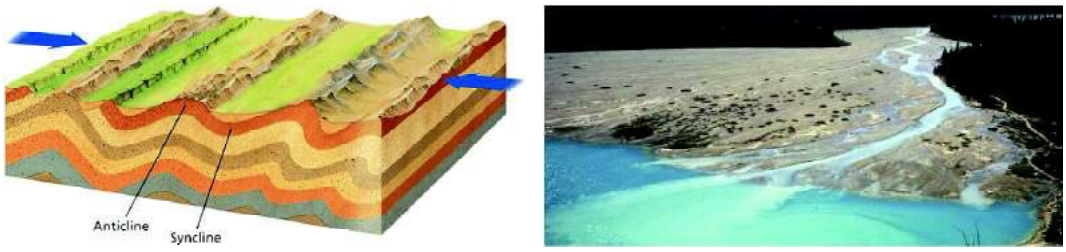


Fig. 4.1 Exogenic forces

Exogenic Forces: The external forces are also known as Exogenic forces. These forces are found on the surface of the Earth, which bring changes through degradation and aggradation processes. The important external forces are river, glacier, wind, sea waves etc.,

Mass Movements

Mass movements are directly under the influence of gravity. Transfer of one mass of rock debris down the slopes is the regular activity of mass movement or mass wasting. The term includes a variety of gravity induced movements of slope material, but excludes transportation by running water, wind, glacier etc.,

The processes of mass wasting and the landforms they produce are extremely varied and tend to grade one into another. The mass movements usually depends on: a) kinds of earth materials involved b) kinds of motion that occur and c) physical properties of those materials. The most important forms of mass movements or wasting are Rockfall, Talus, Earthflows, Mudflows, Landslides, Rockslides etc.,

The external and internal forces of the Earth play a major role in changing the face of the Earth. Geomorphic processes are building mountains, continents and other landforms. The shaping, sculpturing and carving of the surface of the Earth is the outcome of geomorphic processes. The end result of this process is formation of relief features, soils, and its influence on land use, vegetation, biomes and biodiversity.

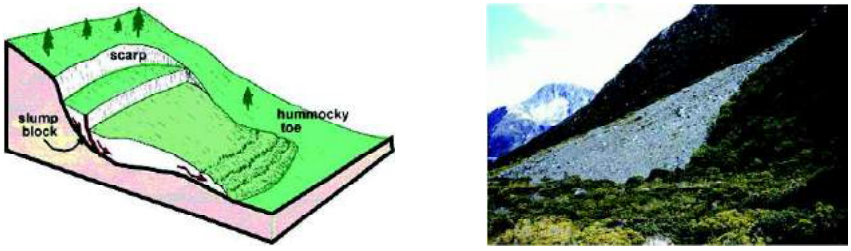


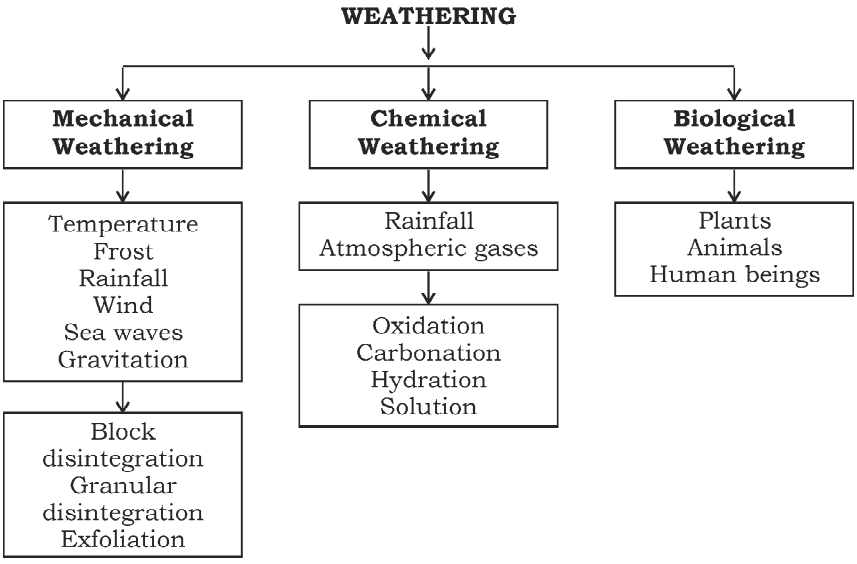
Fig. 4.2 Mass movements

4.2 WEATHERING

The process of disintegration and decomposition of rocks is known as **"Weathering"**. Factors like temperature, pressure, rainfall, frost, wind, plants, animals, and human beings are responsible for weathering.

The character of the rock, its chemical composition, hardness, texture, joints & permeability play an important role in weathering.

Types of Weathering:- There are three types of Weathering processes: i)Mechanical weathering ii) Chemical weathering iii) Biological weathering



I. MECHANICAL WEATHERING : The disintegration of rocks by mechanical way and without any chemical changes is called **"Mechanical weathering".** It is also called **"Physical weathering**". Mechanical weathering is mainly influenced by temperature, frost, wind and sea waves. The agents of mechanical weathering are:

a) Temperature: High temperature leads the rocks to expand and low temperature makes them to contract. During the day the rocks expand due to high temperature and at night contraction takes place due to reduction in temperature. This continuous process leads to breaking or disintegration of rocks.

Fig. 4.3 Weathering by Temperture

b) Frost: In the cold and frigid regions during night time, due to low temperature water solidifies into ice (freezing) and in the day ice melts (thawing). Continuous freezing and thawing leads to expansion and contraction of rocks, resulting in the disintegration of rocks.

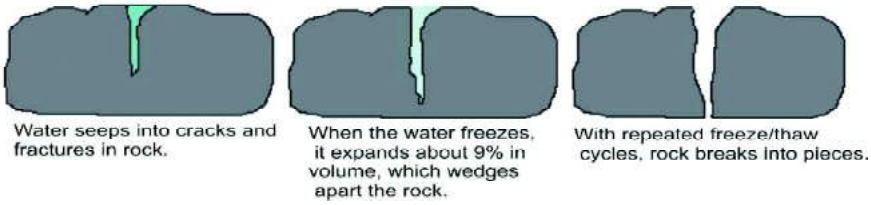


Fig. 4.4 Weathering by Frost

c) Wind: In the desert, wind carries sand materials from one region to another and causes friction of particles on the rock surface. This results in scratching and breaking of rocks.

Fig. 4.5 Weathering by Wind

d) Gravitation: The gravity of the Earth makes the huge rocks to roll towards the slope. Rolling rocks strike against each other and break up into pieces.

Fig. 4.6 Weathering by Gravitation

e) Sea waves: Sea waves brush against the coastal rocks of the Sea and cause breaking of rocks.

Fig. 4.7 Weathering by Sea waves

The process of Mechanical weathering is in various forms, depending on the type of rock. They are:

1. **Block disintegration:** Due to temperature variation, there is continuous expansion and contraction in the rocks causing tension and stress. Later these rocks disintegrate into blocks known as “Block Disintegration”.

Fig. 4.8 Block disintegration

2. **Granular disintegration:** Rocks consist of several types of minerals and these minerals react differently to heat. As a result, the rocks break into different mineral grains known as “Granular Disintegration”.

3. **Exfoliation**: Due to the heat of the Sun, outer surface of rocks gets heated up, but inside it remains almost cool. This makes the rock to expand and crack. The thin layer of rocks peel off, like the peeling of an onion. This process is called “Exfoliation”.

Fig. 4.9 Exfoliation

II. CHEMICAL WEATHERING: Disintegration and Decomposition of rocks by chemical processes is called “Chemical Weathering”.

In this process secondary or new minerals are developed from the original minerals of the rocks .The rain water and atmospheric gases are the main agents of chemical weathering. It is very common in humid regions.

Types of Chemical weathering

There are four types of chemical weathering processes. They are: a) Oxidation b) Carbonation c) Hydration and d) Solution

a) Oxidation: The rain water with oxygen, reacts on rocks containing iron and produce oxides. This chemical reaction is known as “Oxidation”. The common process of rusting of iron is an example of oxidation.

b) Carbonation: The rain water with carbon-di-oxide, becomes a weak carbonic acid and it reacts with calcium carbonate or limestone to form calcium bicarbonate, which dissolves easily. This process is called “Carbonation”. It is very active in limestone regions.

c) Hydration: The rock minerals take up water, the increased volume creates physical stress within the rock. As a result certain minerals like feldspar and gypsum are reduced into powder. This process is called “Hydration”.

d) Solution: The rain water is able to dissolve some of the soluble minerals, such as rock-salt, gypsum, potash. This process is called "Solution".

III. BIOLOGICAL WEATHERING: The disintegration of rocks caused by plants, animals and human beings is called **"Biological Weathering**".

a) Plants: The roots of the plant grow through soil and in the cracks of rocks to find water and minerals. As the roots grow deep in the rock they widen and disintegrate the rocks. This process is most prominent in thick forests and vegetative regions.

Fig. 4.10 Weathering by plants

b) Animals: The burrowing animals like rats, rabbits, ants, earthworms and termites influence in the breaking up of rocks and make passages below the ground. The seepage of air and water through these passages results in rapid weathering of rocks.

c) Human beings: Human beings play an important role in weathering of rocks, through activities like agriculture, mining, quarrying, oil drilling, deforestation etc.

IMPORTANCE OF WEATHERING

1. Weathering is an important process in the formation of soil and helps for natural vegetation and agriculture.
2. The process of weathering produces a new landscape and variety of sceneries.
3. This process prepares the ground for the work of different agents of denudation.

4.3 DENUDATIONAL AGENTS

The word denudation is derived from the **Latin** word **"denudare"** means, **to lay bare.** The wearing or tearing away of the land surface is referred as **"Denudation".** The surface of the Earth is changing regularly due to influence of various natural agents viz., Endogenic (internal) and Exogenic (external) agents.

Agents of Denudation

The natural agents which are responsible for the modelling and shaping of the Earth's surface are known as, **"Agents of Denudation".** The important agents are:

1. **River -** Its activity is common in the drainage (river) regions.
2. **Underground water -** Its activity is familiar to the limestone regions.
3. **Glaciers -** Its activity is widespread in the polar and high mountain regions.
4. **Wind –** Its activity is regular in arid regions.
5. **Waves -** Its activity is familiar in the coastal regions.

The Denudational agents perform three important works. They are:

I. **Erosion -** The wearing away of the land surface.

II. **Transportation –** Carrying the eroded materials.

III. **Deposition –** Deposition of materials eroded and transported.

Work of River

River is an important external (Exogenic) agent of denudation on the ever - changing face of the Earth. The work of river is more or less common in all the drainage systems of the World.

A river is a natural water course, usually freshwater, flowing towards a sea or an ocean. The river gets its water from the rainfall, underground water, glaciers etc.

The place where a river rises is called the '**Source'** or '**Birth place of River'.** The place where the river meets or drains into a sea or an ocean is called '**River mouth'** (**mouth of the river).** The path of the river in which it flows from its source to its mouth is called '**Course of the River'**. A ridge of high land which separates two river (stream) system is called **'Water Shed'** or **'Water Divide'. 'Catchment area'** is the region from which a river or stream receives water from different sources. The main river is joined by a number of streams or small rivers called **'Tributaries'.** The place where a tributary river joins the main river or another river is called **'Confluence'.** The area drained by a river, and its tributaries, including distributaries form "**River basin".**

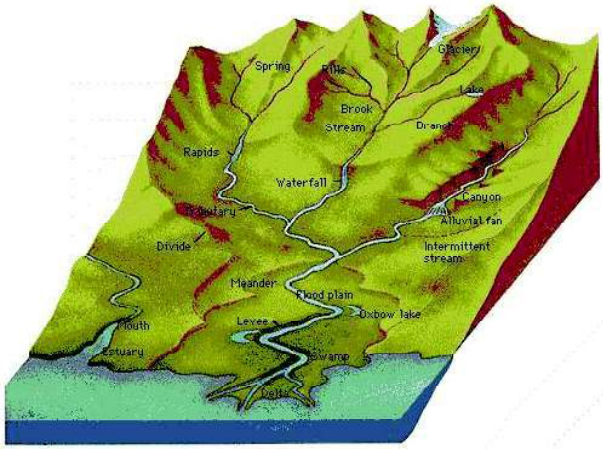


Fig. 4.11 River course

THE RIVER COURSE

The entire path of the river from source to mouth is divided into three courses. 1) The upper course 2) The middle course 3) The lower course.

1. **The Upper course:** It is near the source of a river and is normally found in mountainous areas. Here erosional work is dominant, because the river flows in steep slopes with great velocity. This stage of the river course is known as **'Young stage'.**

2. **The Middle course:** The middle course begins when the river enters the plateau and plains from the mountains. The dominant work of the river in this stage is transportation**.** This stage of the river course is called **'Mature stage'.**

3. **The Lower course:** It is the plain course of a river near its mouth. In the lower course the slope is very gentle, the valley is broad, the speed of the river is very slow, hence deposition work is dominant. This stage of the river is known as **'Old stage'.**

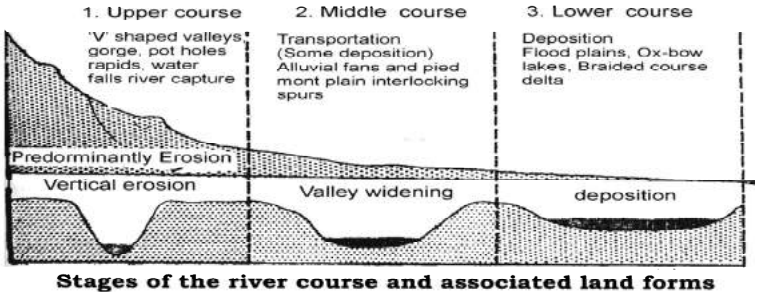


Fig. 4.12 Stages of River course

The work of river consists of three closely interrelated activities. 1. Erosion 2. Transportation and 3. Deposition

1. **Erosional work: -** The process of wearing and taking away the part of rock is known as '**Erosion'.** It depends upon the volume and velocity of water, nature of slope and the nature of rocks.

   The erosional work of the river is performed in two ways.

   i) **The Mechanical erosion:-** It involves hydraulic action.

   ii) **The Chemical erosion: -** It involves corrosion or solution.

There are various landforms associated to erosional work of river. They are 'V' shaped valley, Gorges, 'I' shaped valley, Canyon, Potholes, Waterfall, River capture etc.

a) **'V' shaped valley:** In the mountain course the speed of the river is greater and volume is less. As the water rushes down the steep slopes there is maximum vertical or lateral erosion. The rapid down cutting or vertical erosion results in the formation of 'V' shaped valley.

Fig. 4.13 'V' shaped valley

b) **Gorge:** A deep and narrow valley with steep rocky sides in the river course is known as 'Gorge'. They are formed by the regular vertical cutting by the rivers in the valleys. eg. Narmada gorge, Gangothri gorge etc.,

Fig. 4.14 Gorge

c) **'I ' Shaped Valley** : A very steep, deep river valley formed by the river, looking like 'I' alphabet, is called 'I' Shaped Valley. These are very deep compared to gorges.

d) **Canyon:** It is a wide, deep and steep valley almost with vertical walls like feature found in the arid or semi arid regions is called 'Canyon' eg. Grand canyon of River Colorado in USA.

Fig. 4.15 Canyon

Facts File

The Grand Canyon of Colorado river is one of the **Natural Wonders** of the world. It is known as **"Bad lands"**of U.S.A. The Grand Canyon is 446 km long, up to 29 km wide and attains a depth of over 6,000 feet / 1,800 m. Nearly two billion years of the Earth's geological history has been exposed as the Colorado River and its tributaries cut their channels through layer after layer of rock while the Colorado Plateau was uplifted.

e) Potholes: These are the small depressions in the rocky beds of the river valley. They are formed by corrosion. Pebbles, sand and small rocks carried by the river swirled around on the river bed. This action erodes the rock on the river bed forming potholes.

Fig. 4.16 Potholes

f) Waterfalls: Huge volume of water falling from a great height along the course of a river is called 'Waterfalls'. They are formed when the hard and soft rocks come in the way of flowing river. The soft rock gets eroded faster and hard rock does not erode easily. Therefore huge amount of water falls from great height and creates waterfalls. eg: The Jog falls (river Sharavathi), The Angel falls (river Churun-Venezuela), The Niagara falls (St.Lawrence – North America), The Victoria falls (river Zambezi – Zambia and Zimbabwe) etc.

Fig. 4.17 Jog Angel Niagara

g) River Capture: It is formed mainly due to head - ward erosion by the river near its source. When the source of a river is captured by another major and strong river it is called 'River Capture'. eg. River Testa – it was a tributary to Ganga but, now it is a tributary to river Brahmaputra.

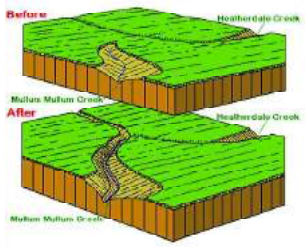


Fig. 4.18 River Capture

2. Transportational work: The process of carrying away the eroded materials is known as 'Transportation'. The rock materials and eroded particles carried by a river is called its **'Load'.** The transportation capacity of a river is based on velocity of water, volume of water, load, slope, smooth valley floor etc.

The most important landforms associated with the transportational and depositional work of the river are Alluvial fans, Alluvial cones etc.

a. Alluvial fans: The term alluvium refers to the debris transported and deposited by rivers. When the fast flowing river enters the plateau or plain region, it experience sudden decline in gradient and obstruction in its path. Due to obstruction the river spreads and deposits many of its light materials in fan shape known as 'alluvial fans'.

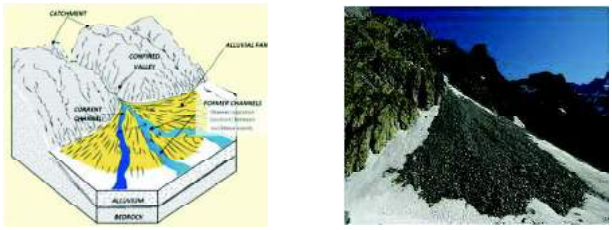


Fig. 4.19 Alluvial fans

b. Alluvial Cones: In the plateau and foot hill region when the river spreads out, the eroded materials (alluvium) carried by the river is deposited in conical shape called 'Alluvial cones'.

3. Depositional work: - The process of carrying and accumulating the eroded materials by the river at the lower course is called 'Deposition'. In the lower course due to gentle slope the river slows down and deposits most of its materials on the banks, course and the mouth.

The important landforms resulting from depositional work of the river in its lower course are Meanders, Ox-bow Lakes, Flood Plains, Natural Levee, River Distributaries, Delta, Estuary etc.

a. Meanders: In the lower course, river flows slowly in zig zag or curved manner due to smaller obstruction in its path. A curve or loop formed by the river in its path is called 'Meander'. When the river course is formed by such crescent shaped loops due to continuous lateral deposition it is called meandering course.

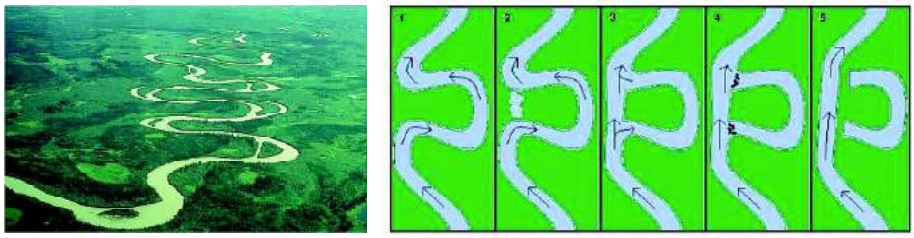


Fig. 4.20 Meanders

b. Ox-bow Lakes: The ox-bow lakes are formed by depositional and erosional actions taking place simultaneously and they are a result of excessive meandering. The River which flows through the shorter route leaving the curve of the meander cut off and crescent shaped lake is formed known as 'Ox-bow lakes'.

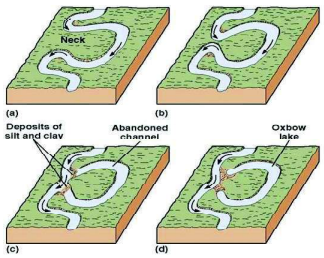


Fig. 4.21 Ox-bow Lakes

c. Flood Plains: When the river is in floods the water over flows on its bank and spreads in the surrounding regions. The silt carried by the water gets deposited in these areas and creates flat plains on both the banks of the river known as 'Flood Plains'.

Fig. 4.22 Flood Plains

d. Natural Levee: During floods the water of the river crosses its banks and deposits the sediments near the bank. Here the river banks are higher than the flood plain. This high wall like feature is called a 'Natural levee'.

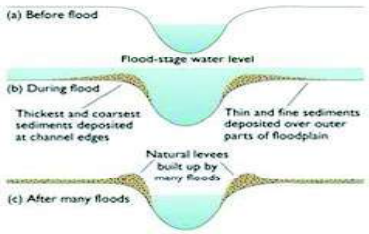


Fig. 4.23 Natural Levee

e. Distributaries: As the river approaches the Sea or Ocean , due to reduction in gradient, joining of tributaries, its volume increases, speed decreases hence, the river begins to break up into a number of branches

from the main river called 'Distributaries'. eg. The Hoogly, The Madhumathi, The Meghana etc.,

Fig. 4.24 Distributaries

f. Delta: A triangular shaped alluvial deposition formed at the mouth of the river is called 'Delta'. Important types of deltas are a) Arcuate or Common delta – Triangular in shape, resembles Greek letter delta (Triangle). eg. The Sunderban delta (Ganga and Brahmaputra : India and Bangladesh – Largest delta in the World) b) Bird – foot delta – Fingers of a hand or Bird foot shape eg. Mississippi and Missouri delta (USA).

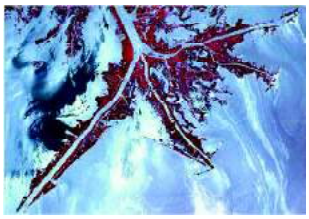


Fig. 4.25 Bird Foot Delta

g. Estuary: Estuaries are the tidal mouth of a river having a narrow, gradually widening lay at the mouth. In estuary river water is mixed with sea water. eg. The Narmada estuary, The Kali estuary, The Nethravathi estuary etc.

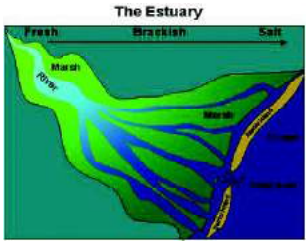


Fig. 4.26 Estuary

Facts File

- **Potomology:** The Science of Rivers.
- **Limnology:** The Scientific study of lakes and ponds with respect to their physical, chemical and biological properties.

IMPORTANT TERMS .....

Endogenic forces	Granular disintegration	Distributaries
Exogenic forces	Oxidation	Gorge
Diastrophism	Carbonation	Canyon
Orogenic activity	Hydration	River capture
Epeirogenic activity	Solution	Meanders
Mass wasting	Denudation	Ox-bow lakes
Mechanical weathering	Water shed	Natural levee
Block disintegration	Catchment area	Delta
Exfoliation	Tributaries	Estuary

I Answer the following in a word or a sentence each.

1. What is geomorphic process?
2. Define Diastrophism.
3. Mention the force responsible for Mass movement.
4. What is Weathering?
5. Name any two factors of Mechanical weathering.
6. How does granular disintegration occur?
7. What is the role of oxygen in Oxidation?
8. Which region is predominant in Carbonation?
9. What is River capture?
10. How are Ox-bow lakes formed?

II Answer the following in two or three sentences each.

1. State the difference between Endogenic and Exogenic forces.
2. What is Mass movement?
3. Name any two types of Weathering processes.
4. Distinguish between Oxidation and Hydration.
5. How does Biological weathering take place?
6. Mention any two agents of denudation.
7. What is Canyon? Give example.
8. Distinguish between Meanders and Ox-bow lakes.
9. What is Delta? Name any two types of delta.
10. Mention the difference between Tributaries and Distributaries.

III Answer the following.

1. What is landform? Explain the different types of geomorphic processes.
2. Describe the factors affecting Physical weathering.
3. Explain chemical weathering with examples.
4. Describe the landforms associated to work of river.

Suggested Activities .....

- Prepare a list of Exogenic and Endogenic forces.
- Prepare a chart to show different processes of weathering.
- Collect photos of weathered regions.
- List out and collect the photos of various landforms associated to work of River.
- Visit the coastal areas and identify the formation of deltas and estuaries.

CHAPTER 5

ATMOSPHERE

Atmosphere is the most important realm of the Earth. It is essential for existence of life on Earth. The elements of the atmosphere are temperature, pressure, wind, humidity etc. The atmosphere is attached to the Earth's surface by the gravitational pull. It acts as a store house of water vapour and helps in its condensation and precipitation. It protects the living organisms on the Earth's surface from the harmful rays (Ultraviolet) of the Sun and meteor showers and acts as a medium of transmitting Radio waves. Atmosphere is dense near the Earth's surface and becomes thin away from the surface. Atmosphere extends to approximately 1,600 km.

The word atmosphere is derived from the Greek words "atmos" - vapour and "spaira" - sphere. In total it is the thin layer of vapour, gases and dust particles around the Earth.

5.1 COMPOSITION AND STRUCTURE OF ATMOSPHERE

The Earth's atmosphere consists of a mixture of various gases, water vapour and dust particles. The composition of air varies from time to time and from place to place. About 78% of the air is made up of Nitrogen and 21% is Oxygen. Although these gases are plentiful they are of great significance to life on Earth. The remaining 1% of air is made up of a number of major and minor gases viz., Argon, Carbon dioxide, Hydrogen, Neon, Helium, Methane, Xenon, Krypton, Ozone etc.

Oxygen is very important for breathing and for combustion. Nitrogen is necessary to dilute Oxygen and it is used indirectly by plants and animals. Carbon dioxide is needed for plants. It traps heat and acts as an insulating agent, that is why the Earth is warm during night. It is also used as fire extinguisher .

Water vapour is the most significant component of the atmosphere, as far as its effect on weather is concerned, although its quantity varies considerably from partially nil to about 4% by volume.

The atmosphere also contains dust particles. The amount of dust particles varies from place to place and is more in urban areas compared

to rural areas. Dust particles help to trap heat and hold the water vapour. It helps water vapour to condense, disperse Sun light and give blue colour to the sky.

STRUCTURE OF THE ATMOSPHERE

The atmosphere extends to about 1,600 km, from the surface of the Earth. But 99% of its mass is found within 32 km. The atmosphere has its multi-layered structure consisting of the following basic layers. Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere.

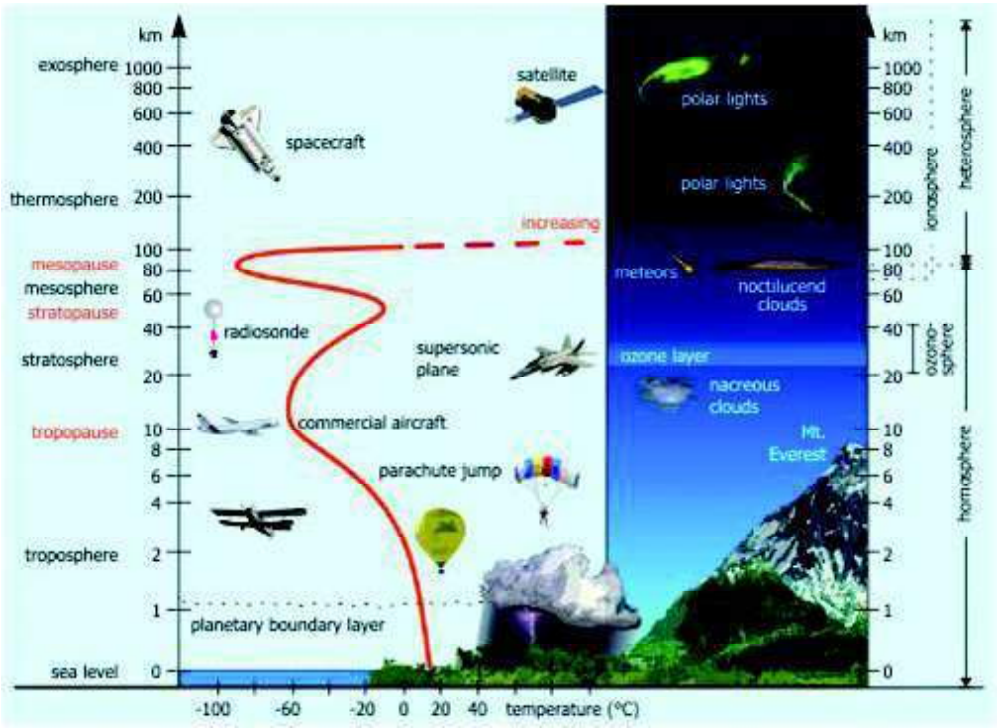


Fig. 5.1 Layers of Atmosphere

Troposphere - Region of Mixing

The term Troposphere literally means “the region of mixing’. It is derived from the Greek word ‘Tropos’ means ‘mixing’ or ‘turbulence’. Troposphere is the lowest layer in which life exists. All changes in weather conditions take place in this layer. It is known as ‘weather manufacturer’. Temperature, pressure, winds, clouds and other special features like thunder, lightning, rainbow and precipitation are common in this layer. This layer serves as a good means of transport for passenger aircraft. This is due to the fact that the density of air decreases with height and so the

heat absorbed is lost. It extends to a height of 8 km at the poles and 18 km at the Equator. The average height of the troposphere is 12 km. Temperature decreases with increase in height at an average rate of 1ºC/ 165 m or 6.4ºC/1000m is called Normal Lapse Rate. Tropopause is the boundary between Troposphere and Stratosphere.

Stratosphere

This is the second layer of the atmosphere. It extends to about 50 km from the surface of the Earth. It is free from water vapour and dust particles. There are no clouds or turbulence in the air, thus, this layer provides ideal conditions for flying of jet aircrafts. Temperature increases due to the absorption of the ultraviolet radiation of the Sun by ozone. This region is rich in Ozone which is vital for life on the Earth. The ozone layer is found between 5 to 20 km. Stratopause is the boundary between Stratosphere and Mesosphere.

Mesosphere

Mesosphere extends to a height of 80 km from the surface of the Earth. It is the 'coldest' layer of the atmosphere. The gases are too thin to absorb the sun rays. Temperature starts decreasing with increase in altitude and reaches up to minus 100ºC at the height of 80 km. Mesopause is the boundary between Mesosphere and Thermosphere.

Thermosphere

This layer extends from 80 km to 600 km from the surface of the Earth. In this layer temperature rises drastically because, the gas molecules in this layer absorb the x-rays and shortwave radiation of the Sun. This results in the break up of the gas molecules into positively and negatively charged particles. These electrically charged particles are known as "Ions" and hence this layer is known as **Ionosphere**. Radio waves transmitted from the Earth are reflected back to the Earth by this layer. It helps in Radar, Navigator communication. The ionosphere protect us from meteors. It also forms Aurora or Natural bands of light. They are Aurora Borealis and Aurora Australis.

Facts File

- Aurora Borealis is a phenomenon of coloured lights seen in the sky in the Northern Hemisphere - 66½º North to 90º North. Similar phenomenon in the Southern hemisphere is called Aurora Australis - 66½º South to 90º South.

Aurora Borealis

Aurora Australis

Exosphere

The region beyond the Thermosphere is called Exosphere. It extends to about 1,000 km and the gravity of the Earth is too weak in this layer. Magnetosphere is found above this layer.

5.2 TEMPERATURE

The Sun is the ultimate source of light and energy for the various phenomena that takes place on the earth's surface and in its atmosphere. The Earth due to its small size and great distance from the Sun, intercepts only a small fraction of the energy radiated by the Sun. The radiant energy received by the Earth is called the incoming solar radiation or Insolation. Temperature is the hotness or coldness of an object or body. The heat is a cause, temperature is its effect. The temperature received (Insolation) by the Earth is responsible for all forms of life and activity on the Earth. The radiant energy from the Sun enables plants to produce their own food. This forms the basis for food needed by all other organisms on the Earth. The circulation of ocean water is also due to the unequal heating of the ocean water.

Heating of the Atmosphere

Our atmosphere is not directly heated from the Sun, but by the terrestrial radiation of the Earth. There are four main processes through which the Earth's atmosphere is heated. They are Radiation, Convection, Conduction and Advection.

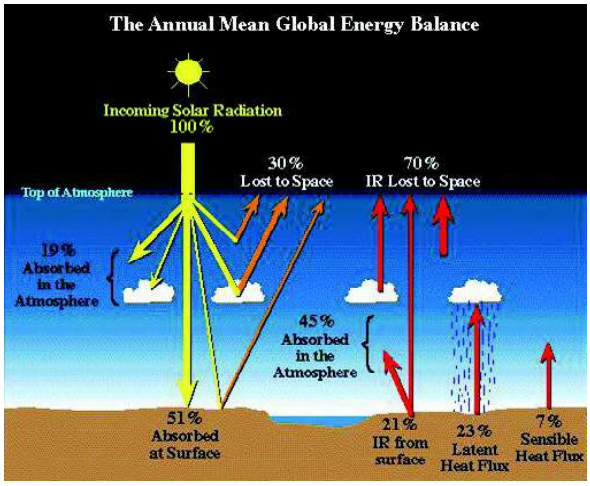


Fig. 5.2 Heat budget

Facts File

- **Albedo:** The proportion of solar radiation falling on a non-luminous body which the latter reflects, is usually expressed in percentage. The albedo of the Earth is approximately 40 % of the solar radiation which is reflected back into space.

Radiation: It is the process by which a body emits radiant energy i.e., energy received from the Sun in the form of heat.

Convection: The transmission of heat from one part of a liquid or gas to another by movement of particles themselves is called convection. It is the upward movement of a mobile medium like air or water, which has been heated by contact with the earth's surface. Air is therefore, said to rise in convection current.

Conduction: It is a process by which heat is transferred directly through matter from point of high temperature. Heat passes from warmer to colder substances, as long as temperature difference exists.

Advection: Wind carries the temperature horizontally from one place to another. The temperature will rise, if a place lies in the path of wind coming from warmer regions.

Thermometer: It is an instrument used to measure the atmospheric temperature. Two types of thermometers are used in the normal life a) Centigrade thermometer and b) Fahrenheit thermometer.

Do you know?

- Centigrade Thermometer – Freezing point 0º C, Boiling point 100º C
- Fahrenheit Thermometer – Freezing point 32º F, Boiling point 212º F

Factors affecting the distribution of Temperature:

Normally the temperature distribution is recorded horizontally and vertically. Horizontal distribution of temperature is determined by latitude. The general decline in temperature from the equator towards the poles is one of the most fundamental and best known facts. The horizontal distribution of temperature is the function of numerous other physical factors. They are: Latitude, Altitude, Distance from the Sea, Ocean currents, Wind, Clouds & Rainfall, the slope of the land, Vegetation and Nature of the Soil.

Of the various climatic elements, temperature, pressure, wind, precipitation have far reaching effects, whether it be horizontally from the equator to the poles or vertically from sea level to high altitudes.

Latitudes

Places close to the equator have higher temperature and are warmer than places away from the equator. This is because the Sun rays reach the Earth after passing through the layers of the atmosphere. In the low latitudes the Sun rays are direct and have to travel a lesser extent through the atmosphere. Hence, the heat of these rays is more intense. But in high latitudes the Sun rays are slanting and have to pass through a greater extent of atmosphere. These rays lose heat and so the areas in the high latitudes are not very hot as compared to the equatorial regions.

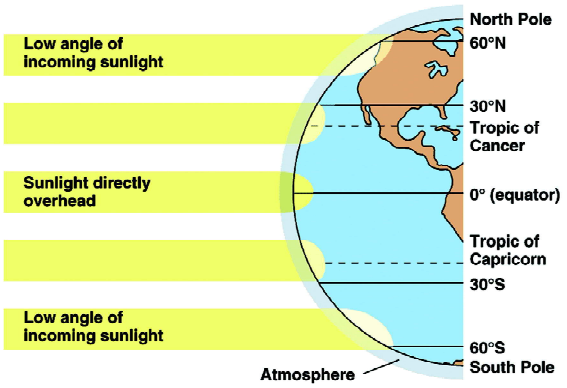


Fig. 5.3 Effect of Latitude

Altitude

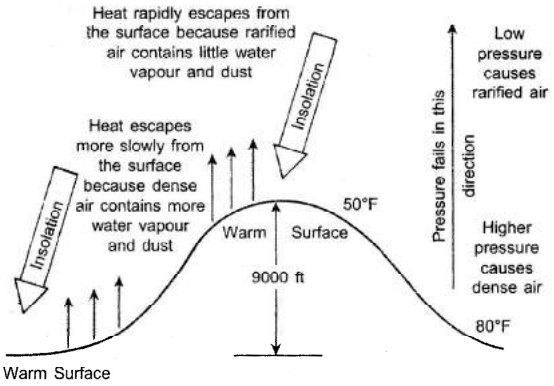


Fig. 5.4 Effect of Altitude

The height of a place above the mean sea level is the altitude of that place. The atmosphere is mostly heated by various heat processes. Air is cooler at higher altitudes than near the Earth's surface. So the places near the Earth's surface are warmer than places higher up. This is because air near the surface is denser and contains gases like carbon dioxide, water vapour and other gases. So their capacity of heat absorption is more than in the upper layers. Temperature decreases with increase in height at an average rate of 1ºC/165 m or 6.4ºC/1000 m. Sometimes temperature increases with the increase in height known as 'Inversion of Temperature'. This feature is common during winter season, less cloudiness, slow movement of winds, clear sky in the mountain valley.

Distance from the Sea

Fig. 5.5 Distance from the sea

This factor also influences on the distribution of temperature and differential heating of land and water. Land gets heated faster compared to water. Water takes longer time to get heated and to cool than land. Hence during the day when the land gets heated quickly, water takes longer time and remains cool. Therefore, during the day time land gets more heat than the surrounding water bodies (sea and ocean). The coastal areas are cooler and wetter than the inland areas.

Ocean currents

Ocean currents increase or decrease the temperature of the Earth's surface. Warm ocean currents along the coast make the coastal areas warmer and cold currents reduce the temperature and cools the coastal areas. Warm currents can be noticed on the eastern margins of the continents in the middle latitude, while it is the cold currents flow at the western margins of the continents. eg. Gulf Stream a warm current, increases the temperature in the eastern coast of U.S.A. and California cold current decreases the temperature of the western coast of U.S.A.

Winds

Winds that blow from the lower latitudes are warm and make the places warmer. On the other hand, winds that blow from the higher latitudes are cold and make the places cooler. Winds that blow from the sea bring plenty of rain especially if they are warm winds. While off shore winds hardly bring any rain.

Clouds

During the day clouds prevent Insolation from reaching the Earth's surface. Clouds also prevent the escape of terrestrial radiation during the night. Clear sky permits Insolation readily during the day time and allow the rapid escape of terrestrial radiation during the night.

Isotherms: Lines drawn on the map or globe joining the places having the same temperature.

Temperature Zones or Heat Zones

The temperature generally decreases as one proceeds from the equator towards the poles. As such, different temperature zones are found on the Earth. They are Torrid Zone, Temperate Zone and Frigid Zone.

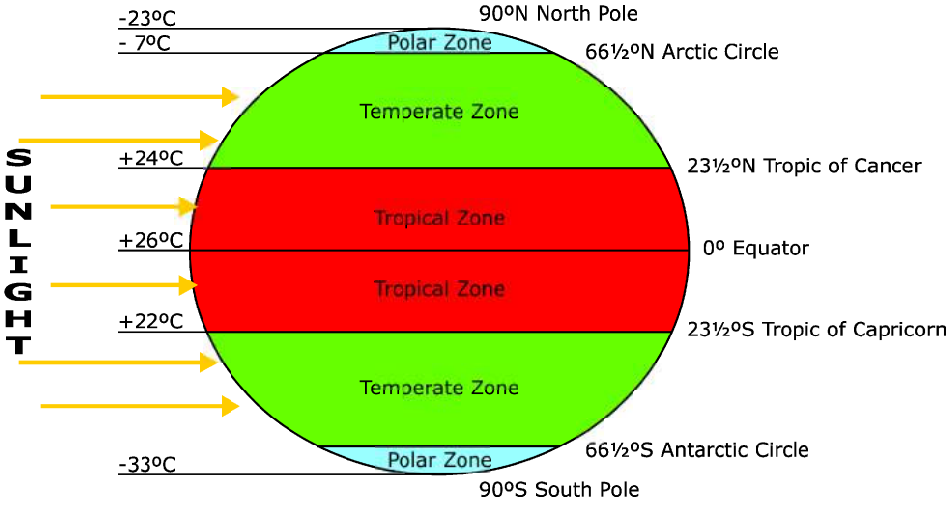


Fig. 5.6 Temperature Zones of the Earth

Torrid Zone: This region receives direct Sun rays throughout the year. It lies between 0º – Equator to 23 ½º N/S latitudes. The three important latitudes that come under this zone are Equator, Tropic of Cancer and Tropic of Capricorn. The shape of the Earth, direct sun's rays make this area always hot with high temperature called 'Torrid Zone'. This belt is also known as **'Tropical Zone'**.

Temperate zone: This region lies between 23 ½º N/S to 66 ½º N/S. It is spread over between Tropic of Cancer to Arctic circle in the Northern Hemisphere and Tropic of Capricorn to Antarctic circle in the Southern Hemisphere. This zone receives oblique sun rays due to the shape of the Earth, inclination and revolution of the Earth. Therefore, this area neither records high temperature nor low temperature. The temperature is more or less uniform. Hence this belt is called 'Temperate Zone'.

Frigid zone: This region receives oblique sun rays for more than 8 to 9 months. The shape of the Earth and oblique sun rays for a long period form very low temperature with freezed weather condition in this zone, called 'Frigid Zone' or **'Polar Zone'**. This zone lies between 66 ½º N/S to 90º N/S. There are two frigid zones a) North frigid zone (66 ½º N to 90º N) b) South frigid zone (66 ½º S to 90º S).

5.3 Atmospheric Pressure

Atmosphere has air which cannot be seen but can be felt. We are surrounded by air on the Earth. Air pressure or atmospheric pressure is the force exerted by air on the Earth. Atmospheric pressure changes from time to time and place to place due to differential heating. Air pressure is crucial to all forms of life and it plays a dominant role in wind movement and precipitation. It directly and indirectly, influences the weather and climatic changes.

The atmospheric pressure is measured by an instrument called **Barometer**. Mercury, Aneroid and Digital barometers are commonly used to measure pressure. Air pressure is expressed by a unit called 'millibar' (mb). The average atmospheric pressure at the sea level is 1013.25 mb.

Fig. 5.7 Aneroid and Digital Barometers

Factors affecting atmospheric pressure

Atmospheric pressure is influenced by various factors. Most important among them are:

Altitude: Air is compressible. Earth's gravity pulls the molecules and gases towards the ground. The lowest layer of the atmosphere gets compressed and also becomes dense. These dense layers exert great pressure and form high pressure. With the increase in altitude there is a decrease in atmospheric pressure, at the rate of 1 inch for every 900 feet.

Latitude: Lower latitudes record high temperature, with that pressure falls. In the same way higher latitudes record low temperature and forms high pressure.

Water vapour: Moist air is light and exerts less pressure than dry air. While cool air exerts high pressure.

MAJOR PRESSURE BELTS

There are seven pressure belts on the globe. They are Equatorial low pressure belt (1 belt), Sub-tropical high pressure belts (2 belts), Sub-polar low pressure belts (2 belts) and Polar high pressure belts (2 belts).

1. Equatorial Trough or Low Pressure belt

This belt extends from 0^0 to 5^0 North and South of the Equator. It receives direct rays of the Sun almost throughout the year. Hence the air becomes hot, expands and rises. Thus a belt of low pressure is created in this region. It is a 'belt of calm' with very little wind, therefore it is known as **'Doldrums'** (Equatorial calm). This is a region of convergence of trade winds. It receives regular convectional rainfall.

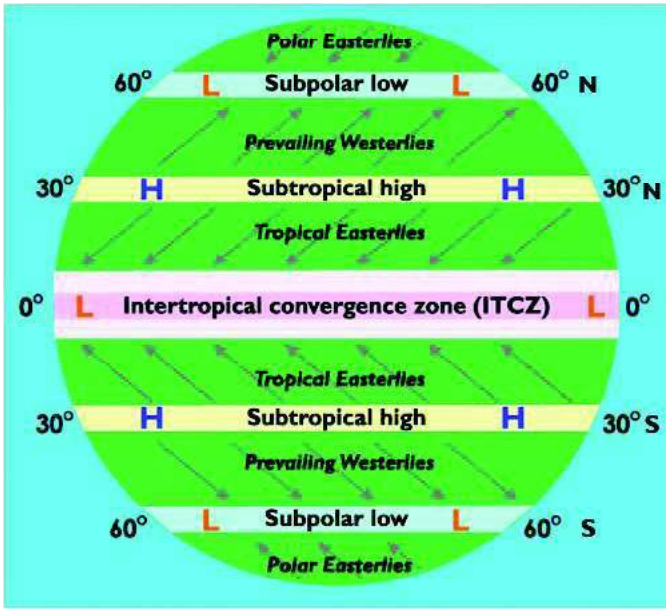


Fig. 5.8 Global pressure belts

2. Sub-tropical High Pressure belt

This belt is found between 25^0 to 35^0North and South of the equator. The formation of this belt is associated with rotation of the Earth and descending air currents. The warm air rises at the equator, blows to higher altitude and diverts towards poles. The wind cools down as it rises and spreads towards the poles. Gradual cooling makes this air heavy and sinks down to the surface at 30^0 North and South of the equator. This results in the formation of high pressure belt. The trade winds and anti trade winds originate in this belt. This belt is also called **'Horse Latitudes'**. There are two Sub-tropical high pressure belts a) North sub-tropical high pressure belt and b) South sub-tropical high pressure belt.

Facts File

- **Horse Latitudes:** Horse latitudes are generally areas of high pressure marked by calm, subsiding air that gets heated during descent. It is said that Spanish sailors ferrying horses to the West Indies were usually stuck for months in these calm waters and had to throw their horses into the water to conserve drinking water for themselves. This led to the term 'horse latitudes'.

3. Sub-polar low pressure belt

This belt lies between 60º to 70º North and South of the equator. A low pressure belt is created mainly due to the rotation of the Earth, which swings the bulk of the air towards the equator. These are the areas of storminess, especially in winter. There are two sub-polar low pressure belts a) North Sub-polar low pressure belt and b) South Sub-polar low pressure belt.

4. Polar high pressure belt

The two polar regions experience low temperature throughout the year. Thus the cold air sinks down because of its greater density. Sinking of cold air in the polar region results in high pressure. Polar high pressure belt extends from 80º to 90º latitudes in both the hemispheres. The polar high pressure belts record extremely cold weather condition so air is dense and heavy. There are two polar high pressure belts a) North Polar high pressure belt and b) South Polar high pressure belt.

Shifting of pressure belts

The above mentioned pressure belts are neither fixed nor permanent. The pressure belts move (5º North and South) in response to the apparent migration of the Sun. We assume that the Sun is directly over head on the equator on all the days of the year. But this happens only twice a year, during Autumn (23rd September) and Spring (21st March) seasons. Between December and June the Sun moves northwards, and between June and December it moves southwards. Therefore, the pressure belts follow the annual migration of Sun towards the North and South. This results in shifting of pressure belt.

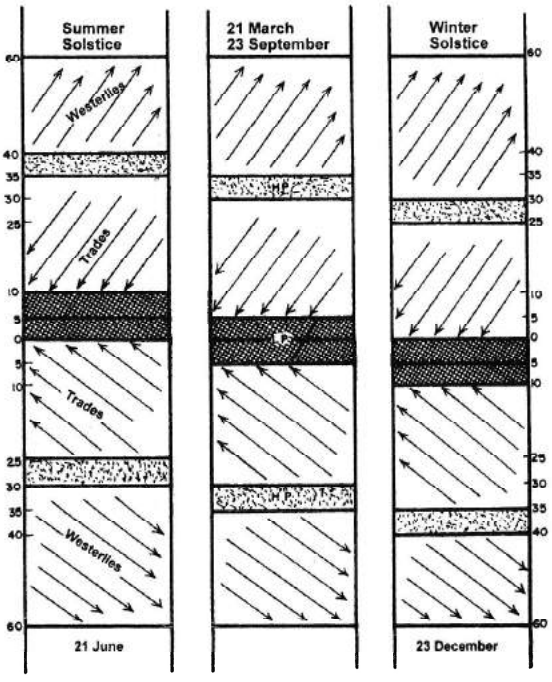


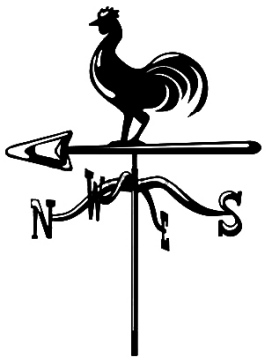
Fig. 5.9 Shifting of pressure belts

Isobars: Lines drawn on the map or globe joining places having equal atmospheric pressure.

5.4 WINDS

The horizontal movement of air, parallel to the Earth's surface is known as **'Winds'**. The winds play an important role in the distribution of temperature and humidity in the atmosphere. Winds are generated due to differences in pressure from one place to the other. Winds have a tendency to move from areas of high pressure to those of low pressure. The direction of the winds is determined by the direction of the pressure gradient.

The direction of winds is identified by an instrument called '**Wind vane'** or **'Wind cock'**. **'Anemometer'** is used to measure the speed of the winds.



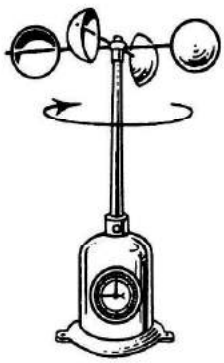


Fig. 5.10 Wind Vane Anemometer

Characteristics of Winds:

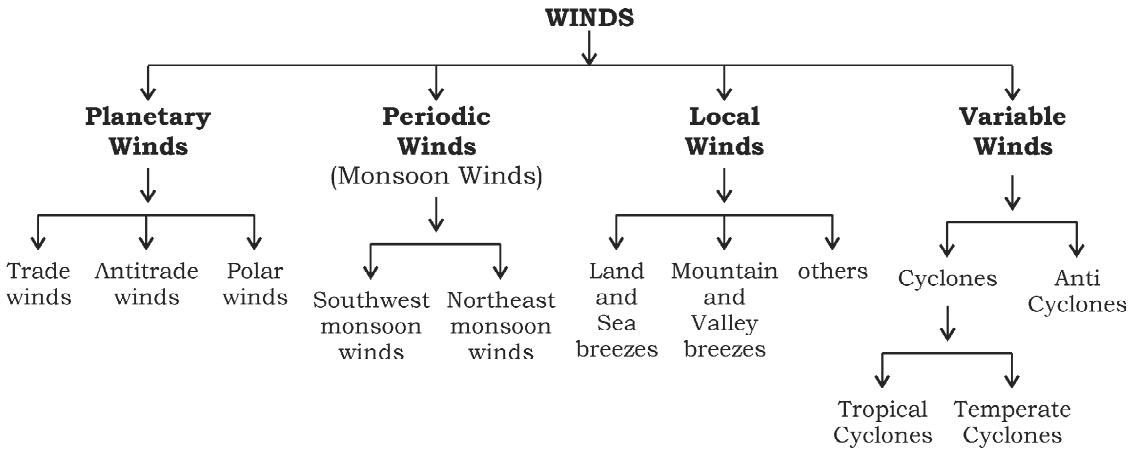
1) **Difference in Pressure:** Wind always blows from places of high pressure to the areas of low pressure. The speed of wind is directly governed by the **'pressure gradient'**. Steeper the gradient greater will be the speed, whereas gentle gradient causes slow movement of air.

2) **The Rotation:** Due to the rotation of the Earth the wind movement is towards its right and become clock wise direction in the northern hemisphere. While in southern hemisphere the wind movement is towards its left become anti clockwise direction (Refer Chapter 2.3 - Coriolis force).

3) **Direction of wind:** The direction of wind is generally identified from its source. On the basis of this, different types of winds are seen on the Earth. eg. In India during June to September wind blows from south west to north east direction and from September to December it blows from north east to south west.

Types of Winds :

Winds are influenced and supported by temperature and pressure. On the basis of origin, nature and features winds are classified into four main types: 1) Planetary winds 2) Seasonal or Periodic winds 3) Local winds 4) Variable winds



1) Planetary winds: Planetary winds are also called Permanent winds. These winds blow regularly from high pressure to low pressure belts in a fixed direction throughout the year. They play a major role in climate change, desert formation, guide navigation routes etc., There are three types of Planetary winds. They are: a) Trade winds b) Westerlies or Antitrade winds and c) Polar winds.

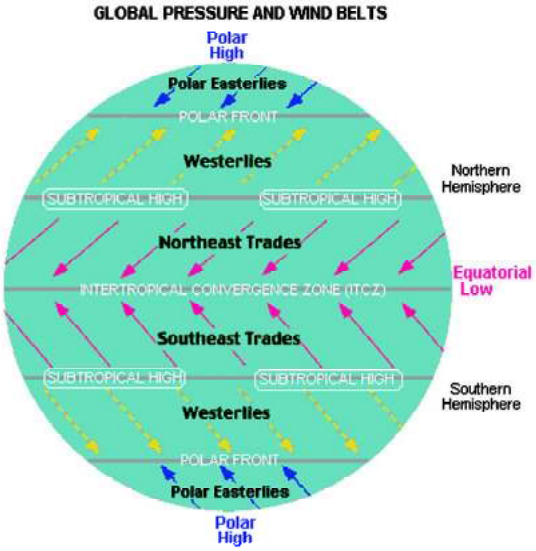


Fig. 5.11 Planetary winds

a) Trade Winds : Trade winds are also called the 'Tropical Easterlies'. These winds originate and blow from Sub-tropical high pressure belts to Equatorial low pressure belt. The word trade is derived from the Latin word 'trado' means, constant direction (Phrase-to blow trades). There are two types of trade winds. 1) **North East Trade** (NET) winds, 2) **South East Trade** (SET) winds.

Trade winds are also called Easterlies. North East trade winds from northern hemisphere and South east trade winds from southern hemisphere meet near the Equator. This region is the converging zone of trade winds known as **'Inter-tropical convergent zone'** (ITCZ). This region has different characteristics-low pressure, variable winds and calm conditions and convergence of trade winds.

b) Antitrade winds : These winds originate and blow from Sub-tropical high pressure belts to Sub -polar low pressure belts. These are from South west to North east direction in northern hemisphere and North west to South east in the southern hemisphere. Therefore, they are called **'Westerlies'.** The direction of these winds are opposite to trade winds. Hence, they are known as **'Antitrade winds'**.

In the northern hemisphere because of the presence of vast land masses with varied relief features large scale disturbance are formed by Antitrade winds.

In the southern hemisphere they are more regular and blow with great velocity because of vast expanse of ocean water. These winds cause great problem to navigation in the southern hemisphere.

The important westerlies in the southern hemisphere are:

1) **'Roaring Forties'** found around 40º south latitude.
2) **'Furious Fifties'** found around 50º south latitude.
3) **'Shrieking sixties'** or 'Screeching sixties' or' Screaming sixties' around 60º south latitude.

c) Polar winds : These are extremely cold winds blowing from Polar high pressure belts to Sub-polar low pressure belts. Polar winds are more regular and blow without much variation. However they are strong in the winter season (cold wave) than in summer.
They blow from North east to South west in the northern hemisphere and South east to North west in the southern hemisphere (similar to trade winds), as such they are also known as **'Polar Easterlies'**.

2) Seasonal or Periodic winds: The winds which change their direction in different seasons are called Seasonal or Periodic winds. Monsoon winds are the best example of seasonal winds. They are primarily formed with the unequal heating of land and water bodies. Seasonal

winds are mainly found in the tropical region and sometimes extended towards temperate regions. They are mainly caused with thermal variation.

In India, South West monsoon winds blow from South west to North east direction during June to September and North East monsoon winds blow from North east to South west direction from late September to middle of December due to thermal variation and pressure difference in the land and water bodies.

3) Local Winds: The regular pattern of planetary and seasonal winds are affected with the local disturbances. Difference in temperature and pressure leads to the development of movement of winds, called as 'Local winds'. Several types of local winds are found in different parts of the world. Important among them are: a) Land and Sea breezes b) Mountain and Valley breezes

a) Land and Sea Breezes: The winds blowing alternatively during day and night from the sea and the land near the coasts are known as 'Sea Breeze' and 'Land Breeze' respectively. These are the best developed local winds near the coastal regions.

During day time land gets heated more quickly than the adjacent sea. So the air gets heated and rise upwards to produce a low pressure region. At the same time the pressure at sea is comparatively high. The warm air of the land, being light, rises upwards allowing the air from sea to enter in. Such incoming air from the sea is called 'Sea Breeze'.

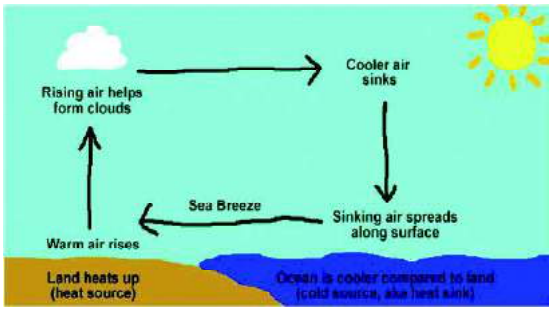
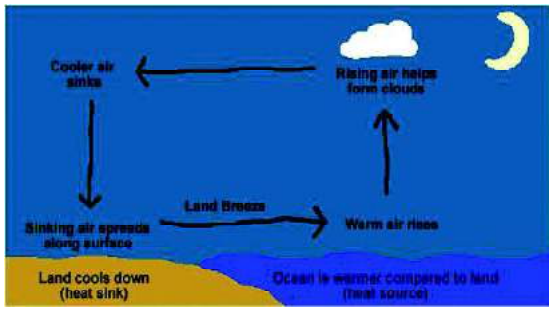


Fig. 5.12 Sea breeze during day



Land breeze at night

At night the land loses its temperature quickly due to rapid radiation and high pressure is developed. As the sea water still retains temperature the air is lighter and rises upward, thus allowing the air from the land to move towards the sea. Such wind is called 'Land Breeze'.

b) Mountain and Valley Breezes : Mountain and Valley breezes are the best developed local winds in mountain regions.

During night the mountain peaks, (height) which are exposed, radiate and get cooled quickly, while the valleys still remain warm. So the dense air of the high altitudes (high pressure) slowly moves down along the slopes towards the valley (low pressure). These are known as 'Mountain Breeze' or 'Katabatic winds'.

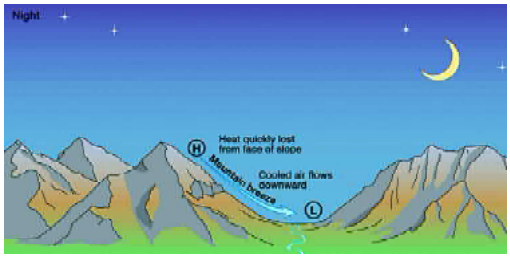
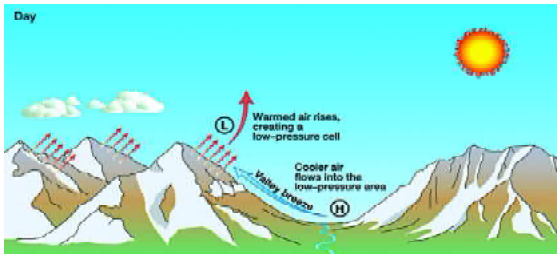


Fig. 5.13 Mountain breeze



Valley breeze

During the day the rays of the Sun strikes the peaks as well as their slopes and they get heated (low pressure) faster than the deep valleys (high pressure). The uprising air of the peaks and slopes allows the dense air of the valleys to move up. Such winds are known as 'Valley Breeze' or 'Anabatic winds'.

Other important local winds found in different parts of the world are: Loo (India), Aandhi (India), Brickfielder (Australia), Blizzard (High latitudes), Sirocco (Sahara desert), Harmattan (Western Africa), Foehn (Northern Alps), Mistral (France), Chinook (USA), etc.,

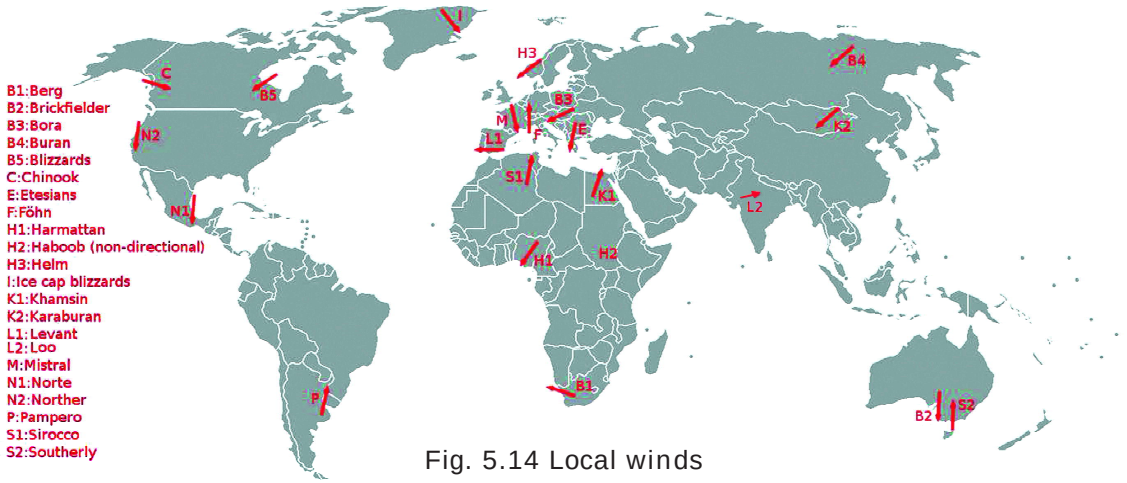
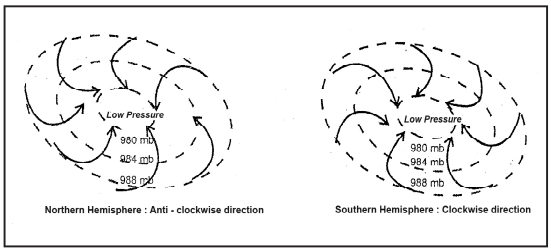


Fig. 5.14 Local winds

4) Variable winds : Local irregularities in temperature and pressure produce the disturbances and form 'Variable Winds'. The 'Cyclones' and 'Anti-Cyclones' are the important variable winds. The origin, extent and direction of these winds are most uncertain and their prediction is difficult.

Cyclones: Cyclone is a small low pressure area in the center surrounded by high pressure. The winds blow spirally towards the low pressure area and form convergence of winds. In the northern hemisphere the direction of cyclonic winds is anti clock-wise and in the Southern hemisphere it is clockwise**.** The cyclones are classified into two types. i) Tropical Cyclones ii) Temperate Cyclones.

i) Tropical Cyclones : The origin of tropical cyclones are much related to intensive pressure gradient with the temperature variation. The rise of convectional currents develop low pressure convergence zone. The high pressure zone in the water bodies develop the movement of winds towards tropical low pressure land masses. This tropical convergent winds form tropical cyclones in the eastern coasts of many countries. They cause heavy rainfall with high velocity winds. Tropical cyclones are highly dangerous and devastating.



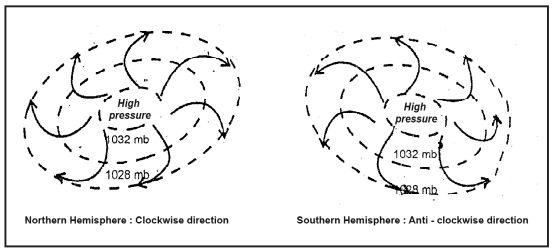


Fig. 5.15 Cyclones Anti Cyclones

ii) Temperate Cyclones : In the temperate region, cyclones are produced by the meeting of warm air mass of tropical region and cold air mass of the polar region. The tropical air mass is lighter and it is pushed up by the advancing dense cold air mass. The process of mixing of these two air masses takes place in the form of cyclones. They are associated with heavy rainfall. The Temperate region thus gets maximum rainfall from the cyclones.

Facts file

- Cyclones are labelled by different names in different parts of the world. Japan and China – 'Typhoon', USA and Mexico – Hurricane, Australia – Willy Willies, UK & Europe – Depression, Russia – Whirlpool, India & nearby countries-Cyclone.
- In the last few years Indian ocean and Bay of Bengal coasts have experienced a few disastrous cyclones. Some of them are Bola, Nargis, Nisha, Aila, Laila, Bijli, Jal, Neelam etc.

Anti-cyclones : As the name itself indicate the Anti-cyclones are contrasting to Cyclones. Anti-cyclone is a high pressure area in the center with winds blowing outwards, towards the low pressure areas. In the northern hemisphere the direction of anti-cyclone wind is clockwise and in the southern hemisphere it is anti-clock wise. These are common in sub-tropical high pressure areas and absent in equatorial region. The weather condition during anti-cyclone is generally fine and dry.

5.5 RAINFALL

Water occurs in three states on the Earth viz, the gaseous(vapour or steam), liquid(water) and the solid(ice). It can change its state from one to another by absorption or release of heat and energy. The process of liquid water passing into gaseous or vapour form is called **'Evaporation'**, water vapour passing into liquid is called **'Condensation'** and water vapour passing into solid state without the intervening liquid state is called **'Sublimation'**.

Humidity is the amount of water vapour or gaseous form of water present in the air or atmosphere. Cloud is made up of water droplets or ice particles suspended in air. Condensation is the process of conversion of water vapour present in the air into water droplets.

Rainfall is the natural process of condensation through which gaseous form of water is converted into liquid water droplets. It occurs due to cooling of saturated air mass, warm and moist air mass rising upward, warm air rising over cold air, sufficient humidity in the air and condensation etc.,

Types of Rainfall : According to the process of formation, nature and features, three types of rainfall are recognized. 1) Convectional Rainfall 2) Orographic Rainfall 3) Cyclonic Rainfall.

1. **Convectional Rainfall :** The rain caused by the process of convection is called convectional rainfall. In the areas of high temperature, air rises up due to heating. This rising air cools, gets saturated, as a result condensation takes place and later rainfall occurs. Conventional rainfall is very common in the Equatorial region and also in the Tropical regions in summer. This rain is accompanied by thunder and lightning.

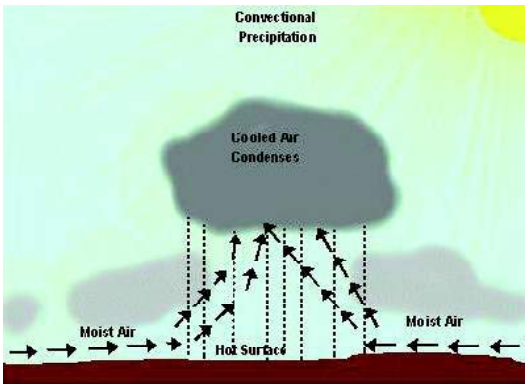


Fig. 5.16 Convectional Rainfall

Do you know?

In the Equatorial region convectional rainfall is named as:

1) Afternoon rainfall
2) Tea Time rainfall
3) 4'o clock rainfall

2. **Orographic Rainfall:** It is the most common and widespread form of rainfall in the world. It is also called **'Mountain Rainfall'** or **'Relief Rainfall'**. During this rain the moisture laden winds are forced to ascend over the mountains in their path. As the wind rises, it expands and looses temperature. This results in condensation, leading to rainfall. This rainfall is found in the windward side of the mountain and is heavy. In the leeward side of the mountain, as the wind begins to descend, temperature steadily increases resulting in dry air by forming 'Rain Shadow Region'.

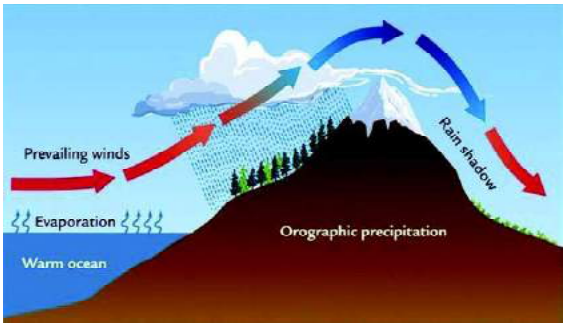


Fig. 5.17 Orographic Rainfall

Do you know?

'Torrential terror in Mumbai'

The Orographic rainfall in Mumbai on 26.7.2005 was exceptional, which broke all the previous records of the last 100 years (Cherrapunji)- 700 mm of rainfall in 12 hours. Unprecedented thunderstorm and thick cloud cover of 15 km.

3. **Cyclonic rainfall**: The cyclonic rainfall is most common in the temperate region. The rainfall caused with a cyclone or depression is known as **cyclonic rainfall.** The winds take a circular movement in the regions where warm and cold air masses meet.

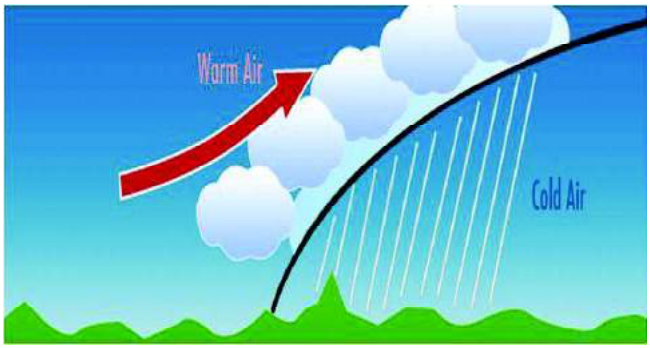


Fig. 5.18 Cyclonic Rainfall

Do you know ?

1. Mawsynram of Meghalaya in India, has recorded 1141 cm of rainfall per year. It is considered as one of the wettest or rainiest places on the Earth.
2. Atacama desert of Chile is considered as the driest region on Earth. It has not received rainfall in the last few years.

Rain Gauge : The amount of rainfall received, is measured by an instrument called Rain gauge.

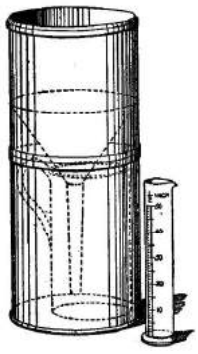


Fig. 5.19 Rain gauge

Isohyets : Lines drawn on the map or globe to show the places having the same amount of rainfall.

5.6 Weather and Climate

Weather and climate are the two terms used to express the atmospheric conditions.

Weather: Weather refers to frequent changes or average conditions in the atmosphere of a place at a given time. It refers to conditions of temperature, pressure, winds, clouds, humidity, rainfall etc., eg. Cloudy weather in the morning, hot weather in the evening etc.,

Elements of Weather: Weather is determined by internal elements of atmosphere like temperature, pressure, winds, humidity, clouds and precipitation.

The scientific study of weather conditions is called **'Meteorology'**. The Head quarters of Indian Meteorological Department (IMD) is situated in Poona (Pune) of Maharashtra.

Climate : The average weather condition of a place for a long period like 30-33 years in known as climate. It refers to long durational changes in the atmospheric condition of a Country/Region/part of the Continent etc., Different types of climate are experienced in the World. eg., Tropical Monsoon type, Desert type, Mediterranean type, Maritime type, Tundra type etc.

The scientific study of climate is known as '**Climatology'**.

Factors determining the Climate :

Factors that determine the climate of a region are latitude, distance from the sea, altitude or height from the mean sea level, prevailing winds, directions of mountains, ocean currents, and nature of land cover.

These factors influence on climate of a region depending on the atmospheric conditions and local features. eg., India has Tropical Monsoon, Southern Europe has Mediterranean type of climate etc.

IMPORTANT TERMS .....

Troposphere	Inversion of Temperature	Furious fifties
Stratosphere	Isotherms	Shrieking sixties
Thermosphere	Tropical zone	Sea breeze
Ionosphere	Temperate zone	Land breeze
Exosphere	Frigid zone	Katabatic winds
Region of Mixing	Barometer	Anabatic winds
Tropopause	Doldrum	Cyclones
Stratopause	Horse latitudes	Anti-cyclones
Mesopause	Isobars	Condensation
Ozone layer	Wind vane	Precipitation
Ions	Anemometer	Sublimation
Aurora	Pressure gradient	Wind ward side
Insolation	Planetary winds	Lee ward side
Radiation	Trade winds	Convectional rainfall
Convection	Westerlies	Orographic rainfall
Conduction	Easterlies	Cyclonic rainfall
Advection	ITCZ	
Normal Lapse Rate	Roaring forties	

I Answer the following in a word or a sentence each.

1. Define Atmosphere.
2. What is the percentage of Nitrogen in the Atmosphere?
3. Why is Carbon dioxide important in the Atmosphere?
4. Which layer of Atmosphere is called 'Weather manufacturer'?
5. In which layer do you find Aurora?
6. What is Stratopause?
7. Which is the coldest layer in the Atmosphere?
8. Define Insolation.
9. What is Convection?
10. Mention the average atmospheric pressure of the Earth.
11. How many pressure belts are there in the globe?
12. Define Doldrms.
13. Where do we find 'Horse latitudes'?
14. Name the instrument used to measure speed of the Wind.
15. What is ITCZ?

16. Where do we see 'Roaring Forties'?
17. Why are Tropical cyclones more dangerous?
18. What is Rain shadow region?
19. Which instrument is used to measure the amount of Rainfall?
20. Mention any two factors that determine the climate of a place.

II Answer the following in two or three sentences each.

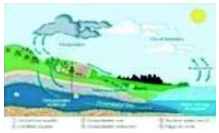
1. Mention any two components of Atmosphere.
2. Name any four important gases present in the atmosphere.
3. Why is Troposphere called 'Region of Mixing'?
4. What is the role of Ionosphere in the Atmosphere?
5. Mention the features of Inversion of Temperature.
6. Why do Pressure belts shift?
7. Name the two important Trade winds.
8. How is Sea breeze formed?
9. Mention the features of a Cyclone.
10. How is Mountain rainfall caused?

III Answer the following.

1. Explain the structure of the Atmosphere.
2. Briefly explain the factors affecting the distribution of temperature.
3. Describe the major pressure belts of the world with a neat diagram.
4. Explain the planetary winds with the help of diagram.
5. What is Rainfall? Explain the types of rainfall with neat diagrams.

SUGGESTED ACTIVITIES .....

- Prepare a model to show the layers of the atmosphere.
- List out the benefits of Oxygen, Carbon-di-oxide and other gases.
- Collect the photos of aurora borealis and aurora australis.
- Prepare model to show temperature zones of the Earth.
- Draw diagrams to show pressure belts of the globe.
- Prepare flow chart to show the different types of winds.
- List out the various local winds and cyclones.
- Prepare models to show Mountain, Cyclonic and Convectional rainfall.



CHAPTER 6

HYDROSPHERE

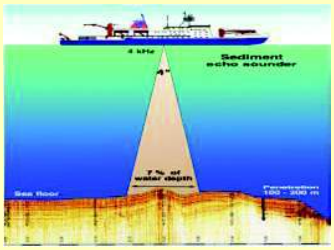
Like Lithosphere and Atmosphere, Hydrosphere is also an important component of the Earth. The study of hydrosphere is very important to geographers to know and understand the various water bodies like lakes, bays, straits, gulfs, seas, oceans etc. The process through which water is formed on the Earth is called **'Hydrological cycle'**. The water bodies of the Earth is in the form of liquid and solid and covers an area about 71% or 361 mil sq km. The seas and oceans contain about 93% of the earth's water. While 5% is in the form of fresh water bodies, ground water and remaining 2% is in the form of ice and glaciers. The Earth has vast expanse of water bodies. Therefore, it is called 'Watery Planet' and 'Blue Planet'. Water is an important resource essential to all forms of life, particularly the life layer.

Hydrological cycle: The cyclic (evaporation, condensation and precipition) movement of water between the atmosphere and the Earth's surface is called Hydrological cycle.

The scientific study of water bodies (Seas, Oceans etc.,) is called **'Oceanography'**. It deals with Ocean bottom topography, temperature, salinity, depth, ocean currents, tides etc.

Fathom is the unit of measurement of the depth of the ocean. One fathom is equal to 6 feet. Fathomometer is the instrument used to measure the depth. The unit to measure length, width, area of the oceans is called nautical miles.

Isobaths: Lines drawn on the map to show the places having same depth in the sea or ocean floor.



Echo sounding: Is a technique of using sound pulses to find the depth of water. Eco sounder is a device for measuring depth of water by sending pressure waves down from the surface and recording the time until the echo returns from the bottom.

6.1 TOPOGRAPHY OF THE OCEAN FLOOR

The surface beneath the water is characterized by a great diversity of relief (topography) features. The major submarine relief features are a) The Continental Shelf b) The Continental Slope c) The Deep Sea Plains and d) The Ocean Deep

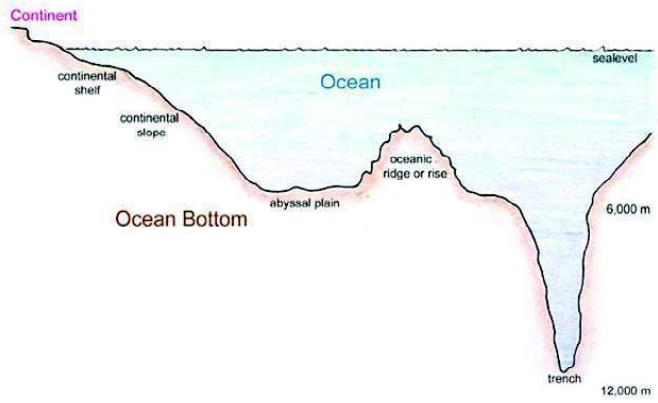


Fig. 6.1 Ocean bottom topography

a) The Continental Shelf: The shallow submerged extension of continent is called the continental shelf. It is the shallowest part of the ocean with depth varying between 20 to 600 m. Its width vary from one ocean to another ranging between 65 to 75 km. The width of the shelf is often related to slope of the adjacent land. It is wide along the low lying land and narrow along the mountainous coasts. Nearly 70% of continental shelves are covered with thick deposits of silt, sand, mud and sediments derived from the land. This region occupies about 7.6% of the ocean floor. Many ports and harbours, major fishing grounds and natural resources like oil, natural gas etc., are found in the continental shelf.

b) The Continental Slope: The steep slope extending to the ocean basin floor from the continental shelf is called the continental slope.It is characterized by gradients of 2-5º. The continental slope makes a boundary between the continental crust and the ocean crust. The depth of water in this region varies from 200 to 2000 m. This region covers an area of about 8.5% of the total area of the ocean floor. The most outstanding land feature found in the continental slope are submarine canyons.

c) **The Deep Sea Plains:** A vast level or plain area found between the continental slope and the ocean deep is called the deep sea plains. This region lies between 3000 and 6000 m below the surface of the ocean. Deep sea plains account for about 82.7% of the total area of the ocean floor. Sea mounts, ridges and guyots are the outstanding land features in this region.

d) **The Ocean Deep or Trench:** An arc-shaped depression in the deep ocean floor is called ocean deep or trench. These are the deepest parts of the ocean floor. Ocean trenches are produced by the subduction of oceanic crust under continental crust. They resemble steep sided valleys or canyons on the land. Trenches or deeps are generally parallel to the coasts facing mountains and along the islands. Great earthquakes and tsunamis generally take birth in this region. About 1.2% of the ocean floor is covered by trenches. Its depth vary from 6000 to 8000 m. As per the records, 57 deeps have been identified in the ocean floor. Of these 32 are in the Pacific ocean, 19 in the Atlantic ocean and 6 in the Indian ocean.

The Challenger deep: The deepest known point in the Earth's sea floor - 10,898 m or 35,755 ft.

Trieste a bathyscaphe descended to the ocean floor on 23.1.1960, manned by Jacques Piccard.

Deepsea Challenger a bathyscaphe descended to the bottom of the Challenger deep, on 26.3.2012 by James Cameron a Canadian film director.

6.2 Temperature of the Ocean Water

The temperature of the oceans is one of the most important component of the study of oceanography. Ocean water gets heated by solar energy. The process of heating and cooling of the ocean water is slower than land. The average surface temperature of the ocean water is 26º Celsius. The temperature decreases from the equator towards the poles. The Sun rays pass through the ocean water up to 200 m. Below this depth temperature decreases slowly. Temperature in the ocean water determines marine life, movements of ocean water, climate of coastal areas, salinity, density of the water etc. Factors affecting the distribution of temperature are latitudes, prevailing winds, ocean currents, unequal distribution of land and water, salinity etc.

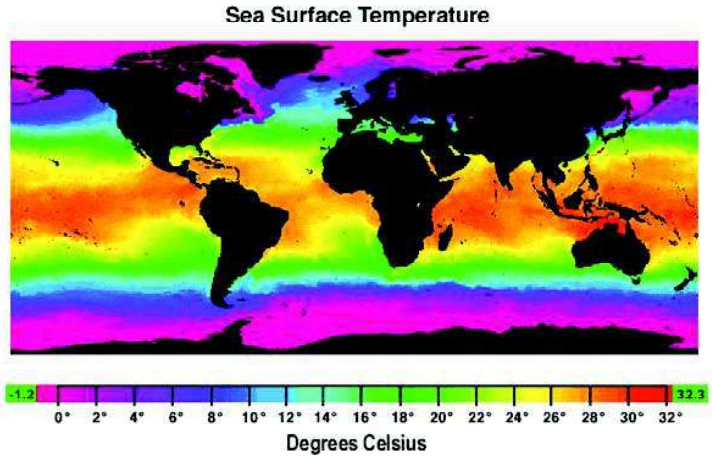


Fig: 6.2 Distribution of Temperature

Salinity of the Ocean water

The total amount of dissolved solids (minerals) in the ocean water is called salinity. The ocean's salinity consists of various elements. They are Sodium chloride, Magnesium chloride, Magnesium sulphate, Calcium sulphate, Potassium sulphate, Calcium carbonate, Magnesium bromide etc. Of these Sodium chloride (77.8%) is the most important constituent.

	Elements of Salinity	Percentage
1.	Sodium Chloride	77.8
2.	Magnesium Chloride	10.9
3.	Magnesium Sulphate	4.7
4.	Calcium Sulphate	3.6
5.	Potassium Sulphate	2.5
6.	Calcium Carbonate	0.3
7.	Magnesium Bromide	0.2

Elements of Salinity in ocean water

Factors affecting the salinity in the ocean water are: a) Evaporation: High evaporation in the ocean water leads to high salinity. b) Precipitation: High rainfall and snowfall in the oceans lowers the salinity. c) Fresh water mixing with ocean water: Continuous mixing of dissolved salts by running water (river), groundwater and glaciers increase the percentage of salt content in the ocean. d) The trade winds drive away saline water to less saline areas resulting in the variation of salt content.

Distribution of Salinity

The average salinity of the ocean water is 35ppt (parts per thousand), means 35 grams of salt per 1000 grams of sea or ocean water. The amount of salt content vary from one ocean to another. The average salinity of the Atlantic ocean is around 36ppt, the Pacific ocean is 35ppt and the Indian ocean is 35ppt.

Latitude, precipitation, mixing of fresh water etc., influence on the horizontal and vertical distribution of salinity. The regions near Tropic of Cancer and Capricorn record high salinity due to high temperature, more evaporation, low rainfall and extensive arid and semi-arid areas. While the equatorial region record low salinity because of high temperature and high rainfall. The polar region record least salinity due to very low temperature, evaporation and less rainfall.

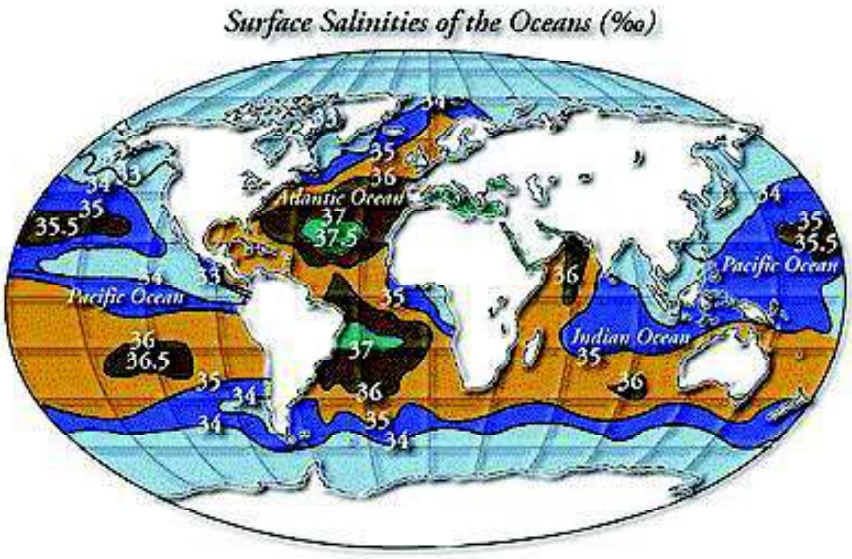


Fig. 6.3 Distribution of Salinity

Isohalines are the lines drawn on the map to show the places having the same amount of salinity.

Most saline water bodies	
1. Lake Van (Turkey)	330ppt
2. Dead sea (Asia)	238ppt
3. Great salt lake (USA)	220ppt
4. Lake Sambhar (India)	205ppt

6.3 Movements of the Ocean Water

The ocean water is not stationary. It is in movement due to the external influence of the Sun, the Moon and the winds and internal influence of its temperature, salinity, density etc. The ocean water has three types of movements. They are waves, currents and tides. Waves and currents are the horizontal movement of the ocean water, while tides are vertical motion.

Waves

Waves are the undulations found on the surface of the sea or ocean. These are formed due to the influence of wind and wind friction on the surface of the ocean water. Sometimes waves are formed by earthquakes, volcanoes, landslides etc. Waves have two parts – the crest and the trough. The upper part of the wave is called 'Crest' and the lower part is called 'Trough'. The horizontal distance between two successive crests or troughs is called 'Wave length'. Similarly the vertical distance between the crest and trough is called 'Wave height'.

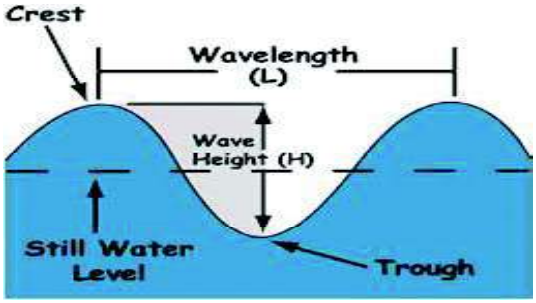


Fig. 6.4 Waves - Crest and Trough

Ocean currents

Ocean current is the general movement of a mass of oceanic water in a definite direction. The faster movement of the ocean water is called 'currents' and the slower movement of water is called 'drift'. The main factors which produce the ocean currents are: a) Rotation of the Earth b) Planetary winds c) Temperature variation d) Variation in salinity e) Configuration of coastlines f) Density of ocean water g) Relief of the ocean floor etc.

On the basis of latitude and temperature two types of ocean currents are identified. They are: 1) Warm currents: These are the high temperature ocean currents flowing from the equatorial regions to polar regions. 2) Cold currents: These are the cool ocean currents flowing from polar regions to equatorial regions.

The three major water bodies of the world viz, the Pacific ocean, the Atlantic ocean and the Indian ocean have their own pattern of currents. Each of these oceans play a major role on the coastal climate of different

countries and continents. Of these the Indian ocean currents are very important because it has its influence on the climate and weather condition of India. The currents of Indian ocean form monsoon winds and drive these winds to put its effect on the Indian sub-continent.

Currents of the Indian Ocean

Indian Ocean is the third largest ocean on the Earth. It is situated between the continents of Africa, Asia and Australia. This ocean is mainly found in the southern hemisphere but a small portion is in the northern hemisphere. Indian ocean is bordered by land in the north and open to water in the south. The currents of this ocean is influenced by the shape of the land mass and monsoon winds.

The Indian ocean currents are of two types. a) North Indian Ocean currents and b) South Indian Ocean currents.

North Indian Ocean currents

The ocean currents of the North Indian ocean is very closely influenced by the monsoon winds. The direction of ocean currents get reversed as a result of monsoonal change of air streams. The south west monsoon and north east monsoon winds change the direction of north Indian Ocean currents twice a year.

In the summer season south west monsoon winds influence on the flow of North Indian ocean water from the Arabian Sea to Bay of Bengal. The currents (**Arabian sea-warm**) flow in a clockwise direction along the east coast of Somalia – Somalia current, Gulf of Aden, brushes the western and eastern coasts of India (Arabian sea and Bay of Bengal currents) and finally joins North Equatorial current.

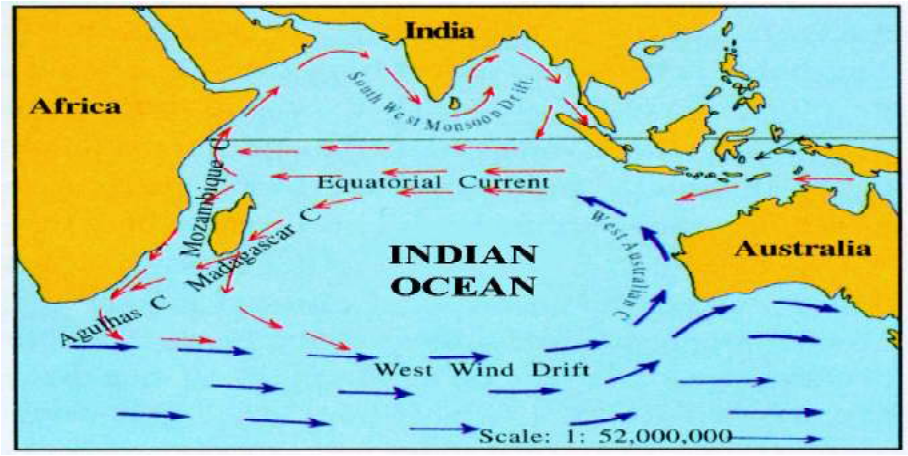


Fig. 6.5 Indian Ocean currents during summer

In the winter season the monsoon winds get reversed, blow from north east to south west. Hence the ocean currents flow from the western coast of Thailand and Myanmar and brushes the eastern and western coast of India as North east currents (warm), passes along Gulf of Aden, Somalia and finally reaches North Equatorial currents in anti-clockwise direction.

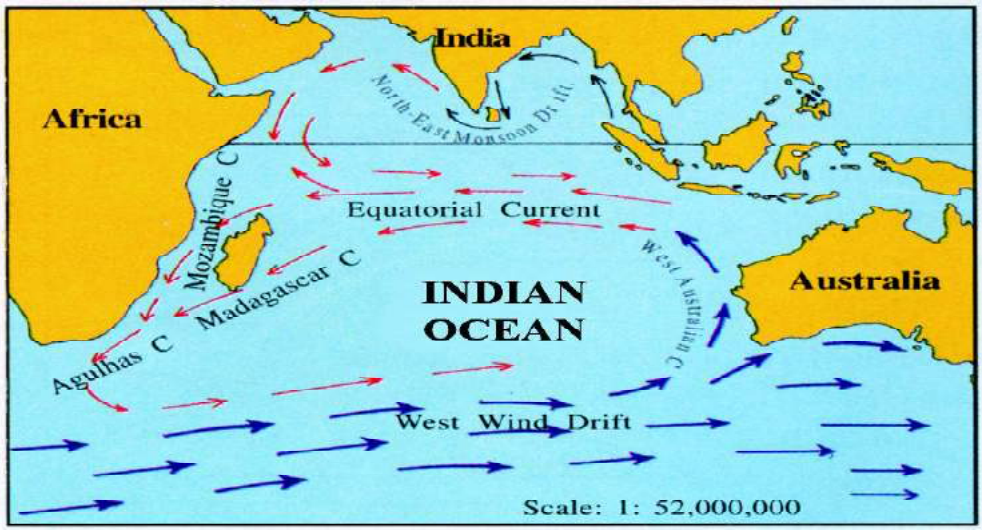


Fig. 6.6 Indian Ocean currents during winter

South Indian Ocean currents

The currents of the South Indian ocean are not affected by the monsoon winds. The South Equatorial current flows from the Indonesian archipelago towards the eastern coast of Africa. After reaching Madagascar it is divided into two branches: **a) Mozambique current** (warm)-Flows between Africa and Madagascar in the Mozambique channel **b) Madagascar current** (warm)-Flows in the east coast of Madagascar towards south. These two currents meet in the east of South Africa and form **'Agulhas current'** (warm). This current further flows southward and reach Cape of Good Hope in the south tip of Africa.

In the south of Indian ocean West wind drift flows towards Australia due to the influence of westerlies. After reaching Australia it separates into two branches as: **a) West Australian cold current**-Moving northward in the west coast of Australia and finally joins South Equatorial current **b) West wind drift** (warm)-Flows to the south of Australia and finally merges into the Pacific west wind drift.

6.4 TIDES

The regular rise and fall of water level in the world's sea and oceans is called 'tides'. Causes for the occurance of tides are: a) Gravitational attraction of the Moon b) Gravitational pull by the Sun c) Centrifugal force of the Earth.

Tides are universal and are an every day activity on the water bodies. Generally 4 tides are observed in a day. Of this 2 are high tides and 2 are low tides. Whenever the sea level rises it is called **'High tide'** or '**Flood tide'** and, when the sea level falls it is known as **'Low tide'** or **'Ebb tide'**. The interval between two high tides and two low tides is around 12 hours and 26 minutes and between one high tide and one low tide it is around 6 hours and 13 minutes. In a period of 24 hours and 52 minutes, 2 high tides and 2 low tides take place. The time between successive high tide and low tide is known as **'Tidal period'**.

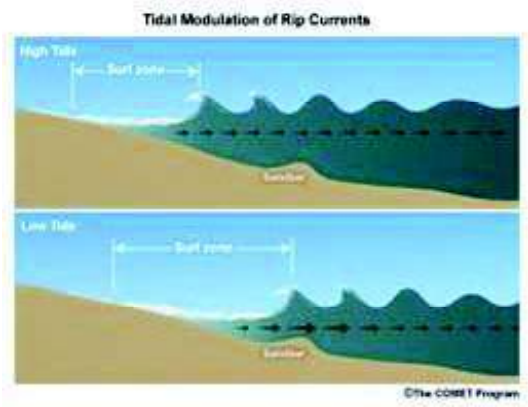


Fig. 6.7 Tides (High tide & Low tide)

Types of Tides

The tides are of different height and magnitude in different regions of the sea or ocean. In the open ocean its height is different compared to closed water bodies. On the basis of the strength of gravitational attraction by the Sun and the Moon tides are classified into two types. a) Spring tides b) Neap tides

a) Spring tides: These tides occur during full moon and new moon days. When the Sun, Moon and the Earth are in a straight line (Syzygy), the gravitational attraction by the Sun and the Moon together act on the water bodies of the Earth. Therefore, the water level in the ocean or sea rises to maximum height causing very high tidal forces known as 'Spring tides'. Every month two spring tides occur with a gap of 15 days each.

Fig. 6.8 Spring tide

b) Neap tides: These tides occur on the days when the moon is in first quarter or in the third or last quarter. When the Sun and the Earth are in a straight line and the Moon is perpendicular (right angle) to the Earth the gravitational force of the Moon and the Sun will be in opposite direction. Therefore, minimum pull is exerted on the seas and oceans. This results in the formation of low tidal forces known as 'Neap tides'. Every month two neap tides occur with a gap of 15 days each.

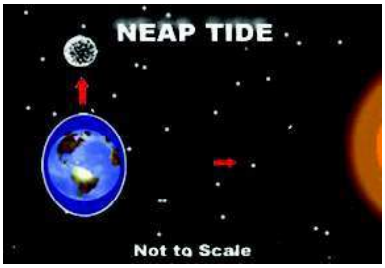


Fig. 6.9 Neap tide

Uses of tides

Tides are useful to man and society in various ways. They are:

1. Tides increase the depth of water in shallow harbours and help navigation during high tides.
2. Tides clean the entrance of ports, harbours and river mouths.
3. Tides help fishing and other aquaculture activities.
4. Tides promote salt and foam production in the coastal areas.
5. To some extent Tides prevent, the freezing of sea or ocean water in the coast.
6. Tides promote the generation of tidal energy - France, USA, Germany, Italy, Japan etc.,

6.5 Conservaton of Oceans

In the prehistoric period, people used to live near the sea or ocean coast to use marine resources. Traditionally man used the oceans for fishing (food), transportation and defence. Fishing and transportation have been the two most important economic activities of man for a very long time. Oceans are the storehouse of various resources, which man is using in an unplanned and non-judicious manner. The exploitation of the marine resources are in the form of extraction of minerals like crude oil, natural gas, thorium, magnetite, common salt, generation of power in the form of wave energy, tidal energy, biomass conversion and marine food resources like fish, plankton, animals, seaweeds etc.,

Over population, unplanned economic development, exploitation of resources, territorial and marine boundary supremacy, nuclear test etc., have resulted in fear and threat to marine organisms, resources, configuration of coastal areas etc.,

To control the exploitation and pollution in the sea or ocean, conservation of Ocean is very much necessary and important. A few measures recommended by the experts are: 1) Sewage disposal must be regulated and treated. 2) Oil leakage has to be brought under control 3) Disposal of toxic metals, pesticides must be reduced 4) Radioactive or Nuclear mineral dumping must be stopped 5) Coastal mining activities have to be regulated and monitored 6) Over fishing, aquaculture activities have to be controlled 7) Unwanted battles and wars, military establishments near the coasts have to be reduced 8) Literacy and education programmes on marine features must be initiated and promoted 9) Proper law to be enacted to save sea and ocean 10) World wide awareness programme must be arranged to show the pros and cons of the marine pollution etc.,

IMPORTANT TERMS .....

Hydrological cycle	Salinity	Agulhas current
Oceanography	Isohalines	West Wind drift
Fathom	Sea waves	High Tide
Isobaths	Crest	Ebb Tide
Continental shelf	Trough	Tidal Period
Continental slope	Currents	Spring tide
Deep sea plains	Arabian sea currents	Neap tide
Ocean Trench	Bay of Bengal currents	

I Answer the following in a word or a sentence each.

1. What is Hydrological cycle?
2. Define Oceanography.
3. Which instrument is used to measure depth of the Ocean?
4. Name the region which covers largest area in the ocean floor.
5. What is Salinity?
6. Which lines are drawn on the map to show places having same salinity?

7. What are Sea waves?
8. Where do we find the 'Agulhas current'?
9. How does a tide occur?
10. What is Tidal period?

II Answer the following in two or three sentences each.

1. Name the four submarine relief features of the Ocean floor.
2. Mention the important features of Continental Shelf.
3. Why is Ocean deep or Trench important in the Ocean bottom?
4. State any four factors that influence on the distribution of temperature in the ocean.
5. Mention any four dissolved minerals in the Ocean water.
6. What factors affect the salinity in the Ocean water?
7. Name the two types of Ocean currents. Where are they found?
8. Mention any four South Indian Ocean currents.
9. Distinguish between High tide and Low tide.
10. Mention any four uses of tides.

III Answer the following.

1. Explain the topography of the Ocean floor with a diagram.
2. Describe the salient features of Salinity of the Ocean water.
3. Explain the Indian Ocean currents with the help of Maps.
4. Briefly explain the types of tides.
5. What is Conservation of Ocean? Mention the important measures.

SUGGESTED ACTIVITIES .....

- Draw diagram to show 'Hydrological cycle'.
- Prepare chart to show the relief features of the Ocean floor and list out the important deepest places in the sea floor.
- Draw the outline map of Indian Ocean and show the important ocean currents.
- Prepare models to show spring and neap tides.
- Prepare a list of uses of Oceans and a few important measures recommended for conservation of Oceans.

CHAPTER 7

BIOSPHERE

Earth is called 'Biosphere Planet' or 'Living Planet' because, it is the home of various forms of life. The existence of living organisms on the Earth is the result of solid lithosphere, gaseous atmosphere and liquid hydrosphere.

All forms of life - plants, animals and micro organisms found in a contact zone between lithosphere, hydrosphere and atmosphere is called **'Biosphere'** (Bio-life and Sphaira-sphere or zone).

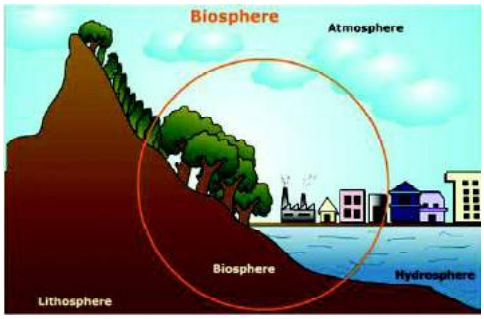


Fig. 7.1 Biosphere

Biosphere and its components are very significant elements of environment. These elements interact with the components of the natural landscape like water and soil. They are also influenced by atmospheric elements such as temperature, pressure, wind, precipitation etc., The interaction of the Biosphere with land, air and water is important for the evolution, growth and development of organisms.

7.1 ENVIRONMENT

The word Environment is derived from the French word "Environer", which means "to surround". The whole sum of surrounding external conditions within which an organism, a community or an object exists is called **'Environment'**. In other sense it includes everything that surrounds us. The environment is not uniform on the Earth. Change in Environment takes place due to natural and human activities. Irregular and over exploitation of nature by human activities pose the greatest danger and threat to the environment.

Human beings use the environment for their living, and for development activities. This may disturb its natural status. If the disruption is less, nature adjusts by it self, but when the exploitation is excess and beyond its control, nature is not able to set the things right.

Types of Environment :

The Environment is divided into two types.
1) Physical Environment 2) Cultural Environment

1. **Physical Environment :** The environment which is created or formed naturally with biotic things is called Physical Environment. Land, water, soil, rainfall, winds and biological features on the Earth are the factors of Physical Environment.
2. **Cultural Environment :** The environment created or formed by human beings for their living conditions is called Cultural Environment. Civilization, culture, religion, language, customs, traditions, economic activities etc., are the factors of Cultural Environment.

The economic development of a Country depends on the favourable physical and cultural environmental factors. The regions where the physical and cultural factors of environment are co-related with each other, have achieved progress and prosperity, while the regions where such co-relation is not existing are facing several problems even today.

7.2 ECOLOGY

Ecology is the science of the relationship between living organisms and their surroundings. It deals mainly with the healthy interaction between biotic (living) and abiotic (non living) components. The subject matter of ecology is the influence of organisms on environment and counter influence of environment on organisms. The components in the ecosystem exists with varying ranges of environmental conditions. On the Earth plants, animals and micro-organisms are co-exit with various ecological conditions.

Ecology is a human science as well. There are many practical applications of ecology in wetland management, natural resource management (agro ecology, agriculture, forestry, agro forestry, fisheries), city planning (urban ecology) and human social interaction (human ecology). Ecosystems maintain evolutionary dynamics between living (biotic) and non living (abiotic) components of the planet. Ecosystems sustain life-supporting functions and produce natural capital through the regulation of continental climates, global biogeochemical cycles, water filtration, soils, food, fibres, medicines, erosion control, and many other natural features of scientific, historical and economic value.

The **'Ecological Balance'** or **'Balance of Nature'** is a theory that says that ecological systems are usually in a stable equilibrium, which is to say that a small change in some particular parameter will be corrected by some negative feed back that will bring the parameter back to its original "Point of Balance" with the rest of the system. It may apply where populations depend on each other and may also apply, at times, to the relationship between the Earth's ecosystem, the composition of the atmosphere, and the world's weather.

Man is a product of environment. He/she is one of the important components of living sphere, adjusting himself with the environment. Urbanization, industrialization, modern life styles and excess growth of population etc., are causing plenty of problems and changes in the human environment and ecology.

7.3 BIOMES

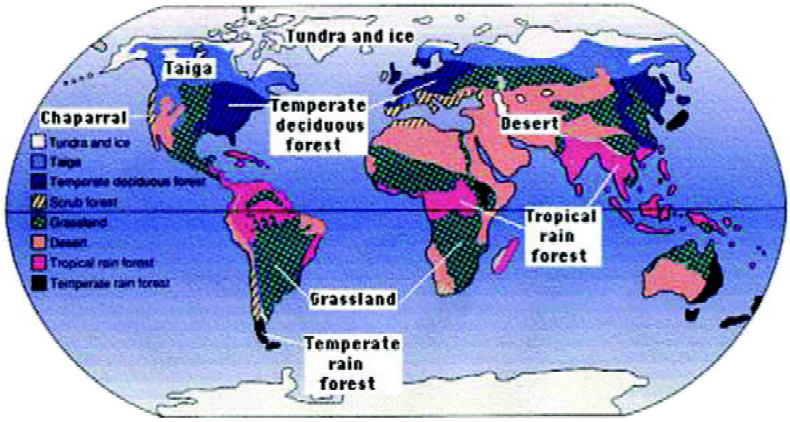


Fig. 7.2 Biomes of the World

A distinct group of life forms and the environment in which they are found is called 'Biomes'. In other words, Biome is a plant and animal community that covers a large geographical area. It is the largest recognizable sub-division in a terrestrial ecosystem. The boundaries of different biomes on land are determined mainly by climatic conditions like rainfall, temperature, humidity and soil conditions. It is the total assemblage of plant and animal species interacting within specific conditions.

Types of Biomes

Geographers recognize 10 to 20 major types of terrestrial ecosystems or biomes in the World. On the basis of the dominant life form, six major biomes are identified. They are: 1) Forest biome 2) Savanna biome 3) Grassland biome 4) Desert biome 5) Tundra biome & 6) Aquatic biome.

1. **Forest biome:** Trees are the dominant life form of forest biome. High temperature, humid climate and soil moisture help for thick tree cover. Equatorial region is dominant with forest biome.



Fig. 7.3 Forest Savanna Grassland

2. **Savanna biome:** It is the transitional biome between the forest biome and grassland biome. Savanna biome comprises of trees with grasses and herbs . It occupies the areas of low and seasonal rainfall.
3. **Grassland biome:** In this biome grasses constitute the dominant vegetation. It is dominant in the moderate soil water deficit regions, semi-arid areas of dry tropical, sub-tropical and mid-latitude regions.



Fig. 7.4 Desert Tundra Aquatic

4. **Desert biome:** It includes organisms capable of surviving in moderate to severe water deficit for most of the year. In this region temperature may range from hot to cool. Most common plants found in this belt are xerophytes (survives in dry weather).
5. **Tundra biome:** It includes small plants that can grow quickly during a short warm to cool summer season, in the low temperature and high latitudinal areas.
6. **Aquatic biome:** Aquatic regions house numerous species of plants and animals, both large and small. This is where life began billions of years ago. Without water, most life forms would be unable to sustain themselves and the Earth would be a barren, desert-like place. Important Aquatic biomes are found in Ponds, Lakes, Rivers, Wetlands and Oceans.

7.4 BIODIVERSITY

The varied range of flora and fauna found within a specified geographic region is called 'Biodiversity'. The term 'Biodiversity' is derived from two words 'Bio'-life and 'diversity'-variety. It is expressed as the totality of different organisms (plants, animals and micro-organisms), the genes they contains and ecosystem they form.

The study of biodiversity has become a major environmental issue because environments are being degraded at an accelerating rate. Much diversity is being irreversibly lost through the destruction of natural habitats, and science is discovering new uses for biological diversity (Wilson, 1988).

Biodiversity has five main aspects: 1) The distribution of different kinds of ecosystem 2) The total number of species in a region 3) The number of endemic species in an area 4) The genetic diversity in an individual species 5) The sub-population of an individual species which embrace the genetic diversity (Majid Husain-2009)

The study of biodiversity is dealt at three levels. 1. Genetic Diversity 2. Species Diversity 3. Ecosystem Diversity

1. **Genetic Diversity:** Genes are the basic building blocks of various life forms. Genetic biodiversity refers to the variation of genes within the species. It refers to the variation of individual organisms having certain similarities in their physical characteristics called species. Human beings genetically belong to the homo-sapiens group and also differ in their characteristics such as height, color, hair, physical appearance etc., This genetic diversity is essential for a healthy breeding of population species.

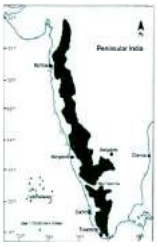
Do you know?

Gene pool and Gene pool centre:

- The Gene pool is the set of all genes or genetic information, in any population, usually of a particular species. This also proves to be the basic level at which evolution occur.
- The Gene pool centres are the places of origin of plants and animals for the first time. They are the regions where large scale domestication occurred for the first time for particular species.
- Major Gene pool centres of India : 1) Western ghats (Niligiri), 2) North east and 3) Western Himalayas

2. **Species Diversity:** The Species diversity refers to the variety of species. It relates to the number of species in a defined area and it is measured through its richness, abundance and types. Some areas are more rich in species than others. Areas rich in species diversity are called the **'Hot Spots'** of biodiversity.

Fig. 7.5 Bio hot spots of the World



Bio hot spots of India-Western Ghats

3. **Ecosystem Diversity:** Broad differences between ecosystem types and the diversity of habitats and ecological processes occurring within each ecosystem constitute Ecosystem diversity. The boundaries of communities (association of species) and ecosystem are not clearly defined. The demarcation of ecosystem boundaries is difficult and complex.

Biodiversity is important for human existence. All forms of life are so closely interlinked that disturbance in one gives rise to imbalance in the others. If species of plants and animals become endangered, they cause degradation in the environment, which may threaten human being's own existence (NCERT 2006).

Thus, Biosphere with its elements like environment, ecology, biomes and biodiversity describes the characteristics of life layer, types and their spatial distribution on the Earth. Understanding the inter-relationship between man and nature and their existence is the essence of the study of life layer.

"The planet Earth is able to provide natural resources to fulfill essentials of man but, not unlimited desires".

– Mahatma Gandhi

"SAVE EARTH AND SAVE MOTHER PLANET"

IMPORTANT TERMS .....

Living Planet	Forest biome	Genetic diversity
Environment	Savanna biome	Species diversity
Ecology	Desert biome	Ecosystem diversity
Ecological balance	Tundra biome	Hot spots
Biomes	Biodiversity	

I Answer the following in a word or a sentence each.

1. Why is the Earth called 'Living Planet"?
2. What is Environment?
3. Define Ecology.
4. What is Biomes?
5. Define the term Biodiversity.

II Answer the following in two or three sentences each.

1. What are the components of Biosphere?
2. Name the two types of Environment.
3. What is 'Ecological balance'?
4. Mention any four types of biomes.
5. State the features of Genetic biodiversity.

III Answer the following.

1. Briefly explain the Biomes.
2. Describe the main aspects and three levels of study of Biodiversity.

SUGGESTED ACTIVITIES .....

- Prepare chart to show the different types of environment.
- Draw the outline map of the World and show the important biomes.
- Conduct group discussions on biological imbalance and biodiversity.

PART-B : PHYSICAL ENVIRONMENT OF INDIA

CHAPTER 8

INDIA

8.1 INDIA - LOCATION AND ITS ENVIRONS

India, is an important (Physical and Cultural) country in the world in the 21st century. It is universally called **'Bharat'** or **'Hindustan'**. It is a subcontinent having various physical, climatic, social, cultural, economical and political diversities. It is popularly called, 'land of great unity in diversity'.

The physical environment of India has diversified features. eg. The Mountains in the North, the Plateaus in the South, the water bodies and coastal plains in the East and West, the dry desert in the north west, monsoon climate, rivers etc., with a most strategic peninsular location.

India is situated in the southern part of Asian continent and lies to the northern tip of the Indian Ocean. It is a peninsula covered with water on three sides (West, South and East) and land on the North.

Fig. 8.1 India in Asia

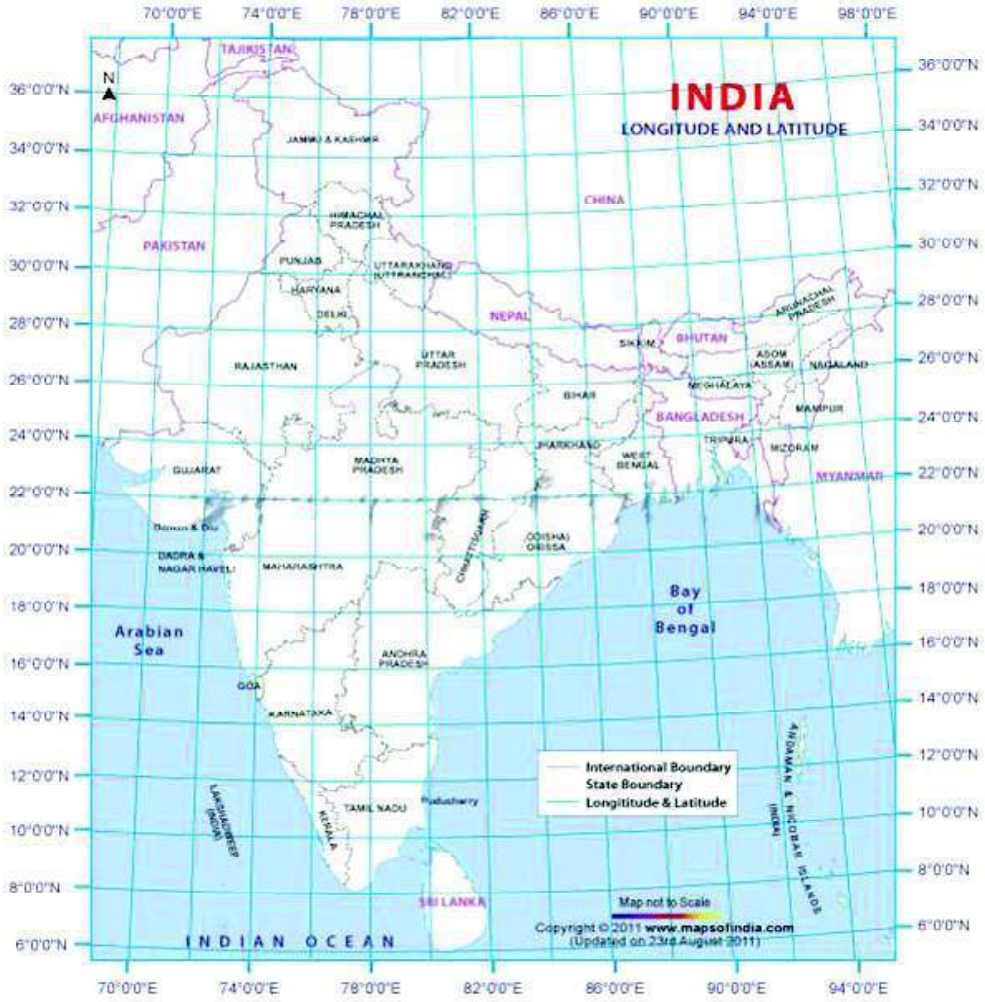


Fig. 8.2 India – Latitude and longitude

Location

The main land of India extends between 8º 4´N to 37º 6´N latitude and 68º 7´E to 97º 25´E longitude. The latitudinal and longitudinal extent of India is around 30º. The country stretches to 3214 km from North to South and 2933 km from West to East. The northern tip of India is recognized as 'Indira Col' in Jammu & Kashmir while, the southern tip (main land) is 'Kanyakumari' or 'Cape Camorin' in Tamilnadu. In the same way the western and eastern tips of the country are 'Sir Creek' or 'Rann of Kutch' in Gujarat and 'Luhit' or 'Lohit' in Arunachal Pradesh respectively.

The territorial limit of India extends up to 6º 45´ North latitude. 'Indira point' situated at this latitude in Great Nicobar Islands of the Andaman and Nicobar group is recognized as the Southern most point (territorial boundary) of India.

The main land of India has 6100 km of coastline while, the total length of coastline including islands (Lakshadweep and Andaman and Nicobar Islands) is 7516 km. The territorial water extends into the sea to a distance of 12 nautical miles (22.2 km) from the coastal baseline.

India is a peninsula, located at the north tip of the Indian Ocean. It is bordered by the Arabian sea in the west, Indian ocean in the south and Bay of Bengal in the east and covered by land in the north - China, Nepal, Bhutan etc.,

The Tropic of Cancer -23½º N latitude and the Indian Standard Time (IST) -82½º E longitude are the most important lines in the country. Tropic of Cancer passes through the middle of India (West to East) and divides the country into almost two equal halves. The northern part is called North India and southern part is called South India. This line passes through 8 states of India.

82½º E longitude which passes through the middle of India (North to South – 5 states) is recognized as standard longitude of the country to keep Standard Time. The Indian Standard Time (IST) is 5½ hrs ahead of Greenwich Mean Time (GMT). This line passes through Allahabad (a historical city) of Uttar Pradesh.

SIZE

India is the seventh largest country (area) in the world next to Russia, Canada, China, USA, Brazil and Australia. It has a total geographical area of 32,87,263 sq.km. This constitutes about 2.4% of the total land area of the Earth.India is the second most populous country in world next to China. According to 2011 census the total population of the country was 121.6 crore or 1216 million or 1.21 billions, which accounts for about 17.45 % of the total world's population. India has 28 States, 6 Union territories and 1 National Capital Region (New Delhi). Among the states, Rajasthan is the largest state and Goa is the smallest state in area. In terms of population UP ranks first and Sikkim occupies the last position.

Frontiers

India has 15,200 km of long land frontier extending from west to east running from Gujarat in the west to West Bengal in the east. The Himalayas form a natural boundary in the north, between India and China. Similarly, Thar desert in the west & northwest and eastern hills acts as boundary between India & Pakistan and India & Myanmar respectively. India share land frontier with seven countries, they are Pakistan and Afghanistan to the Northwest, China,Nepal and Bhutan to the North and Bangladesh and Myanmar to the East.

Sri Lanka, an island country, situated to the southeast, is separated by Palk Strait and Gulf of Mannar.

The important international boundary lines demarcated between India and neighbouring countries are:

1. The Durand line - India and Afghanistan (80 km) by Mortimer Durand.
2. The Mc Mahon line - India and China (PRC) (3488 km) by Henry Mc Mahon.
3. The Radcliff line - India and Pakistan (2910 km) by Sir Cyril Radcliff.
4. India and Bangladesh (4097 km).

In addition to the above Nepal – 1751 km, Myanmar – 1643 km and Bhutan – 699 km also have land boundaries with India. (Source: Wikipedia – Dec, 2012)

Even though India has natural and manmade boundaries, it has land disputes with many countries. Most important are: India & Pakistan- North West Jammu and Kashmir (POK), India & China- North east Jammu and Kashmir – Aksai chin, India & Bangladesh - West Bengal and Assam, India & Myanmar – Mizoram and Nagaland and India & Nepal – Kalapani area etc., The disputed areas are causing hitch and threat to the country in the form of frequent boundary line problems, destruction of flora & animal wealth, water sharing, transportation, national security, utilization of resources, infiltration, slow growth in the economic activities etc.,

IMPORTANT TERMS .....

Sub-continent	Kanyakumari	Indian Standard Time
Peninsula	Sir Creek	Durand line
Indira Col	Luhit	Radcliff line
Indira Point	Tropic of Cancer	Mc Mahon line

I Answer the following in a word or a sentence each.

1. State the geographical location of India.
2. Name the southernmost and northernmost points of main land of India.
3. In which Island of India, is 'Indira Point' situated?
4. What is the total geographical area of India?
5. Mention the International boundary between India and China.

II Answer the following in two or three sentences each.

1. Write the latitudinal and longitudinal extent of India.
2. Name the water bodies that surround India.
3. Which latitude and longitude passes in the centre of the Country?
4. According to 2011 census what is the total population of India and what is its percentage to total World's population?
5. Name the international boundaries between India & Pakistan and India & Afghanistan.

III Answer the following.

1. Explain the location, size and frontiers of India.

SUGGESTED ACTIVITIES .....

- Draw the outline map of Asia and locate India.
- Draw the outline map of India and show the latitudes, longitudes and international boundaries.

CHAPTER 9

PHYSIOGRAPHY

Physiography is the systematic description of nature in general. India is a land of varied physiographic diversity. The physical features which are formed naturally in a country, have evolved over a very long time by crustal movements, denudation and climatic conditions. The Sub-continent of India has various physical features which have its direct influence on the drainage, climate, forest, soil, land use and other human activities.

9.1 PHYSICAL DIVISIONS

India is characterised by great diversity in its physical features. It includes mountains, plateaus, plains, coastal plains, desert etc. On the basis of physiography, the country is divided into four major physical divisions. They are: 1) The Northern Mountains 2) The Northern Plains 3) The Peninsular Plateau 4) The Coastal Plains (Islands).

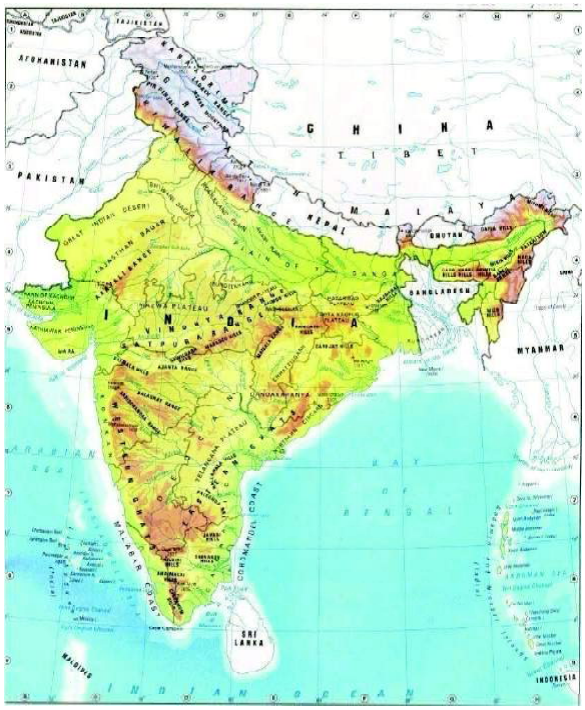


Fig. 9.1 Physical map of India

1.The Northern Mountains (The Himalayas):

The Northern Mountains are the loftiest, snow covered chain of young fold mountains in the world. They are formed by the tectonic forces in the recent past with the folded layers. Hence, they are called 'Young fold mountains'. These mountains stretch in a continuous chain from Pamir Knot in the north west, (North West of Jammu & Kashmir) to Arunachal Pradesh in the east along the northern boundary of India and then run in south west direction towards Myanmar. It is in the convex shape towards India. The length of this mountain is around 2400 km and width is 240 to 320 km. The average height of this mountain is 6000 m and it covers an area of 5 lakh sq km.

The Northern mountains are divided into three major systems. a) The Trans-Himalayas b) The Himalayas c) The Purvachal or Eastern off-shoots.

a) The Trans-Himalayas: This is a continuous range of mountains found in Jammu & Kashmir commencing from Pamir knot to Indus valley. The Trans-Himalayas comprises of three important ranges running parallel to each other. i) Karakoram range ii) Ladakh range and iii) Zaskar range. Karakoram ('backbone of high Asia') is a range of high mountain peaks and glaciers. K2 or Mt Godwin Austin (8611m), India's highest peak (POK) and the World's second highest peak is found in this range. Other important peaks are Hidden peak, Broad peak, Gasherbrum peak etc., The important glaciers of this region are Siachen, Biafo, Batura, Hispar and Baltaro etc., Siachen is the longest and largest glacier of India. It is the highest battle ground in the world.

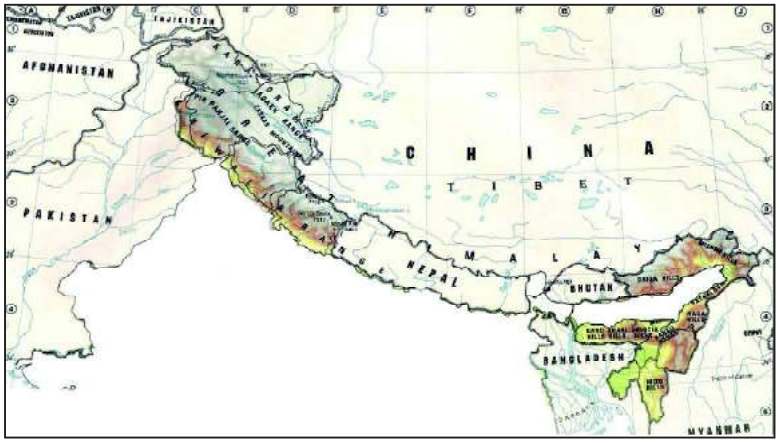


Fig. 9.2 Map of the Himalayas

b) The Himalayas: This is the loftiest and snow covered (Himalaya – 'abode of snow') mountains in the world. The area occupied by the Himalayas was earlier a part of 'Tethys Sea'. The formation of this mountain is by tectonic forces (folding and faulting) of Gondawana and Angara land masses. It is situated to the north of the Indus, Ganga and the Brahmaputra plains. The slope of the Himalayas are gentle towards the north (China) and steep towards south (Indo-Gangetic plain). The Himalayas have distinct characteristics of high relief, snow covered peaks, complex geographical structures, parallel separated by deep valleys and rich temperate vegetation etc.,

The Himalayas are classified into three parallel ranges based on altitude and latitude. i) The Great Himalayas or Himadri ii) The Lesser Himalayas or Himachal iii) The Outer Himalayas or Siwaliks.

i) The Great Himalayas: These are the inner most loftiest and continuous ranges of mountains (Himadri-abode of gods). The average height of the Great Himalayas is 6100 m and the width varies between 120 and 190 km. The important peaks of great Himalayas in India are, Kanchenjunga - 8598 m (third highest peak in the world) in Sikkim (highest peak of India, under its control), NangaParbat - 8126 m, Nandadevi, Badrinath,Kamet, Trishul etc.

Mt. Everest is the highest peak on the Earth (named after Sir George Everest).

It is called **Sagarmatha** in Nepal and **Chomolungma** or **Qomolangma** in China

First successful ascent - 29.5.1953 by **Tenzing and Hillary**

First Indian woman to climb – **Bachendri Pal,** 23.5.1984

Youngest Indian to climb – **Arjun Vajpai**, 22.5.2010

Youngest person to climb – **Jordan Romero** (13 yr), 22.5.2010

Peaks of Great Himalayas

Mt. Everest	- 8850 m.
Kanchenjunga	- 8598 m.
Makalu	- 8481 m.
Dhaulagiri	- 8172 m.
Manaslu	- 8156 m.
Cho Oyu	- 8153 m.
Nanga Parbat	- 8126 m.
Annapurna	- 8078 m.
Nandadevi	- 7817 m.

Fig. 9.3 Mt. Everest

K 2 or Mt. Godwin Austin

Mt. Kanchenajunga

ii) The Lesser Himalayas: These ranges are also known as Inner Himalayas or Himachal ranges. It is situated between Greater Himalayas in the north and Outer Himalayas or Siwaliks in the south. Its average height is around 1500-4500 m and the width is about 60 to 80 km. These are very rugged and complex ranges due to erosion by rivers.The important ranges in Lesser Himalayas are Pirpanjal, DhaulDhar (Mussorie range) and Nag-Tiba etc.,The important Hill stations are Shimla, Mussorie, Ranikhet, Nainital, Almora, Chakrata, Darjeeling etc. This range is famous for valleys. Some of them are Kulu valley, Kangra valley, Spiti valley etc.,

iii) The Outer Himalayas or Siwaliks: These are the outer most ranges situated to the south of Lesser Himalayas, known as Siwaliks. The Siwaliks extend from Jammu & Kashmir in the north west to Arunachal Pradesh in east. The average height of this range is around 600-1500 m and its width varies between 15-50 km. The Siwaliks are formed from the sediments brought down by the rivers of Lesser and Greater Himalayas.

There are flat floored structure valleys between Siwaliks and Lesser Himalayas called Doons / Duns. Some of the important doons are Udampur, Kotli, Dehradun (largest doon), Kota, Patli,Choaukamba etc. The Outer Himalayas are fertile, intensively cultivated and thickly populated regions.

c. Purvachal or Eastern off shoots: Other than the above ranges there are some hills and hill ranges in the north eastern region, popularly called Purvachal or Eastern Hills. These are the extension of Himalayas in north east towards Myanmar. Their height is lesser than other mountain ranges but are covered with dense forest. The important ranges and hills are Dafla, Miri and Mishmi hills, Patkai Bum (Arunachal Pradesh), Naga hills (Nagaland), Mizo hills (Mizoram), Mikir hills (Assam),Garo, Khasi and Jaintia hills (Meghalaya) – Mawsynram of Meghalaya receives highest rainfall in the country. These are inhabited by various tribes and nomadic groups.

Regional or Longitudinal divisions of the Himalayas

The Himalayas are also classified into Regional and Longitudinal divisions. They are: 1) The Kashmir Himalayas 2) The Himachal Himalayas 3) The Kumaun Himalayas 4) The Central or Sikkim Himalayas 5) The Eastern Himalayas

1. **The Kashmir Himalayas:** They are spread over in Jammu and Kashmir for about 700 sq km. The important parallel ranges in the Kashmir Himalayas are Karakoram, Ladakh, Zaskar and Pirpanjal. They are characterised by high snow covered peaks, largest number of glaciers, deep valleys and high mountain passes. The north-eastern part of the Kashmir Himalayas (Ladak region) is a cold region and it lies between the Greater Himalayas and the Karakoram ranges. A special feature of the Kashmir valley is the Karewas. The important mountain passes are Banihal (Jawahar Tunnel), Zoji-la, Chang-la, Khardung-la etc.

Karewas: It is a special feature of the 'Vale of Kashmir' consisting of silt, compact sand and clay. These are the thick deposits of glacial clay and other materials embedded with moraines. This area is famous for cultivation of Almond, Saffron (Zafran), Apple, Pear etc.

Banihal pass: It is a pass across the Pir Panjal range. This range separates the Kashmir valley from the outer Himalayas and plains to the south. National Highway 1A (Jammu to Srinagar), is built on this pass. Jawahar road tunnel - 2.5 km is the longest road tunnel built in this mountain pass. Indian Railways has constructed 11.21 km railway tunnel in this mountain pass to reduce the distance. This is the longest railway tunnel in the country, built between Qazigund and Banihal.

2. **The Himachal Himalayas:** It is found in Himachal Pradesh and parts of Punjab, comprising of all the three ranges (Great, Lesser and Siwaliks) of Himalayas. The beautiful valleys of Kullu, Kangra, Lahul and Spiti known for orchards and scenic beauty are found here. Shipki-la, Rohtang, Bara-lacha la are the famous mountain passes and Kullu-Manali, Shimla, Dalhousie, Chamba etc., are the popular hill stations of this region.

3. **The Kumaon Himalayas:** It extends from river Sutlej in the west to Kali in the east, and lies in the states of Himachal Pradesh (parts) and Uttarakhand. Peaks like Nanda Devi, Kamet, Trisul, Badrinath,

Kedarnath, Gangotri are found in this region. Gangotri, Yamunotri, Pindar, Alakapur are the famous glaciers. The important mountain passes are Mana, Niti, Balcha Dhura etc. Mussorie, Nainital, Raniket, Almora are the famous hill stations.

Fig. 9.4 Valley of Flowers

'**Valley of Flowers' (Uttarakhand)**: Longest valley of flowers in the world having Alpine flowers and a variety of flora. It has many colourful flowers, taking on various shades of colours as time progresses. It is the home of Brahmakamal, Blue poppy, Cobra lily flowers. It is under Nanda Devi Biosphere Reserve.

4. **The Central or Sikkim Himalayas:** This range stretches from river Kali to river Tista. The major part of it lies in Sikkim and a small part in West Bengal. The highest peaks of the world are found in this part. This region has two famous passes Nathu-la (Silk route) and Jelep-la (Largest pass in India). In Sikkim, the slopes of Himalayas have been developed for tea cultivation.

5. **The Assam or Eastern Himalayas:** This range extends from river Tista to Brahmaputra valley covering the states of Assam and Arunachal Pradesh. Important mountain passes in this region are Debang, Tse-la, Bomdi-la etc., Due to heavy rainfall, fluvial erosion is quite prominent. This region (Tea gardens in Assam) is very important for tea cultivation.

The important lakes in the Himalayas are: a)Wular lake (Largest fresh water lake of India) – Jammu & Kashmir b) Dal lake (biggest tourist lake of India, water freezes during winter) - Jammu & Kashmir c) Loktak lake (Floating National Park - Keibul Lamjo) - Manipur etc.

The important Pilgrimage centres in the Himalayas are: Vaishno Devi and Amarnath cave (Jammu and Kashmir), Yamunotri, Gangotri, Kedarnath, Badrinath and Hemkund Sahib (Uttarakhand) etc.

Significance of the Himalayas

The Himalayas play a very important role in the life of the people and economy of the country. It is said that, the 'Himalayas are the body and soul of India'.

1. They act as a natural frontier (boundary) in the north and check foreign invasions.
2. They influence on climate - prevent cold winds blowing from Central Asia to India during winter season.
3. They cause heavy rainfall in the north eastern region by obstructing the rain bearing south-west monsoons.
4. They are the source of many perennial rivers - Ganga, Indus, Brahmaputra and their tributaries.
5. They are very rich in forest resources and the habitat for various animals.
6. They are the store house of minerals - copper, lead, zinc, nickel, uranium etc.
7. The climate of the Himalayas is suitable for cultivation of various crops – Tea, Apple, Cherry, Pear, Almond, Saffron, Walnut etc.,
8. Hill stations and Pilgrimage centres in the Himalayas attracts National and International tourists.
9. Recreation and sport activities like rafting, gliding, mountaineering, trekking etc. are quite popular in the Himalayas.
10. The Himalayas are suitable site for the generation of hydro electricity. eg. Bhakra Nangal, Tehri, Silal etc.

2. The Northern Plains

The Northern plains or the Great plains of India is a transition zone between the Northern Mountains in the north and the Peninsular plateau in the south. These plains are formed by the alluvial deposits brought by the rivers like the Indus, the Ganga and the Brahmaputra. Therefore, it is also called the Indo- Gangetic and Brahmaputra plains. The Northern Great Plains stretch for about 2,400 km from west to east, width varying from 240- 320 km and cover an area of about 7 lakh sq.km. The average depth of alluvium is 1300-1,400 m. The Northern Plains is spread over in the states of Punjab, Haryana, parts of Rajastan, Uttarkhand, Uttarpradesh, Bihar, Jharkhand, West Bengal and Assam.

Fig. 9.5 Northern plains

The Great plains may be divided into a number of smaller regions on the basis of the characteristics of the alluvium, slope of the land, drainage channels etc.

a) **Bhabar plains:** This region is found all along the foot of the Siwaliks from the river Indus to the Tista. It consists of gravel and unassorted sediments deposited by the Himalayan rivers due to sudden break in the slope. This area is not suitable for agriculture but big trees with large roots thrive.

b) **Terai plains:** It is found to the south of Bhabar with wide marshy tract, where streams reappear to the surface. It is a marshy land wide spread in the regions of excess dampness, thick forests, rich wild life etc.

c) **Bhangar plains:** It is a type of alluvial soil formed by the deposition of the older alluvium and lie above the flood-limit of the plains. The main constituent of Bhangar is clay which at places gives way to loam and sandy loam.

d) Khadar plains: The younger alluvium of the flood plains of the numerous rivers is called the Khadar. It is enriched by fresh deposits of silt every year during the floods. It consists of deposits of sand, silt, mud and clay.

On the basis of regional characteristics the Northern Plains is divided into three regions: 1. The Western Plains 2. The Central Plains 3. The Eastern Plains

1. **The Western Plains:** This plain is spread over in Rajasthan, Punjab and Haryana. Most of the Rajasthan plains are covered by vast stretches of sand, formed by sand dunes.

The Punjab-Haryana plains are formed by the aggradational activity of the Sutlej, Beas and the Ravi rivers. The Bari Doab (between Beas and Ravi), the Bist Doab (between Beas and Sutlej) are the most important agricultural regions.

2. **The Central Plains or Ganga Plains:** The Ganga plains extend from the Yamuna river in the west to the western borders of Bangladesh. It is formed by the Ganga and its tributaries. It spreads in the states of Uttarkhand, Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand and West Bengal. It slopes towards the south east. The Ganga Plain is a low lying plain, which causes floods during the rainy season. The lower Ganga plains has a vast network of distributaires. In the lower part, the Ganga and Brahmaputra collectively form Sunderban delta. It is considered as the 'Largest Delta in the World'.

3. **The Eastern Plains or Brahmaputra plains**: The Eastern plains is also known as Assam Valley. It is formed by the Brahmaputra and its tributaries. It is a low level plain, surrounded by high mountains on all sides except on the west. The Brahmaputra brings red soil from the mountain and deposit in its plains. Therefore, this plain is called '**Red plain'**. Due to low gradient the Brahmaputra is a highly braided river and has numerous river islands. **Majuli** is the largest river island of India and Second largest in the world.

Significance of the Northern Plains:

1. The Northern plains have fertile soil, uniform surface and perennial rivers -suitable for agriculture.

2. The Plains have encouraged the development of transport and communication.
3. They are helpful for agro-based industries and urbanization.
4. They have great social, religious and political significance.
5. The rivers in the plain help in the development of inland water transportation.
6. It has rich underground water, useful for irrigation and other activities.
7. It has cultural and traditional importance - house hold goods, art, articrafts, music etc.
8. The Northern plains have high concentration of population - 45% of India's population.

3. The Peninsular Plateau

This is the oldest and the largest physiographic division of India. It lies to the south of the Northern Great Plains and covers an area of about 16 lakh sq km. The elevation of this upland varies from 600 to 900 m. This is in inverted triangle shape, with wide base lying in the north and the apex formed in the south, with tilt towards south east. It is bounded by the Aravallis in the north west, Bundelkhand plateau in the north, Rajmahal hills in the north east, the Western Ghats in the west and the Eastern Ghats in the east. The highest peak of Peninsular Plateau is Anaimudi (2695 m) situated in Annamalai hills of Kerala. The fault in which the Narmada river flows divides the region into two unequal parts.

On the basis of relief features the Peninsular plateau can be divided into two main divisions.

a) The Central Highlands.

b) The Deccan Plateau.

a) The Central Highlands: This is a smaller region of peninsular plateau situated to the north of the Narmada river. It is slightly tilted towards north. It include the Aravallis, the Malwa plateau, the Vindhya range, the Bundelkhand , the Baghelkhand and Chotanagpur Plateau and Rajmahal Hills etc.

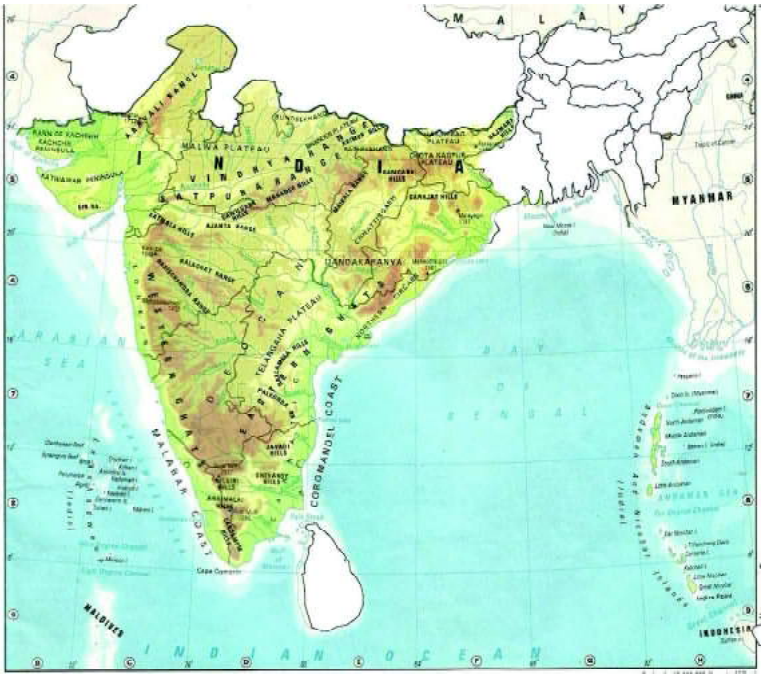


Fig. 9.6 Peninsular Plateau

The Aravallis

It is a range that runs from north east to south west for about 800km between Delhi to Palanpur (Gujarat). It is one of the oldest folded mountains of the world. Its highest peak is Guru Shikar (1722m). It separates Rajasthan into two parts as i) Western Rajasthan-Desert region ii) Eastern Rajasthan-upland and agricultural region. The Aravallis are composed of quartzites, gneisses and schists. Rivers like the Luni, Sabarmathi and the Mahi flow from Aravalli Ranges. Mt Abu, a well known place is situated in this range.

Do you know ?

- **Rashtrapathi Bhavan** is built on the **Raisena hills**, which is a part of the Aravalli.
- **The Goranghat:** connects Guru Shikar and Mt. Abu.
- **The Haldighat**: connects Rajsamand and Pali districts.

The Malwa plateau

It is bordered by the Aravallis in the north and the Vindhyan range in the south. This plateau has two drainage systems i) Narmada and Mahi towards the Arabian sea ii) Chambal, Sind, Betwa and Ken towards the Bay of Bengal.

The Vindhya Range

It extends in east west direction for about 1050 km. The Kaimur hills lies in the east of Vindhya range and the Maikala range forms a link between the Vindhya and Satpura ranges.

The Chotanagpur Plateau

It is spread over in the states of Chhattisgarh, Jharkhand, West Bengal and Odisha. It covers Ranchi, Hazaribagh, Singhbhum, Dhanbad, Palmavu, Santhal Paragana and Purulia regions. This region is composed of granite, gneiss and dharwar rocks, which are rich in mineral wealth. Chotanagpur plateau is prosperous in minerals as well as industries. Therefore, it is called 'Mineral bowl of India' and 'Ruhr of India'. The Subernarekha and the Damodar rivers drain the Chotanagpur plateau.

b) The Deccan Plateau: This is a triangular plateau situated to the south of the river Tapi or Tapati. The Deccan trap is the crystalline core of the peninsular plateau and it is made up of very old and hard rocks. The lava effusions forming this plateau are believed to have occurred through a fissure volcano and this region is considered a lava shield. It occupies the areas of Maharashtra, Karnataka, Andhra Pradesh and parts of Chhattisgarh, Odisha and Tamil Nadu.The Deccan Plateau is bordered by the Western Ghats in the west, Eastern Ghats in the east and the Satpura, Maikal and Mahadeo hills in the north. The Deccan plateau is divided into Maharashtra plateau (Maharashtra), Telangana plateau (Andhra Pradesh) and Karnataka plateau (Karnataka).

The Western Ghats

The Western ghats are also known as Sahyadris. They are almost continous mountain system running parallel to west coast for about 1600 km, from north-west to south direction (Tapti Valley to Kanyakumari). The western slope of Sahyadri is steep, while the eastern slope is gentle. The western ghats meet the eastern ghats in Nilgiri hills (Blue Mountains). Further, it continuous to south as Palani, Annamalai and Cardamom hills (potential region for wind energy).

The Western ghats form a watershed of the peninsular rivers. Important rivers like the Godavari, Krishna, Kaveri, Sharavati, Periyar etc, rise in this belt. The southern parts of western ghats have more rugged topography, giving rise to the formation of waterfalls, which are beneficial for generating hydro-electricity. They are covered with dense evergreen and monsoon forests and rich bio-diversity zones.

The average height of Western Ghats varies between 1000-1300 m. The important peaks of this region are Anaimudi (2695 m), Mullainagiri (1923 m), Kudremukh (1882 m), Pushpagiri (1714 m), Kalsubai (1646 m), Salher (1567 m), Mahabaleshwar (1438 m) etc. The important ghats are Thalghat, Bhorghat, Palghat, Agumbeghat, Shiradighat, Charmadighat, Kollurghat etc.

The western ghats are also rich in minerals. Basalt, granite, gneiss and schist are widespread rocks, which have sufficient quantities of Iron ore, Manganese ore, Bauxite etc.

- **Agumbe:** Receives highest rainfall (above 400 cm/year) in South India. It has the highest King Cobra population in the country. Best place to watch Sun set.
- **Agumbe ghat:** Connects Udupi and Shimoga.

- **Famous Waterfalls:** Jog, Iruppu, Abbe, Lalguli, Doodsagar etc.

- **Thalghat**- connect Mumbai and Nasik
- **Bhorghat**- connect Mumbai and Pune
- **Palghat-** connect Trivandrum and Chennai

The Eastern Ghats

They form eastern boundary of the Deccan Plateau. They are not continuous chain of mountains like western ghats. They are separated by the river valleys. The eastern ghats stretch to 800 km from Mahanadi valley in the north to Nilgiri hills in the south. Its average height is around 600 m.

The important peaks of the eastern ghats are Aramakonda (1680 m) Singaraju (1516m), Nimalgiri (1515 m), Mahendragiri (1501m) etc. The Aramakonda (Andhra Pradesh) is considered as the highest peak of the Eastern Ghats.

Nallamalla, Kondavidu, Velikonda, Palkonda, Tirumala (Andhra Pradesh) Kallamalai, Pachmalai, Gondamalai, Shevaroy, Javadi (Tamil Nadu), Biligiri Rangana Betta and Malai Mahadeshwara Betta (Karnataka) are the important hills of Eastern ghats.

The Eastern ghats are rich in Iron ore, Manganese ore, Limestone, Coal, Mica etc., minerals.

Significance of the Peninsular plateau:

1) This region is rich minerals. eg. Iron ore, Manganese, Bauxite, Coal, Mica, Uranium, Gold, Diamond etc.

2) The peninsular region is the source of many rivers. eg. Narmada, Mahanadi, Godavari, Krishna, Kaveri etc.,

3) The Western Ghats are rich in bio-diversity and are of great ecological significance.

4) This region is covered with black, red and laterite soils, which are favourable for the cultivation of cotton, coffee, millets, maize, tobacco, tea, pulses, cashew, groundnuts etc.

5) The high lands of the plateaus are covered with thick forest. They provide timber, fuel wood, medicinal plants and other forest products.

6) The western ghats check south west monsoons and cause heavy rainfall in the west coast and windward side of the western ghats.

7) The rivers flowing in peninsular India create waterfalls and rapids and are useful for the generation of hydro electricity.

8) There are numerous hill stations and tourist centres: Ooty, Kodaikanal, Mahabaleshwar, Khandala, Pachmarhi, Mt. Abu, Kemmannugundi, Bababudangiri, Biligiriranganabetta, Nandi hills, Chamundi hills etc.,

9) The hills of peninsular region are habitat of many tribes. eg.Uralis (Nilgiris), Pullayans (Palni Hills) Bhils, Badagas, Karwas, Mundas, Kurumbas, Yeruvas (Central Highland) etc.

4. The Coastal Plains

The peninsular plateau of India is flanked by narrow coastal plains of varied width from north to south, known as the West coastal plains and the East coastal plains. They are formed by the depositional action of the rivers and the erosional and depositional actions of the sea waves.

The main land of India has a coastline of 6100 km from Gujarat (Rann of Kutch) in the west to West Bengal in the east. This coastline is washed by the water of Arabian sea in the west and the Bay of Bengal in the east.

The coastal plains of India is divided into two parts. They are: a) The West coastal plains and b) The East coastal plains.

a) The West Coastal Plains: It lies between the Western ghats and the Arabian Sea, from the Rann of Kutch to Kanyakumari. It is narrow, steep and rocky (except in Gujarat) coast, having an average elevation of 150 m above sea level. The west coastal plains is almost straight and has many sandy beaches, sand dunes, lagoons, estuary, residual hills etc.

The west coastal plains have Gujarat, Konkan, Karnataka and Malabar Coasts. The **Gujarat Coast** comprises of Rann of Kutch and Cambay Coasts. It is formed by the alluvial deposits of Sabarmati, Mahi, Luni and other small streams. Gujarat has the longest coast line in India. Kandla and Okha are famous sea ports and Alang is the biggest ship breaking centre. This coast produces highest salt in the country. The **Konkan Coast** lies to the south of Gujarat coast and extends from Maharashtra to Karnataka for about 530 km. It is a broken coast line which provides suitable site for natural seaports. eg: Mumbai, Navasheva (Jawaharlal Nehru Port), Marmagoa, Karwar, New Mangalore etc.,This coast records highest coastal erosion. It is very rich in Petroleum and Natural gas (Bombay high). The **Karnataka Coast** is a part of Konkan coast. It extends from Karwar in the north to Mangalore in the south. It is the narrowest part of west coastal plains. Karwar and New Mangalore are important ports in this belt. Sea Bird, the Naval base near Karwar is the largest naval base in India. The **Malabar Coast** extends from Mangalore to Kanyakumari. Sand dunes, lagoons and backwaters are the important features of Malabar Coast. Cochin or Kochi is the biggest seaport in this coast. Backwaters of Kerala facilitate navigation and tourists enjoy travelling through small country boats. The first south west monsoon rainfall is received in this coast.

b) The East coastal plains : It lies between the Eastern ghats and the Bay of Bengal stretching from the delta of Hoogly in the North to Kanyakumari in the south. Compared to the west coastal plains the east coastal plains are broader. These plains are formed by the alluvial fillings. The coastal plain has a straight shoreline with well defined beaches of sand and shingles. eg. **Marina beach** of Chennai. Many rivers of south India cut across the east coastal plains and have formed deltas eg. Mahanadi, Godavari, Krishna, Kaveri deltas etc. Due to its gentle slope, the sea water near the coastal plain is shallow.

Hence, this coast does not have natural harbours except at Vishakpatnam. Other ports like Chennai, Kolkata, Paradeep etc. are artificial (man-made) ports. The southern part of east coast is known as the **Coromandel coast** (Kanyakumari to delta of Krishna). While, the northern part is known as **North Circar coast** (delta of Krishna to river Hoogly). The Coromandel coast gets more rainfall from the north east monsoons and it is highly affected by cyclones.

There are few lakes in the east coast. They are: a) Pulicat lake (border of Andhra Pradesh & Tamilnadu) b) Kolleru lake (Andhra Pradesh) c) Chilka Lake (Odisha)

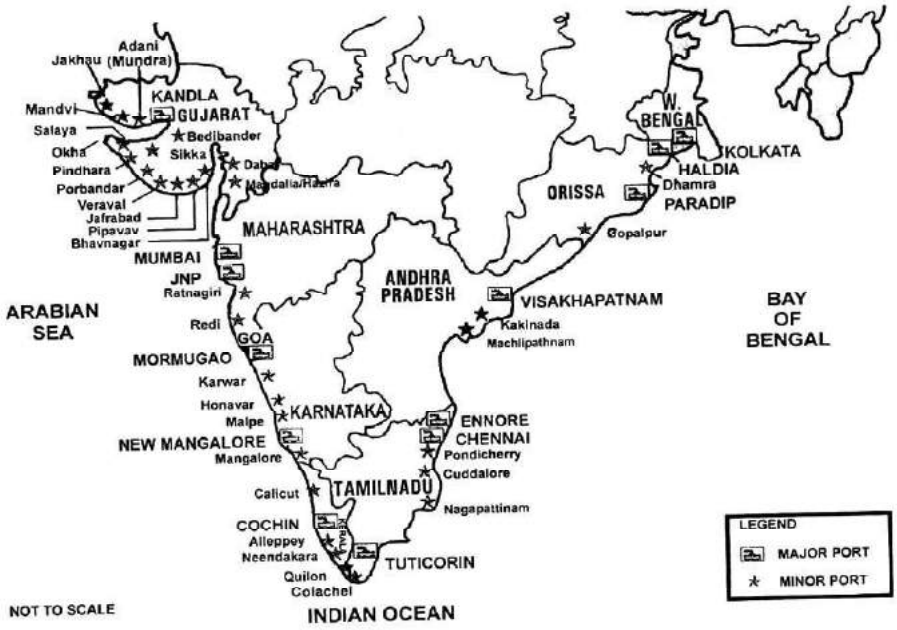


Fig. 9.7 Coastal Plains and Ports

Sriharikota: An island situated on the Pulicat lake. It is a Satellite launching centre of India.

Chilka lake (Odisha): Biggest lake in the country.

Tuticorin (Tamilnadu)**:** Is the biggest Coral and Pearl rearing centre in India.

Wheeler Island (Odisha): Is a famous missile testing place of India.

Important Beaches of Karnataka:

Gokarna
Om
Malpe
Kaup
Murudeshwar
Maravanthe
Panambur
Ullal etc.

Significance of the Coastal plains:

1) The coastal plains provide natural and man-made harbours.
2) The plains are very productive agriculturally .
3) The coastal areas are centres for fisheries and other aquaculture activities.
4) The backwater and lagoons are useful for inland navigation.
5) The low laying areas of the coastal plains are favourable for the production of salt, foam, coral and pearls.
6) The coastal plains are rich in minerals. eg. Thorium.
7) The beaches in the coast provide for recreation and tourism.

The Indian Islands:

India has a total of 247 islands. Of these 204 are in the Bay of Bengal and the remaining 43 are in the Arabian Sea.

The islands of the Bay of Bengal are called **Andaman and Nicobar Islands**, which are largely tectonic and volcanic in origin. In Andaman there are four group of islands – North Andaman, Middle Andaman (biggest group), South Andaman and Little Andaman. Port Blair, the Capital of Andaman and Nicobar islands is situated in South Andaman islands. **Barren** and **Narcondam** are famous volcanic islands in this group.

In the Nicobar there are three group of islands - Car Nicobar, Little Nicobar and Great Nicobar (biggest island).

The Andaman and Nicobar islands have warm tropical climate and receive heavy rainfall during monsoon seasons (southwest and northeast). They have thick forest and rich wildlife.

The islands of the Arabian Sea are called **Lakshadweep Islands.** These islands are very close to Kerala. These are coral in origin and are surrounded by fringing reefs. Kavaratti is the capital of Lakshadweep islands. Minicoy and Amindivi are the important groups in Lakshadweep.

The Indian Desert

The Indian desert or Thar desert lies to the west of the Aravallis. This desert is formed by the work of wind and climatic extremities. The total

area of the desert is around 1,75,000 sq.km. Rajasthan, parts of Gujarat, Punjab and Haryana come under Thar desert.

The central regions of the desert is called 'Marustali', while the outer region is called 'Bhagar'. Rajasthan bhagar in Rajasthan and Bhivani Bhagar in Haryana are the two outer limits of the Thar region.

The Atmospheric condition in the desert is extreme. During summer temperature exceeds 50º Celsius and in winter it comes down to 10º Celsius and below. Sri Ganganagar of Rajasthan has recorded more than 54º Celsius of temperature. It is recognized as the hottest place in India. The rainfall in the desert is very low. Roylee, a place in north Rajasthan, recorded the lowest rainfall in the country (8 cm per annum).

Indian desert comprises mainly of sand dunes. There are a few salt lakes in the desert eg. Sambhar, Tal, Katu. The desert has very thin vegetation. A few species of vegetation found here are bushes, shrubs, babul, acacia, munj, kans etc.

9.2 River System

A river is a natural water course, usually freshwater, flowing towards a lake, a sea, an ocean or another river.

The origin and development of the main river and their tributaries is known as **'River system'**. The area drained by the main river including all its tributaries is known as 'river basin'.

Rivers are the water resources of a country. They provide water for drinking, domestic purposes, agriculture, fisheries, irrigation, navigation, generation of hydro-electricity, industry, recreation, etc. Rivers are the centres of civilization, culture and tradition of a country, and they influence on life layer.

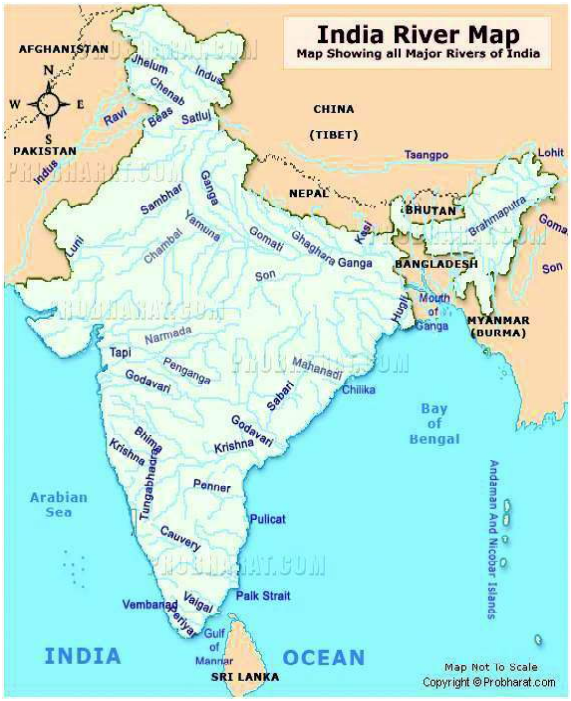


Fig. 9.8 India - Rivers

On the basis of origin and flow the river system of India can be broadly divided into two groups. They are, 1) The Himalayan Rivers or North Indian Rivers and 2) The Peninsular Rivers or South Indian Rivers.

1. **The Himalayan Rivers:** The Himalayan rivers are also known as North Indian Rivers. These rivers take birth in the Himalayan mountains by glaciers (snowfed) and flows throughout the year (perennial). There are three main river systems in the Himalayan rivers. They are the Indus, the Ganga and the Brahmaputra.

The Indus (Sindhu)

The Indus is one of the most important river systems of India. It rises near Mt. Kailash(6714 m), has a length of 2880 km, of which 709 km lies in India. It flows through narrow gorges between Ladakh and Zaskar ranges in the north west direction in Jammu & Kashmir.

Fig. 9.9 The Indus system

It is one of the oldest river systems of the world. Major part of its course and catchment area are in Pakistan. The main tributaries are Jhelum, Chenab, Ravi, Beas and Sutluj. **The Jhelum:** It rises from a spring at Verinag in the south eastern part of the valley of Kashmir. It flows in north west direction where, it enters the Wular lake (Largest fresh water lake of India). Dal lake is also formed by this river. Jhelum Treaty has temporarily settled the water dispute between India and Pakistan. **The Chenab:** The river Chenab rises in the greater Himalayas, it is called Chandra Bhaga in Himachal Pradesh. The Baglihar, Selal and Dulhasti are the famous hydroelectric projects on this river. The Baglihar has become a disputed project (between India & Pakistan) in the south western part of Jammu & Kashmir. **The Ravi:** It rises near Rohtang pass in Kullu, very close to the source of the Beas river. It flows along the Indo-Pak boundary along Gurudaspur and Amristar districts. **The Beas:** It rises at Beas Kund

near Kullu. It flows in the Kullu and Kangra valley and finally joins the Sutlej near Harike. **The Sutluj:** The Sutluj river rises from the Lake Rakas in China. This is the only tributary of the Indus, which takes its birth outside India. It enters India through Shipki-la Pass in Himachal Pradesh. The Bhakra Nangal multi-purpose river valley project is constructed on this river, near Bhakra gorge. It is the joint venture of Punjab, Haryana and Rajasthan. The Bhakra dam is the second highest dam (741 ft.) of India. The Govindasagar lake (reservoir) is considered as the largest man-made lake of India.

The Ganga

The Ganga is the longest (2500km) and the largest river system of the country. It is generally called, the **'National river'** of India. The Ganga has two head streams - the Bhagirathi and the Alakananda. The **Bhagirathi** takes its birth in Gangotri and **Alakananda** rises near Badrinath in Garhwal himalayas. These two meet at Devaprayag, and continue to flow as the Ganga. After flowing across the Himalayas, the Ganga enters the great plains at Haridwar. From Haridwar it flows towards south and south east upto Mirzapur. Further, it continues to flow eastwards in the Gangetic plains of Bihar and West Bengal and enters Bangladesh, where it joins the Brahmaputra and become Padma, and finally flows into Bay of Bengal.

The Hooghly, an important distributary of Ganga flows through Kolkata. Hooghly is a tidal river on which the Kolkata port is situated. The water level of Hooghly river is maintained from the Farakka barrage.

Gangetic Dolphin is the National Aquatic Animal of India

Tehri dam on the river Bhagirathi is the highest dam (855 ft.) of India.

Fig. 9.10 The Ganga and The Brahmaputra rivers

The Ganga receives water from many tributaries. Two important groups are: 1) Left bank tributaries 2) Right bank tributaries

1) **Left Bank tributaries:**The main left bank tributaries of the Ganga are Ramganga, Sarada, **Gomati, Ghaghra, Gandak** and **Kosi.** The Gomati is an important tributary on which Lucknow city is situated. The Ghaghra river is joined by the Sarada, later they meet Ganga near Chapra. The Gandak flows from Nepal and joins the Ganga near Patna. The Kosi is one of the largest tributaries in this group. It is often referred to as the 'Sorrow of Bihar', because the river which has shifted its course by more than 100 km, cause devastating floods regularly in Bihar.

2) **Right Bank tributaries:** The main right bank tributaries of the Ganga are **Yamuna** and **Son**. **The Yamuna** is the longest (1380km) and largest tributary of the Ganga. It rises in Yamunotri glacier, flows as a right bank tributary and joins Ganga at Allahabad. Prayag or Allahabad of Uttar Pradesh is called **'Triveni Sangama'**, where the Ganga, Yamuna and the Saraswathi meet. Delhi, Mathura and Agra cities are situated on the banks of the river Yamuna. The river Yamuna has a few tributaries – The Chambal, Sind, Betwa and Ken. **The Chambal** river is famous for its extensive ravines (Chambal valley - Bad lands) in Madhya Pradesh, Rajastan and Uttar Pradesh. The important dams built across the river are Gandhi Sagar, Rana Pratap Sagar (Rawatbhata) and Jawahar Sagar. **The Son:** The river son is also an important right bank tributary of Ganga. It flows from Madhya Pradesh and joins the Ganga. The Rihand dam is constructed across the river Rihand, which is a tributary of Son. Govinda Vallab Panth Sagar is the reservoir of Rihand dam.

The Damodar: This river drain the eastern parts of the Chotanagpur plateau. It is called the 'Sorrow of West Bengal', for its devastating floods. After the construction of Damodar valley multi-purpose project (now DVC), it has become the backbone of Jharkhand and West Bengal. It meets Hooghly river at Falta in West Bengal.

The Brahmaputra

It is one of the largest river systems in the world. It rises in Chemayung dung glacier near Manasarovar (China). The Brahmaputra is called **'Tsang Po'** in China, 'Brahmaputra' in India and **'Jamuna'** in Bangladesh. The total length of the river is 2580 km but, in India it flows for about 750 km.

It enters India from Namcha Barwa (Arunachal Pradesh) by piercing the great Himalayan ranges. The catchment area of the Brahmaputra receives heavy rainfall. Therefore, it has numerous tributaries. The main tributaries are Subansiri, Dhansiri, Manas, Tista, Dihang, Lohit, Burhi Dihang etc., This river basin is notorious for flooding and river bank erosion. The river has produced many river islands. Majuli is the largest in the Assam region.

Sundarban delta is formed by the river Ganga and Brahmaputra. It is the largest delta in the world.

2. The Peninsular Rivers

The Peninsular rivers are also known as South Indian Rivers. The Peninsular plateau of India has the largest network of river systems in the country. Most of the south Indian rivers rise in the western ghats and central high land regions. On the basis of the direction of flow the rivers are grouped into two types. i) The East flowing rivers ii) The West flowing rivers.

i) **The East flowing rivers:** These rivers rise in Peninsular region, flow in eastern direction and finally join the Bay of Bengal. The important east flowing rivers are the Mahanadi, Godavari, Krishna and the Kaveri.

The Mahanadi: It rises in Sihawa or Simhava region of Chhattisgarh and is the most important river of Odisha and Chhattisgarh. The river flows to a length of 885 km and joins the Bay of Bengal near Cuttack. The main tributaries of Mahanadi are Seonath, Hasdeo, Mand and Jonk. The Hirakud (longest dam in India), Naraj and Tikarpara dams are built across this river.

The Godavari: It is the longest and largest river of Peninsular India. It rises at Triambakeshwar in Nasik district of Maharashtra. It flows through Maharashtra and Andhra Pradesh to a length of 1465 km and joins the Bay of Bengal near Kakinada (Andhra Pradesh). The main tributaries of Godavari are the Purna, Penganga, Pranhita, Sabri, Indravathi and Manjra. The delta of Godavari is characterised by a number of Channels and Mangrove associated with lagoons. The Kolleru lake is one of the island lagoons.

The Krishna: The Krishna is the second longest and largest east flowing river of peninsular India. It rises near Mahabaleshwar in Maharashtra, flows to a length of 1400 km before joining the Bay of Bengal near Divi point (Andhra Pradesh). The Koyna, Yerla, Panchganga, Dudhganga,

Bhima, Ghataprabha, Malaprabha, Tungabhadra and the Musi are the main tributaries. Important dams built on the Krishna and its tributaries are Nagarjunasagar, Alamatti (Lal Bahadur Shastri), Narayanpura, Tungabhadra, Koyna etc.

Important reservoirs: 1. Narayanpura dam – Basavasagara 2. Alamatti dam – Shastrisagara 3. Tungabhadra dam – Pampasagara

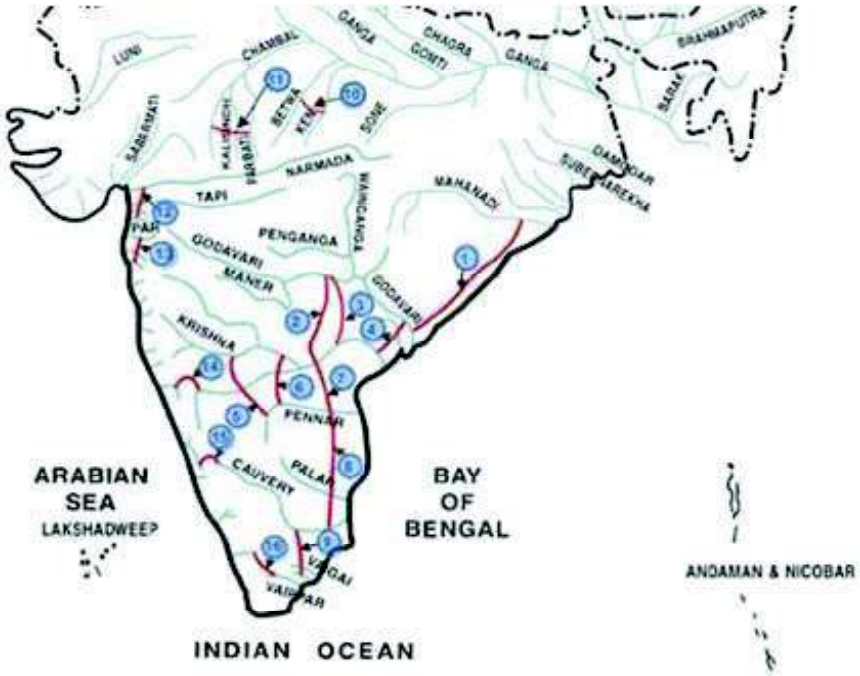


Fig. 9.11 Peninsular rivers

The Kaveri (Cauvery): The Kaveri is a sacred river like the Ganga. Therefore, it is also known as 'Ganga of South India'. It rises at Talakaveri in the Brahmagiri hills of Kodagu district, flows to a distance of 805 km and joins the Bay of Bengal near Kaveripattanam. Karnataka, Tamilnadu, Kerala and Pondicherry are benefited by the waters of Kaveri. Its main tributaries are Arkavathi, Hemavathi, Harangi, Lokapavani, Shimsa, Lakshmanathirtha, Kabini, Suvarnavathi, Bhavani and Amaravathi. Along its course, the river passes through Srirangapattana, Shivanasamudra and Srirangam islands. It also flows through series of rapids, cascades and waterfalls viz, Gaganachukki, Barachukki, Mekedatu, Hogenkal falls etc., The first hydroelectric project of Asia was started on the river Kaveri, in 1902 at Shivanasamudra (Shimsha). After Srirangam the river divides

into two branches. The Northern branch - 'Coleroon' and the Southern branch – 'Kaveri'. The Gorur, Harangi, Kabini, Krishnarajasagara (KRS), Mettur and Bhavani are the important dams on the river Kaveri.

The other east flowing rivers of Peninsular plateau are Subarnarekha, Palar, Pennar, Vaigai, Tamraparni etc.

ii) West flowing rivers: These rivers rise in the peninsular region, flow in western direction and join the Arabian sea. These are short and swift rivers flowing through rugged topography of the Western ghats. The main rivers are the Luni, Sabarmati, Mahi, Narmada, Tapi (Tapati), Mandovi, Zuari, Kali, Sharavathi, Gangavati, Bedthi, Netravathi, Periyar etc. **The Luni:** It rises near Ajmer in the Aravalli ranges and flows through the Thar desert and then runs into the Rann of Kachch. **The Narmada:** The Narmada river rises in the Amarkantak hills of Chattisgarh and passes through impressive marble gorges of Madhya Pradesh. Dhunwadhar and Kapiladhara are the important waterfalls in the Narmada course. The 'Sardar Sarovar' multi-purpose river valley project is constructed on this river. It is the longest and largest west flowing river of peninsular India, having alluvial deposits in its valley. The Narmada forms the biggest estuary at Bharuch in Gujarath. **The Tapi:** It is the second largest west flowing river of the peninsular region. It rises at Multai in Madhya Pradesh and flows through a rift valley between Satpura and Ajanta ranges. It joins the Arabian sea near Surat of Gujarath. **The Kali:** It rises near 'Supa' in North Canara and flows westward through narrow gorges and joins the Arabian sea near Karwar. Lalguli waterfalls is formed by the Kali river. **The Sharavati:** It rises at Ambuthirtha in Shimoga district and flows in Shimoga and North Canara districts. The river flows in a westerly direction and joins the Arabian sea near Honnavara. The Sharavathi is famous for the magnificient 'Jog falls' (275 m) and production of hydro-electricity. The Mahatma Gandhi hydel power station and Linganamakki dam are in this river. **The Netravati** is an important river in South Canara district. It rises in Kudremukh ranges, flows towards west and joins the Arabian Sea near Mangalore. **The Periyar:** It is the largest river in Kerala. It rises in the Sivagiri forests, flows in western direction and joins the Arabian Sea near Pallipuram. The Periyar project is constructed on this river.

Comparison between North and South Indian rivers

Sl. No.	North Indian Rivers	South Indian Rivers
1.	The North Indian rivers are perennial as they flow by melting of ice in the summer and rain water during rainy season.	The South Indian rivers are non-perennial, as they flow with monsoon rain.
2.	They have long and broad valleys.	They have short, narrow and deep valleys.
3.	They flow slowly through gentle slope valleys.	They are swift rivers, flow through rugged topography make rapids and waterfalls.
4.	The rivers have been used mainly for agriculture and other allied activities.	The rivers have been harnessed mainly for generation of hydro electricity.
5.	They make vast plains and deltas.	They make deep valleys and estuaries.
6.	They rise in the Himalayan mountains.	They rise in the Peninsular plateau.
7.	They are suitable for navigation.	They are generally not navigable.
8.	They make numerous sharp meanders and ox-bow lakes.	They make shallow meanders.
9.	They transport huge quantities of sediments.	These have low carrying capacity
10.	The rivers are much younger compared to Peninsular rivers.	The rivers are much older.
11.	River capturing is a regular phenomenon.	There is no river capturing.

River Regimes

The pattern of the seasonal flow of water in a river is called its regime. It is the variability in its discharge throughout the course of a year in response to precipitation, temperature and drainage basin characteristics.

The pattern of flow of water (regime) in the Himalayan river is different from the peninsular river due to difference in climate. The Himalayan rivers are perennial and their regimes are dependent on the pattern of water supply by the melting of ice in the Himalayan mountain and rainfall in the foot hills and plains of India. On the other hand, the regime of the peninsular rivers are seasonal as they are dependent on monsoon rains. Also the rivers in penisular India have inequal distribution of water through monsoon rains.

The discharge is the volume of water flowing in a river measured over time. It is measured either in cusecs (cubic feet per second) or cumecs (cubic metres per second). TMC is the measure of volume of water, meaning thousand million cubic feet of water. Usually refers to volume of water in storage dams.

The Ganga has its minimum flow during the January-June period. The maximum flow is attained either in July or August. After September there is a steady fall in the flow. The river thus, has a monsoonal regime.

The Narmada has a very low volume of discharge from January to July but it suddenly rises in August when the maximum flow is attained. The fall in October is as spectacular as the rise in August.

The Godavari has the minimum discharge in May and the maximum in July-August. After August, there is a sharp fall in water flow although the volume of flow in October and November is higher than that in any of the months from January to May.

The Kaveri has maximum flow during July and August but, it has minimum flow from January to May.

The data on water discharge in different rivers in different parts of the year has important implications on their utilization by states. It is on this count that inter-state disputes arise.

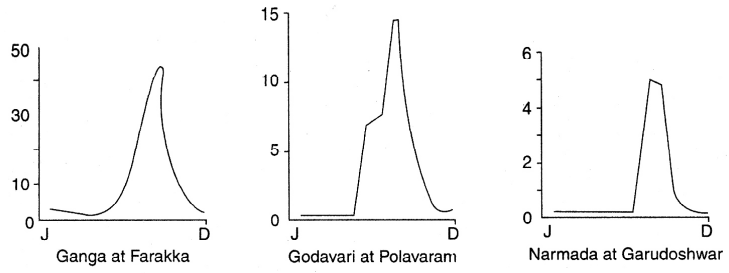


Fig. 9.12 River regime graphs

The River water disputes

Water is a primary natural resource, a basic human need and a precious national asset. Water is essential to our daily lives and is a principal compound in nature. The significance of water is increasing with the tremendous increase in population.

Water, being the most precious resource is required for domestic, irrigation and industrial purposes. Most of the Indian rivers flow across more than one state. Each of the state of the river tries to obtain the maximum quantity of water. This has resulted in many water disputes in the country.

In the recent years the rivers flowing across more than two countries are also creating trouble between the neighbouring countries. At present river water dispute has become a global phenomenon.

India is a country with inadequate water resources. Many rivers are non-perennial and seasonal. The states are utilizing the river water for maximum purposes.

In the Indian constitution (1950) water is a state subject. Under the water dispute act 1956, a tribunal of three sitting judges of the Supreme Court has to be constituted by the central government for the settlement of an inter-state water dispute when a request is received from a state government.

Some of the important inter-state water disputes in India are 1) TheKaveri water dispute between Karnataka, Tamilnadu, Pondicherry and Kerala. 2) The Tungabadra water dispute between Karnataka and Andhra Pradesh. 3) The Krishna water dispute between Karnataka, Maharashtra and Andhra Pradesh 4) The Mandovi water dispute between Karnataka and Goa, 5) The Narmada water dispute between Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. 6) The Yamuna dispute between Uttar Pradesh, Haryana, Rajasthan and Madhya Pradesh 7) The Godavari water dispute between Maharashtra, Chhattisgarh, Karnataka and Andhra Pradesh, 8) The Ravi and Beas water dispute between Punjab, Haryana, Rajasthan and Jammu and Kashmir, 9) The Mulla Periyar water dispute between Kerala and Tamilnadu etc.

In the same way a few international water disputes are also found in the international borders of India eg., a) The Jhelum and the Chenab water dispute between India and Pakistan, b) The Brahmaputra water

dispute between India and China, c) The Tista water dispute between India and Bangladesh, d) The Barak water dispute between India and Bangladesh, e) The Indus water dispute between India and Pakistan etc.,

In the developing countries like India the inter-state water dispute must be resolved quickly so that water resources could be utilized and harnessed properly for basic need and economic development. One of the measures could be to declare all the major rivers as national property and national schemes under Central assistance should be launched for the development of total command area of the concerned states. Establishment of separate corporations, river diversion and linking projects may be useful in this direction.

Inter-linking of Rivers

The distribution of rainfall in India is highly uneven and seasonal. The Himalayan Rivers are perennial while the peninsular rivers are seasonal. During rainy season, much of the water is lost in floods and wasteful flow into the sea. But in other seasons there is scarcity of water. Even in India some parts get more rainfall and some other parts get very low rainfall. Consequently there are floods in one region and drought and famine in other regions in the country. The problems of floods and drought can be minimized through the inter-river linkages or through national water grid, under which water from one river basin can be transferred to another river basin for optimum utilization.

The Indian Rivers Inter-link is a large-scale civil engineering project that aims to join the majority of India's rivers by canals and so reduce persistent water shortages in parts of India. In 1972 the Ministry for Irrigation proposed a 2640 kilometer long link between the Ganga and Kaveri rivers. In 1974 plans were proposed for the '**Garland Canal'**. In 1982 the National Water Development Agency was set up to carry out surveys of the links and prepare feasibility studies.

The Inter-link would consist of two parts, a northern Himalayan River Development component and a southern Peninsular River Development component.

The northern component would consist of a series of dams built along the Ganga and Brahmaputra rivers in India, for the purposes of storage. Canals would be built to transfer surplus water from the eastern tributaries of the Ganga to the west. The Brahmaputra and its tributaries would be

linked with the Ganga and the Ganga with the Mahanadi river. This part of the project would provide additional irrigation and generate electricity. In theory it would provide extra flood control in the Ganga and Brahmaputra river basins.

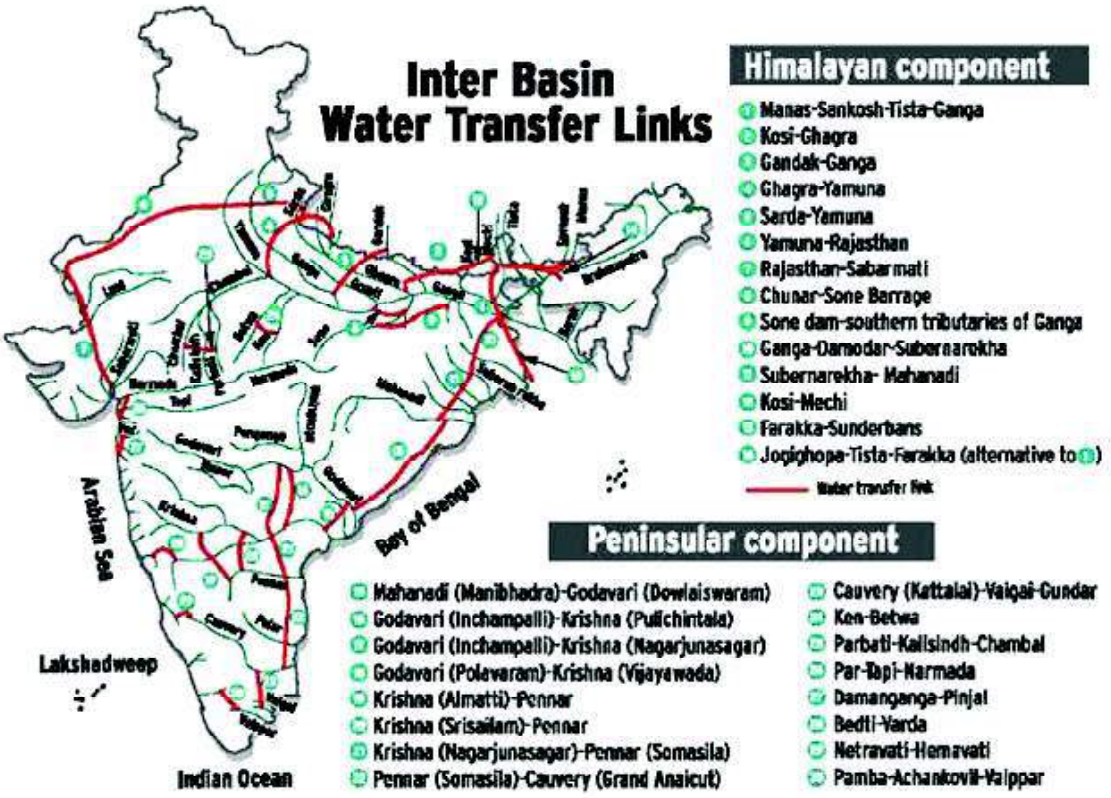


Fig. 9.13 Inter-link of River projects

The main part of the project would be to send water from the eastern part of India to the south and west. The southern development project would consist of four main parts. First, the Mahanadi, Godavari. Krishna and Kaveri rivers would all be linked by canals. Extra water storage dams would be built along the course of these rivers. The purpose of this would be to transfer surplus water from the Mahanadi and Godavari rivers to the south of India. The Ken and Chambal rivers would be linked in order to provide better water facilities for Madhya Pradesh and Uttar Pradesh. A number of west-flowing rivers along the Western Ghats simply discharge into the Arabian Sea. As many of these as possible would be diverted for irrigation and generation of hydroelectricity purposes.

The important inter-linking river projects proposed are:

1) The Ganga-Kaveri link canal connecting the basins of the Son, Narmada, Tapti, Godavari, Krishna and Pennar.
2) The Brahmaputra – Ganga link canal passing through Bangladesh.
3) The Narmada canal passing through Gujarat and Rajasthan.
4) The link canals between the rivers of the Western ghats towards the east.
5) The canal from the Chambal to central Rajasthan.

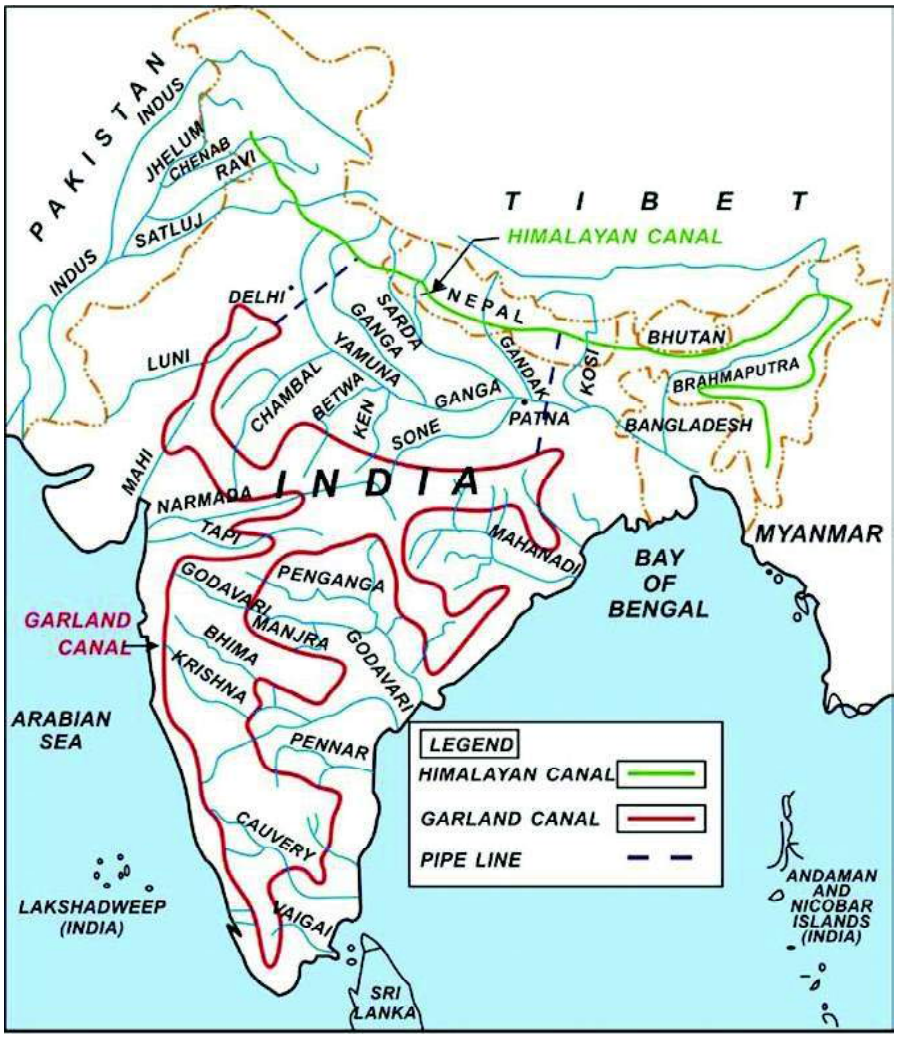


Fig. 9.14 Proposed inter-linking of Rivers

IMPORTANT TERMS .....

Young fold mountains	Terai plains	Pulicat lake
Trans-Himalayas	Bhangar plains	Kolleru lake
Purvachal	Khadar plains	Chilka lake
Abode of Snow	Doab	Barren Islands
Tethys Sea	Sunderban delta	Narcondum Islands
Siwaliks	Red plain	Marustali
Doons	Majuli	Bhagar
Karewas	Anaimudi	Drainage system
Banihal pass	Deccan trap	National river
Shipki-la	Kutch coast	Devprayag
Nathu-la	Konkan coast	Sorrow of Bihar
Jelep-la	Karnataka coast	Triveni Sangama
Wular lake	Malabar coast	River regimes
Dal lake	Coramandal coast	Inter-linking rivers
Loktak lake	North Circar coast	Garland canal
Bhabar plains		

I Answer the following in a word or a sentence each.

1. What is the other name to the Himalayas?
2. Which mountain range is called 'backbone of Asia'?
3. Name the longest and the largest glacier of India.
4. What is the other name to Outer Himalayas?
5. Name the largest doon of India.
6. In which regional Himalayas Jelep la pass is found?
7. What is Terai plain?
8. Mention the highest peak of Peninsular plateau.
9. Which region of India is called 'Ruhr of India'?
10. Where do Western Ghats and Eastern Ghats meet?
11. Name the longest coastal plains of India.
12. Why are the Himalayan rivers perennial?
13. From which mountain pass does the river Sutlej enter India?
14. Which is the longest and the largest tributary of Ganga?
15. Name the largest and the longest river of South India.

II Answer the following in two or three sentences each.

1. Mention any two ranges of Trans Himalayas.
2. Name any two hill stations of the Himalayas
3. Distinguish between Bhangar and Khadar plains.

4. Name any two ghats of the Western Ghats.
5. Which coastal plains are found in Karnataka and Tamil Nadu?
6. State the difference between Lakshadweep and Andaman and Nicobar islands.
7. Name any four tributaries of river Indus.
8. Mention any four west flowing rivers of Peninsular India.
9. What are the salient features of River regime?
10. What is the necessity of Inter-linking of Rivers?

III Answer the following.

1. Name the important physical divisions of India. Explain the Himalayas.
2. Briefly explain the Regional Himalayas.
3. Describe the significance of Northern Plains.
4. Peninsular Plateau is the largest physical division of India. Explain its features.
5. Briefly explain the Coastal plains of India.
6. Describe the important features of Islands and Indian desert.
7. Explain the river system of India with suitable maps.
8. Compare the North Indian rivers with South Indian rivers.
9. Why does River water dispute arise? Mention the important disputes and proposed measures.
10. Briefly explain the importance of inter-linking of Rivers in India.

SUGGESTED ACTIVITIES .....

- Prepare model to show the physical divisions of India.
- List out the important peaks, passes, glaciers and tourist places of the Himalayas.
- Prepare a model of Peninsular plateau of India and show the important plateaus, hills etc.
- List out the important coastal plains, ports, harbours and ship building centres.
- Prepare a list of North Indian and South Indian rivers with their tributaries.
- List out the West flowing and East flowing rivers of Peninsular India.
- Prepare table to show the rivers and major projects.
- List out the important inter-linking river projects of India.

CHAPTER 10

CLIMATE, SOIL AND FOREST

India is a peninsula covered by water on three sides and land on the other. The Tropic of Cancer passes through the center of the country. The Tropical location, water bodies and topography influence the climate, soil and forest resources of India.

10.1 CLIMATE

India's climate is said to be "Tropical Monsoon", due to its tropical location and reversal of winds seasonally. The word Monsoon is derived from an Arabic term 'Mausim' means 'reversal of winds' or 'Seasons'. Monsoons are the periodic winds in which there is a reversal of wind direction periodically. On account of the variability in climatic conditions, seasonally and regionally, India is called 'Meteorological Unit'. The seasonal variation in the climatic condition is due to various factors like temperature, pressure, wind, rainfall etc.

There is a wide variation in the distribution of temperature and rainfall over the entire sub-continent of India. In summer the western Rajasthan records more than 55°c of temperature while, during winter Ladakh in Jammu and Kashmir record -25^{0}C of temperature.

The distribution of rainfall vary from region to region. Mawsynram of Meghalaya receives the highest rainfall - 1141cm per year while, Roylee of Rajasthan receives less than 8 cm of rainfall per year.

Factors determining the climate of India

India's climate is controlled by a number of factors. The main factors are latitude, mountain ranges, distribution of land and water bodies, relief and monsoon winds.

i) **Latitude:** The northern part of India lies in sub-tropical and temperate zone and the part lying to the south of the tropic of cancer comes under tropical zone. The tropical zone being nearer to the Equator, experiences high temperature throughout the year, with small daily and annual range (Trivandrum and Chennai). Area north of the Tropic of Cancer being away from the Equator, experiences high daily and annual range of temperature (Amritsar and New Delhi).

ii) **Mountain ranges:** The lofty Himalayas in the north along with its extension, act as an effective climatic divide. The towering mountain chain provides an invincible shield to protect the sub-continent from the cold northern winds.

iii) **Distribution of Land and Water:** India is flanked by water bodies on three sides and land on the other. The differential heating of land and sea creates different air pressure zone in different seasons in and around the country. This difference in air pressure causes movement and reversal in the direction of winds.

iv) **Relief:** The relief features of India also affects the temperature, air pressure, direction and speed of wind, the amount and distribution of rainfall. The windward side of Western Ghats and North east receive high rainfall from June to September, whereas the eastern side (rain shadow region) of Western Ghats remain dry eg. Mumbai to Trivandrum - windward region, Jalgoan to Coimbatore - leeward region.

v) **Monsoon Winds:** The climatic conditions of the country are greatly influenced by monsoon winds. The winds blow in a particular direction during one season, but get reversed during the other season. South West monsoon winds blow from south west to north east, while north east monsoon winds blow from northeast to south west.

SEASONS OF INDIA

On the basis of temperature, wind and rainfall the climate of India is classified into four seasons. These are: 1) The Winter or Cold weather season 2) The Summer or hot weather season 3) The South West monsoon season and 4) The Retreating monsoon season.

The Winter Season (Mid December to End of February): The winter season is also called cold weather season. In this season direct rays of the Sun fall on Tropic of Capricorn. Therefore, India receives oblique Sun rays. The temperature in the country is not uniform from north to south. Regions lying to the north of Tropic of Cancer record low temperature compared to regions in the south. There is a general decrease in temperature from south to north. December is the beginning of cold weather season and it extends up to February. The annual average temperature is around 18º C. In the northern parts of the plains temperature falls below 5º C. January is the coldest month in the year. Jammu and Kashmir, Punjab, Haryana, UP and parts of Bihar record very low temperature with snow storms (cold wave). This is the clear sky season with lowest rainfall in the year. Some parts of Tamil Nadu and Jammu and Kashmir receive

small quantity of rainfall. Though the rainfall is less, in some parts on North India it is beneficial for Rabi crops. Annual rainfall in this season is around 2%.

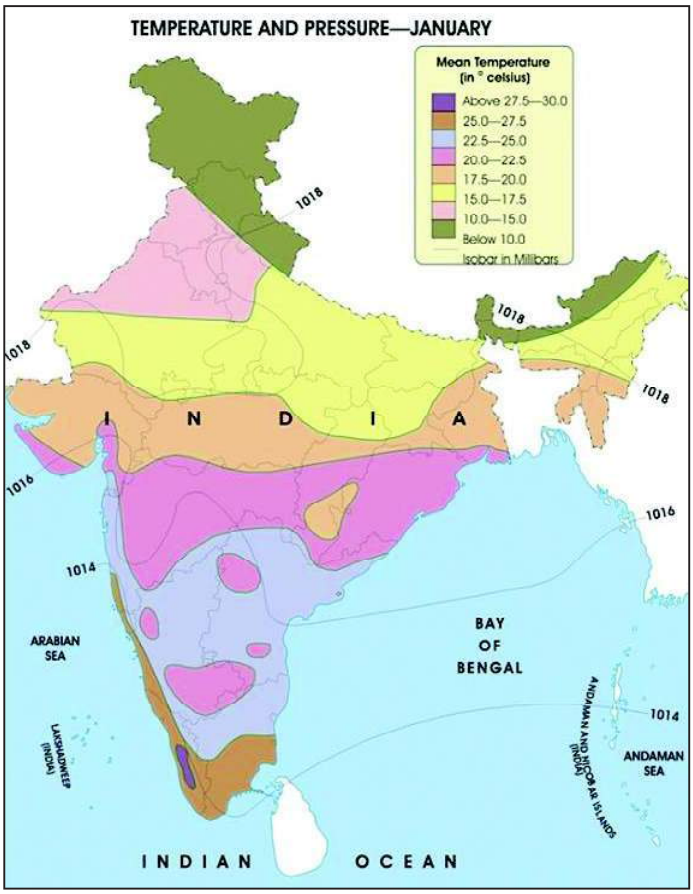


Fig: 10.1 Temperature distribution in Winter

The Summer or Hot Weather Season (March to End of May): The summer season is also known as hot weather season. It begins in March and continues up to May. During this season there is gradual increase in temperature from south to north due to shifting of Sun rays

from Tropic of Capricorn towards the Equator. In this period south Indian states - Tamil Nadu, Andhra Pradesh, Karnataka and Kerala record high temperature. Some parts of Andhra Pradesh and Karnataka (Raichur and Bellary) record more than 40^{0}C of temperature. Sri Ganganagar of Rajasthan has recorded the highest temperature of above 52^{0}C. The average temperature of the country will be around 24^0 C. In this season some parts of India receive convectional rainfall. They are "Mango Showers" in Kerala, "Cherry Blossoms" in Karnataka and "Kalabaisaki" in West Bengal and Assam. During this season the country receives 10% of annual rainfall.

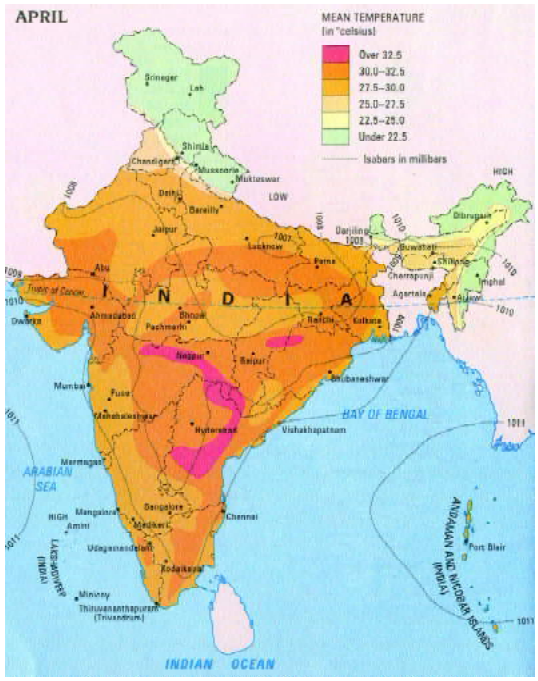


Fig. 10.2 Temperature distribution in Summer

The Southwest Monsoon Season (June to September): It is also known as Advancing Monsoon Season or Rainy Season. This season begins in June and extends up to September due to the influence of temperature, pressure and winds. During this season, India gets more than 75% of its annual rainfall and more than 90% of the country's area receives downpour. It is the prime season for Kharif crops.

In the middle of June the direct rays of the Sun fall on Tropic of Cancer due to shift in the position of the Sun from Equator towards northern hemisphere. Therefore, there is an increase in temperature from south to north. The temperature in the main land of India and nearby land masses is high compared to water bodies of the Indian Ocean, Arabian Sea and the Bay of Bengal. The high temperature results in the formation of low pressure in the land, while the water bodies record high pressure. The pressure gradient from water to land form monsoon winds in the Indian Ocean and they blow towards India as Southwest Monsoon winds. These winds after taking birth in the Indian Ocean blow towards western coast of India as Arabian Sea winds (branch) and the other branch as Bay of Bengal winds.

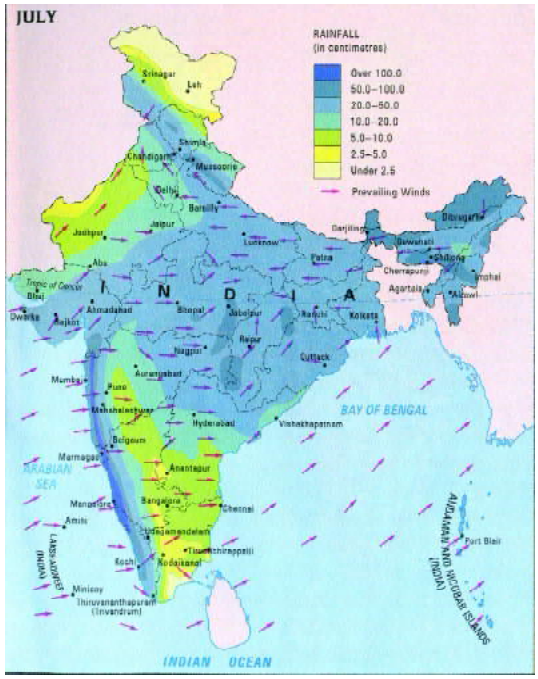


Fig. 10.3 Rainfall distribution in July

The Arabian Sea winds by carrying more moisture blow along the western coast of India and cause heavy rainfall in the western parts of Western Ghats due to obstruction. These winds behave like sea breeze and cause continuous rainfall in the wind ward side of the Western Ghats till they lose their moisture. The Malabar Coast of Kerala receives the first southwest monsoon rainfall in the country. The first monsoon rainfall received here is called “Monsoon Outburst”. Agumbe of Karnataka receives the highest rainfall during this season. It is called ‘Mawsynram of South India’. The regions coming under southwest monsoon winds receive good rainfall wherever they get obstruction by hills and plateaus. But this rainfall is scanty and insufficient in the western parts of Aravalli Mountains because this range runs parallel to southwest monsoon winds and the winds lose moisture by the time they reach Western Rajasthan.

The Bay of Bengal winds (branch) blow from water bodies towards the Indian mainland due to variation in pressure. These winds carry moisture from the Bay of Bengal and blows along eastern coast and finally reach north eastern hills. In its path, whenever these winds receive obstruction,

they cause good rainfall. The eastern part of Eastern Ghats and north eastern hills receive heavy rainfall. These winds after crossing eastern coast merge with the Arabian Sea winds.

The Arabian Sea and the Bay of Bengal winds, after merging, blow towards north eastern regions of India. The Shape of the Himalayan mountains and northeastern hills greatly obstruct these winds. Therefore, the Meghalaya Plateau region, particularly Nokrek areas of Mawsynram and Cherrapunji, receive very high rainfall. The altitude of Mawsynram, thick vegetation cover and hill locked location help this place to receive the highest annual rainfall in the world. This place is popularly called 'Rainiest' or 'Wettest place on the Earth'.

The Southwest monsoon after crossing northeastern region blow towards east. Since the Himalayas obstruct these winds they have to take westerly direction and blow along the foot hills (Siwalik) of Himalayas. The shift in the direct sun rays from Tropic of Cancer towards Equator (September) results in the gradual disappearance of southwest monsoons.

Agriculture, industry, transport, communication, generation of hydroelectricity, inland navigation and various other economic activities in India depend on the Southwest Monsoon. In other words, Indian economy depends on the Monsoons to a large extent.

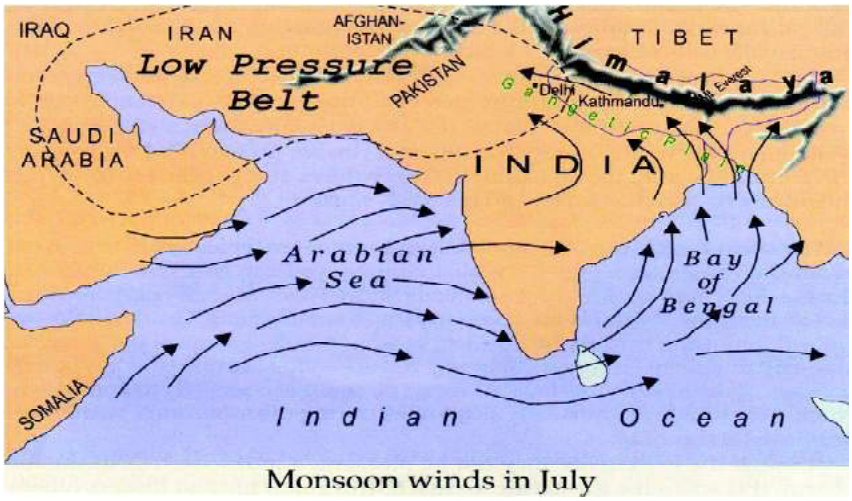


Fig. 10.4 South West Monsoon winds

The Retreating Monsoon Season (Mid September to Mid December): This season is also called North East Monsoon Season. It starts in the middle of September and extends up to middle of December. On September

23rd the direct rays of the Sun falls on Equator. Therefore, there is a change in temperature and pressure in the land and water bodies. In this period the Indian Ocean records high temperature compared to the land bodies of Indian sub-continent. The high pressure formed in the northern part of Bay of Bengal results in movement of wind from northeastern part of India towards southwestern region (Arabian Sea and Indian Ocean). These winds blow along the eastern coast of India and Bay of Bengal. While blowing, they carry moisture and cause rainfall in the east coast particularly the Coromandel Coast due to its shape and obstruction by the land. During the northeast monsoon season the country receives 13% of annual rainfall.

Fig. 10.5 Rainfall distribution in October

In this season due to pressure variation between the Bay of Bengal and main land of India variable winds- cyclones and anti-cyclones originate in the Bay of Bengal. The tropical Cyclones take birth in this season and cause great damage in the eastern coast of India. The coastal areas of Tamil Nadu, Andhra Pradesh, Odisha and West Bengal come under the frequent effect of cyclones. Some cyclones recorded in the last few years are Bola, Nargis, Nisha, Laila, Jal, Neelam etc.

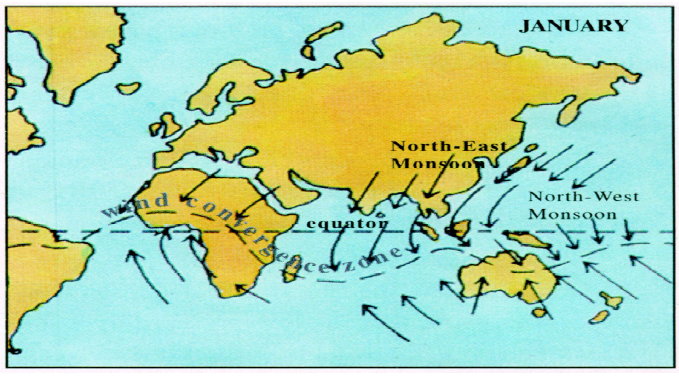


Fig. 10.6 North East Monsoon winds

Significance of the Monsoon

The Monsoon of India play a pivotal role on all the economic activities of the country. The cropping pattern, crop season, nature and types of crops, yield and production has direct relationship with the monsoon.

The agro based industries, transport and communication network have their base in the southwest and northeast monsoons.

Generation of Hydro-electricity, Inland navigation, fishing and various other agro allied activities depend completely on the Indian monsoon.

Of the total rainfall in the country, nearly 88% is received during the southwest and northeast monsoon seasons. June to September and September to December are the period for more economic activities in the country.

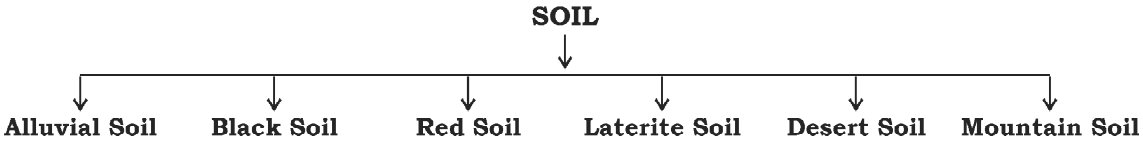
10.2 Soil

Soil is the minute or finer rock particles found on the surface of the Earth. It is formed naturally, due to the weathering of rocks, under the influence of climate. Other factors in its formation are vegetation, age of the rock, parent material and relief. Soil as a natural resource, provide nutrients and water to the plants. The scientific study of soil is known as 'Pedology'. The soil Research Institute of India is situated at Bhopal in Madhya Pradesh.

India is a vast country having great variations in its relief and climatic conditions. The geo-climatic conditions of the country have affected the general distribution of soils, their texture, structure, colour, pH value and porosity. The combined result of climate and relief features has produced various types of soils in the country.

Types of Soil

The main types of soil in India are : 1) Alluvial Soil, 2) Black Soil, 3) Red Soil, 4) Laterite Soil, 5) Desert Soil, 6) Mountain Soil.



1) Alluvial Soil: This soil is formed by depositional work of rivers and they are mainly found in the flood plains & deltas. Alluvial soil covers largest geographical area 43.36% in the country. They are mainly distributed in the river plains of the Ganga, Brahmaputra and the Indus. Uttar Pradesh has the largest area under alluvial soil. It is also found in the deltas of east flowing rivers. Alluvial soils of India are mainly of two types
a) Khadar – new alluvium, finer in nature, found in the low lying flood plains and rich in fertility.
b) Bhangar – older alluvium, coarse and pebble like in nature, found at the lower depths of the plain. Alluvial soils are more suitable for the cultivation of Wheat, Sugarcane, Rice, Maize, Pulses etc.

Fig. 10.7 Soil map of India

2) Black Soil: This is one of the most important soils in the peninsular India. Deccan trap region has the largest distribution of black soil. This soil is also called 'Cotton soil' or "Regur soil". It is derived from the weathered basalt rocks. This soil holds water for long period and become hard whenever it is dry. It is light-black to dark-black in colour. Nearly 15.09% of the country's area is covered with this soil. Maharashtra and Gujarat have the largest distribution of black soil in the country. Other states are Madhya Pradesh, parts of Karnataka, Andhra Pradesh and Tamil Nadu. Important crops grown in this soil are Cotton, Sugarcane, Tobacco, Pulses, Millets, Citrus fruits, Sunflower etc.


Fig. 10.8 Black Soil


Red Soil


Laterite Soil

3) **Red soil:** This soil is formed by the weathered granite rocks. It is red in colour and rich in ferrous content. Generally the top layer of this soil is red, while the horizon is yellowish in colour. Red soil covers the second largest area 18.49% in the country. Larger parts of Peninsular region is covered with red soil. Tamil Nadu has the largest distribution of this soil in the country. Other states are Karnataka, Andhra Pradesh, Madhya Pradesh, Maharashtra, Chhattisgarh, Jharkhand and Odisha. Rice, Ragi, Jowar, Groundnut, Tobacco, Millets, Oil seeds, Potato are the main crops cultivated in this soil.

4) **Laterite soil:** The hot and humid tropical regions of India are rich in laterite soil. This soil is derived from the fragmentation and dis-integration of rocks in the hilly and mountain ranges. It is mainly found in the Western Ghats, parts of Eastern Ghats and Northeastern hills of India (3.70%). Plantation corps like Tea, Coffee, Rubber, Cashewnut, Arecanut are cultivated in this soil.

5) **Desert soil:** This soil is also called 'arid soil'. They are mainly found in the desert and semi-desert regions of Western and North Western parts of India (4.42%) . This soil has the least water holding capacity and humus content. Generally it is not suitable for cultivation of crops. This soil is mainly found in Rajasthan, Parts of Gujarat and Haryana. With water facility crops like Bajra, Pulses and Guar are cultivated in this soil.

6) **Mountain soil:** The Himalayan mountain valleys and hill slopes are covered with Mountain or Forest soil (5.51%). It is found in the mountain slopes of Jammu and Kashmir, Himachal Pradesh, Uttarkhand regions. Crops like Tea, Almond, Saffron, Walnut are cultivated in this soil.

Other than the above, Alkaline, Saline, Peaty, Marshy, Grey and Brown soils are also found in different parts of the country. These soils are distributed in smaller areas compared to major soils (9.43%). Marshy soils are mainly found in the coastal deltas while, other types are spread over in small pockets.

Soil Erosion

The removal or wearing away of the top soil by various natural agents and man-made factors is called 'Soil Erosion'. High temperature, Rainfall, Wind and Waves are the natural agents while, human activities like deforestation, over grazing, shifting cultivation, improper and unscientific methods of agriculture cause Soil Erosion.

The rate of soil erosion differs from region to region and agent to agent depending on climate and man-made factors. In the hilly regions rainfall and temperature cause more soil erosion. In coastal areas sea waves and in desert, winds are the dominant factors in the soil erosion process. Jammu and Kashmir, Uttarkhand, West Bengal, Rajasthan, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Chhattisgarh are most important regions under the influence of soil erosion.

Fig. 10.9 Soil Erosion

Deforestation, Overgrazing, improper methods of agriculture, shifting cultivation are the most familiar human activities which are causing soil erosion in the country.

According to one estimate nearly 40% of the total area of the country is adversely affected by soil erosion. This has resulted in decrease of fertility, reduction in cultivable land, more flooding, silting, decrease in percolation of water etc.

Conservation of Soil

Soil conservation is a set of management strategies for prevention of soil being eroded from the Earth's surface or becoming chemically altered by overuse, acidification, salinization or other chemical soil contamination.

Conservation of Soil is an important activity in the country to protect the soil layer, which is useful to man for various purposes. Soil conservation is very much necessary to have different activities like agriculture, agro based engagements, some industrial activities and also to conserve vegetation and animal wealth.

The important measures followed in the Conservation of Soil are: i)Afforestation ii) Control of over grazing iii) Contour ploughing iv) Terrace farming v) Erection of bunds vi) Construction of check dams vii) Crop rotation viii) Control of shifting cultivation ix) Strip farming x) Mulching

xi) Control of floods xii) Reclamation of Ravine & Badlands xiii) Proper use of water xiv) Literacy and Education programmes on soil conservation etc.,

Fig. 10.10 Terrace farming

Afforestation

Erection of bunds

10.3 Forest

A forest is usually an area filled with trees. It is a region with variety of botanical species such as trees, shrubs, climbers and grasses. The forests that grow naturally undisturbed over a long time are called Natural Vegetation. They function as habitats for organisms, hydrologic flow modulators and soil conservers, constituting one of the most important aspects of the biosphere.

The varied relief features, soils and climatic conditions have contributed to the growth of a variety of forests in India. Forests are distributed unevenly in the country. According to the world estimates, the forest area in India is about 22.50%, which is very less when compared to the world's average of 34.5%.

The forests and their resources are useful to man in various forms. Therefore, they are called **'Green Gold'.**

The peninsular region of India has the largest forest cover with around 57% of the total forest area. The Himalayan region has the second largest forest cover having 18%, while the Indo-Gangetic plains and desert regions have the least forest cover in the country. Madhya Pradesh has the largest area under forests, while Haryana has the least forest cover.

Types of Forests: On the basis of administration and legal aspects the Forests in India are classified into three types. a) Reserved Forests b) Protected Forests and c) Unclassified Forests.

According to geo-climatic conditions, forests are classified into: 1) Evergreen Forests 2) Deciduous / Monsoon Forests 3) Coniferous Forests 4) Desert / Arid Forests 5) Mangrove Forests

1) The Evergreen Forests: These forests are found in the regions of heavy rainfall (above 250 cm) and high temperature (above 27º C). Tall umbrella shaped trees with dense assemblage is a prominent feature of this forest. The evergreen forests always look green because, various species of trees are found here and they shed leaves in different seasons. The hardwood trees, rosewood, white cedar, toon, gurjan, chaplash, ebony, mahogany, canes, bamboo, shisham etc. are very common in this forest. These forests are found in North-east India, Western Ghats, Andaman and Nicobar islands, parts of Assam and some areas of Himalayan foot hills.

Fig. 10.11 Evergreen Forest Deciduous Forest

2) **The Deciduous Forests:** The Deciduous forests cover a wide range of rainfall regimes. The trees of these forests seasonally shed their leaves. The Indian deciduous forests are found in a range of landscapes from the plains to the hills. These forests provides shelter to most endangered wildlife in the country, such as the Tiger, Asian Elephant, Bison, Gaur etc. The deciduous forests are of two types. viz., a) The moist deciduous forests and b) The dry deciduous forests.

a) **The Moist Deciduous/Monsoon Forests:** The moist deciduous forests are found in wet regions, receiving annual rainfall between 100 cm to 200 cm and temperature of 25º to 30ºC. The trees of these forests shed their leaves during spring and early summer. They are found on the eastern slopes of the Western Ghats, Chota Nagpur Plateau, the Siwaliks etc. Some of the important trees found in these forests are Teak, Sandalwood, Sal, Khair, Mango Tree, Wattle, Bamboo, Deodar, Blue gum, Ebony, Jackfruit, Semal, Arjun and the Banyan Tree. Teak is considered as one of the most important species of this region.

b) **The Dry Deciduous Forests or Grassland:** The dry deciduous forests are found in the areas where annual rainfall is between

50 cm to 150cm and temperature of 25° to 30°C. Sal is the most significant tree found in this forest. Varieties of acacia and bamboo are also found here. These forests are found in areas of central Deccan plateau, South-east of Rajasthan, Punjab, Haryana and parts of Uttar Pradesh and Madhya Pradesh. Dwarf Deciduous trees and long- grasses grow in these regions. Most of the areas of these forests are used for agriculture.

Fig. 10.12 Moist Deciduous forest

Dry Deciduous forest

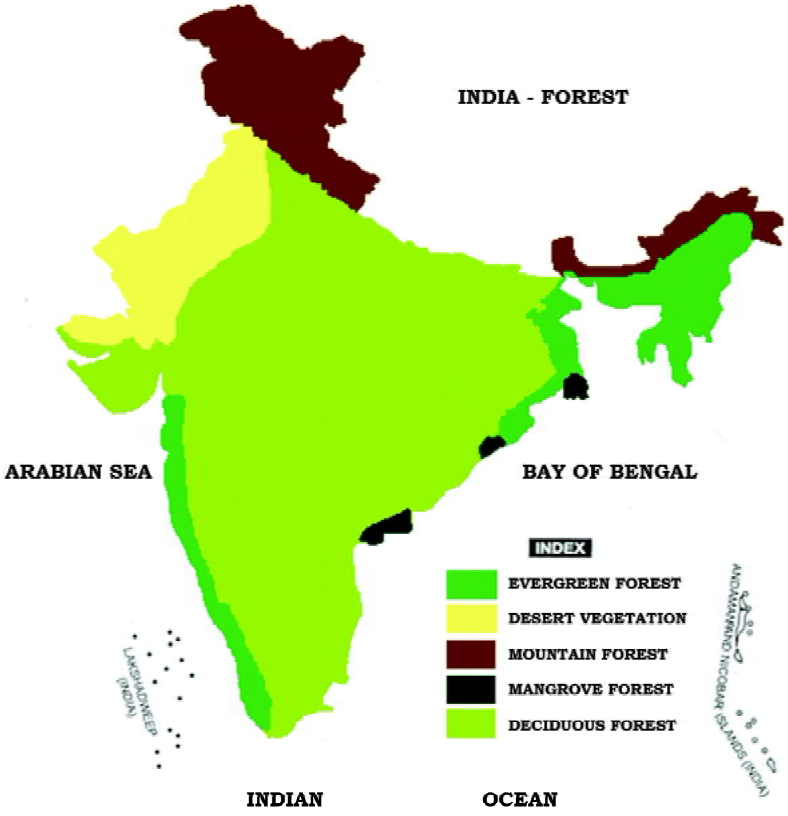


Fig. 10.13 Forests in India

3) **The Mountain/Coniferous forests**: As the name indicates these forests are confined to the Himalayan region, where the temperature is less compared to other parts of the country. The trees in these forests are cone shape with needle like leaves. The important trees are oak, fir, pine spruce, silver fir, deodhar, devdar, juniper, picea, chestnut, cedar etc. They provide softwood for making country boats, packing materials and sports articles.

4) **The Desert/Arid forests:** These forests are found in the areas of very low rainfall (50 cm per year). Thorny bushes, shrubs, dry grass, acacia, cacti and babul are the important vegetation found in these forest. The Indian wild date known as 'Khejurs', is common in the deserts. The plants grow far apart from each other. They have spine leaves, long roots and thick fleshy stems in which they store water to survive during the long drought. These vegetations are found in Rajasthan, parts of Gujarat, Punjab and Haryana.

Fig. 10.14 Coniferous forest Arid forest Mangrove forest

5) **The Mangrove (Tidal) forests:** These forests occur along the river deltas (Ganga, Mahanadi, Godavari and Krishna) of eastern coast and also concentrated in the coastal areas of Katchch, Kathiawar, and Gulf of Khambat (Cambay). The mangrove forests in the Ganga delta are called Sunderbans because, they have extensive growth of Sundari trees. The trees in these forests are hard, durable and are used in boat making and as fuel. In the recent years mangrove vegetation is being grown in the coastal areas to control effects of tidal waves (Tsunami) and coastal erosion.

Importance of forests

Forests are multipurpose resources rendering various benefits to man and environment. The important benefits are:

1) Forests supply fresh air, food and fodder.

2) Forests are the rain bearers, help in causing good rainfall.

3) They control soil erosion and desertification.

4) Forests provide various products like bamboo, timber, resin, lac, gum, cane, fuel wood etc.

5) They provide medicinal trees and plants used in ayurvedic medicines eg. Neem tree, Basil, Brahmi etc.

6) They provide shelter to various birds and animals.

7) They absorb much of the rainwater and control floods and safeguards against drought.

8) They act as wind breakers and protect the agricultural crops.

9) The forest soils are rich in humus and thereby maintain the fertility of the soil.

10) They provide raw materials to paper, match box, plywood and sports articles industries.

11) They provide pastures for grazing animals.

12) Forests control the local weather and climate - temperature, wind, rainfall etc.

13) They provide beautiful scenic spots and become recreational centers.

14) They provide employment opportunities and also promote foreign trade.

15) They maintain the ecological balance.

Thus, forests play a vital role in influencing on the life and activities of man.

Conservation of Forests: Forests, once destroyed, take thousands of years to regenerate into their original form. The conservation of forests is concerned with proper utilisation of forest, protection from destructive influences, misuse of forests etc. The important measures of conservation of forest are:

1) Careless felling of tree, over-grazing and shifting cultivation should be avoided. Afforestation should be practiced.

2) Forest fires, pests and diseases should be controlled through the scientific methods.

3) Use of fuel wood, wood-charcoal by the tribal people must be prohibited.

4) Encroachers of forest area should be severely punished.

5) Government should promote intensive tree planting programmes in urban centers.

6) Forest education, research and training should be expanded through programmes like Vanamahotsava, social forestry, reforestation, etc.

7) Massive awareness about the aesthetics of forests (Chipko and Appiko movements) should be created through mass media, workshops, live programmes etc

8) Industrial and mining activities in the forest regions should be compensated by reforestation.

9) Development of Green belts in the urban areas.

10) Plantation of trees along the roads, railway lines, river, canal banks, tanks and ponds.

Thus, the forests are interrelated with life and environment. A rich forest resource symbolizes the national heritage of our country. Forests should be safeguarded to maintain biological diversity, ecological balance, to increase agricultural and industrial production and to create pollution-free environment.

Biosphere Reserves

The biosphere reserves protect every plant and animal species in its natural habitat so that this natural heritage can be transmitted to future generations. The regions surrounding the biosphere reserves would be utilized for the research and experimentation in developing forest and other products.

The Man and the Biosphere Programme (MAB) of UNESCO was established in 1971 to promote interdisciplinary approaches to management, research and education in ecosystem conservation and sustainable use of natural resources.

The Government of India has established 18 Biosphere Reserves of India, which protect larger areas of natural habitat (National Park or Animal Sanctuary) and often include one or more National Parks along buffer zones that are open to some economic uses. Protection is granted not only to the flora and fauna of the protected region, but also to the human communities who inhabit these regions, and their ways of life.

Eight of the Eighteen biosphere reserves are a part of the World Network of Biosphere Reserves, based on the UNESCO Man and the Biosphere (MAB) Programme list.

1.	Nilgiri Biosphere Reserve	Tamil Nadu, Kerala, Karnataka	2000
2.	Gulf of Mannar Biosphere Reserve	Tamil Nadu	2001
3.	Sunderbans Biosphere Reserve	West Bengal	2001
4.	Nanda Devi Biosphere Reserve	Uttarakhand	2004
5.	Nokrek Biosphere Reserve	Meghalaya	2009
6.	Pachmarhi Biosphere Reserve	Madhya Pradesh	2009
7.	Simlipal Biosphere Reserve	Odisha	2008
8.	Achanakmar - Amarkantak Biosphere Reserve	Chhattisgarh, Jharkhand	2012

Other Biosphere reserves of the country are Great Rann of Kutch (Gujarat), Cold desert (HP), Dehang Debang (Arunachal Pradesh), Sheshachalam hills (AP), Manas (Assam), Khangchendzonga (Sikkim), Agasthyamalai (Kerala), Great Nicobar (Anadaman & Nicobar Islands), Dibru-Saikhova (Assam) and Panna (MP).

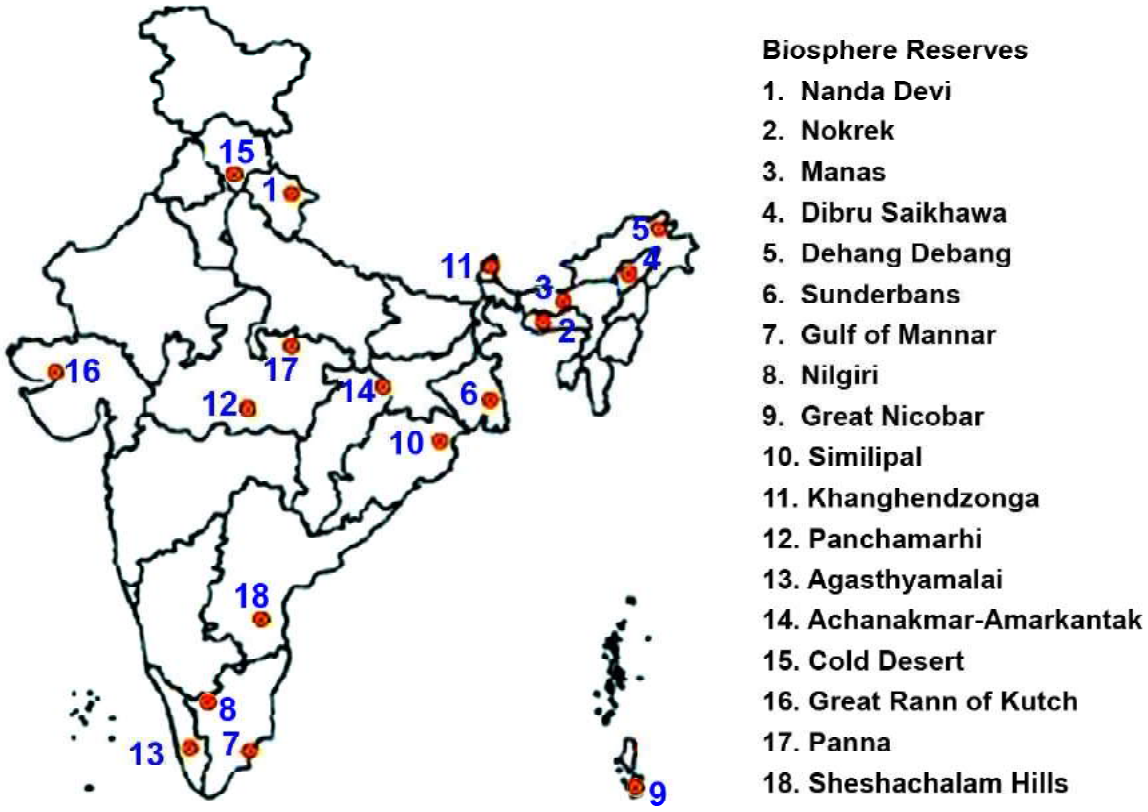


Fig. 10.15 Biosphere Reserves

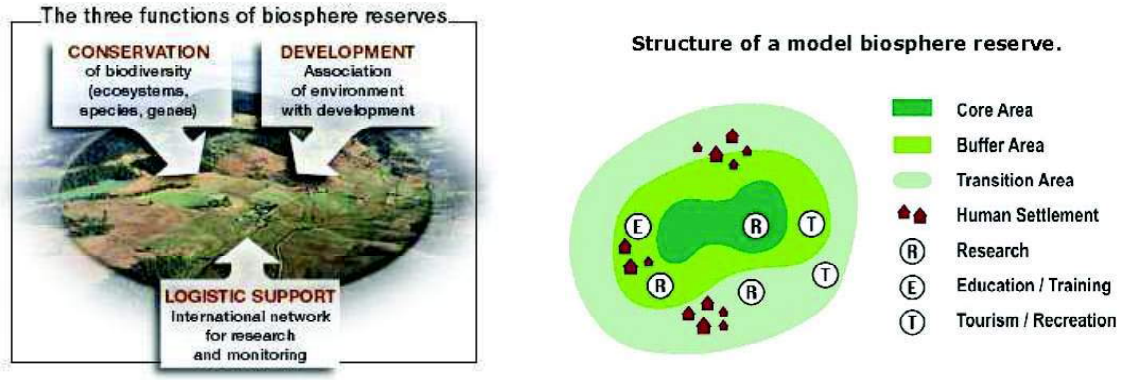


Fig. 10.16 Functions and Structure of Biosphere Reserves

IMPORTANT TERMS .....

Tropical Monsoon	Agumbe	Evergreen Forest
Seasons	Mawsynram	Moist deciduous
Range of temperature	Retreating Monsoon	Dry deciduous
Winter	Cyclones	Coniferous forest
Cold wave	Pedology	Arid forest
Mango showers	Regur soil	Mangrove forest
Cherry blossom	Soil erosion	Conservation of forest
Kalbaisaki	Conservation of Soil	Biosphere reserves
South west Monsoon	Green Gold	Man and Biosphere (MAB)

I Answer the following in a word or a sentence each.

1. What type of climate is found in India?
2. Define Monsoon.
3. Mention the place which records high range of Temperature.
4. Which is the driest season in India?
5. Name the region which receives 'Monsoon outburst'.
6. Which is called 'Mawsynram of South India'?
7. Why are cyclones formed during North East Monsoon season?
8. Define Pedology.
9. Name the soil which covers vast area of the country.
10. Why is Black soil called Regur soil?
11. Where do we see Laterite soil?
12. What is 'Green Gold'?
13. Mention the average forest cover of the country.
14. Which forest has high economic value trees?
15. Where do we find Dehang Debang Biosphere reserve?

II Answer the following in two or three sentences each.

1. Why is India called 'Meteorological Unit'?
2. Mention any two convectional rainfall of India.
3. Write the significance of Monsoon.
4. Mention the importance of Red soil.

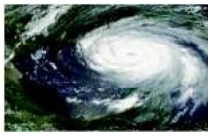
5. Name any four factors that affect Soil erosion.
6. State four best measures in the conservation of soil.
7. Name the states which have the highest and the lowest forest area in the country.
8. Write the salient features of Evergreen forests.
9. What is Mangrove forest? Why has it become important in the recent years?
10. Mention any four measures of conservation of forest.

III Answer the following.

1. What is Climate? Explain the factors that determine the climate of India.
2. Explain the South West Monsoon season with the help of a map.
3. Briefly explain the characteristic features of Winter and Summer seasons.
4. Give details of North East Monsoon season.
5. What is Soil? Explain the major types of soils.
6. Explain soil erosion and conservation of soil.
7. Describe the major types of forests in India.
8. Briefly explain the importance of forests.
9. Explain the important measures of conservation of forest.
10. What are Biosphere reserves? Mention the important biosphere reserves of India.

SUGGESTED ACTIVITIES .....

- Prepare a list of factors that influence on the climate of India.
- Prepare table to show the features of Indian monsoon.
- Prepare model to show types of soil.
- Collect a few soil samples found in your region.
- List out the important measures to check soil erosion.
- Construct model to show types of forest and biosphere reserves.
- Collect samples of plant species found in and around your region.
- List out the importance of forest and suggest remedies for conservation of forest.
- Draw the outline map of India, name and mark the important Biosphere reserves.



CHAPTER 11

NATURAL HAZARDS AND DISASTERS

A **Natural Hazard** is a threat of a naturally occurring event that will have a negative effect on people or the environment. Many natural hazards are interrelated eg. earthquakes can cause tsunamis and drought can lead directly to famine or population displacement. It is possible that some natural hazards are inter-temporally correlated.

If the Natural Hazard becomes a serious reality then it becomes a disaster. A **Natural Disaster** is a major adverse event resulting from natural processes of the Earth eg. earthquakes (Tsunami), floods, severe weather (drought & famine), volcanic eruptions, cyclones, landslides, coastal erosion and other geologic processes. A natural disaster can cause loss of life or property damage and typically leave some economic damage in its wake, the severity of which depends on the affected population's resilience or ability to recover.

Disasters are of different types in their origin. Some of them are Tectonic (Earthquakes, Volcanoes), Meteorological (Hurricanes, Cyclones, Floods, Droughts), Topographical (Landslide, Avalanche) etc.

India is one of the most natural disaster prone countries in the world. Some of the major natural disasters are: i) Earthquake and Tsunami ii) Floods iii) Cyclones iv) Drought and famines v) Landslides vi) Avalanches and vii) Coastal erosion.

EARTHQUAKES

Earthquake is a sudden vibration or shaking in the Earth's crust. It is considered to be one of the worst natural disasters causing wide spread destruction and loss to human life.

Causes

Earthquakes are caused due to various natural and man–made factors. They are i) Tectonic forces – folding, faulting ii) Volcanic activity iii) Landslides and Landslips iv) Collapse of underground cave roofs. Man-made factors are a) Mining b) Huge dams and reservoirs c) Digging of deep wells d) Nuclear tests etc.,

Distribution

The distribution of earthquake in India is mainly found in the fractured zones, folded areas, faulting belts and human interference regions on the crust. National Geophysical Laboratory, Geological Survey of India, Department of Meteorology along with the National Disaster Management have made an intensive analysis of more than 1200 earthquakes that have occurred in India in different years in the past, and based on these, they have divided India into five main Seismic Zones.

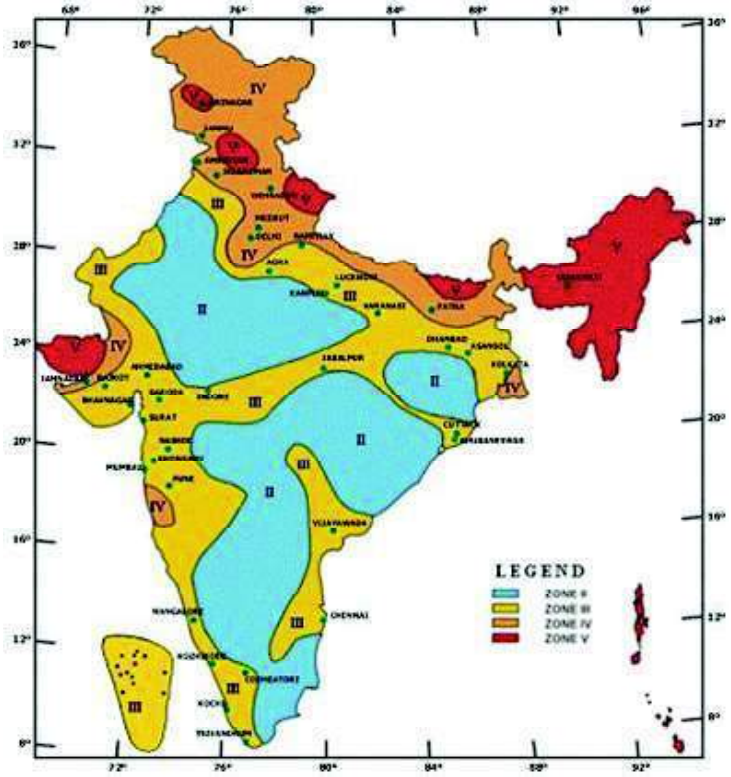


Fig. 11.1 Seismic Zones

- **Zone V**: This is the most severe (intensity above 7 in Richter Scale) seismic zone and is referred as Very High Damage (disastrous and catastrophic) Risk Zone. The areas are Northeastern states, parts of Jammu & Kashmir, Uttarakhand, Bihar and Kutch region.
- **Zone IV:** This zone is second in severity (intensity between 5 and 7 in R.S) to zone V. This is referred to as High Damage (destructive) Risk Zone. Northern regions of Jammu and Kashmir, Himachal Pradesh, Parts of Bihar, UP, Gujarat, West Bengal lie in this region.

- **Zone III**: This is termed as Moderate Damage (Very Strong) Risk Zone (intensity between 3 and 5 in R.S). The areas are Gujarat, Madhya Pradesh, Rajasthan, Chhattisgarh, Odisha, Maharashtra, Northern Karnataka, Andhra Pradesh, West coastal region etc.
- **Zone II:** This zone is referred to as Low Damage (Strong) Risk Zone (intensity 2 to 3 R.S). The areas are Rajasthan, Madhya Pradesh, Parts of Karnataka, Andhra Pradesh, Odisha etc.
- **Zone I**: This zone is termed as Very Low Damage (Slight–tremor) Risk Zone. The left out parts of India and Deccan Plateau region.

Tsunami

Tsunami ("Tsu"-harbour, "nami"- wave) means "Harbour Waves". It is a series of waves generated in an ocean water in the form of high waves. The impact of Tsunami is less over the Ocean and more near the coast, where they cause large-scale devastations. After reaching the coast, the water flows turbulently into the land destroying port cities and towns, structures, building and other settlements, causing loss of life and property. East coast of India, especially the Coromandel Coast has recorded a few tsunamis in recent years.

FLOODS

Floods are natural hazards related to the Monsoons, which are uncertain and uneven in the country. When there is heavy rainfall in the catchment area of a river, there are floods in the lower basin. Floods are high stream flow that overflows the natural banks of the rivers.

Causes

Floods are caused by both natural and man-made factors. They are : a) Natural factors- i) Continuous rainfall for a long period ii) Cyclones iii) Obstruction on flow of river water iv) Storm surge (coastal areas) v) Melting ice and snow vi) Presence of eroded material due to soil erosion vii) Blockage of free flow of water due to volcanic eruptions, landslides and meandering of river. b) Man-made factors **-** i) Deforestation ii) Unscientific Agricultural practice (iii) Urbanization iv) Disturbance along the natural drainage and channel v) Occupancy of flood plains and river beds etc.,

Distribution

India, being a peninsular country and surrounded by the Arabian sea, Indian ocean and the Bay of Bengal, is quite prone to floods. As per the Geological Survey of India, the major flood prone areas of India cover more than 12.5% area of the country. Every year, flood, the most common disaster causes immense loss to the country's property and lives.

Fig. 11.2 Flood prone areas

Flood prone areas of India

1. The Ganga basin: The badly affected states of the Ganga basin are U.P, Bihar and West Bengal. Besides the Ganga River, Sarada, Gandak and Ghagra cause flood in Eastern part of U.P. The Yamuna is famous for flooding Haryana, U.P. and Delhi. Bihar experiences massive and dangerous flood every year by the Kosi. Rivers like the Mahanadi, Bhagirathi and Damodar also cause floods.
2. The Brahmaputra basin: The Brahmaputra along with its tributaries floods the areas of Assam and North West Bengal regions.
3. The Central India and Peninsular river basin: In Odisha spilling over of river banks by the Mahanadi, Baitarnika and Brahmani causes havoc. Southern and central India experience floods caused by the Narmada, Godavari, Tapti and Krishna during heavy rainfall. Cyclonic storms in the deltaic regions of the Godavari, Mahanadi and the Krishna flood the coastal regions of Andhra Pradesh, Odisha and Tamil Nadu. Small rivers of Kerala and Mud stream from the nearby hills add on to the destruction.

CYCLONE

Cyclone refers to a whirl in the atmosphere with very strong winds circulating (high pressure to low pressure) around it in anti-clock wise direction in the Northern hemisphere and clock wise in the Southern hemisphere.

Indian Ocean is the center for the formation of cyclones. The Bay of Bengal of India regularly forms Tropical cyclones during October to December and cause heavy damage and destruction in the eastern coast. The western coast record cyclone very rarely but, is not far away from the cyclones. Usually the cyclones of India originate in the Bay of Bengal and blow towards eastern coast.

Causes

Cyclones are caused by atmospheric disturbances around a low pressure (Bay of Bengal) area distinguished by swift and often destructive air circulation. They are usually accompanied by violent storms and bad weather. The Bay of Bengal is subject to intense heating, giving rise to humid and unstable air masses that produce cyclones.

Distribution

The occurrence and distribution of cyclones in India is mainly found in the eastern coast – Coromandel and North Circar Regions. Coastal Tamil Nadu, Andhra Pradesh, Odisha and West Bengal are severely affected by cyclones. The northeast Monsoon period, by forming tropical cyclone, cause great damage and disaster in the eastern coast of the country. The Malabar and the Konkan coast are also affected by mild cyclonic storms. The severity in this region, is less than eastern coast.

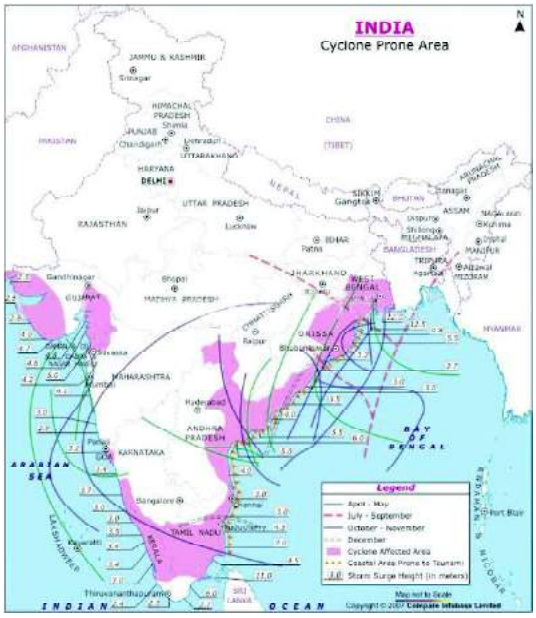


Fig. 11.3 Cyclone prone areas

Cyclone Nilam affected areas

DROUGHT AND FAMINE

The term 'drought' is applied to an extended period when there is a shortage of water availability due to inadequate precipitation, excessive rate of evaporation and over utilization of water from the reservoirs and other storages, including the ground water. When drought becomes severe there is a famine. Drought occurs when rainfall is less than 25% to 50% of the average rainfall. If rainfall is below average, famine occurs.

Causes

The main causes for the occurrence of drought and famine are reduction in annual rainfall, long period scarcity of surface and underground water, scarcity of stored water, excess utilization of fresh water, overgrazing, deforestation, improper agricultural practice, mining etc.,

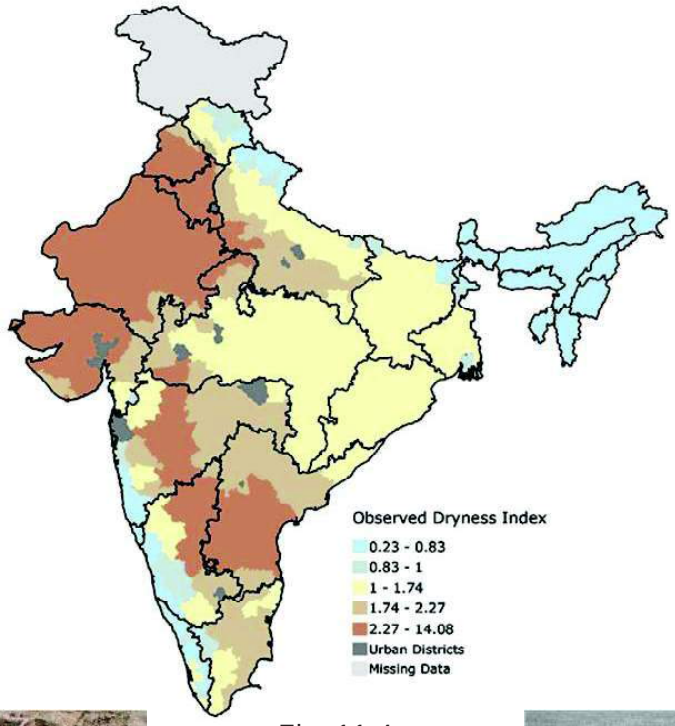


Fig. 11.4
Drought prone areas

Distribution

On the basis of severity of droughts, India can be divided into three drought prone areas.

1. The Extreme drought prone areas: This is the most important drought prone area of the country which has been recording continuous drought for many years. The regions are western parts of Rajasthan, Kutch regions of Gujarat and semi-arid and arid regions of Western and North western parts of India.
2. The Severe drought prone areas: This is the second important drought prone areas of the country. The eastern parts of Rajasthan, western parts of Madhya Pradesh, parts of Maharashtra, interior parts of Andhra Pradesh, north and northeastern parts of Karnataka, northern and interior parts of Tamil Nadu, interior Odisha and southern parts of Jharkhand.
3. The Moderate drought prone areas: This region is mainly found in northern parts of Rajasthan, western parts of Haryana, southern regions of U.P., parts of Gujarat, Maharashtra, Jharkhand, Tamil Nadu and Interior parts of Karnataka.

LANDSLIDES

Landslides are the mass movement of rocks and debris due to various surface activities eg. high rainfall, snowfall, gravitation etc. Landslide is the rapid sliding of large mass of rocks by the force of Gravity.

Fig. 11.5 Landslide Landslide hazard zone

Causes

Landslide and landslip are caused by natural and human induced forces. It is largely controlled by localized factors (i) Severe Marine erosion of sea coast (iii) Seismic activity (iii) Heavy rainfall (iv) Construction of roads, railway lines, tunnels v) Canals and channel construction (vi) Mining and quarrying vii) Over grazing viii) Deforestation (ix) Unscientific agricultural activities along the hill slopes etc.,

Distribution

Landslides are more common in the hills, mountains and high altitudinal regions. Hill states like Jammu and Kashmir, Himachal Pradesh, Uttarkhand, parts of West Bengal, Sikkim and many parts of northeastern states come under regular and severe damage by landslides and landslips.

COASTAL EROSION

The landward displacement of the shoreline caused by the forces of sea waves and ocean currents is called coastal erosion. It is mainly found in certain coastal areas of the country. Coastal zone is a transitional area between the land and the sea. As per the recent estimate about 23% of shoreline along the Indian mainland is affected by coastal erosion.

Fig. 11.6 Coastal Erosion

Causes

Major causes of coastal erosion are: 1) Natural Causes: i) Wave action ii) Tsunami iii) Wind iv) Tides v) Ocean currents vi) Storm surge 2) Man-made causes (Human interferences): i) Construction of artificial Structures ii) Mining of beach sands iii) Offshore dredging or building of dykes iv) Destruction of mangroves and other natural buffers.

Distribution

The coastal erosion is mainly found in the coastal regions of Indian mainland. Most affected areas are Western and Eastern coasts of India. The Konkan, Canara, Malabar, Coromandel and North Circar coasts record more coastal erosion. The coastal areas of Kerala, Karnataka (Ullala and Maravante) and Maharashtra are facing maximum threat by coastal erosion.

AVALANCHE

Avalanche is also one of the important natural hazards and disaster in certain specified areas of the country. Avalanche is the mass of snow, ice and rock debris that come rushing down the mountain slopes. They are extremely powerful, fall rapidly under the force of gravity in the snow covered mountains.


Fig. 11.7 Avalanche

Causes

The important causes for avalanches are: i) Heavy snowfall and nature of mountain slope ii) Heavy snow storms iii) Earthquake and tremors iv) Explosions, heavy sound of vehicles v) Deforestation vi) Hill slope cutting etc.

Distribution

The avalanche prone areas are mainly found in the Himalayan states of Jammu and Kashmir, Himachal Pradesh, Uttarkhand, Sikkim, parts of Arunachal Pradesh etc. The snow covered mountains in this region occasionally cause severe damage by causing avalanche. The irregular weather condition and influence of human interference have caused great threat to the Himalayan belt by sliding of snow.

Consequences of hazards and disasters

The consequences of natural hazards and disasters are more or less same with respect to different agents of disaster. The areas of disaster and their effect vary from region to region and season to season.

The most important consequences of natural disasters are loss of human life and property, animal wealth, destruction of vegetation etc. Natural disasters create fear, anguish and trauma in the human beings leading to various physical, biological and psychological changes. Natural disasters affect population, its distribution and density. In addition to this, agriculture, cropping pattern, industries, transport and communication, public health, water supply, food, fodder, buildings, settlements and in total human life and existence are affected by these Natural Disasters.


IMPORTANT TERMS .....

Natural hazard	Floods	Landslides
Natural disaster	Drought	Coastal erosion
Earthquakes	Famine	Avalanche
Tsunami	Cyclone	

I Answer the following in a word or a sentence each.

1. What is a Natural Hazard?
2. What do you mean by Natural Disaster?
3. Mention any two types of disasters.
4. What are floods?
5. Name the most important flood prone area of India.
6. Why are cyclones caused in the Bay of Bengal?
7. What is drought?
8. Which region of India is in the extreme drought prone area?
9. Why does landslide occur?
10. Mention the most important avalanche prone area of India.

II Answer the following in two or three sentences each.

1. Name the two most important seismic zones of India.
2. Mention any four factors that cause floods.
3. State two important flood prone areas of the country.
4. Name any four factors that cause drought and famine.
5. Mention any four consequences of natural hazard and disasters.

III Answer the following.

1. Explain the major seismic zones of India.
2. Briefly explain the distribution of flood prone areas of India.
3. Explain the major drought prone areas of India.

SUGGESTED ACTIVITIES .....

- Show the seismic zones of India on the outline map.
- Draw the outline map of India, name and mark the flood, drought, coastal erosion and cyclone prone zones.
- Collect photographs and articles of recent natural disasters.
- List out the important methods of disaster management.

PART-C : CARTOGRAPHY

CHAPTER 12

Cartography is the study and practice of making maps. Combining science, aesthetics, and technique, cartography builds on the premise that reality can be modeled in the ways that communicate spatial information effectively.

The art of drawing maps, charts, globe, models and graphs is also known as “Cartography”. It is an important branch in Geography which acts as a bridge between Physical sciences and Social sciences.

A Cartographer should have the knowledge of physical and cultural geography, art, geodesy, earth science, measurements, engineering, remote sensing, computer, photography, GIS, GPS, etc.,

Map represents a small part or the whole surface of the Earth. Cartographer should study the Lithosphere, Atmosphere, Oceanography, Biosphere etc., for making maps. The art of map making is not only a practical science like Physics and Chemistry but also a social science because, it includes some aspects of History, Culture, Economics, Sociology, Political science, Population, Trade, Commerce etc. Cartography is based on science and logic. The field and scope of modern cartography is gaining more importance after the introduction of computer application and usage of GIS and GPS techniques.

12.1 MAPS

The word Map is derived from the Latin term ‘Moppa’ means, a Table Cloth or Cloth Cover. A part or whole of the Earth drawn on a paper according to scale is called a Map.

A scale is a ratio between any two points on the ground surface and their corresponding distance on the map. All good maps should possess a scale which helps reader to find the actual distance on the ground.

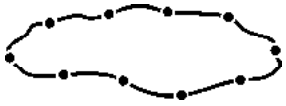
Essentials of a Map

A Map must help and guide a reader to understand various features marked on it. It should be like a mirror to know the location, direction,

distance and to draw comparative analysis of the spatial distribution of various items in a Country or on the Earth.

Following are the essential features of a map.

1) **Title** - A Map should have a title eg. India Physical, Karnataka Political, World Cultural, District Roads etc.
2) **Scale** - A Map must have a scale and Maps have to be drawn according to scale. It denotes the relationship between the length on the map and the actual distance on the ground. Scales may be Verbal or R.F (Representative Fraction) or Graphical eg. 1 cm = 10 km, 1 inch = 100 miles, 1: 1000, 1: 100000 etc.
3) **Direction** - A Map should have a direction symbol which helps the reader to understand the direction of a Place or Area or City or Country etc.
4) **Index** - It is a key or legend to the map. The conventional signs and symbols are shown in the index of a map. It helps the reader to find the required information from the map.

   1) National Capital 
   2) State Boundary 
   3) Mountain Peak 

   4) Sea Port 
   5) River 

5) **Latitudes and Longitudes** – A Map must have a network of horizontal and vertical lines known as latitudes and longitudes. These are the Geographic co-ordinates through which location of a place or city or country is identified. In addition to this, they help to understand the direction and to calculate distance between places.

Types of Maps

Maps may be broadly divided into two types. 1) On the basis of Scale 2) On the basis of Purpose.

1) On the basis of Scale Maps are classified into three types. a) Large Scale Maps b) Medium Scale Maps c) Small Scale Maps.

   a) Large Scale Maps: The Maps drawn on the scale of 1cm=1km or 1:1,00,000 and 1inch=1mile or 1:63,360 eg. Cadastral maps (Village, Town and City maps).

   b) Medium Scale Maps: The Maps drawn on the scale of 1cm=1km to 1cm=10km or 1:1,00,000 and 1:10,00,000 eg. Topographical Maps (Mountains, Plateaus, Plains).

   c) Small Scale Maps: The Maps drawn on the scale below 1cm=15km or 1:15,00,000 eg. Atlas and Wall Maps. These maps show broad physical and cultural features.

Fig. 12.1 Large scale map Medium scale map Small scale map

2) On the basis of purpose various types of Maps are prepared.

   i) Topographical Maps: To show relief features, forests, land use, river system, roads, railways, pipelines, distribution of rural and urban settlements etc.

   ii) Cadastral Maps: The Cadastral maps are drawn to register the ownership of field, farm, building, firm (boundary) etc.

   iii) Economic Maps: These maps provide information about human economic activities eg. agriculture, mining, industry, marketing, trade etc.

   iv) Population Maps: These maps show the information about distribution, growth, density, migration, age and sex composition of population. These maps are also drawn to show the distribution of occupational structure, language, social groups of people etc.

v) Weather Maps: These are useful to analyze weather condition and distribution of temperature, pressure, humidity, winds, rainfall etc.

Uses of Maps

1. Maps are essential to a Geographer, to present spatial information systematically.
2. They help to get correct picture of relief features of the Earth.
3. Maps/Charts are useful to study the invisible features like winds, temperature, pressure etc.,
4. They are very much helpful at the time of war and defence.
5. They are useful to locate wells, lakes, rivers, vegetation, coastal features and also to understand the distribution of soils, minerals, crops, population, tourist places, etc.,
6. Maps are useful for planners (City and Economic) agriculture, industry, transportation, communication etc.,
7. Maps are the most important teaching aid to the Teachers.
8. They are a source of various information-Physical, Cultural, Economic, Social, Historical etc.
9. Maps help to analyze various physical and cultural items to prepare plans, programmes.
10. Maps help to mark political boundary, administrative areas to formulate legislation and legal jurisdiction.

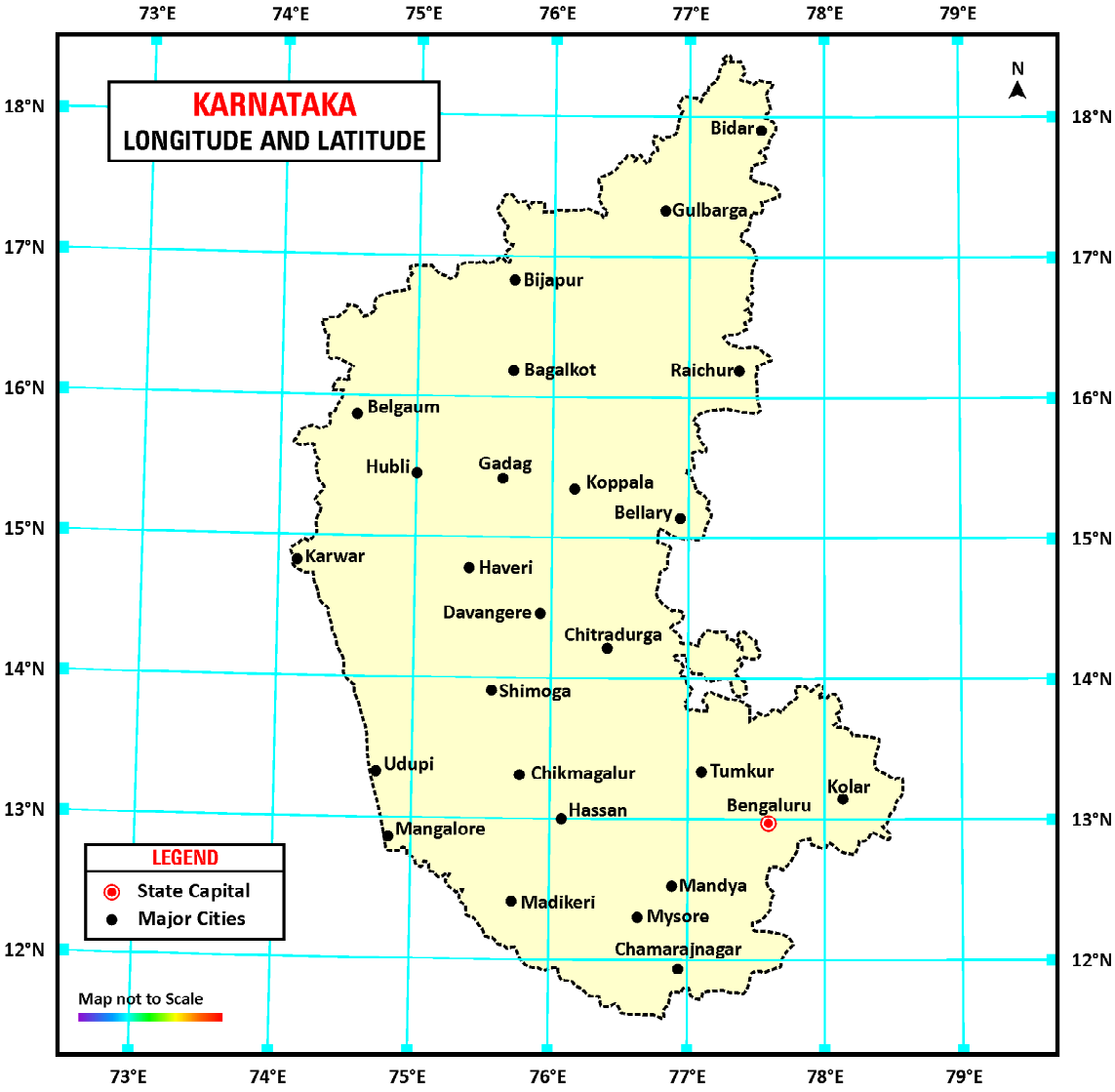
12.2 Map Reading

Identification of Places, Latitudes and Longitudes - Karnataka

Map reading is nothing but the study of places, latitudes and longitudes, direction and features of a map. A Map reader must have the knowledge of both physical and cultural aspects. The reader must be in touch with conventional signs, index, scale, direction, latitude and longitude. With the help of latitudes and longitudes one can identify a Place, Taluk, District, State, Nation etc.

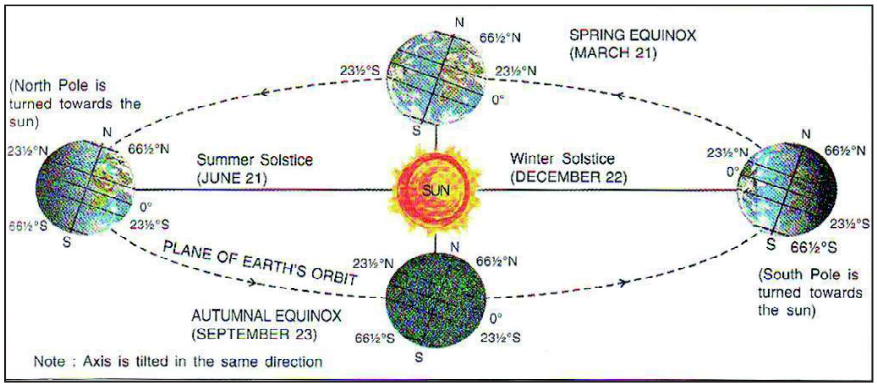
Identify the places, latitudes and longitudes in the map of Karnataka.

Latitude and Longitude Map of Karnataka

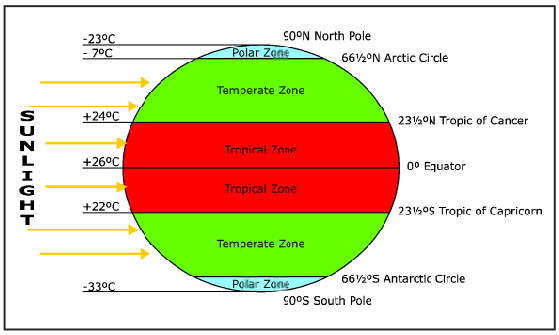


1.	Bengaluru	- 13° N	– 77° 35´E	**6.**	Haveri	- 14° 48´N	– 75° 24´E
2.	Mysore	- 12° 18´N	– 76° 38´E	**7.**	Bellary	- 15° 09´N	– 76° 56´E
3.	Madikeri	- 12° 25´N	– 75° 44´E	**8.**	Hubli	- 15° 21´N	– 75° 10´E
4.	Tumkur	- 13° 20´N	– 77° 06´E	**9.**	Belgaum	- 15° 52´N	– 74° 30´E
5.	Mangalore	- 12° 51´N	– 74° 50´E	**10.**	Bidar	- 17° 54´N	– 77° 35´E

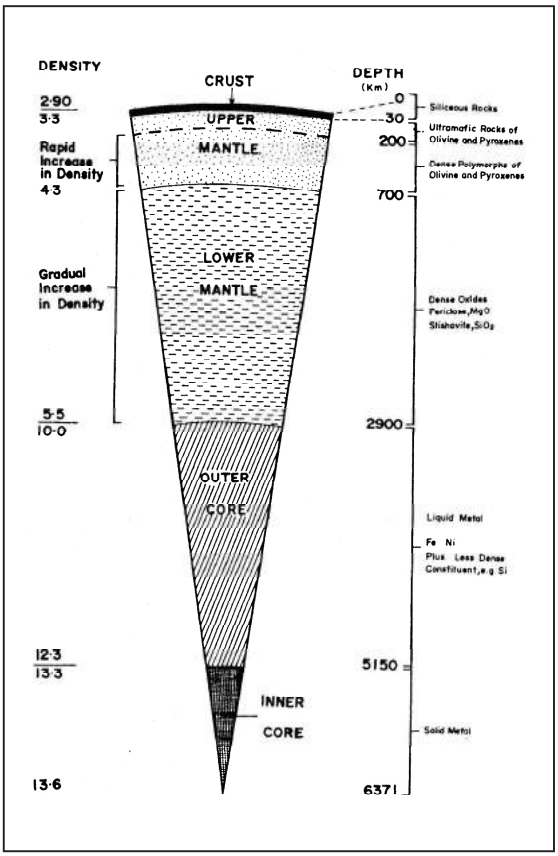
12.3 Representation of Physical Aspects Through Diagrams



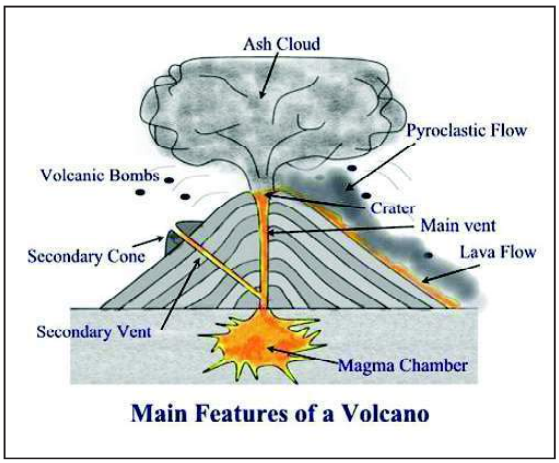
1. Cycle of Seasons



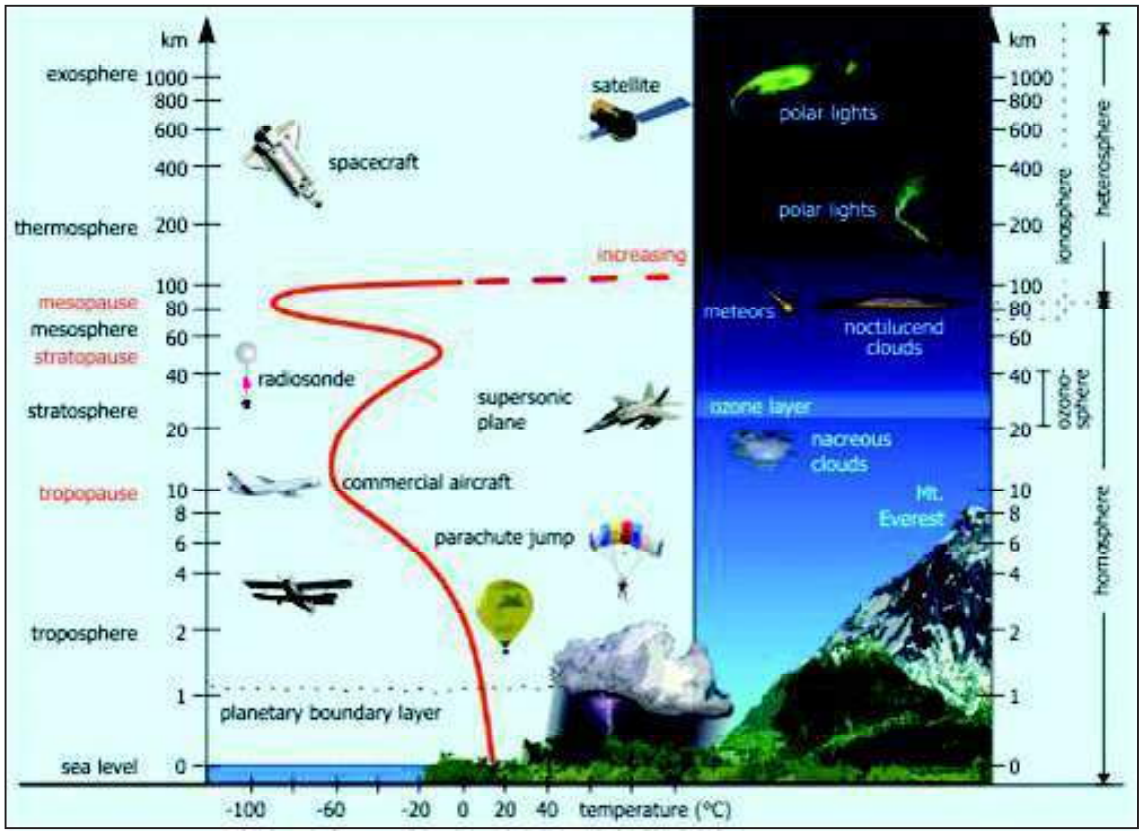
2. Temperature or Heat Zones



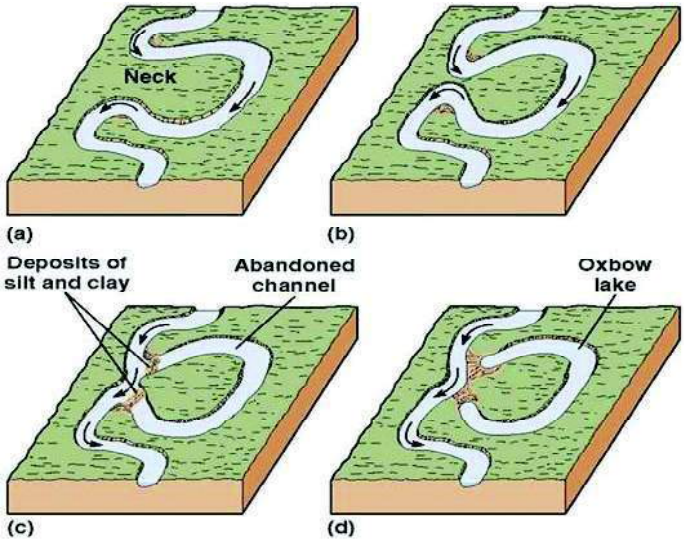
3. Layers of the Earth's interior



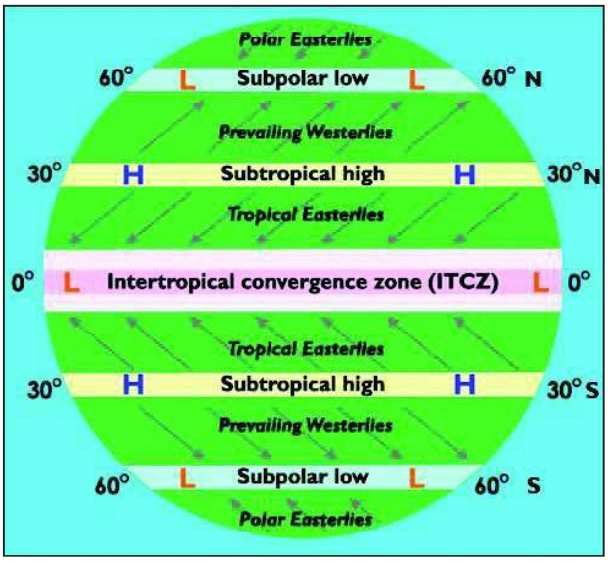
4. Volcano



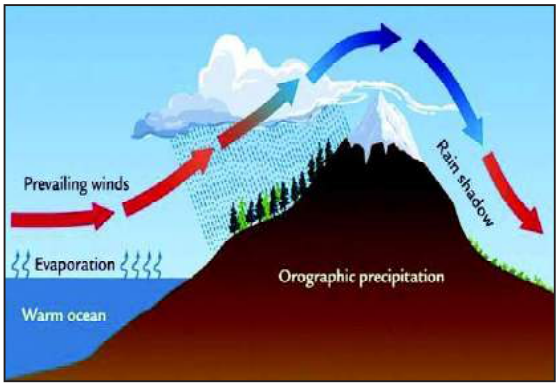
5. Layers of the Atmosphere



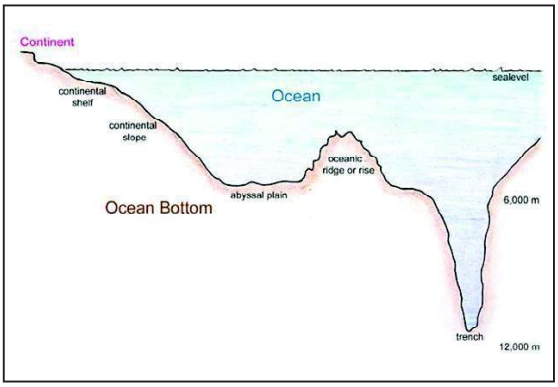
6. Ox-bow Lakes



7. Pressure belts



8. Orographic Rainfall

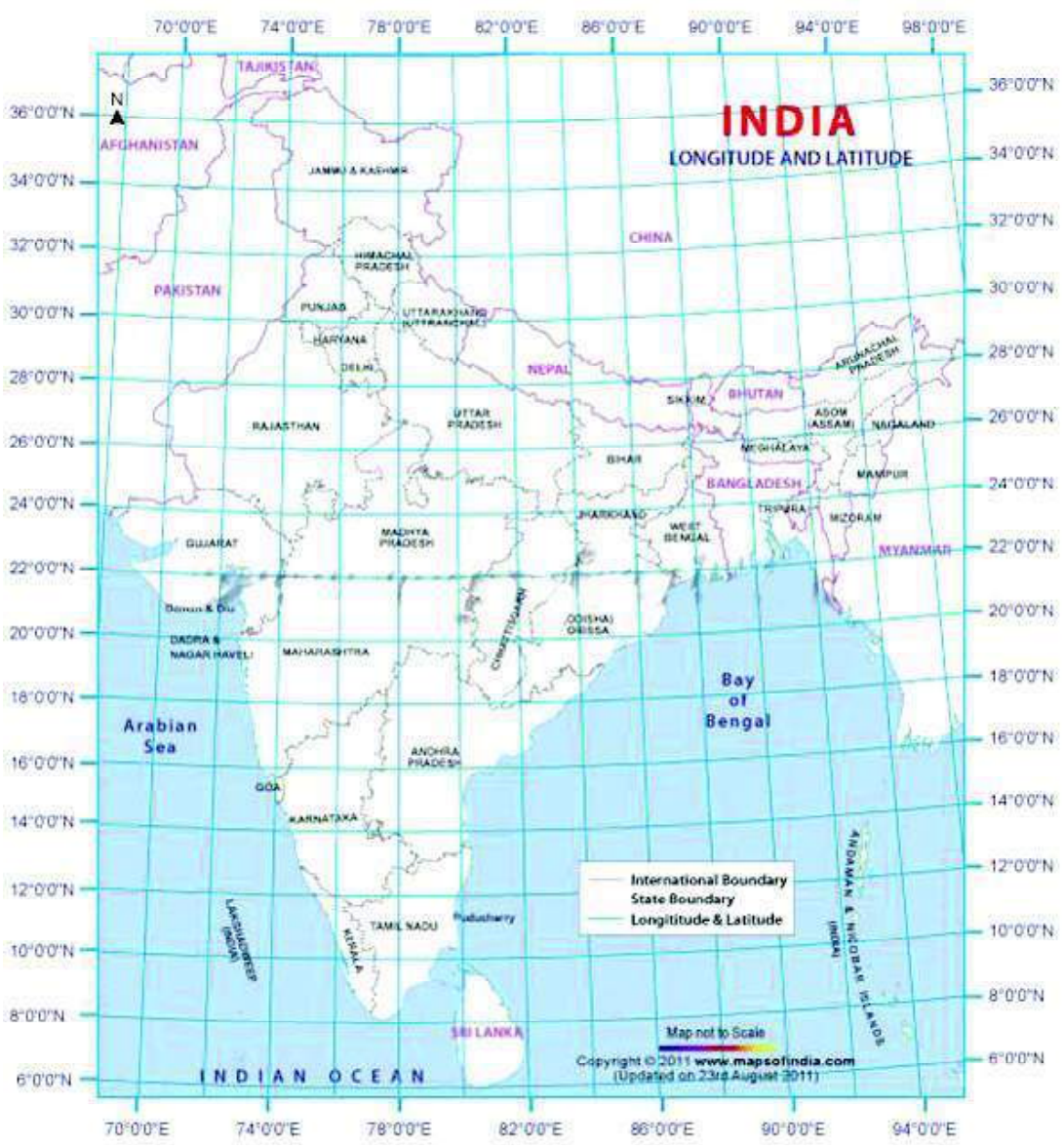


9. Bottom Relief of the Ocean floor

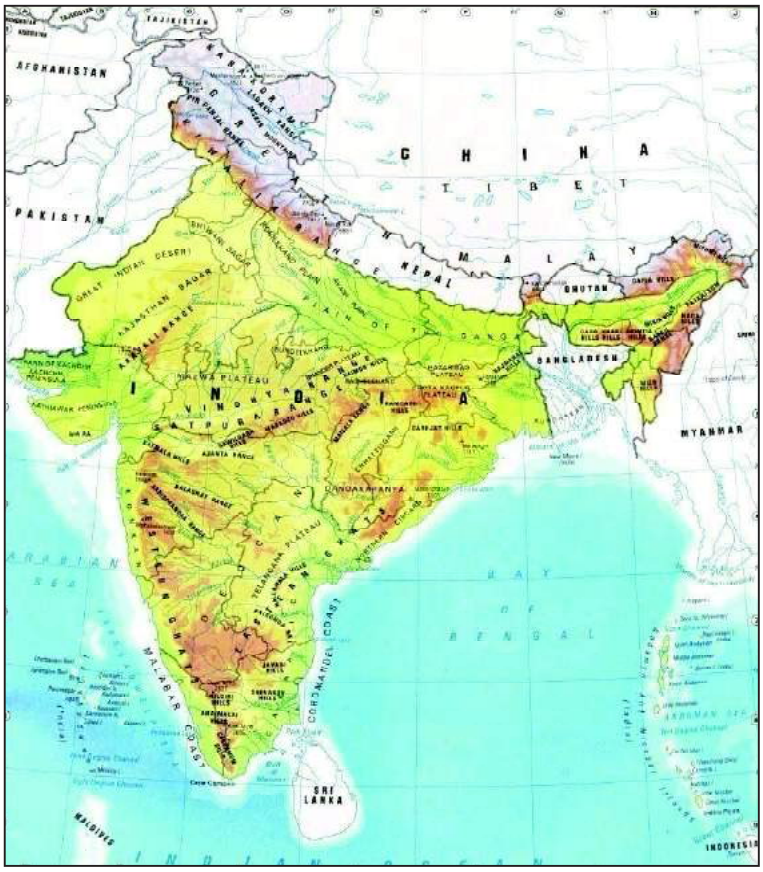
10. Tides

12.4 Map Drawing

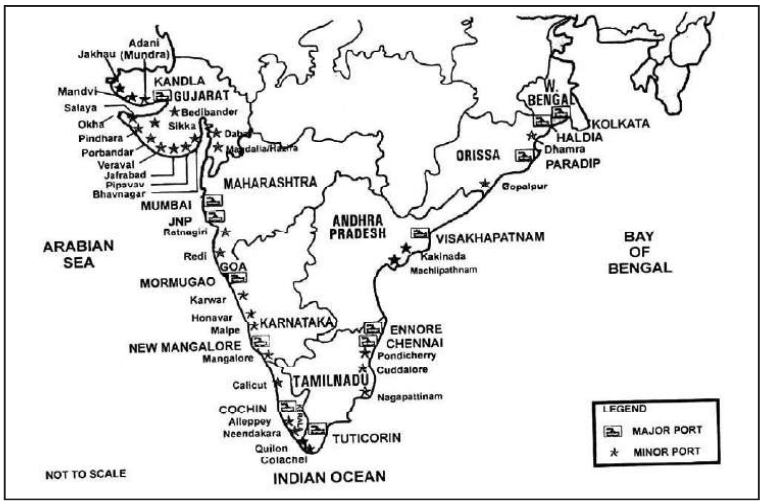
Outline map of India and showing Physical aspects.



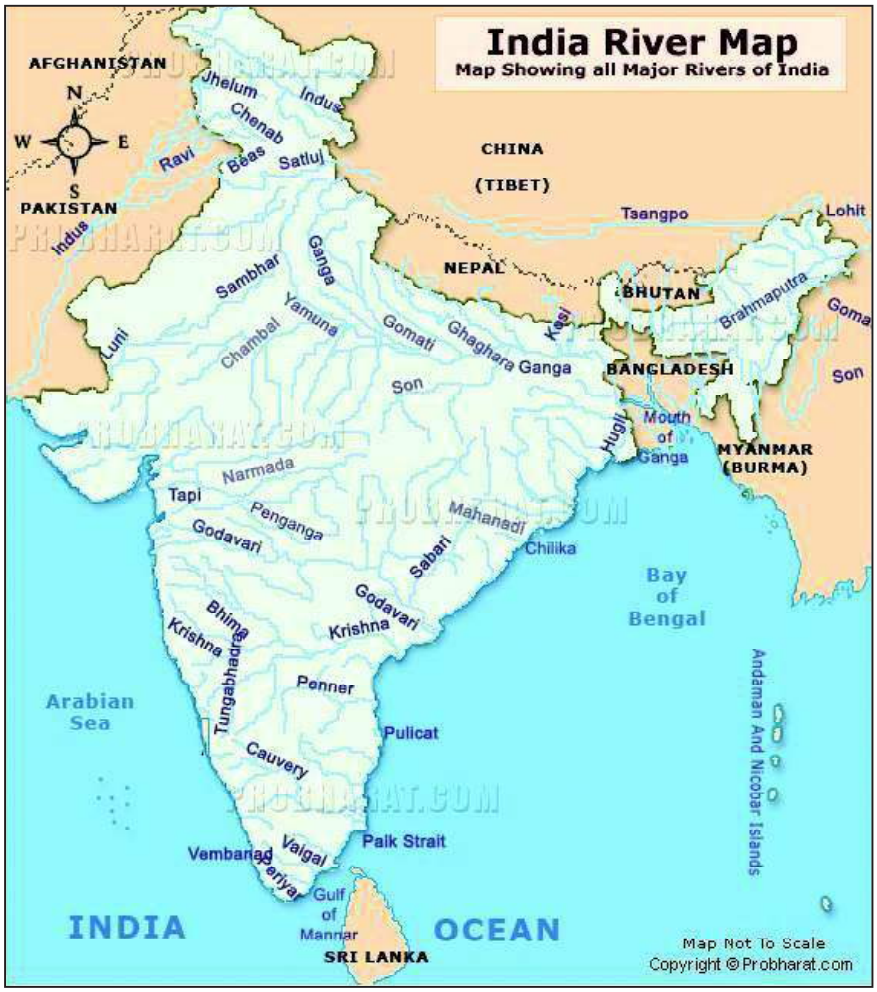
1. Latitude and Longitudinal extent of India



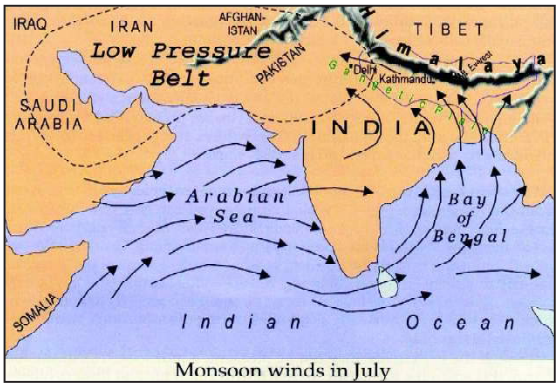
2. Physical divisions of India

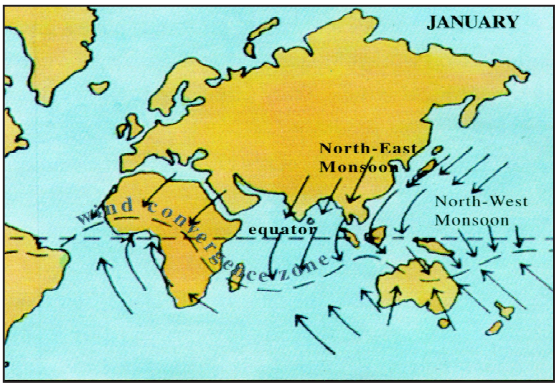


3. Coastal Plains and Ports of India

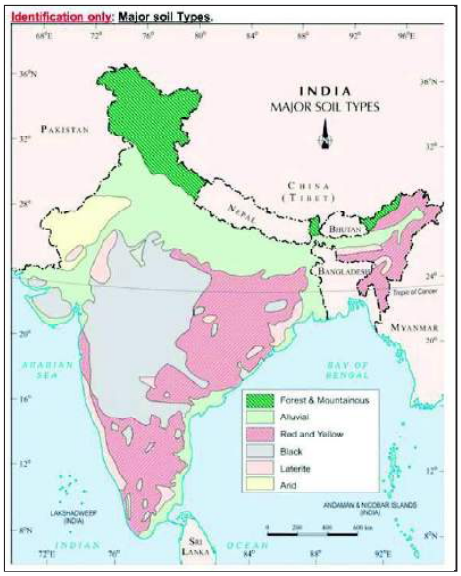


4. Rivers of India

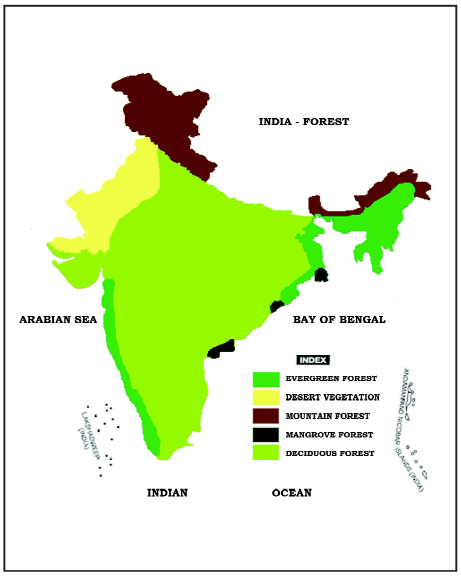




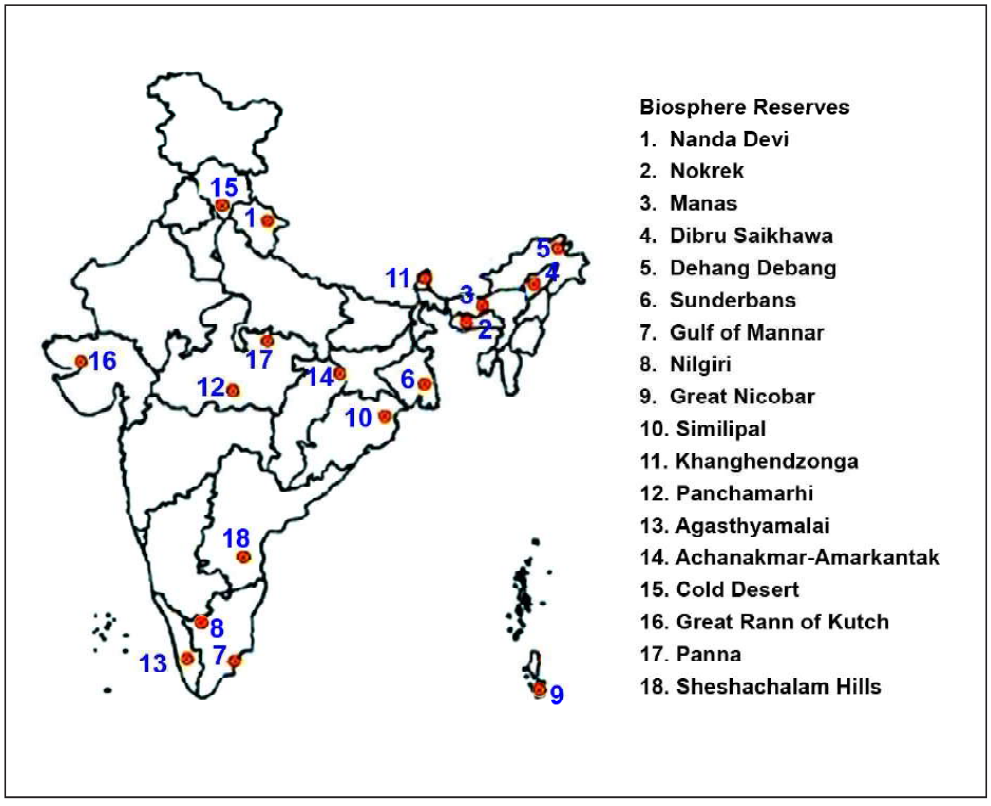
5. Southwest and Northeast Monsoons



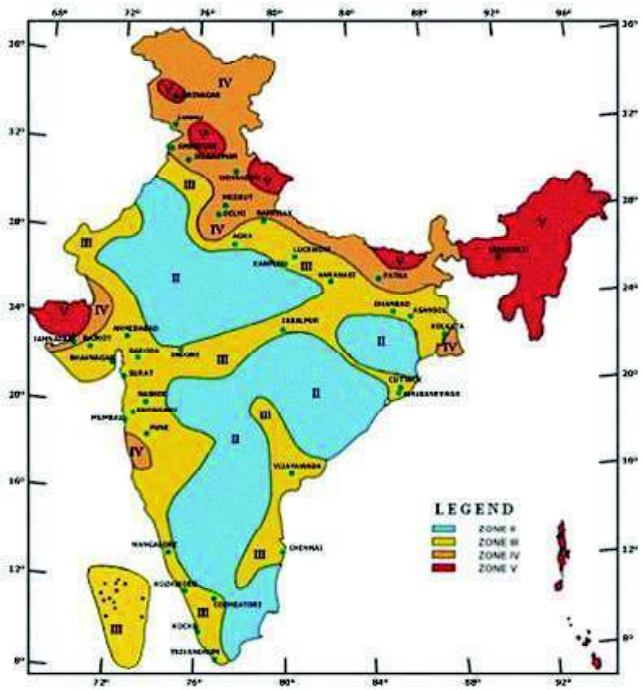
6. Soils of India



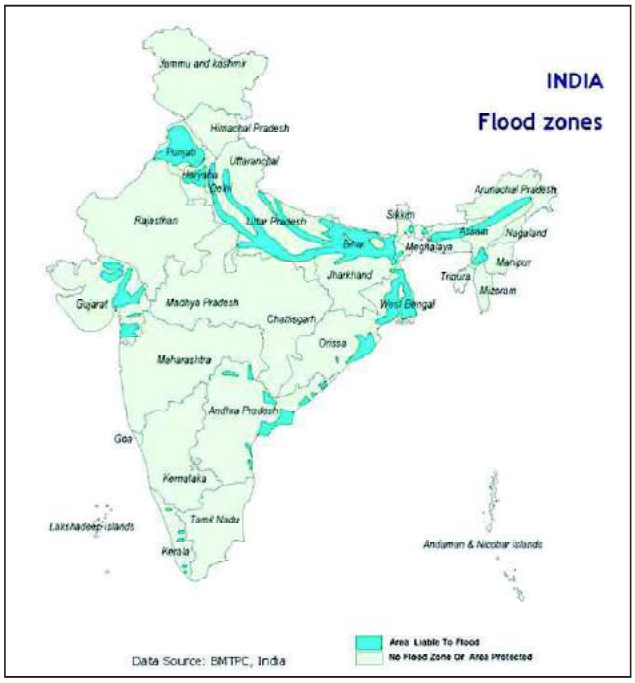
7. Forests of India



8. Biosphere Reserves



9. Earthquake Zones



10. Flood prone areas

IMPORTANT TERMS .....

Cartography	Direction	Cadastral maps
Maps	Index	Atlas
Scale	Latitude & Longitude	
Title	Topographical maps	

I Answer any five of the following in a word or a sentence each. 1x5 = 5

1. Define the term Cartography.
2. What is a Map?
3. Name any two essential features of a Map?
4. What is Scale?
5. Draw the Geographical symbol of River.
6. Mention any two uses of Maps

II Identify the latitudes and longitudes for the given places in the map of Karnataka. 1x5 = 5

* Latitude and Longitude map of Karnataka must be given.

1. Bengaluru
2. Mangalore
3. Bellary
4. Hubli
5. Bidar

III Draw diagrams to any two of the following. 2x2 = 4

1. Cycle of Seasons
2. Layers of the Earth's interior
3. Draw any two Geographical symbols

IV Draw the outline map of India, mark and name the following 2

1. Physical divisions of India 2
2. Forests of India 2

SUGGESTED ACTIVITIES .....

- Practice to draw different maps with the help of latitudes, longitudes and symbols.
- Prepare chart to show types of maps.
- List out the uses of Maps.
- Identify the places, latitudes and longitudes with the help of Atlas.
- Practice to draw the diagrams to show various physical aspects.
- Learn how to draw the outline map of India and to show the physical aspects.

GEOGRAPHY

Model Question Paper

GEOGRAPHY

Pattern of I PUC Question Paper

I. Answer the following in a word or a sentence each.
10 questions-one mark each 1x10=10

II. Answer any ten of the following in two or three sentences each.
12 questions-two marks each (2 Choices) 2x10=20

III. Answer any eight of the following.
12 questions-five marks each (4 Choices) 5x8=40

IV. Answer any one of the following.
2 questions-ten marks each (1 Choice) 1x10=10

V. Questions on Cartography.

a. Answer the following in a word or a sentence each. 1x5=5

b. Identify the latitudes and longitudes for the given Places (5 places) in the map of Karnataka. 1x5=5

c. Draw diagrams to any two of the following. 2x2=4

Draw the outline map of India, mark and name the following

d. Drawing of outline map of India 2

e. Showing the physical aspects of India - 2 questions 2x2=4

Total 100

I PUC GEOGRAPHY (24)

Model Question Paper : BLUE PRINT

Unit	Periods and Marks Allotted		Know-ledge		Understanding				Appli-cation		Skill		Total				
			1	2	1	2	5	10	2	5	1	2	1	2	5	10	
1	5	5	1				1						1		1		
2	10	9	1							1			1		1		
3	12	12		1				1						1		1	
4	14	14	1		2	1	2	1		1			3	1	3	1	
5	16	16		1	1	1	1		1	1			1	3	2		
6	8	8	2	1		1				1			2	2	1		
7	6	6			1								1				
8	3	5	1	1					1				1	2			
9	14	12				1				2				1	2		
10	14	12					1			1					2		
11	6	5		1		1								2			
12	12	20	5								6	6	11	6			
Hours Marks	120	124 +20	11	5	4	5	5	2	2	7	6	6	21	18	12	2	53

Total Marks = 144

No. of questions 53

MODEL QUESTION PAPER

Sub: GEOGRAPHY (24)

Time: 3.15 hrs Max. Marks: 100

Class: I PUC

Note: 1) Answer all questions.
2) Draw maps and diagrams wherever necessary.
3) Question no. V is on Cartography.

I Answer the following in a word or a sentence each. 1x10=10

1. What is the shape of the Earth?
2. Mention the equatorial diameter of the Earth?
3. Give an example for Metamorphic Rock.
4. Define Mineral.
5. What is denudation?
6. What are Isotherms?
7. One fathom is equal to how many feet?
8. Define the term Biosphere.
9. Name the important latitude that passes through the middle of India.
10. Define 'Tsunami'.

II Answer any ten of the following in two or three sentences each. 2x10=20

11. Name any two types of Volcanoes.
12. What are exogenic and endogenic forces?
13. What is air pressure? Name the instrument used to measure atmosphere pressure.

14. Give two examples for local winds.
15. What is convectional rainfall?
16. Mention the difference between weather and climate.
17. Name any two important salts present in the ocean water.
18. What is the latitudinal and longitudinal extent of India?
19. Name the international boundaries of India with China and Pakistan.
20. Name any four tributaries of river Cauvery.
21. What are Natural hazards and disasters?
22. State the difference between flood and famine.

III Answer any eight of the following in 25 to 30 sentences each. 5x8=40

23. What is Geography? Explain how Geography is an integrating discipline.
24. Explain the revolution of the Earth with its effects.
25. Write a detail note on Earthquakes.
26. Name the major types of rocks and describe Sedimentary rocks.
27. Give a detail account of the geomorphic processes.
28. What is weathering? Explain the types of weathering.
29. Describe the pressure belts of the globe with a neat diagram.
30. Give an account of topography of the ocean floor.
31. Name the physical divisions of India and explain the coastal plains.
32. Explain the North Indian Rivers of India.
33. Write briefly about the types of soils found in India.
34. Explain the major types of forests of India.

IV Answer any one of the following. 10x1=10

35. Explain the important types of Rocks with suitable examples.
36. Describe the work of river with suitable diagrams.

V (A) Answer any five of the following in a word or a sentence each. 1x5=5

37. What is Cartography?
38. Define Map.
39. What is Scale?
40. What is Index?
41. Draw the Geographical symbol of Sea Port.
42. Give an example for small scale map.

(B) Identify the latitudes and longitudes for the given places in the map of Karnataka. 1x5=5

* Latitude and Longitude map of Karnataka must be given.

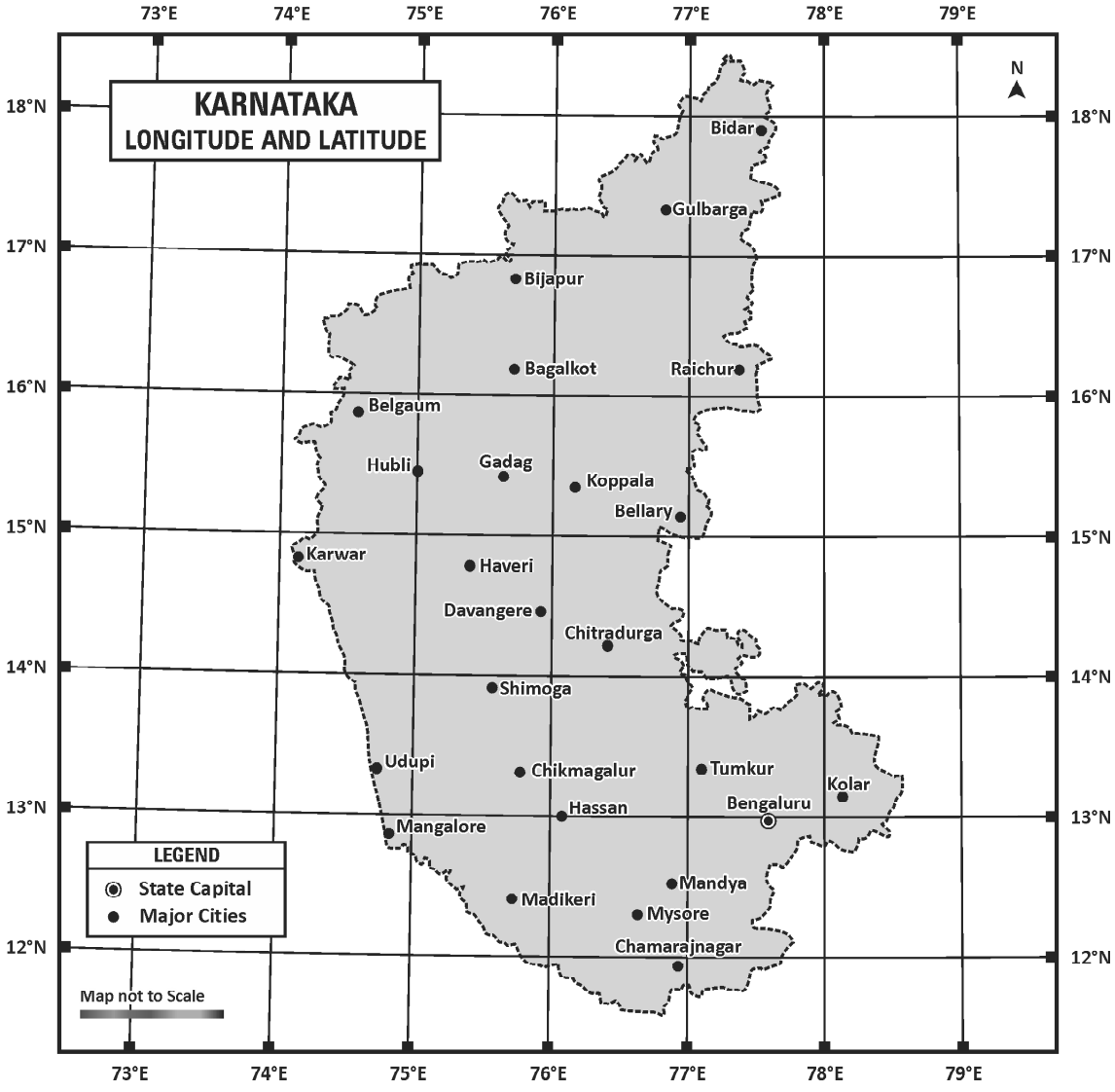
43. Mysore
44. Tumkur
45. Mangalore
46. Haveri
47. Bidar

(C) Draw diagrams to any two of the following. 2x2=4

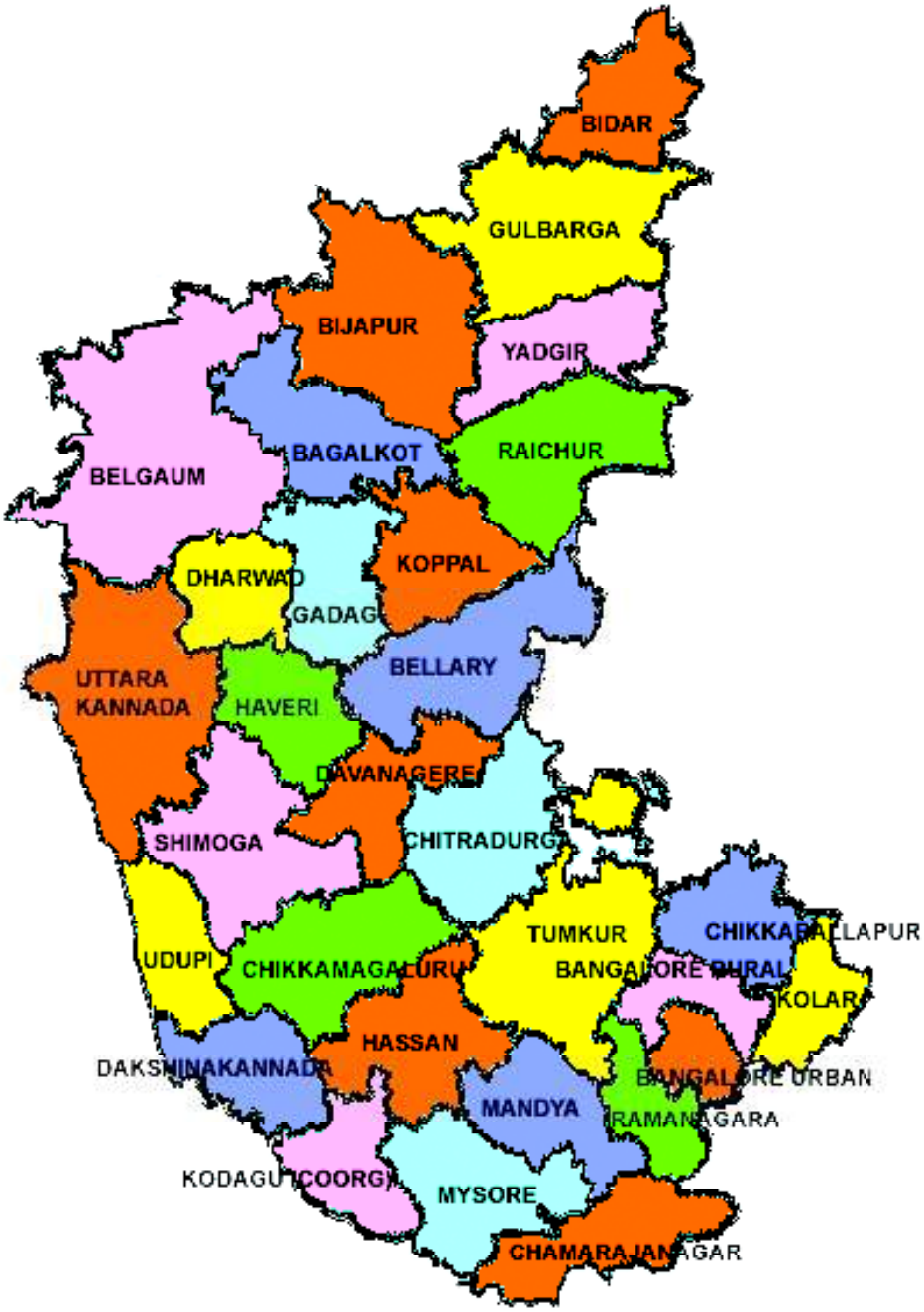
48. Pressure belts of the globe
49. Orographic rainfall
50. Draw any two Geographical symbols

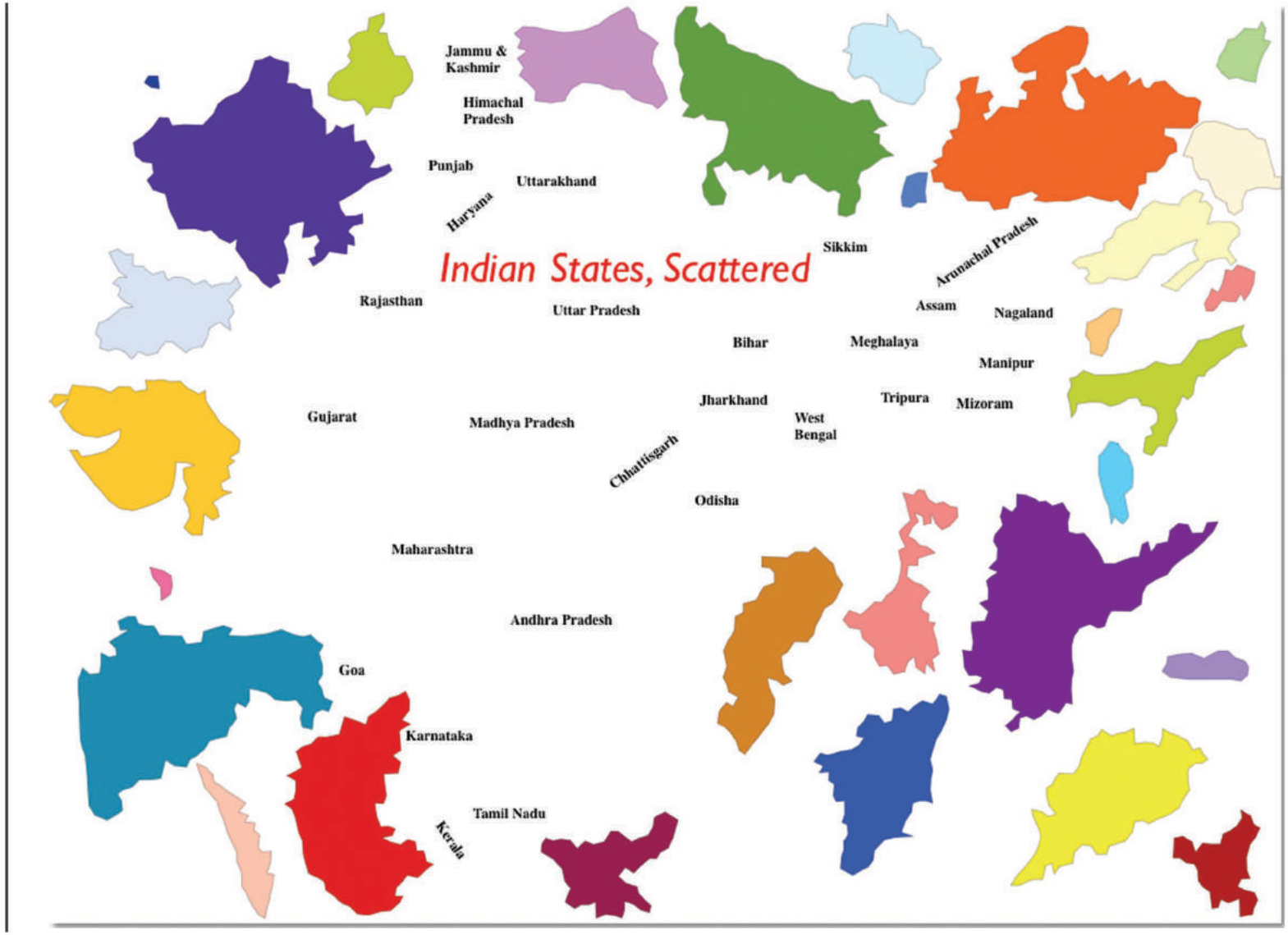
(D) Draw the outline map of India, mark and name the following.

51. Outline Map of India **2**
52. Southwest and Northeast monsoon winds **2**
53. Nokrek and Agasthyamalai biosphere reserves **2**


KARNATAKA
LONGITUDE AND LATITUDE
N
73°E
74°E
75°E
76°E
77°E
78°E
79°E
18°N
17°N
16°N
15°N
14°N
13°N
12°N
Bidar
Gulbarga
Bijapur
Bagalkot
Raichur
Belgaum
Hubli
Gadag
Koppala
Bellary
Karwar
Haveri
Davangere
Chitradurga
Shimoga
Udupi
Chikmagalur
Tumkur
Kolar
Bengaluru
Hassan
Mangalore
Mandya
Madikeri
Mysore
Chamarajnagar
LEGEND
State Capital
Major Cities
Map not to Scale

KARNATAKA


BIDAR
GULBARGA
BIJAPUR
YADGIR
BAGALKOT
RAICHUR
BELGAUM
KOPPAL
DHARWAD
GADAG
BELLARY
UTTARA KANNADA
HAVERI
DAVANAGERE
SHIMOGA
CHITRADURG
TUMKUR
CHIKKABALLAPUR
UDUPI
CHIKKAMAGALURU
BANGALORE RURAL
KOLAR
HASSAN
DAKSHINAKANNADA
BANGALORE URBAN
MANDYA
RAMANAGARA
KODAGU (COORG)
MYSORE
CHAMARAJANAGAR


Indian States, Scattered
Jammu & Kashmir
Himachal Pradesh
Punjab
Uttarakhand
Haryana
Rajasthan
Uttar Pradesh
Sikkim
Arunachal Pradesh
Assam
Nagaland
Bihar
Meghalaya
Manipur
Jharkhand
Tripura
Mizoram
Gujarat
Madhya Pradesh
West Bengal
Chhattisgarh
Odisha
Maharashtra
Andhra Pradesh
Goa
Karnataka
Tamil Nadu
Kerala


Kashmir
Jammu
Himachal Pradesh
Punjab
Chandigarh
Uttarakhand
Haryana
Delhi
Harit Pradesh
Jodhpur
Jaipur
Awadh
Gorkhaland
Sikkim
Arunachal Pradesh
Bodoland
Assam
Nagaland
Dimaland
Bundelkhand
Poorvan chal
Mithila
Udaipur
Bihar
Meghalaya
Manipur
Vindhya Pradesh
Jharkhand
North Bengal
Tripura
Gujarat
Madhya Pradesh
East Madhya Pradesh
Saurashtra
Ujjain
South Bengal
Mizoram
Chhattisgarh
Diu
Daman
Dadra and Nagar Haveli
Vidarbha
Kosal
Orissa
Marathwada
Central Maharashtra
Telangana
Konkan
Hyderabad
North Karnataka
Hyderabad metropolis
Goa
Seemandhra
Karavali
Mysore
Pondicherry
West Tamil Nadu
North Tamil Nadu
Kerala
South Tamil Nadu
Lakshadweep
Andaman and Nicobar
UNION TERRITORIES

Notes

Notes

Notes

Notes

GEOGRAPHY

Model Question Paper