ગુજરાત રાજ્યના શિક્ષણવિભાગના પત્ર-ક્રમાંક
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GEOGRAPHY

Standard 11

PLEDGE

India is my country.
All Indians are my brothers and sisters.
I love my country and I am proud of its rich and varied heritage.
I shall always strive to be worthy of it.
I shall respect my parents, teachers and all my elders and treat everyone with courtesy.
I pledge my devotion to my country and its people.
My happiness lies in their well-being and prosperity.

Price : ₹ 43.00

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PREFACE

Gujarat State Board of School Textbooks has prepared new textbooks as per the new curricula developed by the Gujarat State Secondary and Higher Secondary Education Board and which has been sanctioned by the Education Department of the Government of Gujarat. A panel of experts from Universities/Colleges, Teachers Training Colleges and Schools have put lot's of efforts in preparing the manuscript of the subject. It is then reviewed by another panel of experts to suggest changes and filter out the mistakes, if any. The suggestions of the reviewers are considered thoroughly and necessary changes are made in the manuscript. Thus, the Textbook Board takes sufficient care in preparing an error free manuscript. The Board is vigilant even while printing the textbooks.

The Board expresses the pleasure to publish the Textbook of **Geography** for **Std. 11** which is a translated version of Gujarati. The Textbook Board is thankful to all those who have helped us in preparing this textbook. However, we welcome suggestions to enhance the quality of the textbook.

P.Bharathi(IAS)

Director
Executive President

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FUNDAMENTAL DUTIES

It shall be the duty of every citizen of India * :

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

(k) to provide proper opportunities by parents or gardian for education to their children or the ward of 6 to 14 years of age.

* Constitution of India : Section 51-A

CONTENTS

1 Geography : As a Subject

Students, now in Std. (10+1) you are going to study Geography as an independent subject. Geography is a subject of great interest. There is a close relationship between Geography and Science. In Geography you get information about the earths atmosphere, lithosphere, resources, hydrosphere, human activities and their interrelations. A question arises in your mind that why we should study Geography ? Right ? So now, to find an answer to your questions, to have a solution of your problems, let us enter the world of Geography.

What is Geography ?

Besides man, the earth is a habitat of entire living world. The earths physical form is not uniform everywhere. There are mountains, plateaus, plains, valleys, oceans, seas, rivers, vast forests and wilderness. Because of variations in physical elements of the earth, variations in socio-economic and cultural environment have arisen. There are villages, cities, markets, railways, roads, industrial units, ports and many other culturally varied environment created by human beings across the entire period of their cultural development. In some regions man has come under the control of adverse geographical conditions while in some other regions he has made the conditions suitable to him through his hard work, intellect and scientific researches. Variations in physical elements and human elements on the earths surface are studied in Geography. The term Geography was coined by Eratosthenes, a Greek scholar in second century B.C. In Latin, Geo means Earth and Graphia means to describe. Thus, Geography is the science that describes the Earth. Going by meaning of the word, Geography means the Earths description. The science that systematically describes the earths surface is Geography. The location, relief, climate, vegetation, animal life, agriculture and plantation crops, minerals and other resources, industries, transportation of the Earths regions to be studied as well as human groups residing in those regions and their activities and such other systematic information is included in Geography. In the opinion of the well known geographer Hartshorne, Geography is a science that describes variable forms from place to place in the form of human-world.

Some geographers describe the total subject matter of Geography in the form of three short questions or seven words. These are : **What is where and why of it.** Although scope of Geography is as vast as the Earth, it includes study of physical elements and cultural elements, both of which are evaluated keeping man at the centre. Every geographical phenomenon that takes place on the Earth explains functional relationship. If man understands Geography with reference to functional relationship then only knowledge of Geography can become useful in life.

The subject matter of Geography is very vast. In this subject, the origin and evolution of the lithosphere, hydrosphere, atmosphere, biosphere and anthroposphere are studied from scientific view point. So it can be said, the science that studies the five spheres of Earth in detail is Geography. Man has started making rapid use of natural resources. This has resulted in various types of pollution, environmental hazards and biological destruction. The causes for such problems and their solutions form the subject matter of Geography. The German geographer Karl Ritter has said that the study of Geography begins at the earths surface, but as mankind develops means of observation and research, so also the scope of Geography will extend higher and higher and deeper and deeper from the Earths surface.

Geograhy : As a Discipline

The geographers define geographical facts with reference to causal relation. They show more interest in explaining causal relation between two or more geographical facts. e.g., Geography explains that cropping pattern of Punjab and Haryana is different from that of Tamil Nadu and also it discusses diverse relations,

lithosphere, atmosphere, market demand in those states, economic condition of their farmers, use of agriculture related techniques and such other factors.

Most of the geographers who made Geography subject more popular were from India, China, Arabia and Greece. There are quite a large amount of geographical descriptions in our ancient vedas, puranas, aranayaks, brahmin scriptures, Mahabharat and Ramayan. In Atharvaved, the Earth and its characteristics and human population are discussed in detail. In second century B.C., **Eratosthenes** attempted to measure the Earths circumference. The Greek geographer Thales, presented his views on the Earths size, shape, motion in 6th century B.C. Thales is considered the **first geographer** of the world. Claudius Ptolemy, a Greek geographer, presented the Earths latitudes-longitudes and gave information about the geographical location of countries. Strabo, a Roman geographer gave a detailed description about the Earth by compiling 17 books on Geography.

Aryabhatt of India presented details about the solar system and Varahmihir about the Earths diameter. Bhaskaracharya gave information about gravitation and Brahmagupt compiled books on Astronomy and Astrology. The great poet Kalidas in his poems Meghdootam and Kumarsambhavam described the mountains, rivers and forests of India. The Arab geographer, **Ibn Batuta,** visited India and presented information about its land and life of people.

In the 15th century, great travellers of the world discovered new waterways. They gave information about the earths physical form, different places of countries, oceans and life of people of worlds countries. Great geographers of Germany, A. V. Humbolt, Karl Ritter, Imanuel Kant and Fredrich Ratzel and others presented their views on the subject matter of Geography. Geography attained its modern form in Europe, in which physical elements were given preference. In the 20 th century, the Earths relief was studied with two approaches-systematic and regional. By 1950, man realized that natural resources of the Earth provide entire support to the living world. Awareness was given that natural resources are to be used judiciously. In the 21st century, physical geography and human geography both were given equal importance. In the decades 1960 and 1970 use of quantitative techniques and modern technology began in Geography.

Since 1957, artificial satellites were sent into space and this made it possible to take photos of the Earths surface. This made it possible to acquire information about mineral deposits and sources of water. With the help of artificial satellites, Geographic Information Systems, Land Information Systems and Global Positioning Systems techniques have become easily available. Currently with the development of Spatial Information Technology, Environment has become an important field of Geography.

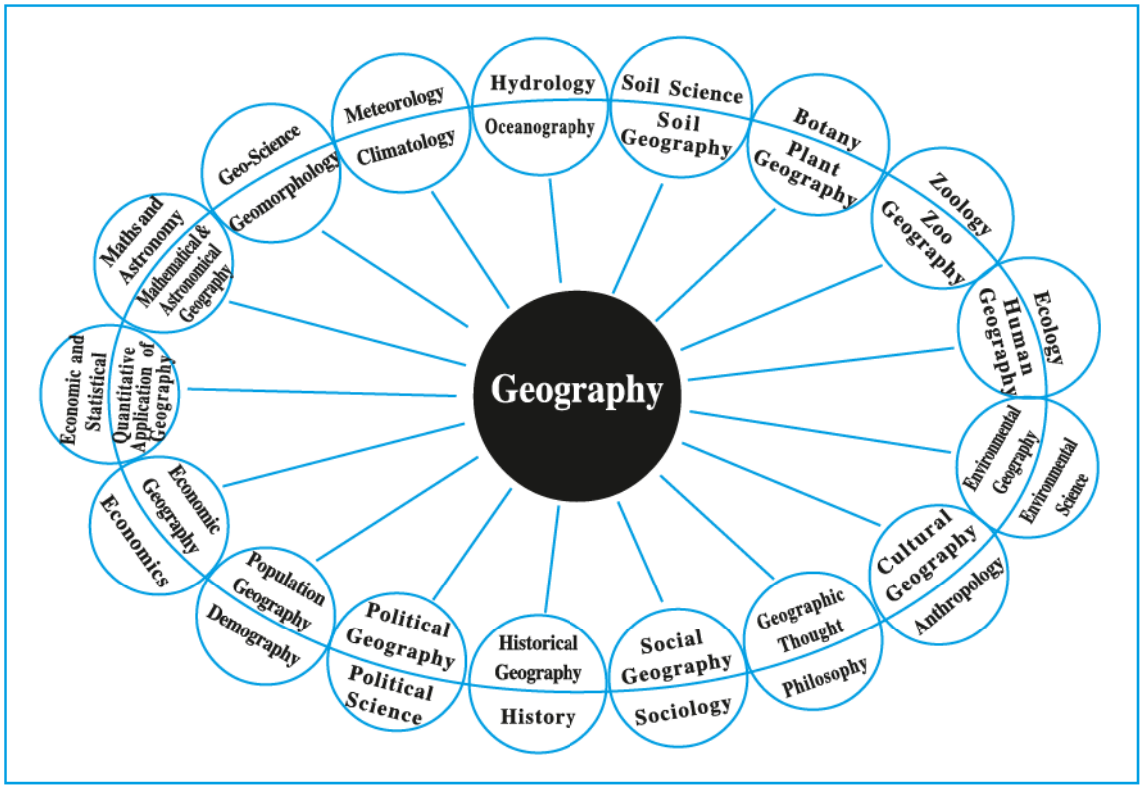
Geography as an Integrating Subject

All natural and social sciences keep in mind one objective-to know the reality. Geography tries to explain the reality in holistic form. All subjects related to science are related to Geography. As an integrating subject, Geography is closely related to several natural and social sciences.

To understand the Earths rotation and revolution, latitude-longitude, standard time, rainfall, graphs of temperature and other geographical aspects, mathematics is a useful subject. To understand eclipse and its time, flood, earthquake and to predict natural hazards, Geography takes help of mathematics and science. To get into the core of important events in nations history or a foreign country, geographical knowledge is necessary. All branches of physical geography are interrelated with natural science. Geography is closely interrelated to geology, astronomy, physics, botany, biology and other sciences.

All subjects of social science-philosophy, history, civics, political science, economics, sociology and anthropology are directly related to Geography. Branches of Geography such as political geography, historical geography, economic geography, population geography have relation with social science. Geographical conditions determine has relation with mans food, clothing, shelter and culture, so Geography is related to social sciences. Geography studies mans economic activities like transportation, communication,

industries, agriculture, etc. Thus Geography has close relations with economics. Knowledge of Geometry is essential for map reading, giving information in maps and for calculating latitudes and longitudes. Every subject has its philosophy, which acts as a fundamental role for the subject. Philosophy is helpful to Geography in preparing The History of Geographical Thought. Geography gets help from history for time synthesis. Geography obtains support from Political Science for analysis of political systems, area of state, population, various organizations, etc. Geography establishes relation with civics so that an international understanding develops in a person, feeling of world brotherhood and duty towards global organizations develops in a person. Thus, Geography establishes its relation with natural and social sciences.



1.1 Relation of Geography with natural and social sciences and Branches of Geography

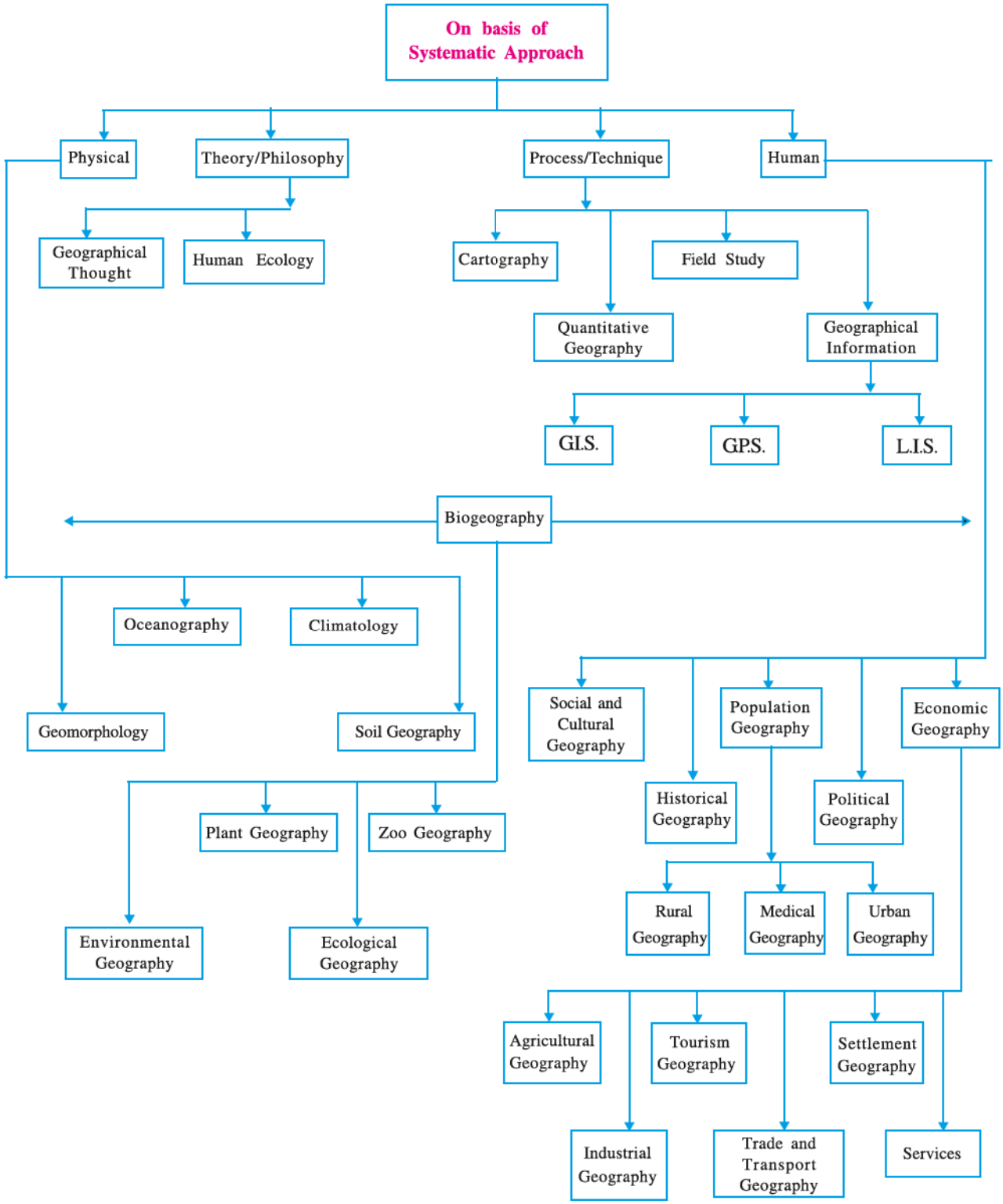
In Geography, there are two approaches to study : (1) Systematic Approach and (2) Regional Approach

(1) Systematic Approach : This is an approach of general geography. German geographer **Alexander von Humbolt** (1769-1859) is a proponent of this approach. In this method, geographical elements are divided into topics and study of each is done at a global level. Lithosphere, atmosphere, biosphere, minerals, agriculture, industry, transport, trade, etc. are placed in different topics and studied.

E.g. Natural vegetation It is first studied at a global level and then information about classified types in regional form is given, such as mediterranean type of vegetation, coniferous type of vegetation, monsoonal vegetation, equatorial type of vegetation, etc. In systematic study, the aspect is studied from the entire to its components.

(2) Regional Approach : Regional approach was developed by German geographer **Karl Ritter** (1779-1859). After dividing the earth into different units, a distinct regional area is studied in respect of all of its geographical aspects.

Amazon river basin in South America, Congo river basin in Africa, Malaysia, Indonesia and Phillipines archipelago can be joined and studied as one natural region as **'Equatorial Forest Region'.** The climate, vegetation, agriculture, minerals, animal life, etc. of this region are studied. This is known as regional approach.



1.2 Branches of Geography

Branches of Geography based on Systematic Approach

(1) Physical Geography : Physical Geography is divided into five sub branches.

(1) Geomorphology (2) Climatology (3) Oceanography (4) Soil Geography (5) Hydrology

In Geomorphology, information about the landforms of the earth surface, their distribution, origin and types are studied. In Climatology, zones of the atmosphere, seasons, components and elements of atmosphere such as temperature, atmospheric pressure, winds, precipitation, clouds, cyclones and local winds, etc. are studied. Oceanography studies the origin of oceans, tides, depth of oceans, their location, ocean currents, relief of ocean bottom, salinity of ocean water and also effects of oceans on human life. In soil science, types of soils, their origin, distribution, characteristics and uses are studied.

(2) Human Geography : Because of interrelations between nature and man, villages, hamlets, cities, countries, factories, roads, railways, settlements develop. Their cultural characteristics and distribution are studied in Human Geography. The main branches of Human Geography are cultural geography, social geography, population geography, rural geography, urban geography, economic geography, industrial geography, agricultural geography, trade and transport geography, political geography, etc. It explains geographical factors and geographical problems that act as barrier to human development. It discusses their solutions. In the opinion of Vidal de la Blache, in human geography the knowledge of interrelations between natural laws that control the earth and the life developed on Earth are included, 'Study of changing relations between active man and unresting earth is Human Geography' - **Ellen Sample.'**

(3) Bio Geography : Interrelations between Physical Geography and Human Geography have given rise to Bio Geography. Zoo Geography, Plant Geography, Ecology and Environmental Geography are the branches of Bio Geography. Zoo Geography gives information about different animals, insects and micro organisms. Plant Geography gives information about forests and different types of vegetation, types and distribution of grasslands. Ecology is the scientific study of changing relations between man and nature, various effects of nature on human life, habitats of species, their areas, development, classification and their distribution. Environmental Geography provides information about the environmental problems, types of pollution, environmental protection, degradation of living environment and impact on human well being.

(4) Geographical methods and Techniques : In the geographical methods and techniques, following sub branches are included :

- Field study (Physical and socio-economic survey)
- General and computer based map making
- Quantitative Geography
- Spatial Information Technology (Geographic Information System, Global Positioning System, Land Information System

Regional Approach :

Sub branches of Regional Geography are as follows :

- Regional Study
- Regional Analysis
- Regional Development
- Regional Planning

Importance of Geography

Study of Geography is essential for the improvement of vision and mission of humanity. Knowledge of Geography is very important for agriculture, trade, transport, industries and of other development. Geography provides fundamental knowledge for understanding different aspects of human life, for analyzing cultural heritage of human society, understanding historical events and for solving current global problems.

Geography plays an important role in the development of international understanding a feeling of world brotherhood, nationalism and other developmental value. Knowledge of Geography is essential for solving national and international problems. There are certain aims and objectives behind study of every subject. Geography is a dynamic subject. Development of its subject matter is science based. By studying Geography, several capacities and skills develop among us. Geography helps us to understand tourism fairs and festivals.

Geographical knowledge promotes international friendship. Geography plays a supportive role developing various skills such as map reading, placing information in map, measuring rain, temperature, earthquake intensity, air pressure, etc. A healthy viewpoint develops among us regarding natural resources and awareness develops for making wise use of resources. Geography gives information about the characteristics and diversities related to the lithosphere, atmosphere, hydrosphere and biosphere. This fulfils mans curiosity. Skills such as observing different types of maps, the earths globe and its natural and physical elements develop in a person. A mental capacity develops to understand cause and effect relationship among geographical phenomena. Knowledge of Geography is a practical necessity for fields such as trade, defense, tourism, industry, agriculture and animal rearing. Geography gives understanding of inter dependence among the nations of the world. Geography is in the background of many of our festivals and social customs. Study of Physical Geography helps us to know mans economic activities, successes and failures. Study of Geography provides necessary guidance regarding natural hazards like earthquake, landslide, storm, flood or famine and also about environment protection and conservation. Essential knowledge about global problems such as energy and water conservation, environmental care, pollution control is incomplete without study of Geography. Knowledge of Geography also becomes essential for finding a solution to problems such as increasing population and decreasing vegetation, poverty and terrorism. The feeling of one world one family is cultivated only through the study of Geography. Development of mental capacities in a person, such as minute observation, drawing conclusions, taking decisions and developing proper opinion, become easier through Geography. Knowledge of Geography is very important so that citizens understand national problems and contribute in solving them.

Dear students, now you are acquainted with the entire subject matter of Geography. In the following chapters we will study Physical Geography. Exercise-questions and activities given at the end of each chapter will fulfill your wish to know something new and also help in taking your academic achievements still higher. So friends, let us study Geography with interest, curiosity and with pleasure.

EXERCISE

1. Answer the following questions in detail :

(1) In the present context Geography is a very useful subject. Explain the statement.

(2) Explain the meaning of Geography and discuss its subject matter.

2. Write a to-the-point answer to the following questions :

(1) Mention the major sub-branches of Geography.

(2) Mention the sub divisions of Physical Geography and describe them in brief.

(3) Define : Human Geography.

3. Answer the following questions in brief :

(1) With which subject is Geography related ?

(2) Mention any four divisions of Human Geography.

(3) What are the current global problems ?

(4) What is Population Geography ?

4. Answer the following questions in one-two sentences :

(1) Which Indian geographer gave information about the solar system ?

(2) Who travelled to India and described its land and people ?

(3) What are the sources to acquire geographical knowledge ?

(4) Write names of two Indian geographers.

(5) Explain the meaning of word 'Geography'.

5. Select the correct option from the options given and write the answer :

(1) Who was the worlds first geographer ?

(a) Thales (b) Ibn-batuta (c) Karl Ritter (d) Bhaskaracharya

(2) The great geographer Karl Ritter was from which country ?

(a) Greece (b) England (c) Arabia (d) Germany

(3) Who travelled to India and described its land and life of people ?

(a) Aryabhatt (b) Ibn-batuta (c) Kalidas (d) Bhaskaracharya

(4) Who composed Meghdootam ?

(a) Chandragupta (b) Bhaskracharya (c) Kalidas (d) Varahmihir

2 Earth's Origin and Evolution

Our Earth is the home of man. All activities of human life are carried out on the Earths surface. After death the human body also becomes one with the Earths soil. That is the reason why man is called the Earths child. The entire history of human civilization is related to mother Earth. Man has been continuously thinking about the Earths origin and its various spheres right since his existence on the Earth. Although science has progressed in various fields, a question still remains controversial- how did the Earth originate ? Mysteries of the Universe have remained unsolved even today.

Right from our childhood we were curious to know why stars twinkle in the sky ? How many stars are there ? Why did God create stars ? When a person dies does he get a place among the stars ? On what does the Earth rest in space ? What is hidden in its interior ? Can we go to the far side of space ? Is there life anywhere else in the world ? To have answers to these questions let us make a purposeful study of this chapter.

Ancient Views about the Earth's Origin

Beliefs and assumptions regarding the Earths origin can be seen in various religious scriptures. In ancient times people of many countries imagined Earth to be elliptical in shape. According to ancient views, Hindus maintained that Lord Brahma remained in penance for several ages and created a gold egg. In Croatia, the Earth is believed to be an egg created by the Sun God. In Scandinavian countries (Sweden, Finland and Norway) the Earth is imagined having a shield shape. This shield like Earth rests on a tree. Root of the tree is patal and the upper crown is paradise. According to Hindu mythology, there is a great tortoise. There are four big elephants on the back of tortoise and the Earth rests on their back. There is abode of Sun (suryalok) high above the Earth.

Some people believed that the Earth rests on a huge, strong back of a demon. Till the demon is asleep, everything is normal, but when he wakes up and moves, there will be earthquakes. Some people believed that the Earth is balanced on three big Whales. Also, people of ancient times believed that there is some complex and intellectual machine hidden beyond the skies. Perhaps it resembles a clock. In it wheels with giant teeth of the size of mountains go around slowly and hence the sky along with stars move around the Earth.

Our ancestors believed that the Earth rests on the head of Sheshnag, and when it shakes its head the Earth shakes. Also, some people believed that the Sun goes around the Earth, resulting in day and night. Such were our ancient beliefs.

It is believed that when the Earth originated some 4.5 billion years ago it was in the form of intensely hot ball of gases. As time passed, its outer surface cooled and solidified to form an outer solid crust. Our Earth is the only member of the solar system on which life exists. The Earths origin is related to the origin of the solar system. Several hypothesis, beliefs and theories have been presented regarding birth of the Earth. There are various theories about the Earths origin : nebular, planetsimal, tidal, unitary star, binary star theory, nebular cloud theory, super nova burst, etc. Every theory has remained controversial in absence of necessary support or evidence.

Theories about the Earth's Origin

Scientists and philosophers have presented several hypothesis about the Earths origin. They can be placed into three categories :

(1) Monistic Hypothesis : According to this hypothesis, the Earth is believed to have originated from a single star. It is also known as one parent hypothesis.

(2) Binary Star or Dualistic hypothesis : According to this hypothesis, the Earth is believed to have originated from a collision between two stars.

(3) Theory based on gaseous and dust clouds : According to this theory, the solar system originated from ancient matter like gas and dust.

(1) Monistic Hypothesis :

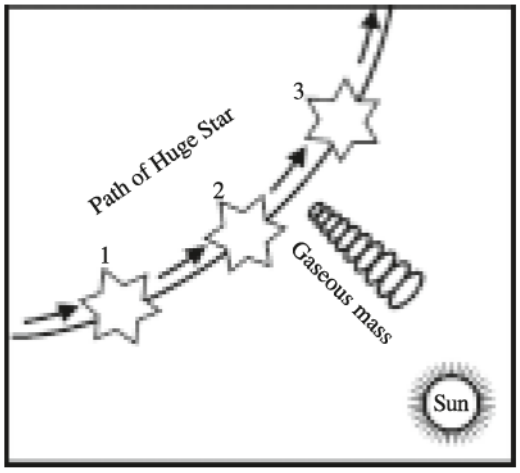
(1) Gaseous hypothesis : The German philosopher **Immanuel Kant** presented this hypothesis in 1755. In his opinion there was a cold and motionless gaseous cloud in space. The particles of this gaseous cloud began to collide against each other under their mutual gravitational attractions. In due course it started spinning around its axis and became a vast hot nebula.

(2) Nebular Hypothesis : In 1796, French astronomer and mathematician **Laplace** presented a modified version to the gaseous hypothesis of Kant. According to him, Sun and planets were formed from premordial gaseous matter.

(2) Binary Star or Dualistic hypothesis :

Planetsimal Hypothesis : Two American scientists **T. C. Chamberlain** and **Forest Ray Moulton** presented the planetsimal hypothesis in 1900. In their opinion, a randomly moving star passed nearby the Sun. Under the gravitational force of this star some matter got separated from the Suns surface and got dispersed in the universe. These separated parts formed into planets and started revolving round the Sun. The hypothesis was later on supported by Sir James Jeans and Sir Harold Jeffrey.

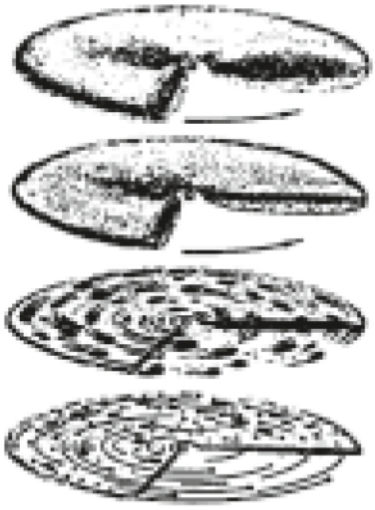
Planetsimal hypothesis is presented in Fig 2.1



2.1 Hypothesis of Chamberlain and Moulton

(3) Hypothesis based on Gaseous and Dust Clouds :

(1) Inter stellar Dust Hypothesis : Russian thinker **Otto Schmidt** in 1943 presented his Inter Steller Dust Hypothesis regarding origin of the solar system. In his opinion, the primitive Sun already existed in the universe. About 600 crore years before present, the planet forming matter existed in atomic form. As time passed, hydrogen and helium gases and dust clouds were formed from these atoms. The dust particles and gaseous clouds were attracted towards each other due to the Suns attraction. The dust and gaseous clouds started revolving around the Sun in the form of a flat disc. Later on planets were formed from dust and gaseous clouds. As indicated in fig. 2.2, dust particles combined to form planets and satellites respectively.



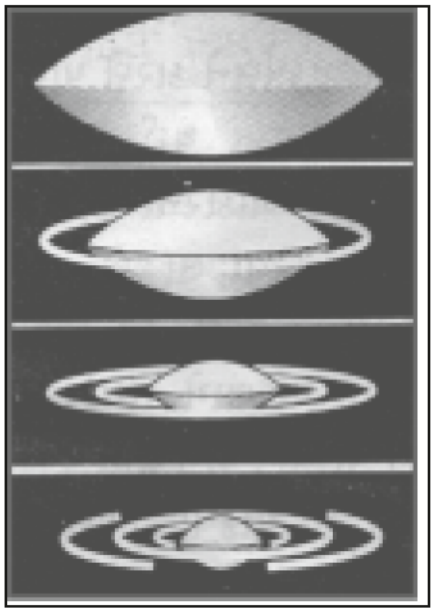
2.2 Formation of planetsimals, planets, satellites from consolidation of particles

(2) Nebular Hypothesis : In the opinion of **Carl Von Weizsacker,** the Sun entered in a gaseous and dust cloud. Because of the Suns attraction, some part of the gaseous and dust clouds began to revolve round the Sun, and the remaining part escaped into space. Dust particles condensed into each other like a necklace of pearls. With the passage of time, big pearls became planets while smaller ones formed satellites. It took almost 10 crore years in the formation of such planets and satellites.

Recent Theories about the Earth's Origin

Among the several hypothesis about the Earths origin, two have been widely recognized (1) Nebular Hypothesis and (2) Tidal Hypothesis. Let us have an idea about them in detail.

(1) Nebular Hypothesis : The German Philosopher, Immanuel Kant presented this hypothesis in 1755. In his opinion, billions of years before there existed a cool and motionless gaseous cloud in space. Because of gravitational force the gas particles in the gaseous cloud were mutually attracted this produced great friction and this gaseopus cloud got heated and got converted into a nebula revolving around its imaginary axis. The gaseous clouds seen between the group of stars in space is known as nebula. In 1796, French mathematician Laplace suggested some modifications. He assumed that there was a hot and huge nebula rotating on its axis. From the outer surface of the nebula, heat was continuously lost. This resulted in a continuous decrease in its heat. It cooled gradually and so parts of its surface contracted and became dense. As the size of the nebula gradually decreased, it increased the rotatory motion of the nebula. So its centrifugal force increased compared to the centripetal force. Because of this centrifugal force, one by one gaseous masses got released from the nebulas surface in the form of rings. This mass of gaseous material began to revolve round the nebula under its own gravitation. As this gaseous material got coalesced and collected, the ring shaped gaseous material took the shape of a sphere, which we know as planets. Before the solidification of planets, the entire process was repeated to form satellites from some planets. The remaining part of the nebula became known as the Sun. In this way the solar system originated crores of years before.



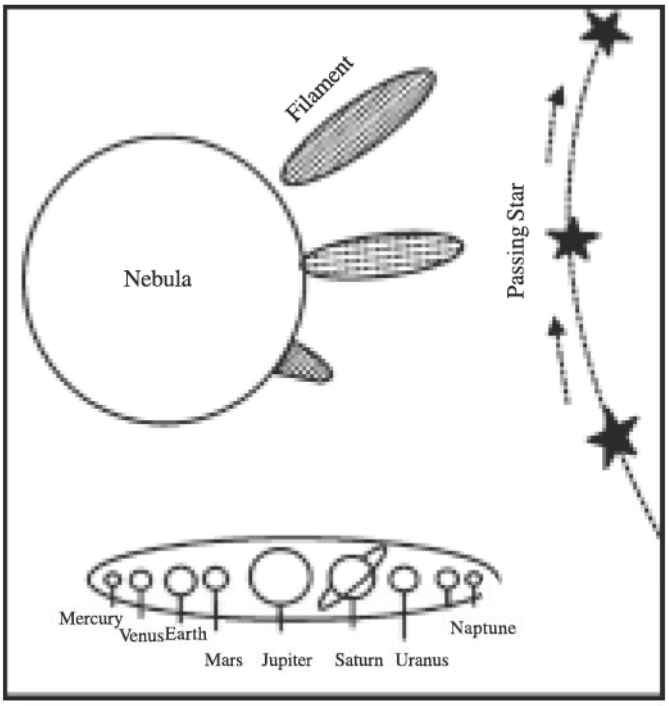
2.3 Nebular Hypothesis

(2) Tidal Hypothesis : Tides are formed in sea water because of the gravitational force of the moon and the sun. Keeping in view these tides, British geographers, Sir James Jeans and Jeffreys presented the Tidal Hypothesis about the origin of the solar system in 1919.

According to this Hypothesis, a moving star happened to pass nearby the primitive Sun with huge gaseous mass.

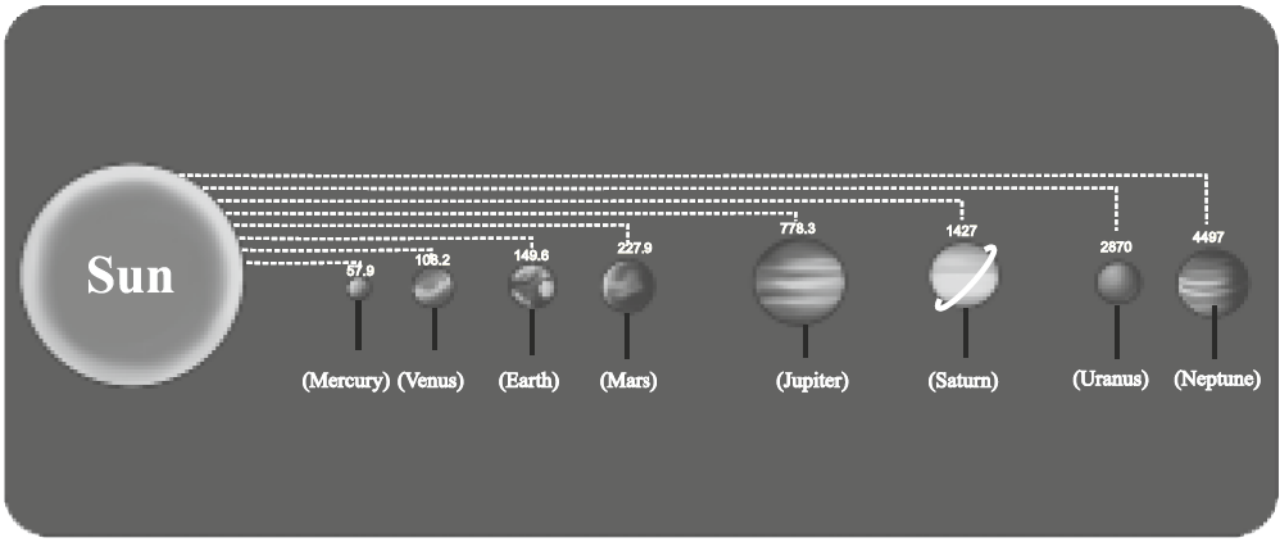
This moving star was several times bigger than our Sun. Hence its gravitational force was also much higher. Under the gravitational force of this roaming star, a gaseous tide was formed on the Suns

surface. As the roaming star approached closer and closer to the Sun, the tide also rose higher and higher. The cigar or cheroot shaped gaseous mass was attracted towards the roaming star and eventually got separated from the Sun. As the roaming star went farther away from the Sun, its gravitational force declined. The fragment or filament that separated from the Sun, attained axial rotation and revolution-motion because of the Suns gravitation. The cigar shaped mass condensed with time. It fragmented because of contraction. Planets were formed from it. The same process was repeated between the Sun and planets to form satellites. Our solar system originated according to this hypothesis. This tidal hypothesis gave solution to many questions such as origin of planets including the Earth, satellites, their sequence and size from the Sun, inclination of axis, number of satellites, etc. This concept became popular and widely accepted. Our solar system is formed from the same tidal process of gaseous materials.



2.4 Tidal Hypothesis

The Solar System : It is a system of planets, satellites, planetoids, meteors, comets, etc., at the centre of which is the Sun. In the solar family, there are eight planets, more than 173 satellites, about more than 45,000 planetoids, comets, meteors, etc., collectively known as the solar family or the solar system.



2.5 Our Solar System

Our Sun is an average sized star, which shines on its own and also provides light to all its members. The Suns diameter is 13,92,000 km, which is about 109 times the Earths diameter. Its gravitation force is 28 times that of the Earth. It is a very hot gaseous mass. Its surface temperature is about 6000^0 C. and the temperature of its centre is about 1.5 crore degrees celcius. The pressure and temperature at the Suns centre is many times higher than that at the Earths centre. Hence in the nuclear process occuring here, the hydrogen nucleii are fused into helium. Tremendous light and heat energy are released during the process. The energy released from the Sun per second is equivalent to the energy produced by burning of about 12,000 billion tons of coal. This energy is emitted into space in the form of radiation.

The black spots seen on the Suns surface (Photosphere) are known as Sun spots. They are rift valleys on the Suns surface, through which the Suns inner heat comes out. When Sun spots increase in number, we experience more heat. The bright layer surrounding the Sun upto 400 km is known as the **Photosphere.** Presently the Sun is in a stage of full development. It is estimated that the Sun will cease to exist after some five billion years.

Sun is our main source of energy. Sun gives essential energy to the Earth. This is highly essential for the origin and evolution of life.

The heavenly bodies with a characteristic shape and appearance and that go round the Sun in an elliptical orbit are known as comets. When seen from the Earth the comets appear to have a bright tail, hence are known as tailed stars. Halleys comet is the most well known. It was last seen in 1986 and would be seen again in 2062. In ancient times, it was believed that appearance of comets will cause war, epidemic, disastrous events like flood, but its appearance is just a normal astronomical event. Shooting stars or meteors seen at night are also members of the solar system. When we observe the clear but dark sky, a long belt of milky colour can be seen stretching from north to south, which is known as the Milky-Way. There is a huge number of star clusters in the **Milky Way.**

Planets :

Our solar system has a total of 8 planets. Mercury, Venus, Earth and Mars are known as **Terrestrial planets.** Jupiter, Saturn, Uranus and Neptune are known as **Jovian planets.** We have obtained information about these planets in earlier standards.

Planets of the Solar Family

Planet	Mean distance from Sun (lac km)	Revolution Time	Rotation Time	Diameter (in km)	Number of satellites	Characteristics	Other
1. Mercury	579	88 days	59 days	4878	0	Mt., valleys, volcanoes on planets surface	Smallest in size but nearest to Sun
2. Venus	1082	225 days	243 days	12,100	0	Venus means Goddess of love and beauty	Brightest, revolves west to east
3. Earth	1496	365.25 days	24 hours	12,756	01	Located between venus and	Life Orange coloured,
4. Mars	2280	687 days	24.6 hours	6787	02	marsTerraforming by NASA	small, cold, dry planet
5. Jupiter	7783	11.86 years	9.9 hours	1,42,800	67	Planets composition resembles Sun	Biggest in size, fastest to rotate
6. Saturn	14,270	29.46 years	10.7 hours	1,20,600	62	Size 700 times that of Earth	3 rings, Titan and Thimal
7. Uranus	28,700	84.9 years	17 hours	51,118	27	Indian Scientist Dr. J C Bhattacharya discovered its 6th satellite.	are satellites Discovered by William Harshall in 1781
8. Neptune	44970	165.9 years	18 hours	49,500	14	Discovered in 1846	Green coloured, Titon, Nerid imp. satellites

(**Note :** Before 2006, Pluto was considered a planet. As per decision in International Astronomical Union, Pluto is not included among planets.)

Earth

Earth, the mans habitat is also a planet. The thickness of atmospheric layer around it is about 800 to 1000 km. It is at a distance of about 15 crore km from the Sun, located between the planets Venus and Mars and dependent on Sun for its light. It is an orange like sphere. Its polar diameter is 12,714 km and equatorial diameter is 12, 756 km. It takes 365.25 days to revolve round the Sun. The Earth rotates round

its axis once in 24 hours, from west to east. Its axis is inclined at an angle of 66.5 degrees with respect to its plane of revolution. The Earths atmosphere is mainly composed of nitrogen and oxygen with carbon dioxide, hydrogen, ozone in trace amounts. The Earths atmosphere protects us from meteors. The layer of ozone gas protects the life by absorbing ultra violet radiation coming from the Sun. Moon is the Earths only natural satellite where there is no life. The Moons diameter is 3475 km and it is at a distance of about 3,85,000 km from the Earth. The moon rotates round its axis and also revolves round the Earth. Its rotation and revolution time is 29.5 days. Neil Armstong became the first astronaut to land on the moon on 20th July, 1969. Its rocks are mainly igneous. Moons gravity is almost 1/6 th of the Earth. So everything weighs lighter on the moon. There are extinct volcanoes on it.

Big Bang and its various stages

In the 20th century, scientists have tried to solve the mystery related to the Universe, over and above that of the Earth and other planets. Presently, the Big Bang theory about origin of the Universe is considered more modern. It is a theory known as the theory of expanding Universe. It is an expansionism theory. The Belgian scientist **George Limaitre** gave the Big Bang theory. In 1920, an astronomer named **Edwin Hubble** declared that the Universe is expanding. The galaxies are continuously receding away from each other with time. According to Big Bang theory, various stages related to expansion of the Universe are as follows :

- The matter from which the Earth originated was initially in the form of a small sphere. They were also stationary at a place. This premordial matter was extremely minute and its temperature and density extremely high.
- With a bang in this small sphere, particles of premordial matter contained in it got dispersed into space.
- Big Bang took place some 13.7 billion years back. After the Bang, particles of the premordial matter dispersed into space in time little more than a second. Expansion of Universe is still continuing but its speed has decreased.
- The first atom was formed just after about three minutes.
- After the Big Bang, temperature fell to about 4500 degree Kelvin in about three lakh years and molecules of matter may have formed.

Evolution of Earth

In the past, the Earth was not in the same form as it is today. The Earth's present form has been attained through several ages of gradual evolution. The Earth was in the form of an extremely heated gaseous sphere at the time of its origin. The Earths atmosphere was composed of hydrogen and helium. But today it is a lively planet with water and beautiful forms of life. Severel phenomena and processes were responsible for such a change in the Earths form. Water is distributed on about 71% of the Earths surface. So it is called a **watery planet**. The layer of air surrounding the Earth is called the **atmosphere**, and the huge watertmass is known as the **hydrosphere**. Oxygen and nitrogen in the atmosphere give life to all living world. The solid layer of the Earths surface made of soil or rock layers is known as **lithosphere**. Lithosphere forms the crust. Various forms of life exist in the atmosphere, hydrosphere and lithosphere. The layer comprising of all living forms is known as the **biosphere**.

Lithosphere

The average thickness of the lithosphere is about 33 km. As we go from the solid surface towards the Earths centre temperature rises by 1^0C for every increase in depth of 32 m. Near the Earths surface there is a thin layer of sedimentary rocks. It has two sub layers : (1) Crust (Sial) and (2) Magma (Sima) - Sial is made of granite while sima is made of basalt rocks. Below the lithosphere and upto a depth of 2880 km there is mantle layer. It is also known as magma. Below the mantle upto the Earths centre is the core. It is also known as the central metallic core. Its diameter is 6020 km. In this layer the mineral matter is mainly of Nickel and ferrous, it is known as Nife. The Earths gravity or magnetic force is due to this metallic core. Because of the Earth movements and interactions taking place in the interior, various landforms are formed, such as continents, oceans, mountains, plateaus, rift valleys, coastal plains, etc.

Origin and evolution of Atmosphere and Hydrosphere :

First Stage : In the Earths primitive atmosphere, there was an abundance of hydrogen and helium gases. Solar winds removed the primitive gases from the Earth. This was the first stage in the evolution of the atmosphere.

Second Stage : The Earth cooled gradually. As a result, gases and water vapour began to escape from its interior. In this stage, there was more of water vapour, nitrogen, carbon dioxide, methane and ammonia gases in the atmosphere. Amount of water vapour and gases in the atmosphere continued to increase due to volcanic eruptions.

Third Stage : In this stage, condensation of water vapour became possible as the Earth cooled. Precipitation occurred. The atmospheric carbon dioxide mixed with precipitation and this decreased the Earths temperature, and resulted in heavy rainfall. This rain water collected in deep and wide depressions of the Earths surface and formed seas and oceans. Oceans were formed about 50 crore years after the Earths origin. Evolution of life began crores of years afterwards. Process of photosynthesis developed 250 to 500 crore years before present. For a long time life remained confined only to oceans. Oxygen increased in the atmosphere due to photosynthesis. Oceans gradually became saturated with oxygen. Amount of oxygen in the atmosphere became sufficient about 200 crore years back.

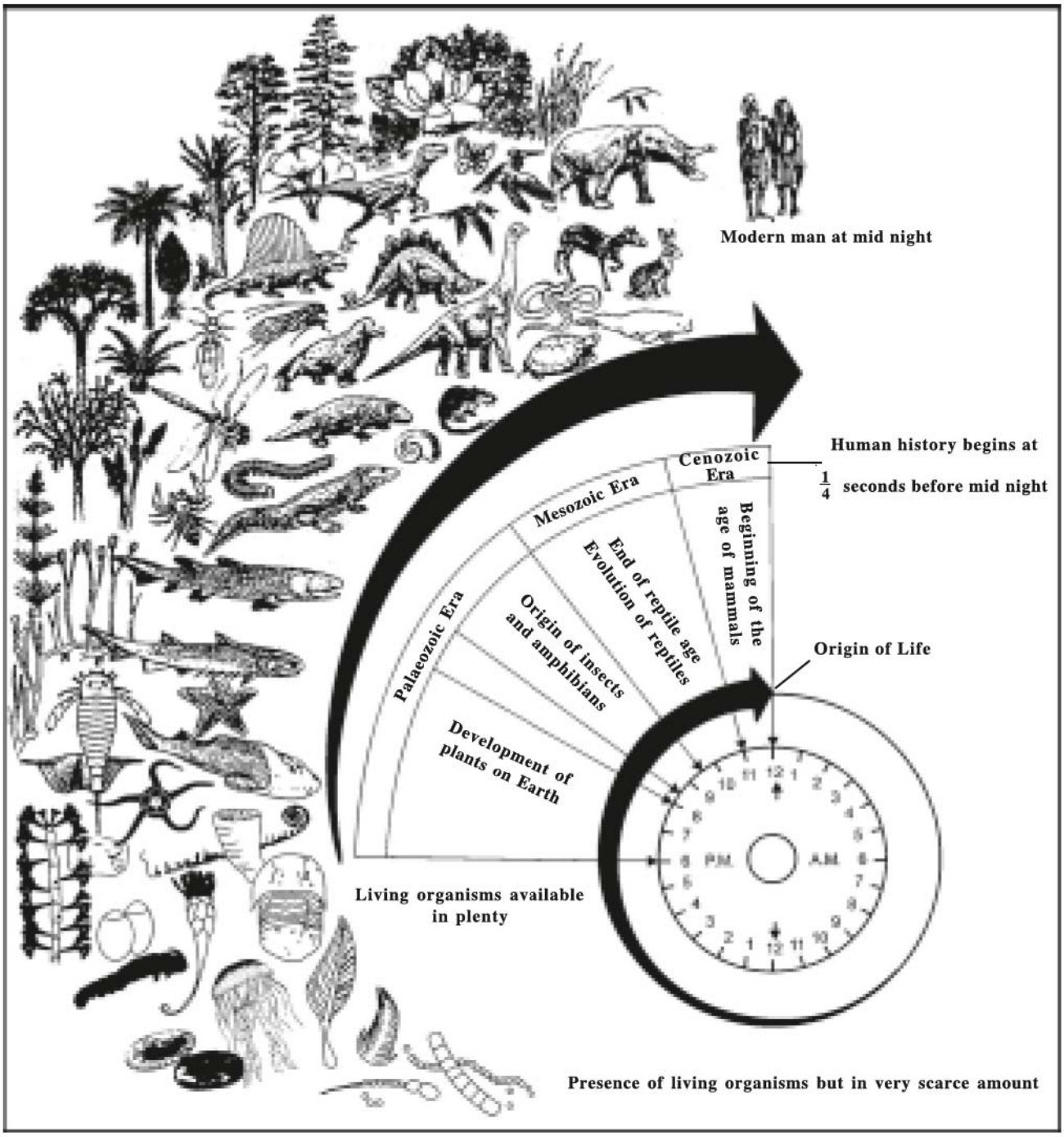
Origion of Life

Initially the Earths atmosphere was not suitable for origin and evolution of life. Hence life originated in the last stage of Earths evolution. Modern scientists believe origin of life to be a chemical phenomenon. It all began with origin of a complex bio molecule. Life originated from such group of molecules.

Life began some 3.8 billion years back, in the form of microscopic organisms in oceanic waters. Life in the beginning was unicellular and was known as amoeba. These microorganisms were like boneless soft mass. With the passage of time, organisms with soft bodies without vertebral column and jaws such as crabs evolved.

Evolution of the plant life also took crores of years. In the beginning, algae developed in oceans, later on followed by terrestrial plants like grass, small plants, flowering plants, climbers and trees.

Later on vertebrates evolved. With time physical changes in the body led to evolution of huge birds and giant sized dinosaurs. As conditions on land became favourable, mammals came into existence. Such animals directly gave birth to their young ones instead of laying eggs. They also took care of their young ones. Apes evolved some four crore years back. With time, animals with developed brain such as chimpanzee, gorilla and baboons developed. Developed apes show some characters resembling humans, hence scholars also call them ape-man.



2.6 Evolution of Life on a 24 Hour Scale

EXERCISE

1. Answer the following questions in detail :

(1) Discuss the Tidal Hypothesis explaining the Earths origin.

(2) Explain Nebular Theory

(3) Describe the Earths interior.

(4) What is the Solar System ? Discuss Earth as a member of the Solar System.

(5) Describe the Big Bang Theory.

(6) How did the atmosphere and hydrosphere develop ? Write in detail.

2. Write to-the-point answer of the following questions :

(1) Write short note on Monistic Hypothesis.

(2) Write about the solar system.

(3) Write about the Binary Star Hypothesis.

(4) Write about the Sun

3. Answer the following questions in brief :

(1) What is a comet ?

(2) What is the Milky Way ?

(3) Which are terrestrial planets ?

(4) Which are the Jovian planets ?

(5) What is Terrafarming ?

(6) Which theories explain the Earths origin ?

4. Answer the following questions in one-two sentences :

(1) Which is the brightest and beautiful planet ?

(2) Triton is a satellite of which planet ?

(3) Who presented the Nebular hypothesis ?

(4) What are sun spots ?

(5) What is a nebula ?

(6) Who gave the Nebular hypothesis ?

(7) Who gave the Inter Stellar Dust Cloud hypothesis ?

5. Select the correct option from the options given and write the answer :

(1) Which is the brightest planet ?

(a) Mercury (b) Venus (c) Saturn (d) Mars

(2) What is the total number of satellites of solar system ?

(a) 173 (b) 141 (c) 09 (d) 136

(3) Which of the following is a name of Saturns satellite ?

(a) Titan (b) Moon (c) Aron (d) Triton

(4) Who gave the theory of Big Bang ?

(a) Limaitre (b) Hubble (c) Otto Schmidt (d) Laplace

(5) Who presented the theory of Nebular Cloud ?

(a) Kant (b) Weizsacker (c) Moulton (d) Chamberlain

3 Constitution of the Earth's Interior

Earth is the planet of the solar system where life exists. The Earth was in a hot gaseous form at the time of its origin. Its matter condensed with time and distinct layers were formed in its interior and outer parts. Initially the Earths surface cooled, condensed and took the form of a solid layer. This solid outer layer of the Earths surface is known as **'crust'**. Just as the Earths origin, man has still not completely understood mystery of the Earths interior. It is not possible for us to directly get knowledge about the structure of the Earths interior, because it is very hot. The Earths interior is in which state ? Why seismic vibrations occur all of a sudden ? Why does a volcano eject very hot matter and earth materials ? Why does tsunami occur ? Are all these phenomena related to the structure of the Earths interior ? So come, let us know the mysteries of the interior.

Sources of Information about the Interior

The Earths centre is located at a depth of about 6370 km. from its surface. It is not possible to go upto the Earths centre and view its interior form. Also, we dont have an X-ray like instrument to know about the Earths interior form. It is also not possible to obtain specimens from the Earths central portion. Since the Earths interior is not visible, our knowledge about the interior is very limited. Whatever we know about the Earths interior is based on indirect sources and imagination. Still, a part of this information is based on direct observations and analysis of material from the interior.

(1) Direct Sources : There are two sources to have direct infornation about the interior : (1) Deep mines and oil wells (2) Material ejected from the interior at the time of volcanism. The worlds deepest mine is the Robinson mine of South Africa. This gold mine is about 4 km deep. Depth of oil well drilled in search of oil is not more than 8 km. Drilling could be done upto 12 km in Kola area of Arctic Ocean. As the Earth has an average radius of 6370 km, mans attempts to know about the interior become futile.

Another source to have direct information about the interior is volcanic eruption. The magma that comes out during eruption, becomes available for research work in laboratory. Still we cannot determine the depth from which the magma comes out.

(2) Indirect Sources : It is possible to get indirect information about the Earths interior by analysing characteristics of materials obtained from the interior. Important indirect sources and their evidences are based on density, pressure, temperature, meteorites, gravitation, magnetic surveys, seismic activities etc.

(1) Density : The Earths average density is 5.5gram/cubic cm. Density of rocks of outer surface of the Earth is 2.7gram/cubic cm. Density of igneous rocks below the lithosphere is 3.0 to 3.5gram/cubic cm. This proves that density of Earths interior part must be more than the parts above. Density of the Earths inner most parts is estimated to be about 11 to 12 gram/cubic cm. The Earths density was first measured in 1774. Measurement of density is based on Newtons law of gravitation.

(2) Pressure : The Earths upper layers exert pressure on the layers below it. Hence as we go towards the Earths centre, density increases due to increase in pressure.

(3) Temperature : Normally, temperature increases by 1 degree Celcius for every increase in depth of 32 metres. At this rate, temperature of the Earths central part is estimated to be more than 6000 degree Celcius. Hot gases and magma, hot water springs and geysers, water vapour ejected during a volcanic eruption suggest that the material in the Earths interior is likely to be in liquid and gaseous state.

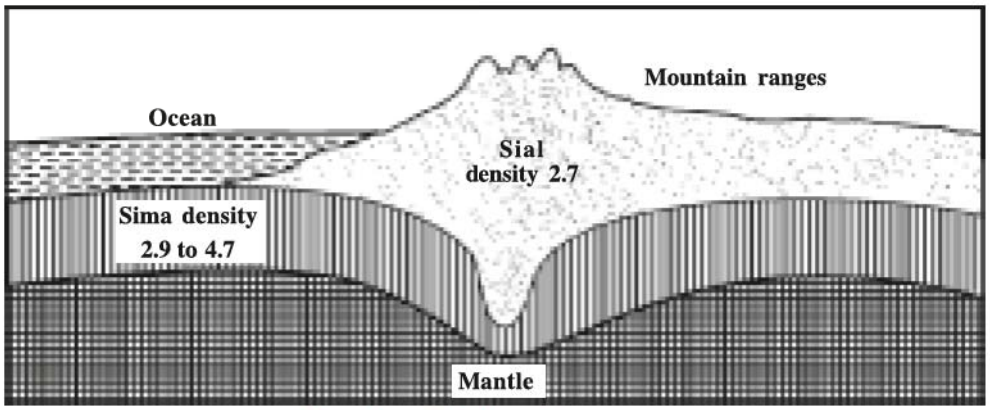
(4) Meteors : Shower of meteors from space on Earth helps to know about the Earths interior. Meteors are known to contain heavy metals like iron and nickel. Its an evidence of presence of heavy metals in the Earths central part. Just like meteors, our Earth is also a member of the solar system.

(5) Gravitation : Different parts of the Earths surface experience gravitational force differently. As the Earths centre is closer to the poles, the gravitation force is more at the poles compared to that at the equator. As the Earths centre is relatively far from the equator, here the gravitational force is lesser compared to that at the poles. Due to uneven distribution of geo-materials in the interior also variations occur in gravitational force. Thus, we can know about the Earths interior.

(6) Magnetic Surveys : Magnetic surveys have proved that distribution of geo-materials is uneven in the Earths interior.

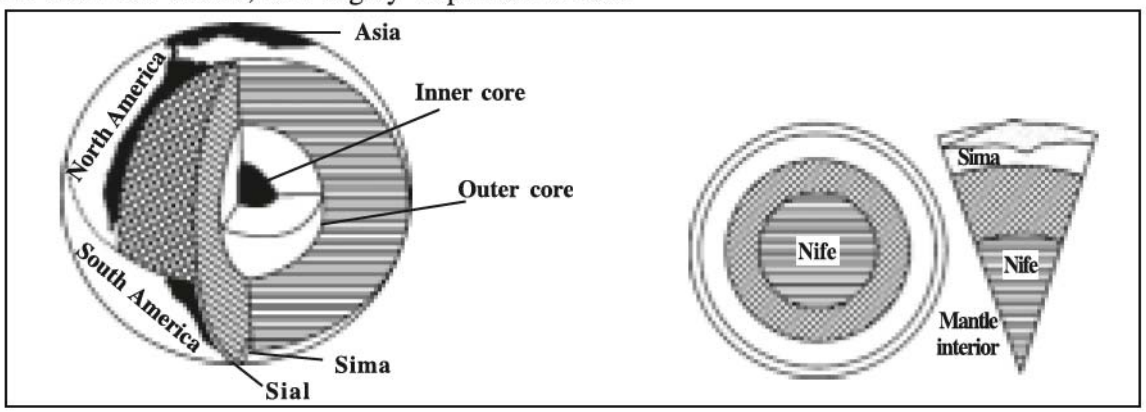
(7) Seismic waves : Seismograph records three types of seismic waves. (1) P-Waves (2) S-Waves (3) L-Waves. On the basis of study of waves recorded, scientists have obtained some information about the Earths interior. On the basis of this information, three divisions have been recognized from surface to the centre : **(1) Lithosphere (2) Mantle (3) Core** . Core has been subdivided into (1) outer core and (2) inner core.

(1) Lithosphere : This is the outer layer of the Earths surface, composed of layers of soil or rocks. It is known as lithosphere or crust. Thickness of the Earths crust is 33 km on an average. It is upto 30 km thick below the continents and 5 km below the oceans. Its thickness is more in the major mountainous regions. Its thickness is about 70 km below the Himalayas. There is a thin layer of sedimentary rocks near the Earths surface. Its lower part is again sub-divided into : (1) Sial and (2) Sima. Sial is composed of granite rocks. It has more of silica and aluminium (Si+Al=Sial). The mean density of this layer is 2.75 to 2.90 gram/cubic cm. Continents are composed of **Sial**.



3.1 Earth's interior structure

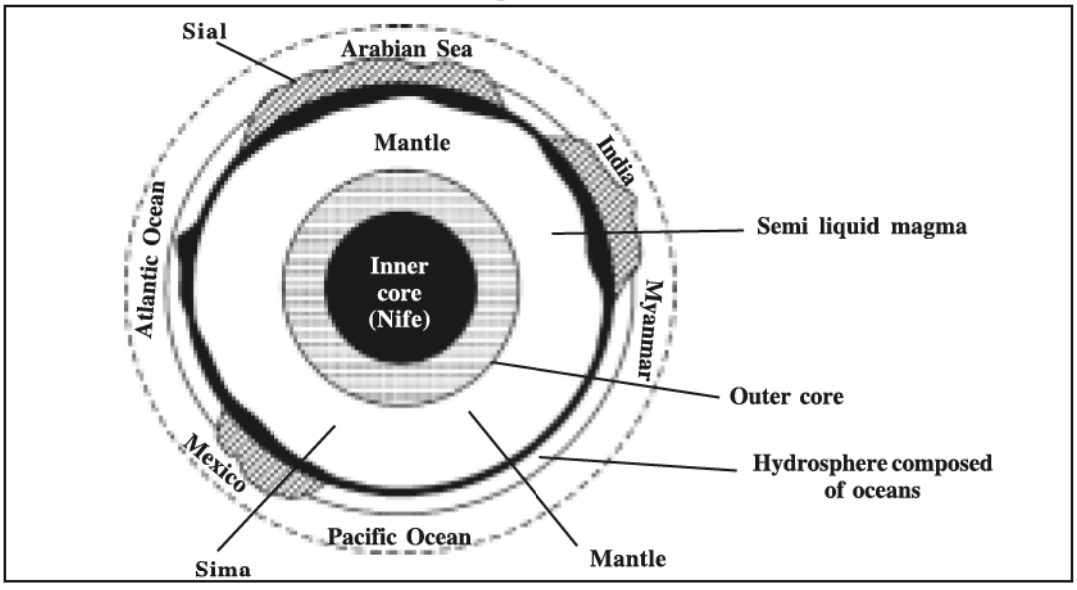
The layer below the Sial has an abundance of silicon and magnesium. Hence this layer is known as **Sima**, from the first two letters of these elements. It is composed of basalt rocks. Here, density of rocks is about 2.9 to 4.7 gram/cubic cm. Its depth is about 1000 km. Sial and sima layers are within scope of man and nature, and highly important to life.



3.2 Earth's interior structure

There is a distinct Sial layer above sima over continents, but in the deeper portions of seas and oceans, the bottom is composed of sima. In Maharashtra, layers of lava can be seen in Matheran near Mumbai. These layers have been formed from spreading of lava ejected during a volcanic eruption. Many rocks of basalt and granite are seen over granite.

(2) Mantle : This layer is below the lithosphere and about 2900 km in thickness. It is composed of mixed mineral content. The upper layer of mantle is known as the Asthenosphere. Its thickness is about 700 km. It has more of basaltic rocks with density of about 3.5. Here matter is in the form of magma. The crust floats over this Asthenosphere.



3.3 Earth's interior structure

(3) Core : The layer from the mantle upto the centre is known as the Core. The Core extends from a depth of about 2900 km to the Earths centre (6370 km). This layer has an abundance of nickel and ferrous mineral matter. It can be sub divided into : (1) inner core and (2) outer core. Outer core is mainly in liquid and semi liquid state. Its density is about 5. The inner core is known as **Nife.** Here density is about 13 gm/cubic cm, which indicates intense pressure. This metallic core is responsible for the Earths gravitational force, magnetic force and rigidity.

EXERCISE

1. Answer the following questions in detail :

(1) Describe structure of the Earths interior, its divisions and explain the lithosphere.

(2) Describe the indirect sources to know about the Earths interior.

(3) Which are the types of sources to know about the Earths interior ? Give information about the direct sources.

2. Write to-the-point answer of the following questions :

(1) What is Sial ?

(2) Write a short note on Mantle.

(3) Write a short note on Core.

3. Answer the following questions in brief :

(1) How many divisions are there according to the Earths interior structure ?

(2) Which minerals are present in Sima layer ?

4. Answer the following questions in one-two sentences :

(1) Lithosphere of the Earths surface is also known as ?

(2) What is the depth of the Earths centre in km from its surface ?

(3) Which is the deepest mine in the world ? In which continent is it located ?

(4) Who gave the law of gravitation ?

(5) What is the average thickness of the lithosphere ?

5. Select the correct option from the options given and write the answer :

(1) The Earths core is also known as ?

(a) Sima (b) Sial (c) Nife (d) Mantle

(2) Which are the major mineral elements in the core ?

(a) Nickle and Iron (b) Silica and Iron

(c) Silica and Magnesium (d) Aluminium and Iron

(3) What kind of rocks are there in Sial ?

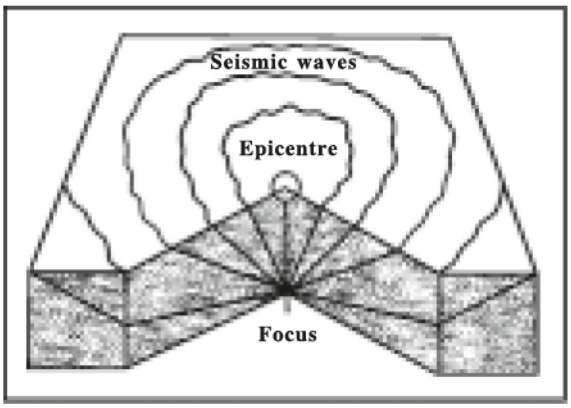
(a) Basalt (b) Granite (c) Lava rocks (d) Sedimentary

(4) Where is the Robinson gold mine ?

(a) U.S.A. (b) Russia (c) South Africa (d) South Korea

4 Earthquake and Volcanoes

The Earths crust appears to have solidified from the outside. But still there is a great amount of heat in its interior. In the interior there is a great amount of pressure of the overlying rock layers. Because of this heat in the interior and changes in pressure, there is expansion or contraction in the form of the rock matter. So movements are experienced in the crust. This process is known as **'Earth movements'**. Earth movements may be slow or sudden.



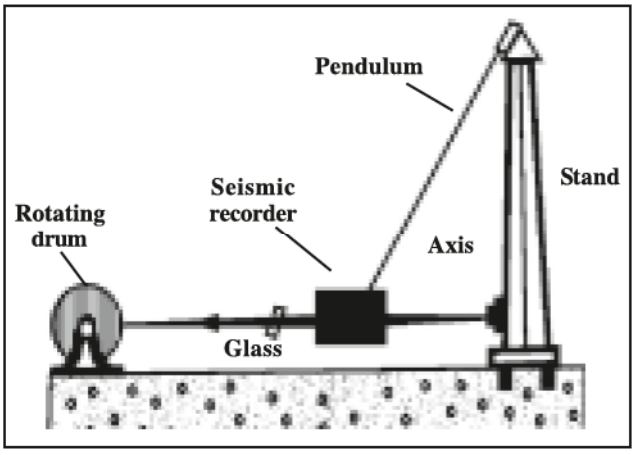
4.1 Focus and Epicentre

The earth movements experienced due to sudden changes in heat and pressure in the interior are known as sudden earth movements. Processes of volcanism and earthquake are sudden earth movements.

It brings many changes in regions of weak geological structure. When due to earth movement some weak portion of the earths surface gets suddenly vibrated, then such vibrations are known as **earthquake**. Earthquakes occur all of a sudden, accidently and rapidly. The Bhuj earthquake of 26 January, 2001 caused great devastation within few minutes. Earthquake is a natural phenomenon. Wave like vibrations that arise from disturbance in rocks within the interior of earth are called earthquake. **(Arthur Holmes)**. Just as circular ripples are produced when a stone is dropped in a pool of calm water that propagate outside from centre, in the same way, seismic waves also spread in all directions from the point of disturbance. The place from where seismic waves originate is called the **Focus**. The place on the earths surface exactly above the focus where seismic waves reach first is called the **Epicentre**. The most disastrous effect of earthquake is experienced around this centre.

The focus of the earthquake is located between a depth of 60 km to 700 km. The earthquake (seismic) waves originate at this depth and reach the surface within few seconds. It is called a **Shallow Earthquake**, if the focus lies upto a depth of 60 km from the surface, an **Interim Earthquake** if the focus lies between 60 km to 250 km, and a **Deep Earthquake** if the focus lies between 250 km to 700 kilometres.

Seismograph and Seismic Waves

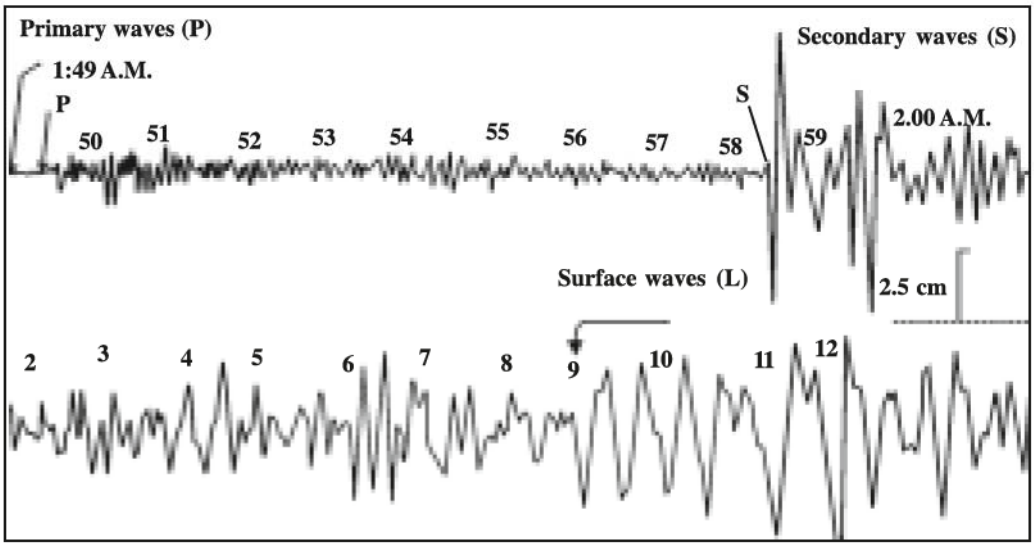


4.2 Seismograph

The science that studies earthquake is called Seismology. The word Seismology is derived from the Greek word Seismos, which means earthquake. Information about earthquake intensity and the point of origin can be obtained from the Seismograph. The main part of this instrument is a hanging pendulum. Its upper end is attached to a pillar. The other end is kept free for movement. A pen is attached to it. The pen rests on a cylinder, around which a paper or a graph is wound. It is linked to a clock as well. During earthquake, lines continue to be drawn on the paper depending on the magnitude of vibration. Being linked with the clock time is also recorded.

By comparing the graphs recorded on **Seismographs** kept at different places, it is possible to obtain information about the focus and epicenter of the earthquake. In India centres that record earthquake are located at Mumbai, Kolkata, Delhi, Dehradun, Hyderabad and in Gujarat at Rajkot, Vadodara, Gandhinagar, etc.

Three types of seismic waves are recorded on a seismograph.



4.3 Seismic waves

(1) Primary Waves (Longitudinal waves or P-Waves) : These waves have the highest speed. Hence they are the first to be recorded on an earthquake station. These waves can pass through both liquid and solid mediums. Their speed decreases as they enter liquid medium. In central part they travel at the speed of 8 to 14 km per second. The waves are refracted as the density of matter changes.

(2) Secondary Waves (S-Waves) : The speed of these waves is less compared to the primary waves. They can pass through only solid medium. In these waves, particles move up and down at right angles to the wave direction. These are similar to light waves. They end up in sea or liquid medium. They also penetrate to greater depths from earths surface.

(3) Surface Waves (L-Waves) : These waves spread over the earths surface in a direction perpendicular to its circumference. These waves are similar to waves produced when a stone is dropped in a calm water body. Their speed is 3 km per second. These waves are the most destructive. Destruction caused by earthquakes is due to these waves. When these waves enter the sea, very high and destructive waves are generated in sea water, known as tsunami. Since these waves cannot pass through the core they are not useful in understanding the earths interior. Characteristics of speed and direction of P and S Waves give information about the interior parts of the Earth.

Causes of Earthquakes

Earthquakes are caused because of some disturbance in the Earths state of equilibrium. Also, earthquakes occur because of some responses to invisible phenomena that occur below the Earths crust. Major causes of earthquakes are : (1) Faulting (2) Volcanic eruption (3) Isostasy (4) Water vapour (5) Man.

(1) Because of tectomic movements in the interior, **tension** and **compression** are created on the rock strata. Under these forces, geo-materials in the interior experience compression and expansion. Earthquakes are caused because of faulting. Faulting is responsible for earthquakes experienced in African Rift Valley and Narmada Valley and in the young fold mountains like the Himalayas, Alps.

(2) Most of the earthquakes that occur on the earths surface are because of volcanic eruptions. During explosion, hot magma tries to make its way out. A strong earthquake is experienced in an area of about 150 to 200 km around the volcano.

(3) When isostatic imbalance occurs, a transfer of magma occurs in the interior at some depth for reestablishment of isostasy, producing vibrations in rock layers. Earthquakes occur because of this in the Hindukush range near the Pamir Plateau. Its effect is seen over long distances. The effect of Nepal earthquake of April, 2015 was experienced upto Bihar in India.

(4) When some surface water enters below the Earth's surface, it gets converted to water vapour because of heat there. Vapour occupies 1300 times more space than water. Because of this pressure of vapour, earthquake occurs in the weak relief zones of the Earth.

(5) Man constructs tunnels, dams and mines on the Earth's surface. He brings out oil from below the surface. He also constructs dams, skyscrapers, railway tracks, roads and levels the land. Experiments of atomic explosions result in artificial earthquake in nearby areas.

(6) Landslide, snowfall, fall of rock boulders and a meteor hit from outer space may also cause earthquake in mountainous regions.

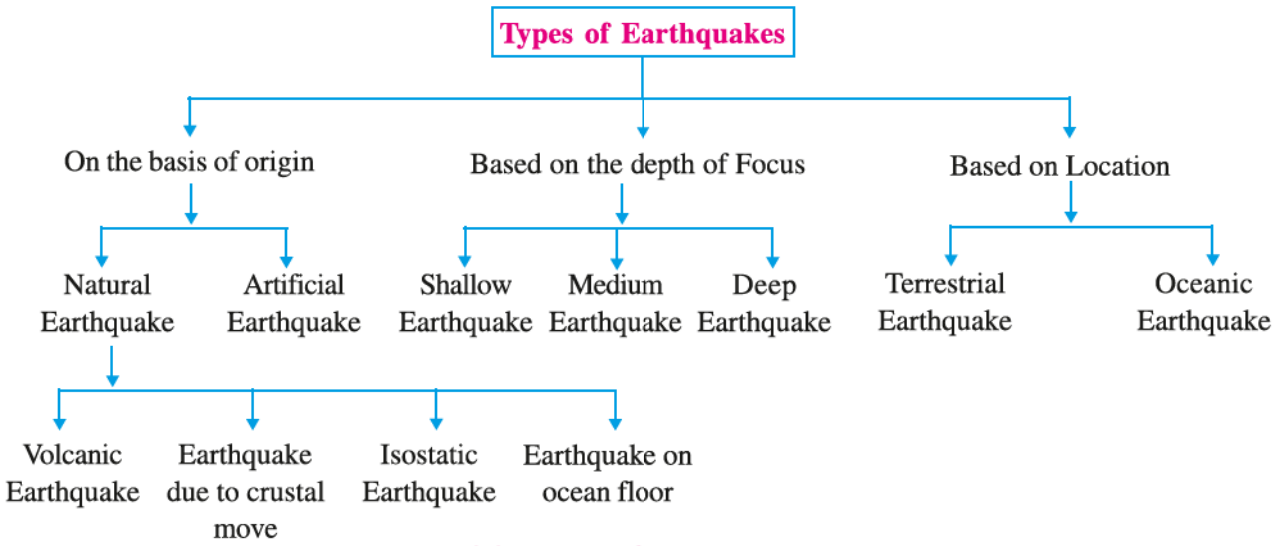
Effects of Earthquakes

Effects of earthquakes are destructive and constructive. Because of earthquakes thousands of human deaths occur. Also several buildings collapse in the earthquake affected area. The Bhuj, Kutch disastrous earthquake of 26 January, 2001 in India had an intensity of 7.9 on Richter scale. Thousands died in the incidence. Parts of Turkeys Tangiers city, Japans Tokyo city, Macedonias Skopje city have been devastated due to earthquakes. Many buildings collapsed into the ground. Roads were broken. Systems of water and electricity were disrupted. Sometimes rivers change their courses due to earthquake. When an earthquake occurred in Assam in 1950, Dihang and Brahmaputra rivers changed their courses. The dam on Subansiri river in Assam was also destroyed. In the past Indus river flowed into the Gulf of Kachchh but now it flows through Pakistan. Thus because of earthquakes, roads are destroyed, railway tracks bent, bridges and dams on rivers collapse and rivers change their courses. When earthquakes occur on sea or ocean bed, a high and huge wave called **Tsunami** develops. In December 2004, tsunami waves developed near Sumatra island of Indonesia and reached the Andaman and Nicobar islands and the Coromandel coast of Tamil Nadu, causing great loss of life and property. A major part of Indias southern most point, the Indira Point has become submerged in water. Such type of waves cause great damage to coastal cities and ports.

Constructive effects of earthquakes

- Because of earthquake we can know about the interior structure of the Earth.
- Because of earthquake tensional and compressional forces act on rock layers, resulting in faulting and folding. As a result landforms such as rift valley, mountains, plains, plateaus, continental shelf, etc are formed. New sources of water become available.
- Earthquakes cause drastic changes in rocks and this makes many minerals available. It helps to locate oil and gas reserves and related research works.
- New islands or archipelago are formed in mid sea water. **New Moor island** to the south of Kolkata in the Bay of Bengal is an example.

Types of Earthquakes



4.4 Types of Earthquakes

There are two scales to measure earthquake : (1) Richter Scale that measures earthquake intensity and (2) Mercalli scale that shows extensiveness of earthquake.

Probable Seismic Zones : Most of the identified seismic zones lie in the oceanic and continoutal margins with a weak geological structure. They are mainly distributed in two belts.

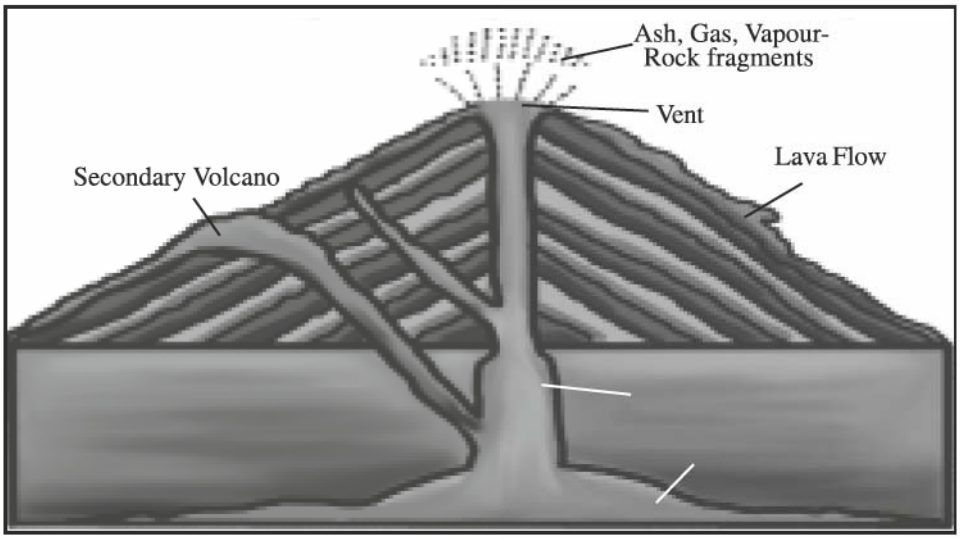
(1) Circum-Pacific Belt : About 68 % of the worlds earthquakes occur in this belt. Rockies and Andes mountain ranges located along the Pacific coast of North America and South America, mountain coastal ranges of China, Japan, Philippines and Indonesia in Asia and also of New Zealand are included in it.

(2) Mid-Continental Belt : About 21 % of the worlds earthquakes occur in this belt. The young fold mountain ranges that extend from Atlantic coast in the west to the Pacific coast in the east are possible earthquake zones. In this belt, earthquakes mainly occur in the Alps and the Atlas mountain ranges located to the north and south of the Mediterranean Sea respectively and in the Himalayas in Asia. Other than these, scattered islands in the Indian and Atlantic Oceans are also possible earthquake zones. (See Figure 4.6)

Volcanoes

Volcanoes are a sudden and surprising phenomena that occur on the Earth's surface. It is a natural phenomena that brings about a change in a limited region of the Earth. Its effects are big and long lasting. When balance of surface relief is disturbed, hot magma, ash, water vapour and other gaseous material rush to the surface with great velocity and making their way through a fissure or vent in the weak rock layers and are thrown out on the surface. This process is known as **Volcanicity**.

The path through which volcanic material magma, gases, ash, water vapour, etc are ejected from the Earths interior on to the surface is known as **'Volcanic Pipe'**. A funnel shaped hole that develops on the land surface above the volcanic pipe through which materials from the interior are ejected on to the surface is known as volcanic mouth or **vent**. Because of repeated volcanic eruptions when the volcanic mouth becomes quite big it is known as **'Caldera'**. When lava, rock material, ash etc get deposited around the vent, a cone shaped mountain is formed, known as **'Volcanic Mountain'**. A saucer shaped landform that develops above the volcanic pipe is known as a **'Crater'**.



4.5 Volcano

The reasons for volcanic eruption are as follows :

(1) The Earth's hot interior and its form : When the Earth originated it was in the form of a hot gaseous ball. The crust cooled and solidified. Still there is great heat in the interior. Due to radioactive decomposition of elements such as uranium, radium, thorium present in the Earths interior, heat is generated. This also keeps the interior hot.

(2) Origin of Magma : When because of some reason, in areas of weak strata, the pressure of overlying rock layers is reduced, the rock materials turn into magma due to heat in the interior. The magma thus formed in the Earths interior is responsible for **volcanic eruption**.

(3) Origin of gases and water vapour : As the magma expands, its heat gives rise to various gases. The surface water percolating through cracks in rock layers on coming in contact with magma, turns into water vapour. Also waters of seas and oceans on entering the interior, get converted into vapour, which rushes to the surface at the time of eruption.

(4) Upwelling of magma to the Surface : Water vapour occupies 1300 times more space than water. When water vapour in the interior doesnt get enough space, it tries to force its way out. It also drags liquid magma to the surface with itself. It rushes out rupturing the rock layers, either as explosion or slowly. This process is known as **volcanic eruption**.

Types of Volcanoes

According to the form or time duration between two eruptions, types of volcanoes are as follows :

(1) Active Volcano : A volcano from which lava, water vapour, gases and other materials continue to be ejected almost continuously is called active volcano. Mt. Etna volcano of Italy is an example. It is active since last 2500 years. In the Stromboli volcano of Sicilys Lipari islands, explosions occur after almost every 15 minutes. Mt. Cotopaxi in South America is the worlds highest (6500m) active volcano. Stromboli is well known as the Lighthouse of the Mediterranean because the light from burning gases coming out of it is seen quite far. Barren Island in Indias Andamans becomes active after regular intervals. Hence it is an active volcano.

(2) Dormant Volcano : When a volcano erupts after remaining quiet for many years, it is called a dormant volcano. Vesuvius of Italy is its best example. After remaining dormant for many years, it erupted in the year 1931. Since then it is dormant. Indonesias Krakatoa, Chiles Aconcagua and Japans Fujiyama are dormant volcanoes.

(3) Extinct Volcano : If the vent of a volcano is filled with water to form a lake and there are no signs that it will erupt in any future, such volcano is called an **'extinct volcano'**. Mt.Kilimanjaro in Africa, Mt. Popa of Myanmar, Irans Koh-e-sultan and Narcondam in Andaman in the Bay of Bengal are extinct volcanoes.

Destructive effects of Volcano

- When volcanic eruptions occur on ocean floor exceptional sea waves tsunami are formed. They cause great destruction near coastal areas. When Krakatoa volcano erupted in 1883 tsunamis caused great destruction in the coastal areas of Java and Sumatra and some regions also got submerged in water.
- Hot gases, ash and hot lava coming out of the volcano cause destruction in the region around volcano. Many people are believed to have been died up till now when Italys Vesuvius volcano erupted spewing hot ash and suffocating gases.
- Gases such as hydrogen, carbon dioxide and sulphur dioxide coming out from a volcano heavily pollute the atmosphere.
- When a volcano erupts on a sea floor, sea creatures of that area are destroyed. This causes marine ecological imbalance.
- Violent eruptions of volcano cause earthquakes. When Mt. St. Helens volcano erupted in 1980 in America, about 40 earthquakes were recorded per hour on that day.
- The natural hazard of volcanic eruption damages human and vegetation life.
- The ash that is added to the atmosphere due to volcano acts as a barrier to air traffic.

Constructive effects of Volcano :

- Volcanoes act as a natural safety valve. Magma and gases under heavy pressure beneath the surface get released through this medium.
- Volcanism helps us in understanding the Earths historical evolution and its structure.
- Many minerals are obtained from the lava that solidifies after a volcanic eruption.
- Igneous rocks like basalt and granite formed from lava are used in building purposes.
- Lava rocks when eroded produce fertile soils. Such soils are very useful for crops like cotton, sugarcane, tobacco, wheat, etc.
- The ash coming out of a volcanic eruption gets deposited in nearby areas. As a result, lands of farms and gardens become fertile. In Italy, after eruption of Vesuvius, the soils that have become fertile with ash deposited on its slope, give maximum yield of grapes.
- In Japan, Hawaii islands and Iceland, volcanoes are useful in getting geo-thermal energy.
- In some areas near dormant volcanoes, natural scenery develops. Hence, tourist places develop here. In Japan, Mt. Aso located at a distance of 50 km from the volcanic mountain Unzen is considered one of the best tourist places. Beautiful white fumeroles coming out of it attract tourists.
- Lakes formed in crater and caldera sometimes form headwaters of rivers. Africas Lake Victoria is its example. The river Nile originating from it is the lifeline of Egypt.
- When rain water collects in a crater, a beautiful crater lake is formed. Lake Lonar in Maharashtra and Dudhia pond over Pavagadh in Gujarat are its examples.
- Volcanic eruptions give rise to hot water springs, hot water ponds and geysers. Taking a bath in such hot water containing sulphur cures skin diseases. In Gujarat, Tulsishyam is well known for its hot water springs. Many patients of skin disease come here.

Distribution of Volcanic Regions

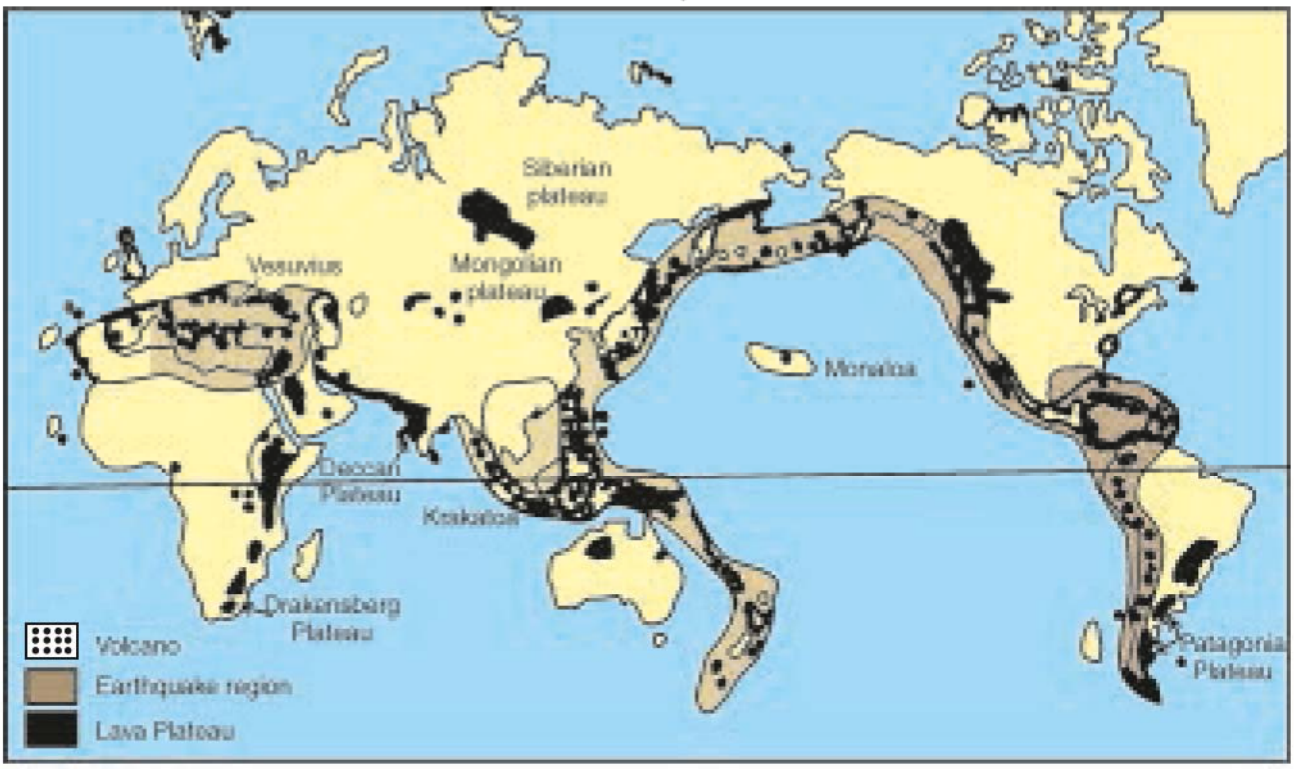
Volcanic regions are located in areas of weak structure of the Earths surface. Volcanoes are also located in areas of young fold mountains. Vodcanoes of the world are mainly located in three areas :

(1)Circum Pacific Belt (2) Mid-Continental Belt (3) Belt of the Atlantic Ocean.

(1) Circum Pacific Belt : Maximum volcanoes are found here. Hence some scholars term it as the Pacific Ring of Fire. On the eastern coast of the Pacific Ocean, the Rockies and the Andes mountain ranges and on the opposite side, New Guinea, Solomon, New Zealand, Indonesia, Phillipines, Japan and Alieutian Islands are included in this zone. In south pole region, Foss Island is a volcanic region. The highest volcanic mountain of the world, Mt. Cotopaxi of Equador in South America (altitude more than 6500 m) is situated in this belt. Besides, Mt. Mayon (Phillipines), Fujiyama (Japan), Popocatipetal (Mexico) are other well known volcanoes of this belt.

(2) Mid-Continental Belt : In this belt, the Alps in southern Europe and the Himalayas mountain range extending east-west in central Asia are volcanic areas. The belt starts from Iceland, passes through Scotland and extends upto Cameroon of Africa. A branch of this belt extends upto West Indies and another branch passes through Spain, Italy, Mediterranean Sea, Caucasus, Iran, Afghanistan and after passing to the north of the Himalayas, turns towards Myanmar. Surprisingly, there is not a single active volcano in the Himalayas. Barren Island and Narcondam Island in the Bay of Bengal are volcanic islands. Also, Koh-e-sultan (Iran), Ararat (Turkey), Kilimanjaro (Africa) and Mt Popa (Myanmar) etc. are well known volcanoes of this belt.

(3) Belt of the Atlantic Ocean : This belt starts from Iceland in the north Atlantic and passing through Azores reaches Tristan-d-Cunha island in the south Atlantic. Azores and St. Helena are major volcanoes of this belt. South Antilles islands is a major volcanic area.



4.6 Distribution of Volcanoes, Earthquakes and Lava Plateaus

EXERCISE

1. Answer the following questions in detail :

(1) Write in detail about the seismic waves.

(2) Describe the destructive effects of earthquakes.

(3) Write about the types of volcanoes.

2. Write to-the-point answer of the following questions :

(1) What are the causes of earthquakes ?

(2) Prepare a short note on seismograph

(3) What are the reasons for volcanic eruptions ?

(4) Describe the constructive effects of a volcano.

3. Answer the following questions in brief :

(1) Underground explosions are harmful. Explain.

(2) What are the types of volcanoes ?

(3) Write names of important volcanoes of the world.

(4) Volcanic eruption is a natural hazard How ?

4. Answer the following questions in one-two sentences :

(1) Which landforms are formed because of earthquake ?

(2) Which is an active volcano ?

(3) Which are the scales for measuring earthquake ?

(4) Which is the worlds highest active volcano ?

(5) Which pond of Pavagadh is formed by filling of water in volcano ?

5. Select the correct option from the options given and write the answer :

(1) Which volcanic mountain of Japan is considered dormant ?

(a) Mount Popa (b) Vesuvius (c) Fujiyama (d) Stromboli

(2) Which country uses volcano to generate geo-thermal energy ?

(a) Sri Lanka (b) Japan (c) India (d) Iran

(3) The earthquake intensity can be measured by which instrument ?

(a) Seismograph (b) Barograph (c) Anemometer (d) Barometer

5 Continents and Oceans

Many problems regarding the origin of continents and oceans have remained unsolved. As knowledge about the Earths structure increased, more and more ideas about the distribution and origin of continents and oceans were also presented. Among these, **continental drift** theory and **plate tectonics** theory became widely accepted. There are various landforms on the Earth such as continents, oceans, mountains, valleys, plateaus, plains, etc. These distinct landforms differ from each other in their characteristics such as shape, rock structure, height, amount of plane surface, slope, etc. Hence they are known as landform. Landforms of the Earths surface are divided into 3 groups (1) Landforms of first order (2) Landforms of second order (3) Landforms of third order.

The landforms that were formed first after the origin of the Earth, such as continents and ocean basins are known as landforms of first order. With time first order landforms such as continents and oceans experienced endogenic earth movements to form mountains, plateaus, plains, rift valleys, etc. which are known as landforms of second order. After a long time, these second order landforms under the influence of exogenic forces (river, glacier, wind, ground water and sea waves, etc.) undergo denudation and deposition to form landforms of third order. Ravines, deltas, valleys, small hills, etc. and such other landforms were formed. Under the influence of Earth movements, a major part of the Earths crust got fragmented. These fragmented continents were drifted in various directions and were placed at various locations. Water was filled in low lying areas. The land masses above the water level are known as **continents** and areas of huge water masses are known as **oceans**.

Characteristics of Distribution of Continents and Oceans

The total area of the Earths surface is about 50.68 crore square km. Out of this about 36.60 crore square km area is occupied by seas and oceans. It is known as the hydrosphere. Continents spread over an area of about 14.08 crore square km. Percentage area of seas-oceans and continents is respectively 71 % and 29 % respectively.

The equator divides the Earth into two equal parts, the northern hemisphere and the southern hemisphere. The northern hemisphere is known as the **land hemisphere**. About 81 % of the Earths land area lies in this hemisphere. Here lie the continents of North America, Europe, Asia and parts of Africa and South America. In the southern hemisphere there is a predominance of water bodies, hence it is known as the **water hemisphere**. If water and land areas are compared, we see that it has about 90.5 % water area and only 9.5 % land area. In northern hemisphere, between 20 and 90 degree latitudes, and in southern hemisphere, between 70 and 90 degree latitudes, there is predominance of land. The Pacific, Atlantic, Indian and Arctic these four oceans together occupy about 92.7 % area of the Earths total water area. Continents and oceans are almost triangular in shape. Oceans are broad towards their southern side and become narrower towards the north. Continents are broad in the north and narrow in the south.

On the earth, the oceans and continents are almost arranged diametrically opposite to each other. Oceans occupy more area in the south, while less area in the northern hemisphere.

Theories about Distribution of Continents and Oceans

Theories about distribution of continents and oceans are helpful in solving the problems of their origin. Solace, Green, Gregory, Kelvin, Harry Hess, Wegener and other scholars have presented their views on the origin of landforms of first order.

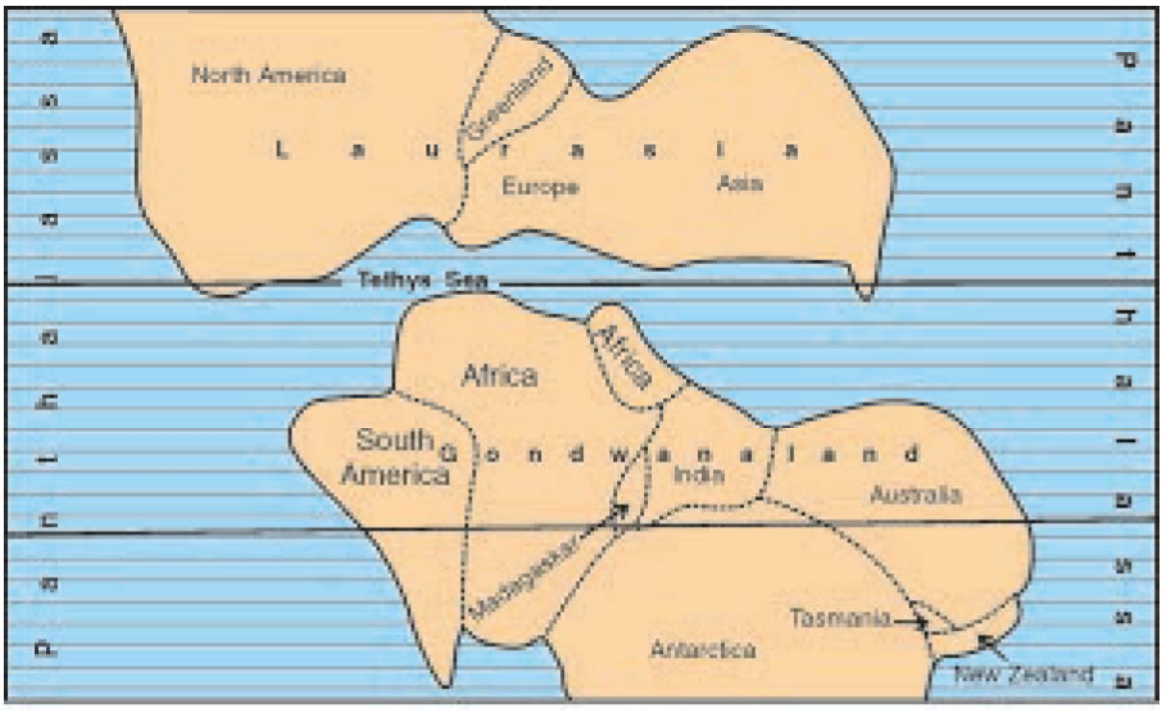
The continents located far and wide away from each other, besides showing variations in their vegetation, geological structure, animals, landforms and other aspects exhibit similarities as well. Marsupials, found in Australias forests have also been found as fossils in South America. Evidences show that the

coal found from the Appalachians in North America and that from west Europe was formed during the same period. Evidences also indicate that climate of some regions was quite different in the past than that from the present. This is possible only if (1) there was a fundamental change in climate or (2) in the remote past, the present continents were located somewhere else and displaced later on.

Keeping in view the second possibility, German meteorologist Alfred Wegener presented his Continental Drift Theory explaining the origin and distribution of continents and oceans in 1912. After its translation to English in 1924, it became popular.

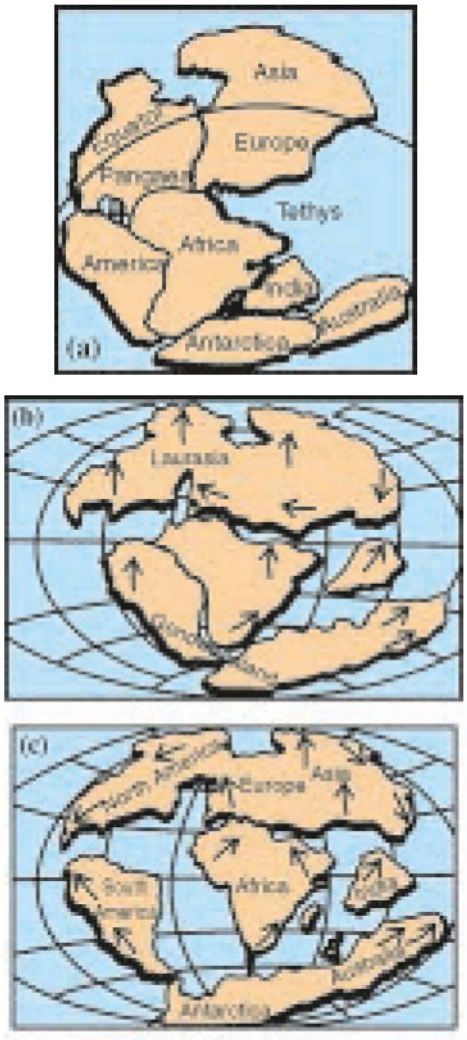
Continental Drift Theory by Wegener

Before Wegener presented his Continental Drift Theory, Snaidor, Fisher, Taylor, Bacon and other geographers had also presented their views about this. The Earths geological and natural history is preserved in its rocks in the form of fossils of ancient animal and plant life. Fossils have been found from various parts of different continents that show resemblance. Based on this, an idea developed in 1912 that about 20 crore years in the past, the present continents were joined with each other. There was one and only one continent on the Earths surface which Wegener termed as the **'Pangaea'**. Pangaea is a German word, which means a primitive continent. According to the Continental Drift Theory, northern part of the Pangaea is known as **'Laurasia'** and the southern part is known as **'Gondwanaland'**. Between these two land masses and extending east-west was the **Tethys Sea**. Laurasia to the north of Tethys comprised of todays North America, Europe and Asia continents. Gondwanaland to the south of Tethys comprised of South America, Africa, Peninsular India, Australia and Antarctica continents. The super continent, Pangaea was surrounded on all sides by a shallow sea known as the Panthalassa. At this time, Antarctica continent was situated near the southern coast of south Africa. This concept provides latest information about the shape of coasts of continents, composition, vegetation, animal life, location, etc. With the passage of time, as the Pangaea fragmented, continents and oceans were formed. Wegener was a climatologist and a geophysicist. He gave evidences from geomorphology, geophysics, geology, climatology and other sciences in support of his Continental Drift Theory. Fig. 5.1 makes clear the theory of Continental Drifting.



5.1 Position of continents about 20 crore years before present

During the Mesozoic Era, because of the Earths gravitation and other forces, the Pangaea was fragmented. The fragmented continents were floating on the Sima below them like huge rafts. Some continents after being detached from the supercontinent, began drifting in the direction of the force. North America and South America after separating from Europe and Africa, began drifting westwards. Africa and Europe moved towards the equator. During the Tertiary Period, Australia and Antarctica drifted southwards. The Indian sub-continent separated from Africa and drifted north-eastwards. With time, the continents attained their present positions. Vacant areas were formed between continents. Water was filled in these vacant areas to form oceans and seas.



5.2 (a) Pangaea (b) Laurasia & Gondwanaland (c) Continents after drifting

Wegeners views on Continental Drift were presented in 1912. Originally written in German language, the book was later on translated to English. The views presented by him got acceptance. American geologists were not ready to accept Wegeners views. However due to Blacketts concept of Polar Wandering (1950-1960), Harry Hess concept of Sea-floor Spreading, (1960), Tetrahedral Theory of Green and Gregory, etc., continental drift theory began to be accepted.

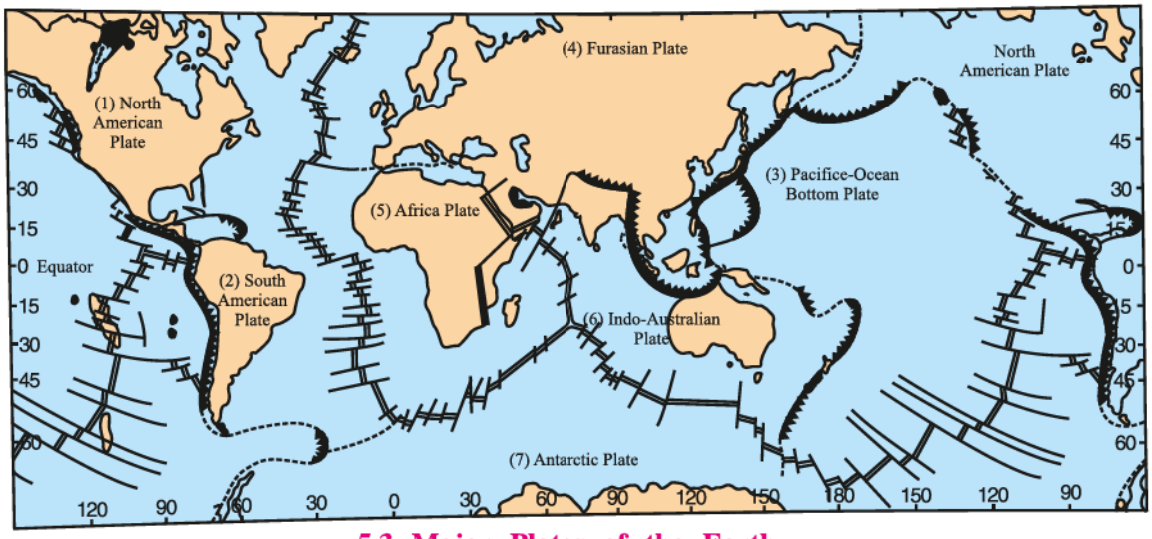
Wegener explained that if the divided continents were properly rearranged they will fit into one complete figure. For this he made use of the Jig-saw fit puzzle. If different pieces were to be placed in their proper places as per Pangaea, a shape as shown in fig. 5.2 is formed. In his opinion, South America and western Africa on either sides of Atlantic Ocean, have shapes that fit well into one another. Similarly, North America and Greenland along with Europe form one whole shape. The shape of northern coast of Australia fits well with the Bay of Bengal.

In the opinion of **Swess**, Sial is spread over the entire Earth including the ocean bottoms. Sima is denser compared to Sial. Central Africa and Brazilian Highlands are composed of similar ancient hard igneous rocks. The geological composition of both coastal regions of the Atlantic Ocean resembles one another. The Arabian Plateau, Peninsular plateau of India and the vast west Australian Plateau are also made of ancient igneous rocks. Also, similarities exist in moraines of these regions. Coal belonging to the same period has been found from the Appalachians of North America and mountainous areas of Europe and British Islands. There is similarity in fossils of ancient vegetation and animals, insects found from coastal regions on either sides of the Atlantic. Some animals and birds even after centuries continue to migrate to their native. Mice and other reptiles of Scandinavia migrate westwards to Iceland, the homeland of their ancestors. Some animals of Iceland resemble to those of north Scandinavia. Above examples provide evidences in support of Wegeners Continental Drift Theory. **'Sea floor Spreading'** and **'Plate Tectonics Theory'** have also increased the significance of continental drift theory. Still some questions about the theory have remained unsolved.

Plate Tectonics Theory : Continents and ocean floors are known to drift as a unit. It also includes the Asthenosphere lying above the mantle. Such rigid landmasses are known as **'Plates'**. This theory provides information about global expansion or contraction of land effects of tidal forces due to the Moon, upliftment of extensive parts of the Earths surface, drifting of continents, sea floor spreading, etc. There are seven major plates : (1) North American Plate (2) South American Plate (3) Pacific Plate (4) Eurasian Plate (5) African Plate (6) Indo-Australian Plate (7) Antarctic Plate. Besides there are another twenty minor plates. These plates are separated from each other by mountain ranges, young fold mountain ranges on land, submerged trenches, etc. After all plates are structural forms. Ridges, trenches, volcanic islands, seismic areas, rift valleys, etc are associated with plate margins.

Plates vary in their areas. Some plates have an area of 10,000 square km or less area, while some other plates extend for more than 10 crore square km area. Pacific, African, Eurasian, etc. are major plates, while Bismark, Solomon, Somalian, Nazca, Cocos, Arabian, Fiji, Phillipines, Caroline, etc are minor plates.

If two plates are moving in opposite directions with respect to each other, they are known as **Divergent Plates**. If two plates are moving towards each other, they are known as **Convergent Plates**. The thickness of plates is likely to be 47 km or more, because the average thickness of continents is 40 km and that of ocean bottom is 7 km. Yet another estimate puts the thickness of plates at 70 km below oceanic areas and 150 km below the continents.



5.3 Major Plates of the Earth

Evidence regarding plate movement is provided by a chain of extinct volcanic mountain chains. It is believed that convection currents originating in the Asthenosphere keep the plates moving. There is very hot matter in the mantle, which provides source for origin of volcano. Volcanoes located on drifting plates when get displaced from very hot central parts become extinct. According to some geographers, convection currents are not responsible for plate motion. In their opinion the magma in the mantle erupts from fissures in the Pyrosphere, forming new ocean bottom. It drifts in the direction of slope under the push of lava. New ocean bottom acts like a conveyor belt. The plates move on it like steps of a ladder.

In the plate tectonics theory, an attempt is made to jointly justify Sea-floor spreading and Continental Drift theory. This is the most important scientific concept explaining the origin and distribution of continents and oceans as well as orogenic process.

Drifting of the Indian Plate

There are seven major plates in the world. Indian Plate is one of them. This plate comprises of the Indian sub continent, Australia continent, Tasmania, New Zealand, ocean bottoms of the Indian Ocean and parts of south-western Pacific Ocean. As the Indian Plate drifts north-eastwards, pressure develops between the Indian and Eurasian plates. This has resulted in the formation of the Himalayas. The Nepal earthquake of April, 2015 is the result of this process. The Indian Plate is believed to have separated from Antarctica about 75 million years before present. This plate has covered a distance of some 5000 km so far.

The Himalayas lie to the north of the Indian Plate, while to the west and south are the Indian Ocean ridges. (1) Ninety East Ridge and (2) Mascarene Ridge lie on the bottom of Indian Ocean. These ridges are part of the global volcanic belt.

EXERCISE

1. Answer the following questions in detail :

(1) Explain the characteristics of distribution of continents and oceans.

(2) Explain the Continental Drift Theory.

2. Write to-the-point answer of the following questions :

(1) What is a landform ? Mention the types of landform.

(2) What is a plate ? Which are the major plates ?

(3) Explain motion of the Indian Plate.

3. Answer the following questions in brief :

(1) Explain the meaning of Pangaea.

(2) Write information about Gondwanaland.

(3) Which hemisphere is known as the Water hemisphere ? Why ?

4. Answer the following questions in one-two sentences :

(1) Continental Drift Theory can be explained on the basis of which theory ?

(2) Which are landforms of the second order ?

(3) Which concept has lent support to the Continental Drift Theory ?

(4) Which are the major plates ?

5. Select the correct option from the options given and write the answer :

(1) What is the number of major plates ?

(a) 7 (b) 8 (c) 9 (d) 15

(2) What is the total % area of Hydrosphere on the Earths surface ?

(a) 70 (b) 72 (c) 71 (d) 80

(3) Pangaea means ...

(a) Tethys Sea (b) Ancient super continent (c) Panthalassa (d) Water hemisphere

(4) In which ocean is the Mascaren Ridge located ?

(a) Pacific (b) Atlantic (c) Arctic (d) Indian Ocean

(5) Who was the German scientist that gave Continental Drift theory ?

(a) Alfred Wegener (b) Gregory (c) Solace (d) Harry Hess

Activity

- Make **Jig-saw-fit** Puzzle under the guidance of a teacher.
- Prepare a diagram of major plates of the Earth

6 Rocks, Minerals and Soil

There are vast layers of solid and liquid matter on the Earths surface. The outer layer known as crust is made of solid matter. This layer of solid matter is known as the Lithosphere. It is made up of solid matter known as rock. Hence this outer crust is known as the Lithosphere or Rocksphere. Rocks are made of combination of different matter. Thus, rock is a combination of one or more minerals.

There are three basic types of rocks based on the process of formation :

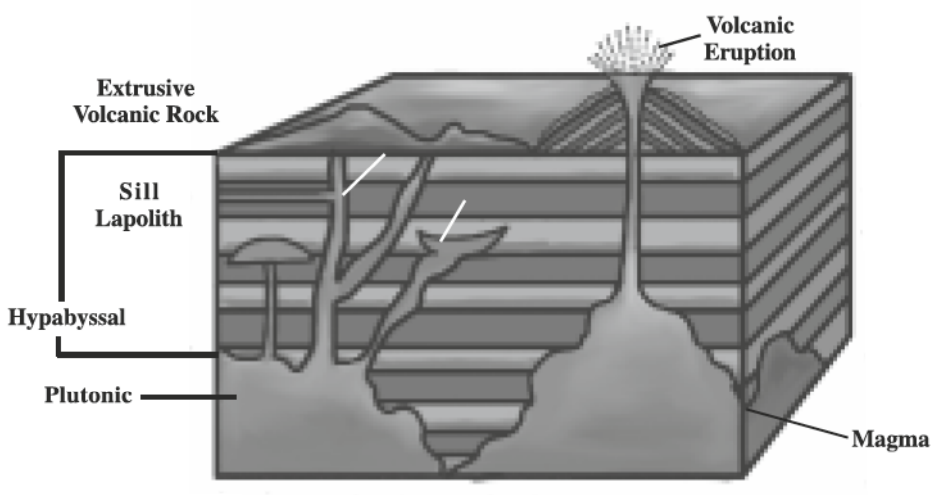
Rock Types

- Igneous Rocks
- Sedimentary Rocks
- Metamorphic Rocks)

(1) Igneous rocks : Meaning of igneous is 'made of fire'. As the Earths interior is hot its red hot material-magma gets cooled into various forms. Rocks formed in this way are known as igneous rocks. As these rocks were formed first, they are also known as **primary rocks**. There are two main types of igneous rocks : (1) Intrusive igneous rocks (2) Extrusive igneous rocks.

Igneous Rocks

- Intrusive
  - Plutonic
  - Hypabyssal
- Extrusive
  - Volcanic



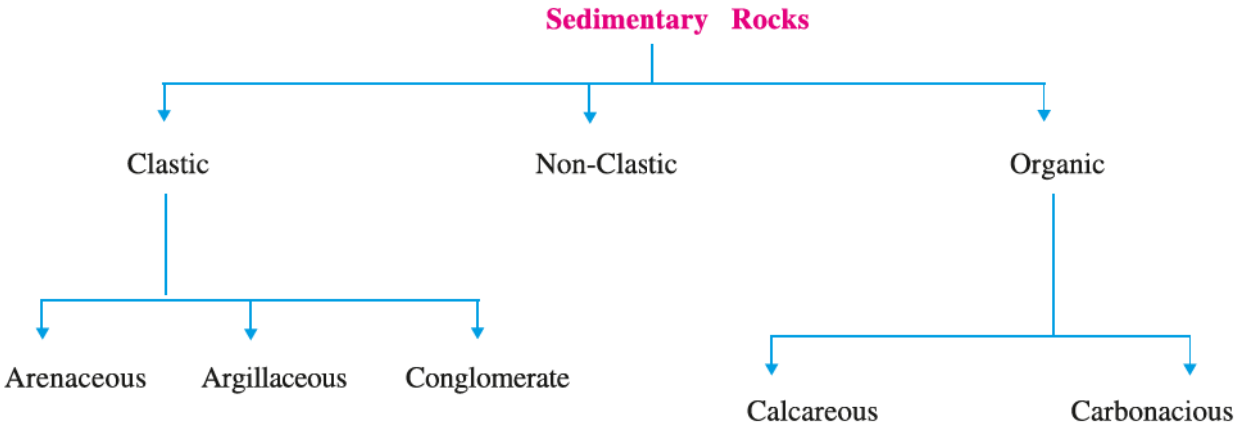
6.1 Forms of Igneous Rocks

(1) Plutonic igneous rocks : These type of igneous rocks are formed by the cooling of magma. If this magma cools and solidifies deep in the interior, such rocks are formed. As there is more heat at greater depth, magma cools and solidifies slowly. Rocks formed in this way have big sized crystals. **Granite** is the best example of plutonic igneous rock. Such rocks are found in plateau of south India, Rajasthan and Madhya Pradesh.

Hypabyssal igneous rocks : During volcanic eruption, magma tries to reach the Earths surface. But gets solidified somewhere between plutonic rocks and extrusive rocks. It takes various forms known as sill, dyke, lopolith and laccolith. These rocks are known as hypabyssal igneous rocks.

Extrusive igneous rock : During a volcanic process, magma comes out rupturing the rock layers. On coming in contact with open air, the lava cools rapidly. Microscopic crystals are formed in it. **Basalt** rock is its example, which is found in south and western Gujarat.

(2) Sedimentary Rocks : Forces of weathering and erosion result in the breaking of igneous rocks. The fragmented rock material continues to be deposited in water and layers are formed. Thus layers develop one above another. After some time, stratified rocks are formed from them. Therefore, sometimes these rocks are also known as depositional rocks. Some chemical and organic matter is found in sedimentary rocks. On the basis of this matter, these are classified into following sub-types :



Clastic sedimentary rocks : Process of weathering disintegrates rocks. Mobile forces like river, glacier and wind transport sediments elsewhere. With decline in speed of these forces, the transported sediments get deposited in different places. Layers of rock matter are formed with the passage of time. Such rocks are known as clastic rocks. Sandstone, shale and conglomerate are examples.

Non-Clastic sedimentary rocks : Certain chemicals present in rocks become dissolved as solution in running water. With decline in speed of water, rocks formed by the deposition of chemical matter dissolved as solution are known as non-clastic rocks. Gypsum and rock-salt are examples.

Organic sedimentary rocks : Animal and plant remains get deposited over a period of time to form rocks. Depending on the amount of lime and carbon they are of two sub-types. When rocks with lime are broken and carried away by rivers and deposited into sea, they are eaten up by coral forming organisms. Remnants of such marine organisms get deposited to form rock layers, known as limestone.

Remains of vegetation get buried and under the impact of pressure and internal heat get transformed into rocks. They are known as carbonaceous rocks. Mineral coal is its best example.

Metamorphic rocks : When there is a change in basic composition and form of igneous and sedimentary rocks, they get transformed into new type of rocks known as metamorphic rocks.

Rocks get transformed in two ways : Physical metamorphism and chemical metamorphism. Thus, shape and form of mineral matter of original rocks get transformed into rocks with new crystals.

When local rocks come in contact with hot liquid magma, they get transformed. This is known as contact metamorphism.

Rocks over wide areas undergo change in their composition and form, because of temperature and pressure. This is known as regional metamorphism. Marble and quartzite are examples.

Minerals

Organic and inorganic matter under the impact of heat and pressure, get transformed with specific chemical composition, known as a **mineral**.

Crystalline composition, density, hardness, colour, lustre etc. are primary characteristics of a mineral. Every mineral has a certain density. Density is a minerals heaviness.

When a scratch is made on a mineral, the resistance offered by it determines its hardness. Hardness of a mineral is given on a scale of 1 to 10. For example, hardness of talc is 1 and that of diamond is 10.

Every mineral surface reflects sunlight. This determines a minerals lustre. Different minerals and metals have different lustre.

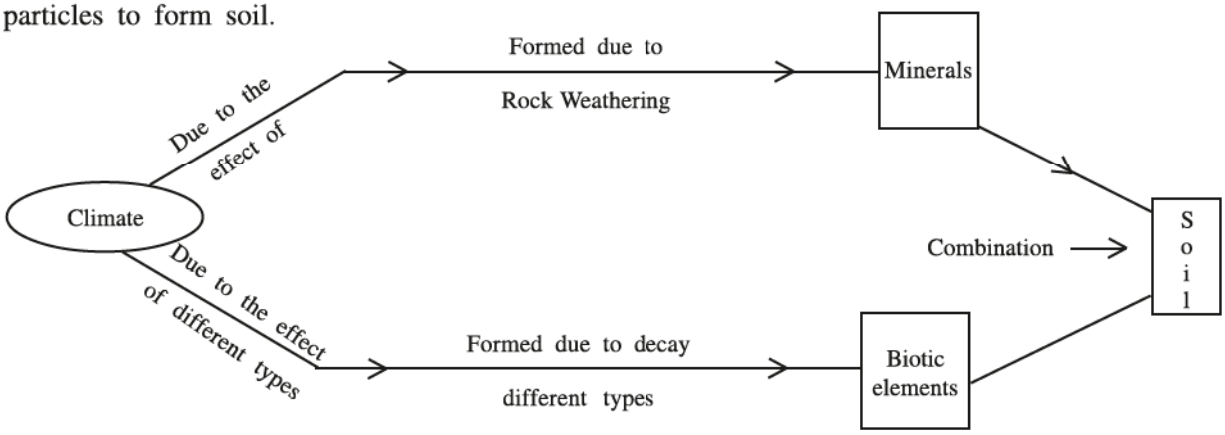
Minerals exhibit different colours as well. Depending on the impurities present, minerals may be dark or light in colour.

Thus, based on primary characteristics, minerals may be categorized as metallic and non-metallic. Iron, copper, gold, etc. are metallic minerals, while potash, sulphur, nitrate and fluorspar are non-metallic minerals.

Coal and mineral oil are used as fuel. Hence they are placed under a special category of power minerals.

Soil

Impact of sunshine, temperature, snow, rain and other forces on the open surface of rocks causes weathering, leading to formation of regolith. Organic matter, air and water get mixed with these rock particles to form soil.



6.2 Process of Soil Formation

When under the influence of climate, mineral matter is formed from weathered rocks and organic matter from decomposition of vegetation and plant remains gets mixed with it, a thin layer of loose material is formed known as soil. Soils have four main physical characteristics :

(1) Colour (2) Structure of particles (3) Arrangement of soil particles (4) Soil structure

Colour is an important characteristic of soil. Colour changes with mineral elements and according to the process of origin. Soils with dark colour have more organic matter. Red, yellow or almond coloured soils have more iron content.

Sand and clay content varies in soils with different composition. Size of sand particles are bigger while that of clay particles are smaller. Hence in clay soils, there is more moisture retaining capacity as well as fertility.

Various soil particles are arranged differently. Thus is formed arrangement of soil particles. This arrangement determines soil porosity. Thus, because of typical soil arrangement or structure, air, water and plant roots penetrate into soil.

If a vertical cut is made on soil layers, distinct layers or Horizons of soil can be seen very easily from top to bottom. It is known as Soil-profile.

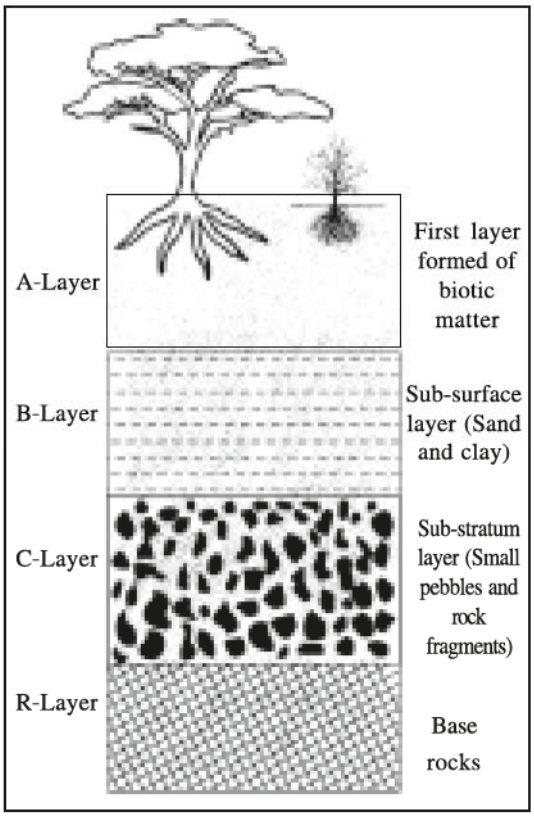
In different layers of soil profile, differences can be noticed in its structure of particles, arrangement of soil particles, colour, etc. These soil layers are known as A-horizon, B-horizon, C-horizon and R-horizon. (Fig. 6.3)

The topmost soil particles of A-horizon are minute. In this layer, animal life is the most active. The layer is more fertile because of more of organic matter.

In B-horizon, there are more sand and clay particles. It has less organic matter and is also known as the sub-soil.

C-horizon is made of pebbles, small rock fragments and big soil particles. Generally, it is less fertile.

R-horizon is at the lowest. It is made of bed rock. Its rock particles are attached to each other.



6.3 Soil Profile

Types of Soil

Depending on the soil formation process, soil can be divided into two main sub-types :

(1) Residual soils (2) Transported soils

After being formed from weathering of parent rocks, soils that continue to overlie them are known as residual soils. Such soils are found in the forest regions.

When under the influence of mobile forces like river, glacier, wind, silt and load is transported from their source and gets deposited elsewhere to form soils, such soils are known as transported soils. Such soils are fertile. There is more amount of minute clay particles of organic and mineral matter in it. Ganga river plain is of this type.

EXERCISE

1. Answer the following questions in detail :

(1) What is a rock ? Explain its major types.

(2) Define mineral and discuss its characteristics.

(3) Explain the process of soil formation and write in detail about its main characteristics.

2. Answer the following questions in brief :

(1) How many types of rocks are there ? Which are they ?

(2) Mention the sub-types of igneous rocks.

(3) What is an organic rock ?

(4) What are the divisions of soil structure ?

(5) Mention the major soil types.

3. Answer the following questions in one-two sentences :

(1) What is magma ?

(2) Give an example of Hybayssal igneous rock.

(3) Which organisms form calcareous sedimentary rocks ?

(4) State the main types of minerals.

(5) What is residual soil ?

4. Select the correct option from the options given and answer the question :

(1) Granite is an example of which kind of rock ?

(a) Sedimentary (b) Igneous (c) Metamorphic (d) None of them

(2) Marble is an example of which kind of rock ?

(a) Igneous (b) Sedimentary (c) Metamorphic (d) Volcanic

(3) Which is the most soft mineral ?

(a) Gold (b) Aluminium (c) Copper (d) Talc

(4) There is similarity between which type of soil and composition of parent rock ?

(a) Transported (b) Residual (c) Both A and B (d) None of them

Activity

- Make a collection of rock and soil specimens around you and display them in your classroom.

7 Landforms

Landforms such as mountain ranges, plains, plateaus, gorges, bays, valleys, waterfalls, moraines and sand dunes, etc. on the Earths surface (continents and oceans) originate, evolve and are destroyed under the influence of natural forces. Thus, when under the influence of natural forces, a part of the Earths surface assumes a specific shape, slope and height, it is known as a **'Landform'**.

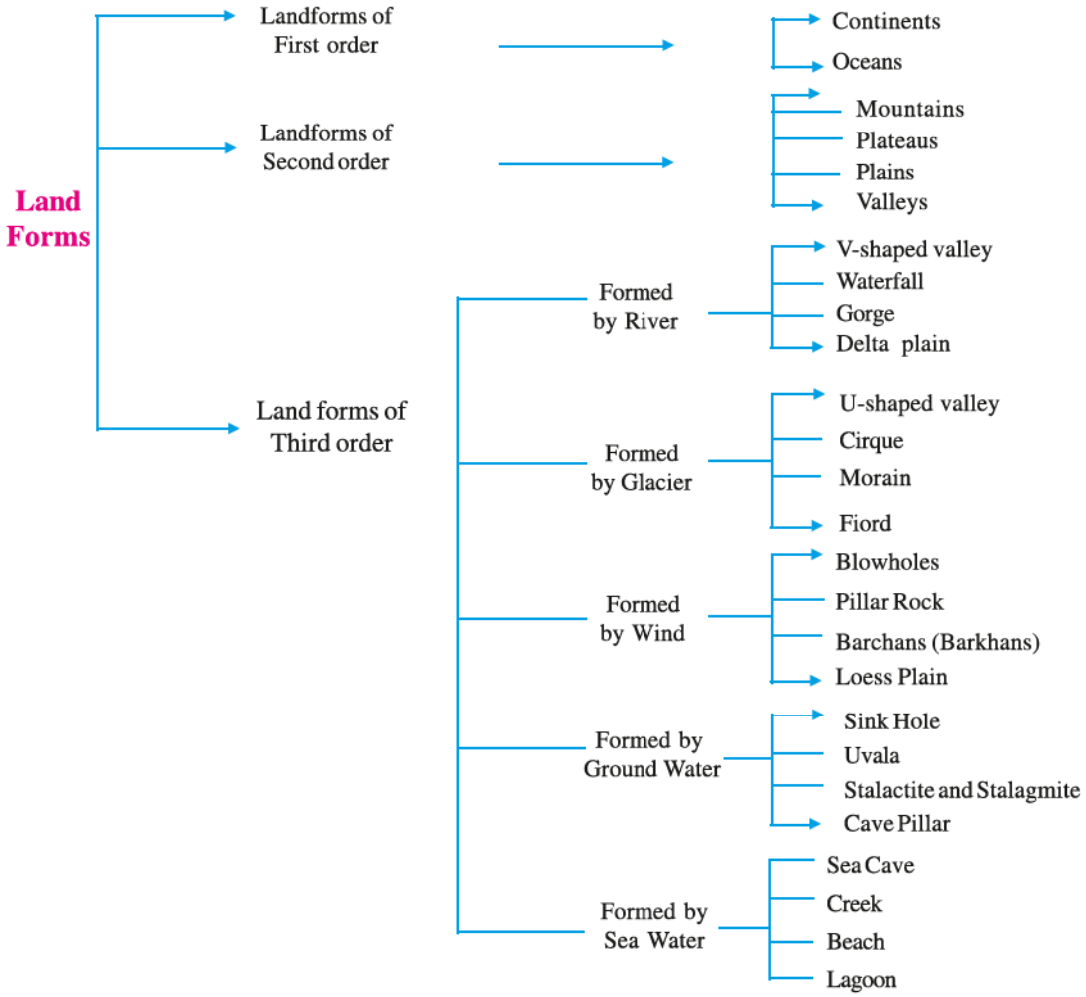
Origin of Landforms

The rocks present in the Earths interior undergo expansion or contraction, followed by adjustment due to changes in the internal heat and pressure in the Earth. Earth movements originate due to this adjustment. As a result landforms such as mountain ranges, plateaus, plains and valleys, etc. originate on the Earths surface. This process is known as earth movements.

Earth movements resulted in the formation of two major landforms such as continents and oceans. Hence they are known as landforms of the first order. Under the influence of internal forces, landforms of second order developed on them such as mountains, plateaus, plains, rift valleys, etc. On them, under the erosional and depositional work of external or mobile forces, various landforms were formed. V or U-shaped valley, waterfall, sand dunes, moraines, stack or sea cliff, etc. are categorized as landforms of the third order.

Types of major landforms

The landforms formed on the continents and ocean beds due to internal earth movements are known as major landforms. Mountains, plateaus and plains are the major landforms.



7.1 Classification of Landforms

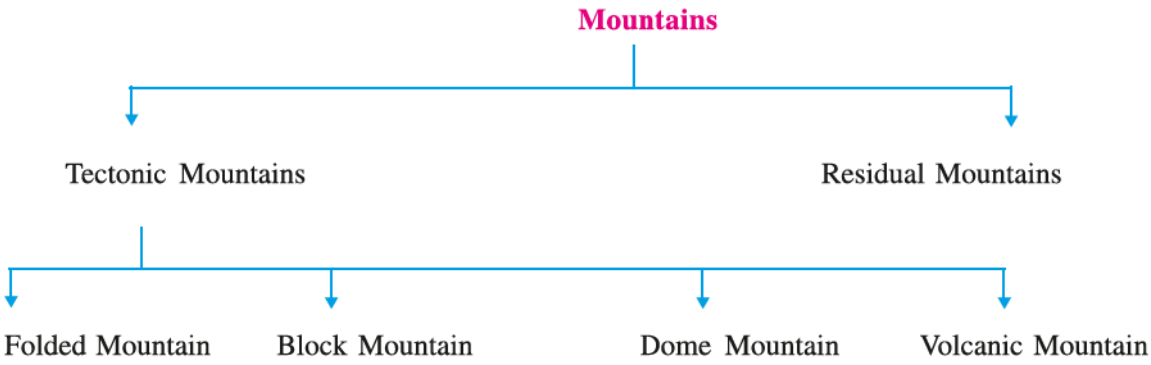
Major Landforms

Mountain : Mountains occupy about 26 % of the Earths surface. Altitude is the main characteristic of mountain. A landform with an altitude of more than 900 m above sea level, uneven slopes and narrow summits is known as a mountain. Inspite of these characteristics, height is not the true identity of a mountain. E.g., Tibet Plateau, although more than 5000 m in altitude, is not termed as a mountain. For this, altitude, shape and slope of a landform also need to be considered.

Types of Mountains :

According to the process of origin, mountains are of two main types :

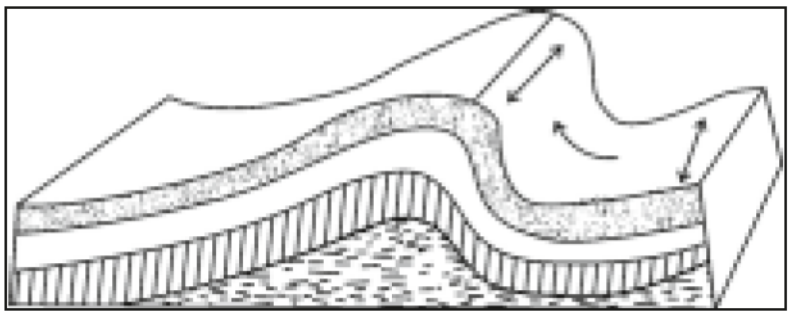
(1) Tectonic mountains (2) Residual mountains



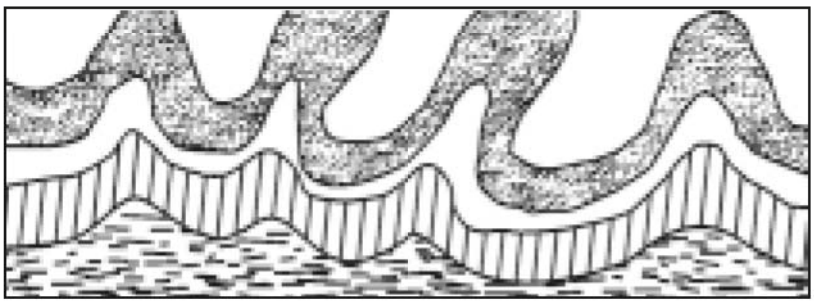
Types of Tectonic mountains

(1) Fold mountain : When in a region of sedimentary rocks bearing geosynclines, a compressional force is exerted in horizontal direction due to earth movement, folds are formed in it. If the compressional force persists for a longer time along with the process of upliftment, some parts get raised up as folds. These are known as fold mountains.

Fold mountains are formed of sedimentary rocks. Remnants of marine organisms and fossils are found in them. This proves that fold mountains have originated from the seas.



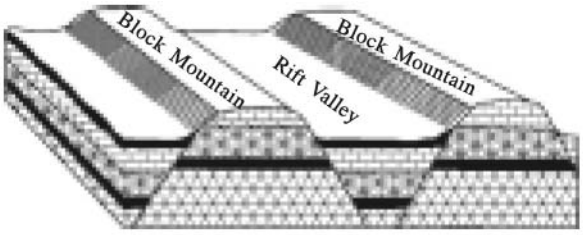
7.2 Folding-1

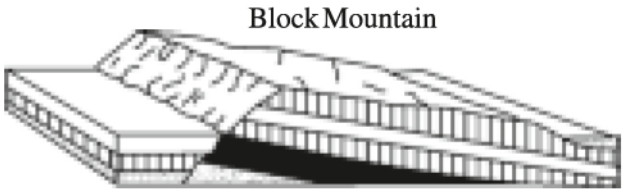


7.3 Folding-2

The fold mountains that were formed crores of years before are called old fold mountains. Examples are Appalachians in eastern part of North America, Urals of Russia, Apennine of Italy, Pennines of UK, Tsingling Shan of China and Aravallis of India. The Himalayas, Andes, Rockies and Alps were formed about 3 crore years before and are called young fold mountains.

(2) Block Mountains : Sometimes due to the Earths internal forces, fissures or faults develop in the surface rocks. When due to Earth movements, a part of the land block between two vertical faults is uplifted, or it remains stationary and land blocks on either side of it subside, a block mountain is formed. If one of the sides of such a landform is steep and flat topped like a table, then it is called a **Plateau**. The middle portion that has subsided is called a **Rift Valley**. Block mountains are formed on either sides of a **Rift Valley**.

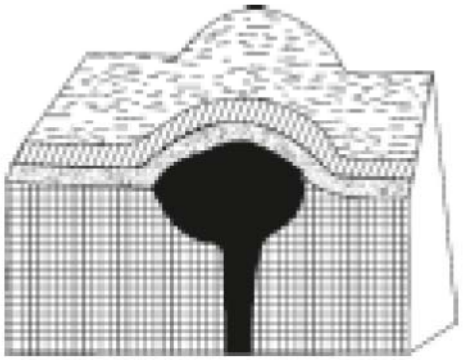




7.4 Block Mountain and Rift Valley 7.5

In Europe, Vosges to the west and Black Forest to the east of the rift valley of the Rhine river are examples of block mountains. Vindhyas lie to the north and Satpuras to the south of the Narmada rift valley. **Horst** mountain of Germany is an example of Block Mountain.

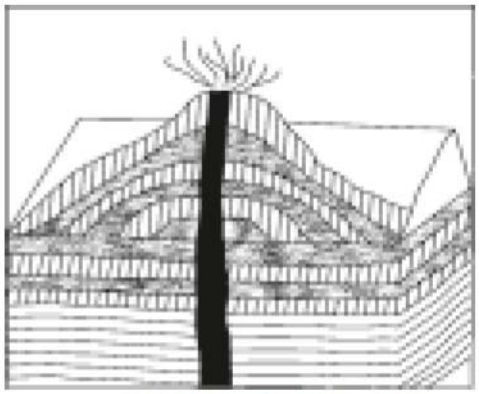
(3) Dome Mountain : Sometimes, magma in the Earths interior tries to come out but solid rocks above it act as a barrier. Due to pressure of magma, rock layers get raised up in the form of a dome. It is known as Dome Mountain. When under the influence of forces of erosion, outer rock layers get eroded away, magma that has solidified in the interior becomes visible. Mountains near Sundha mata pilgrimage place in Rajasthan and mount Henry of Utah state in USA are examples.



7.6 Dome mountain

(4) Volcanic Mountain : During a volcanic eruption, lava, ash, rock fragments, etc. are ejected from the Earths interior and get accumulated around the vent forming a high cone shaped heap, known as a volcanic mountain. Since such a mountain is formed by accumulation of matter ejected from the Earths interior, it is known as Mountain of accumulation.

Vesuvius of Italy, Etna of Sicily, Mt. Kilimanjaro of Kenya, Mt. Fujiyama of Japan, Mayon of Philippines, Krakatua of Indonesia, Popocatepetl of Mexico, Cotopaxi and Chimborazo of Equador are well known volcanic mountains of the world.



7.7 Volcanic mountain

Relict mountains

When raised landforms such as mountains and plateaus are eroded down under the influence of forces of erosion, their remnants appear as cone shape, then such landforms are known as erosional or relict mountains. Examples are Vindhyachal, Western Ghats and Eastern ghats, Parasnath in India, Wales in UK, and Ozark in USA.

Significance of mountains :

- Mountains located on land frontiers help to protect the country.
- Rivers, streams originating from mountain provide source of water.
- Alluvium, mud and organic matter deposited by rivers increase soil fertility.
- Various useful minerals are obtained from mountains.
- Timber, medicines and other forest products are obtained on montane forests.
- High mountains obstruct moist winds and help bring rain.
- Plantation crops like tea, coffee, fruits and other crops can be taken from mountain slopes.
- Mountainous regions become tourist spots.
- Waterfalls in mountains provide favourable sites for hydel power generation.

Plateau

A landform more than 180 m above mean sea level with a flat top with atleast one side of very steep slope is known as a plateau. Figures of height are misleading just as the case with mountains. For example, the Praries plain of USA is higher than the Peidmont Plateau to its eastern part. Plateaus occupy 33 % of area of continents. Some scholars use the term Tableland for plateau.

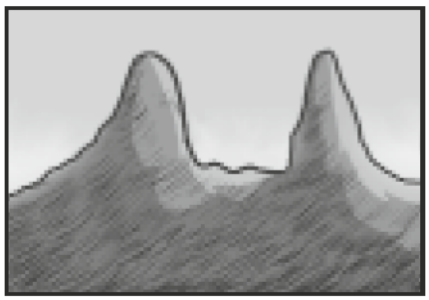
Types of Plateau :

Plateaus are classified into four types according to their geographical location and mode of origin.

Types of Plateau

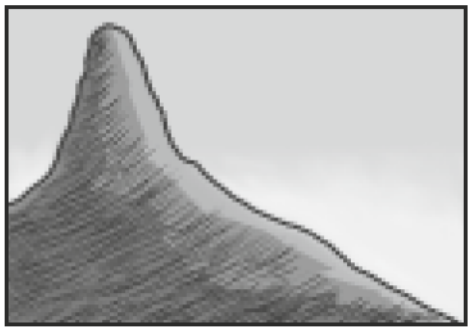
Intermontane Plateau	Peidmont Plateau	Continental Plateau	Coastal Plateau

(1) Intermontane Plateau : A plateau surrounded from all sides by mountains is known as Intermontane Plateau. When compressional force acts on a geosyncline in horizontal direction, fold mountains are raised up and when its middle portion is raised up, the rock strata maintains its original condition without developing folds. Such middle portion is known as intermontane plateau. Slopes of intermontane plateau get mingled with mountain. Their altitude is more than other plateaus.



7.8 Intermontane Plateau

Tibet Plateau to the north of India is surrounded by the Himalayas, Bolivia Plateau of South America by the Andes and the Columbia Plateau of North America by the Rockies mountains.

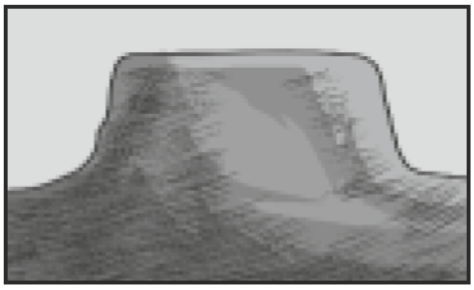


7.9 Piedmont Plateau

(2) Piedmont Plateau : A plateau with high mountains on one side and slope culminating in low plains or sea coast is known as Piedmont Plateau.

Patagonia Plateau of South America and Piedmont Plateau of North America are examples.

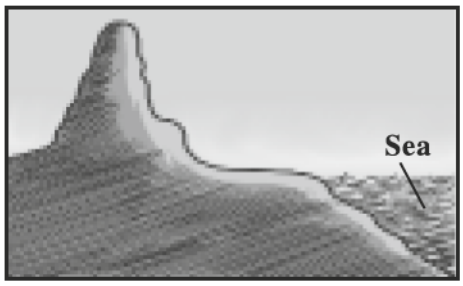
(3) Continental Plateau : Due to the disastrophic forces operating in the Earths interior, when the entire continent or a major part of it gets uplifted along with plain surface, such a landform is known as a Continental Plateau. Sometimes, due to fissure eruption, when lava spreads over wide areas and solidifies, a plateau of this type is formed. The Plateau of South India, Ethiopian Plateau in Africa, Greenland Plateau and Karroo Plateau of South Africa are formed by upliftment of continents.



7.10 Continental Plateau

(4) Coastal Plateau : Due to Earth movements, regions near the coast are raised higher up from the sea level or due to subsidence of coastal regions of continents, the remaining highland is known as a Coastal Plateau. Such plateaus have a continuity with the adjoining continental shelf.

Coromandel Plateau on the eastern coast of South India and Tanganyika Plateau of Africa are examples.



7.11 Coastal Plateau

Significance of Plateaus :

- Plateaus are storehouse of minerals
- Black lava soils of plateaus is best for cotton crop.
- Grasslands of plateaus are favourable for animal rearing.
- Parts of plateaus with heavy rainfall are forested, from which forest products can be obtained, and this provides raw materials to industries.

Plains

The landforms with an altitude of less than 180 m, almost a flat surface and homogenous rock structure are known as plains. Just as with other landforms, figures for altitude of plains is also misleading. In USA, the altitude of plains of Prairies is 1500 m while in West Asia, the plain of Jordan river is even lower than sea level.

Plains occupy almost 41 % land area of continents. There are three main types of Plains :

Types of Plain

Coastal plains | Erosional plains | Depositional plains

(1) Coastal Plains : Plains near the sea coast are known as Coastal plains. Such plains are formed by the upliftment of continental shelf areas. Their slope is seawards. Rivers bring alluvium from the interior of continents and deposit in such plains to make them flat.

Sometimes coastal plains are formed by erosion also. Due to saline soils, such plains are mostly useless for agriculture. Such plains are Malabar in India and east coast plains of Japan.

(2) Erosional Plains : Forces of denudation and erosion such as river, glacier and wind play a role in the formation of such plains. Due to continuous erosion work of mobile forces, mountains and plateaus get eroded and flattened. Soft rocks are rapidly eroded, while hard rocks are eroded slowly at their places. Such plains are known as Peneplain.

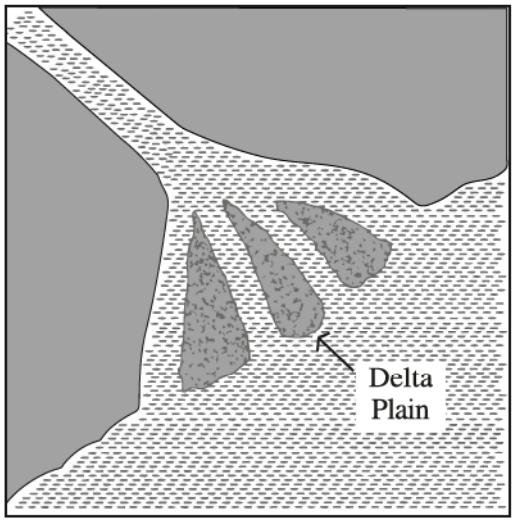
Plains formed by river erosion are Aravalli region to the west of Delhi, plain of East England, central plains of Russia, Paris Basin.

Glaciated plains are located in Canada, Norway, Sweden, Finland, etc.

Wind-eroded plains are found in desert regions with dry conditions and scanty rain.

(3) Depositional Plains : Deposition work is done by mobile forces such as river, glacier and wind. When their carrying capacity to transfer load declines deposition is done. Thus Depositional Plains are formed.

When a river enters a plain from a mountainous region, it deposits gravel, boulders, and sand near its valley to form a Alluvial Plain. It is known as Alluvial fan plain due to its typical shape. When a river is flooded, its waters spread on either sides of its banks. Thus flood plains are formed due to silt deposition. When a river meets the sea, due to its sluggish flow it deposits huge amount of silt at its mouth, where a delta plain is formed. Due to its high fertility, it is best for agriculture.



7.12 Delta

There are certain requirements for the formation of a Delta: (1) The river should have water all the year round. (2) The river should have huge amount of load. (3) When a river meets the sea, its flow should be slow. (4) It is necessary that the sea is free of stormy waves, currents and high tide.

Ganga, Brahmaputra and Godavari rivers in India, Mississippi river in USA, Nile river in Egypt, Irrawaddy river in Myanmar, etc have formed delta plains.

When a glacier melts, materials embedded in it spread around. Plain formed by this depositional work of glacier is known as a Drift Plain. Canada, Norway, Sweden and Greenland located in high latitudes have such plains.

When load carried by wind faces an obstacle or slows down, it gets deposited. The plain formed as a result is known as **Loess**. Plains of yellow clay in China is its best example.

Significance of Plains : Plains have played a great role in the development of man. Ancient civilizations developed in plains. Agriculture, industry, transport, trade and such other activities get opportunity to develop in plains. About 75% of worlds population resides in the plains. Some of the worlds biggest cities have developed in plains. Here, literature, art, music, sculpture, etc. originated, flourished and developed.

Geomorphic Processes : Because of Earth movements, mountains, plateaus, plains, valleys are formed on the Earths surface. Exogenetic forces of erosion begin their disintegration. Thus, nothing is permanent on the Earths surface. The prime source of exogenetic forces is the **Sun**. It is because of it that forces that reduce relief such as wind, river, glacier, sea waves originate. Because of their three processes of erosion, transportation and deposition, landforms originate and are destroyed. Forces that reduce relief are of two types : (1) Static forces (2) Mobile forces.

(1) Static forces :

The forces that break matter in situ are known as static forces. The Suns heat, humid air, snow, rain, plant roots, animal life and humans are included in it. These forces dont have mobility and hence are known as static forces. These forces break rock layers near the surface, resulting in weathering.

Weathering

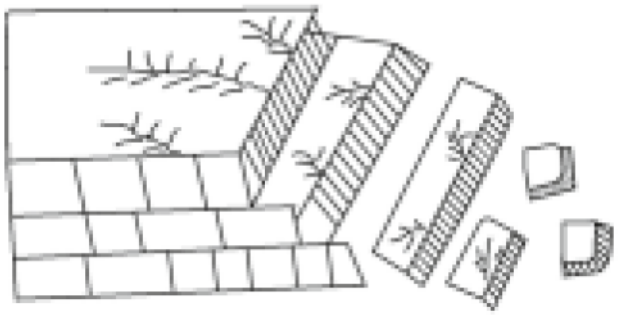
When rocks exposed at or near the Earths surface disintegrate and decompose at their own place under the action of physical, chemical and biological processes, it is known as **weathering**. Weathering is of two main types : (1) Physical weathering (2) Chemical weathering

(A) Physical weathering : Under the influence of temperature, rain, snow, vegetation and human activities, rocks are broken. Their physical form changes but no change occurs in chemical composition. Hence it is known as physical weathering.

Temperature : The exposed rocks get heated up from the Suns heat. This results in their expansion leading to an increase in volume. Temperature decreases during night resulting in contraction. The process is continuously repeated, leading to formation of cracks in rocks. After some time rocks are broken into small and big pieces. This is known as **Block disintegration**. Such type of weathering is mainly seen in basalt rocks.

Various minerals have unequal capacity of expansion when heated and contraction when cooled. This unequal expansion and contraction separates small and big grains from rocks. It is known as **Granular disintegration**. Granular weathering is seen in sandstone and basalt rocks.

In rocks with various layers, layers get detached one after another. It is known as **Exfoliation**. Such type of disintegration is common in basalt rocks.



7.13 Block Disintegration

7.14 Exfoliation

7.15 Granular Disintegration

Snow

In high mountains and the cold regions of high altitudes, water filled in the cracks during day time gets frozen into ice during night. Ice occupies more space than water. This exerts pressure on the sides of rocks. This gradually widens the cracks. After some time this results in block disintegration of hard rocks and granular disintegration of porous rocks.

Due to continuous eroding by rain or wind, rocks break down at their own place. Plant roots penetrate into cracks in rocks and break them. Some insects and animals dig into soils and rocks to burrow, breaking rocks in the process. Human economic activities like mining also disintegrates rocks.

(B) Chemical Weathering : Rocks are composed of several minerals. Temperatue, water vapour and contact with gases causes changes in mineral composition. Rocks weaken and undergo weathering. This process is known as chemical weathering. Oxidation, carbonation and hydration are chief processes among them.

In regions having monsoon climate, oxygen gas in free state or as a water compound reacts with rocks having iron content to form oxide (rust). This process is known as oxidation.

Rain water reacts with atmospheric carbon dioxide to form weak carbolic acid. It chemically reacts with minerals to form carbonates. This process is known as carbonation. As a result rocks weaken and decompose. Its effect can be seen on limestone and marble.

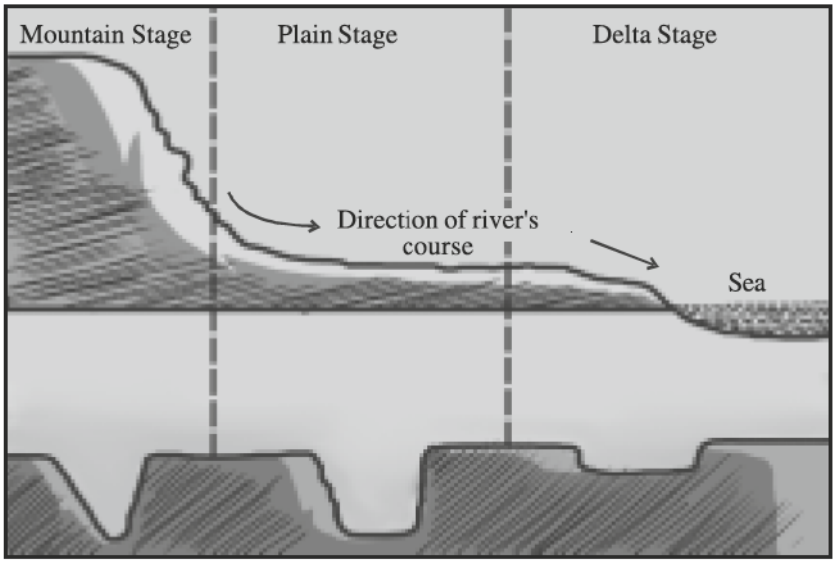
Mobile Forces : Forces that transport material from one place to another and cause denudation of rocks are known as mobile forces. Such forces are flowing water (river), glacier, wind, ground water and sea waves. These forces shape different landforms through the processes of erosion, transportation and deposition.

(1) Flowing water (river) : A natural flow of water downslope under the influence of gravity is known as a river.

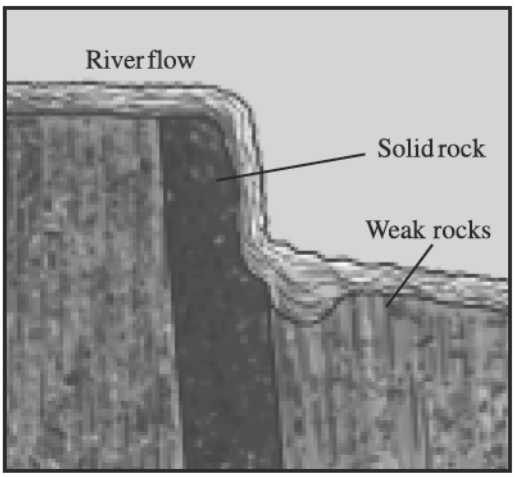
Flowing water gradually removes slope related ruggedness that comes in its course, resulting in a characteristic topography. Thus work of river is divided into three types- erosion, transportation and deposition.

Erosional work

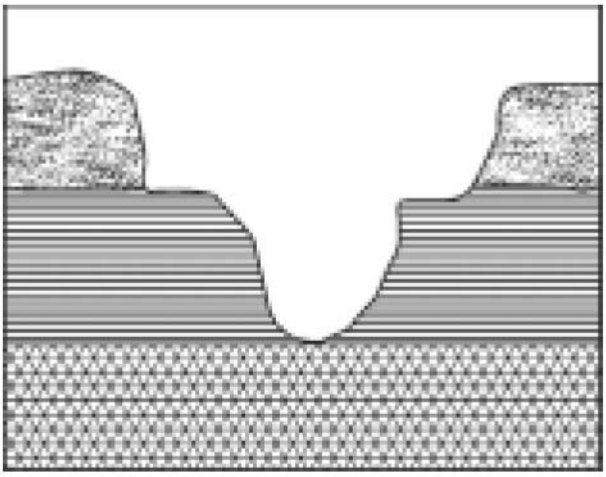
A river breaks rocks that come in its course which becomes its load. It acts as tools in erosion process. Thus erosion depends on mass of load, volume, shape, slope of river bed, composition of rocks and river velocity. Landforms such as V-shaped valley, waterfall, gorge, structural terraces, etc. are formed by river erosion.



7.16 Development of River Valley



7.17 Waterfall



7.18 Structural terraces

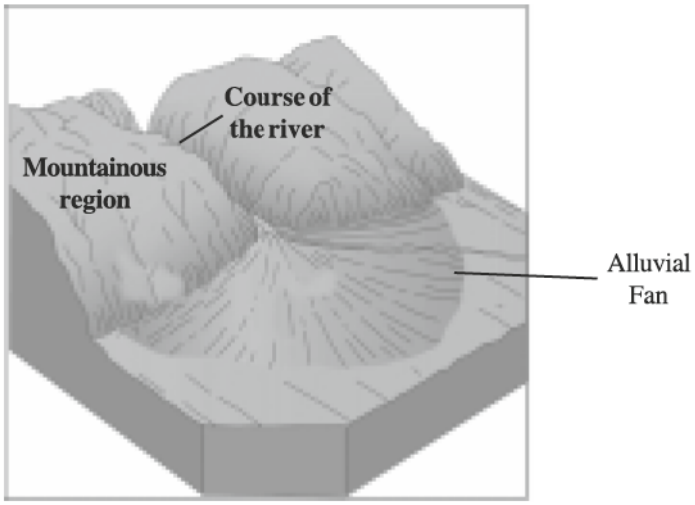
Transportation-work :

The load obtained by a river through its erosional work is carried from one place to another. This is work of transportation of a river. Soluble matter moves ahead in the form of solution. Small particles move as suspension, while bigger particles move ahead by jumping, rolling or are dragged downstream.

Depositional Work :

The load obtained through erosional work begins to settle down with decline in water velocity. This process is known as Deposition.

Alluvial cones, alluvial fans, flood plains and deltas are formed by such deposition.

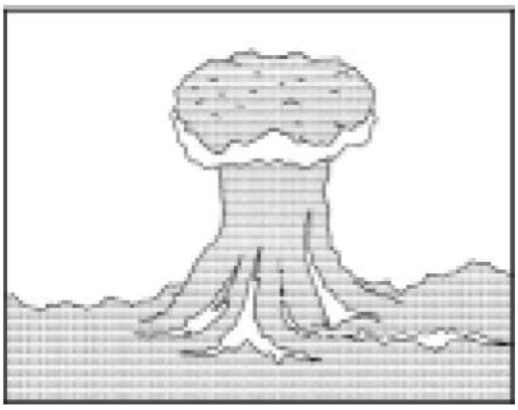


7.19 Peidmont Plain (Alluvial Fan)

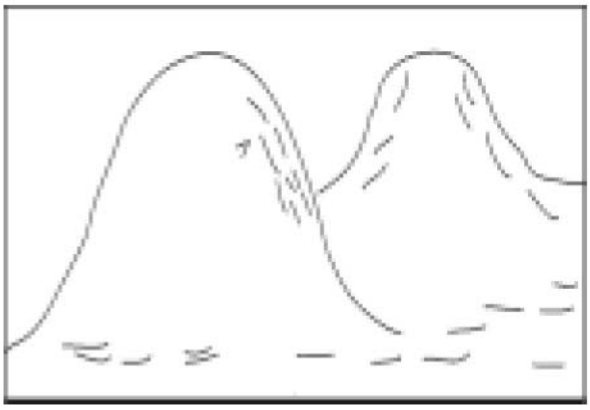
(2) Wind : Wind is also significant among the mobile forces. In the regions with high temperature, scanty rain, arid or semi-arid conditions work of wind is more significant. Wind also shapes various landforms through the processes of erosion, transportation and deposition.

Erosional work

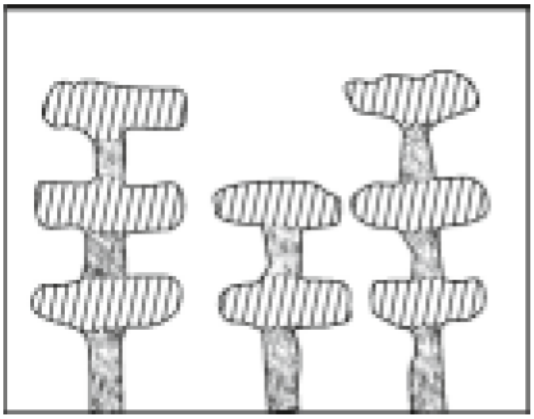
Wind carries matter that comes in its course along with it, using it as a tool to erode the rocks. This leads to formation of several landforms such as deflation basin, mushroom rock, zeugen, yardang, inselberg, etc. It is known as the erosional work of wind.



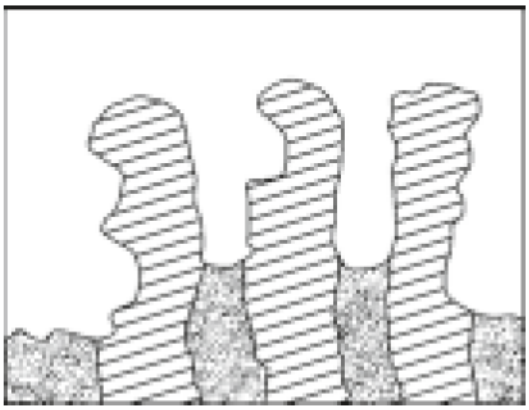
7.20 Mushroom rock



7.21 Inselberg



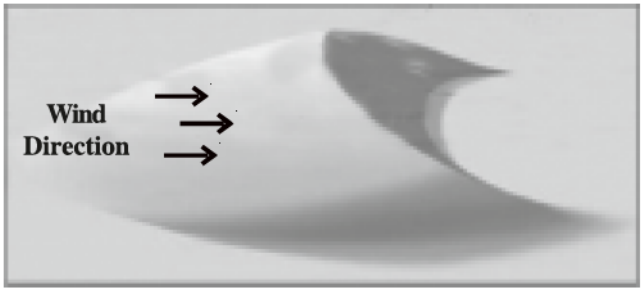
7.22 Zeugen



7.23 Yardang

Depositional work

The load gained by wind from its erosional work gets deposited when wind speed declines and barriers such as scrub-vegetation, trees or higher rock parts come in its way. This is known as wind deposition. Sand dunes, Barchans and loess plains are formed by this process.



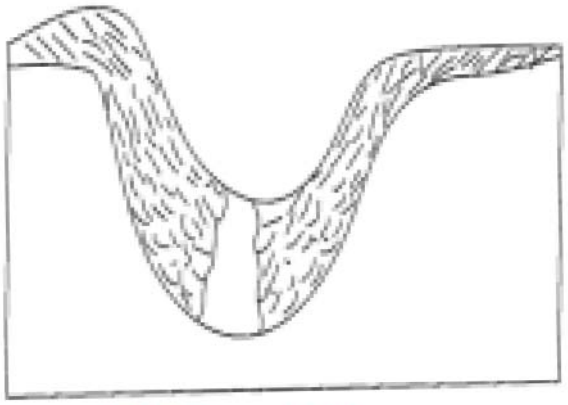
7.24 Barchans

(3) Glacier :

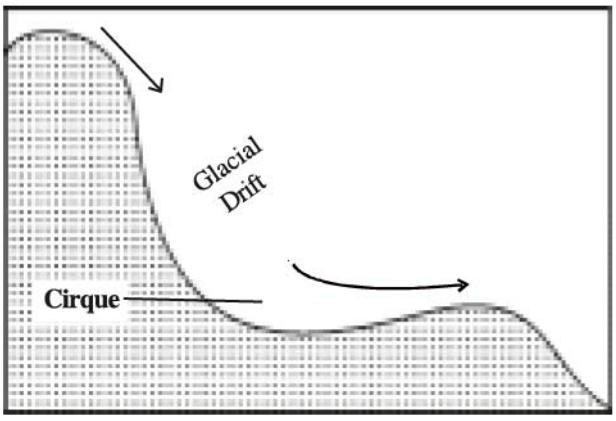
Snowfall is common in regions of high latitudes and high mountainous regions. The snow accumulated from this snowfall gradually moves downslope. Such a slowly moving mass of snow is known as a **'Glacier'**. It also produces various landforms through erosion, transportation and deposition work.

Erosional work

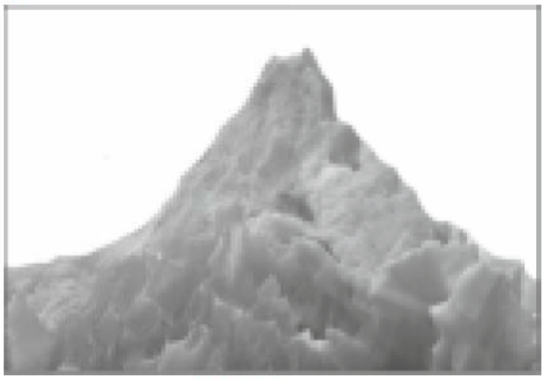
The rock fragments or such other load that come in the way of a glacier, is trapped in the snow. This works as the tool of erosion. U-shaped valley, hanging valley, cirque, arête and fiord coast are formed as a result.



7.25 U-shaped Valley



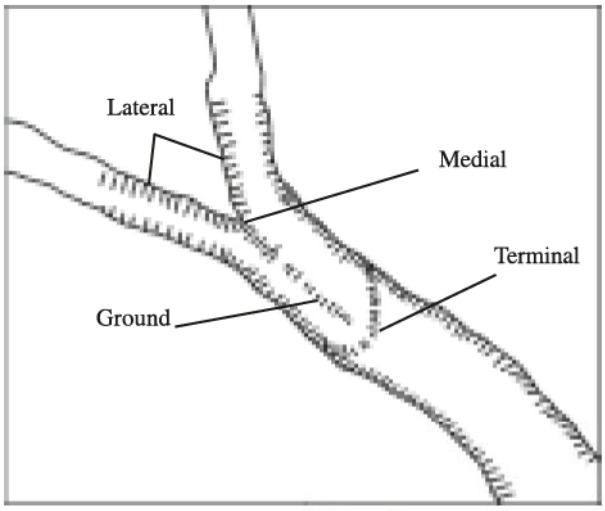
7.26 Cirque



7.27 Glacial Peak

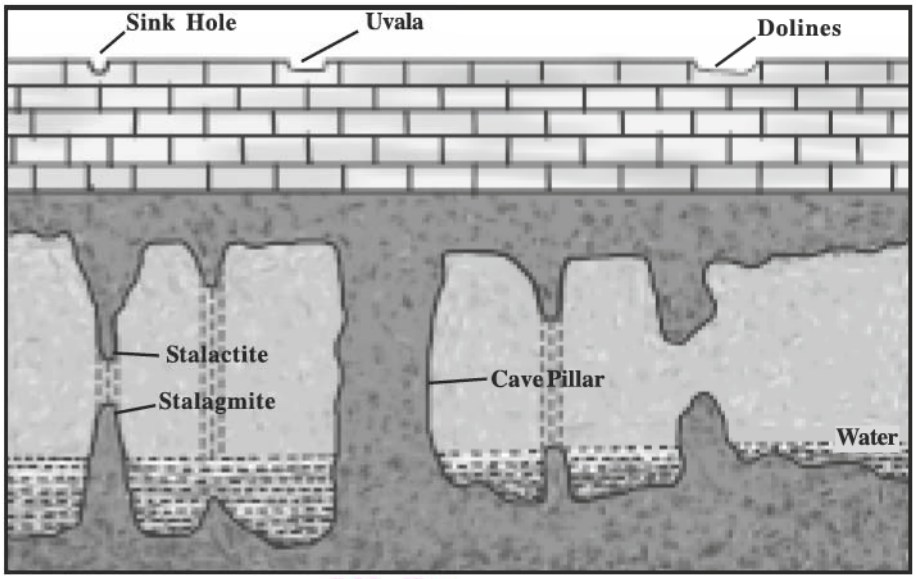
Depositional work

When a glacier slides below the snow line, it begins to melt. Thus the load trapped in it begins to be deposited in various parts of its route. This is known as depositional work of a glacier. **Moraines** are formed from this deposition. Depending on location, they are known as lateral, medial, ground and terminal moraines.



7.28 Morains

(4) Groundwater : Water obtained from precipitation gets deposited inside porous rock layers. This water is known as groundwater. Rainwater in solution form percolates in the lower layers and denudes the rock material coming in its way. Characteristic landforms are formed in regions of limestone. It is known as **Limestone topography** or **Karst topography**.



7.29 Karst Topography

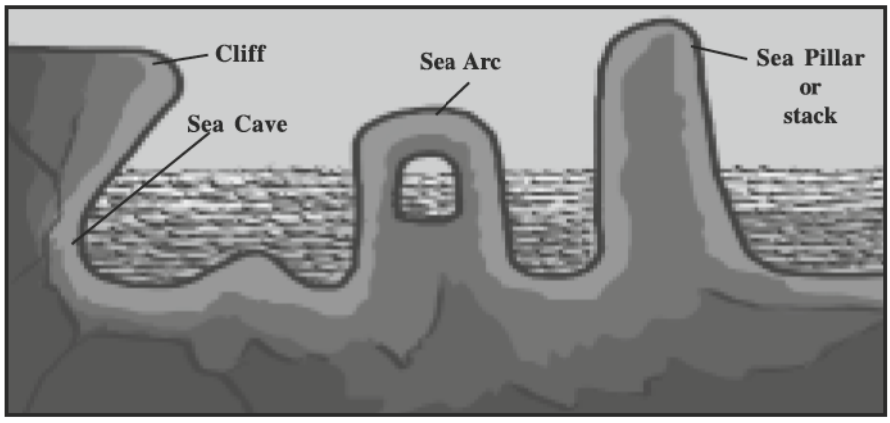
The surface water forms several holes in joints present in limestone layers. These are known as sink holes. When the size of sink holes increases due to erosion, they are known as uvala, dolines and polje.

As the ground water penetrates deeper, lime deposits on the ceiling and floor of a limestone cave. Such deposits develop into stalactite, stalagmite and cave pillars. If the roof of the cave collapses, huge craters are formed known as Polje.

(5) Sea waves : Work of sea waves is limited to the coastal regions. Besides waves, tides and ocean currents also develop various landforms.

Erosional work :

Erosional work by sea waves depends on velocity and pressure of water, size, shape and length of waves and height of the coast etc. Sea waves strike the coast with a great velocity. As a result, rocks of the coast are broken. The process goes on continuously. Several erosional features develop as a result. Sea cliff, sea cave, stack, coves or mini-bays, etc. are formed.



7.30 Erosional work of sea water

Deposition :

Sea waves deposit the load obtained by erosion on the sea coast. It is known as the depositional work of sea waves. Landforms such as beaches, sand bars, etc. are formed by it. Lagoons are formed when sea water is completely enclosed by bars. Chilka of Orissa and Pulicat of Tamil Nadu are examples of lagoon lakes.

EXERCISE

1. Answer the following questions in detail :

(1) Define mountain, and write a detailed note on types of mountain.

(2) What is physical weathering ? Describe its types.

(3) Explain the erosion, transportation and depositional work of wind.

2. Answer the following questions in brief :

(1) How many types of major landforms are there ? Which are they ?

(2) Write a short note on dome shaped mountain.

(3) Explain the formation of peneplains.

(4) Write about the depositional work of ground water.

3. Answer the following questions in one-two sentences :

(1) Mention the names of landforms of first order.

(2) Which are the two main types of mountains ?

(3) Which are the two main forces that reduce relief ?

(4) What are moraines ?

4. Select the correct option from the options given and write the answer :

(1) Which is landform of the second order ?

(a) Continent (b) Pillar (c) Plain (d) Waterfall

(2) Which of the following is a fold mountain ?

(a) Fujiyama (b) Himalayas (c) Henry (d) Vindhyachal

(3) What % of continental area is occupied by plains ?

(a) 41 % (b) 33 % (c) 29 % (d) 21 %

(4) Which is the prime source of exogenetic forces ?

(a) River (b) Wind (c) Sun (d) Vegetation

(5) A lake formed of sea water is known as ?

(a) Pond (b) Bandhara (c) Lagoon (d) Bay

Activity

- Draw diagrams of various landforms and arrange for an exhibition.

8 Atmosphere

Atmosphere

Without atmosphere, life on the Earth is impossible. Oxygen and nitrogen gases in it keep the living world alive. Clouds, fog, rain, snow, water vapour, etc. are various forms of water present in the atmosphere. Particles are important in atmosphere. They are responsible for processes of fog and dew.

Atmosphere is an envelope of air which surrounds the earth from all sides. The layer of the atmosphere from the earths surface up to a height of 32 km contains 99% air. Thus the atmosphere near the surface is dense while it thins out higher up.

Atmosphere is colourless, tasteless and odourless. Air in motion is called wind or breeze. Atmosphere exhibits elasticity and compressibility. Atmosphere is transparent. But some kind of radiation is absorbed as it passes through it and matter is obstructed due to air friction of air. Hence meteors are burnt and end up in the atmosphere before reaching the earths surface. Thus, atmosphere protects the earth from outer space objects.

Composition of the Atmosphere

There are solid, liquid and gaseous components in the atmosphere. There are microscopic particles, salt particles, snow particles, insects, water, various gases and humidity in the atmosphere.

Gas		Amount (%)
Nitrogen (N_2)		78.00
Oxygen (O_2)		21.00
Argon (Ar)		0.93
Carbon dioxide (CO_2)		0.03
Neon (Ne)		
Helium (He)		
Ozone (O_3)		
Hydrogen (H_2)	light gases	0.4
Methane (CH_4)		
Krypton (Kr)		
Xenon (Xe)		100.00

Carbon dioxide is the heaviest gas. Hence it is more in amount in atmosphere up to a height of 20 km from the surface. While oxygen is found up to a height of 110 km and nitrogen up to 130 km. Amount of carbon dioxide in the atmosphere is very less (0.03%). Vegetation takes in carbon dioxide from air during the process of photosynthesis and uses to prepare its food. Oxygen is important in breathing for man and animals. Layer of ozone gas is located at a height of from 15 to 50 km above the earths surface. It absorbs the Suns ultraviolet radiation. At a height of about 130 km from the earths surface, atmosphere is mainly composed of light gases like hydrogen and helium.

Water is seen in solid, liquid and gaseous forms in the atmosphere. Water is present in air in the form of snow particles, water droplets and vapour. Among these, vapour is important. Evaporation from various reservoirs and transpiration from vegetation is the source of water vapour, which is added to

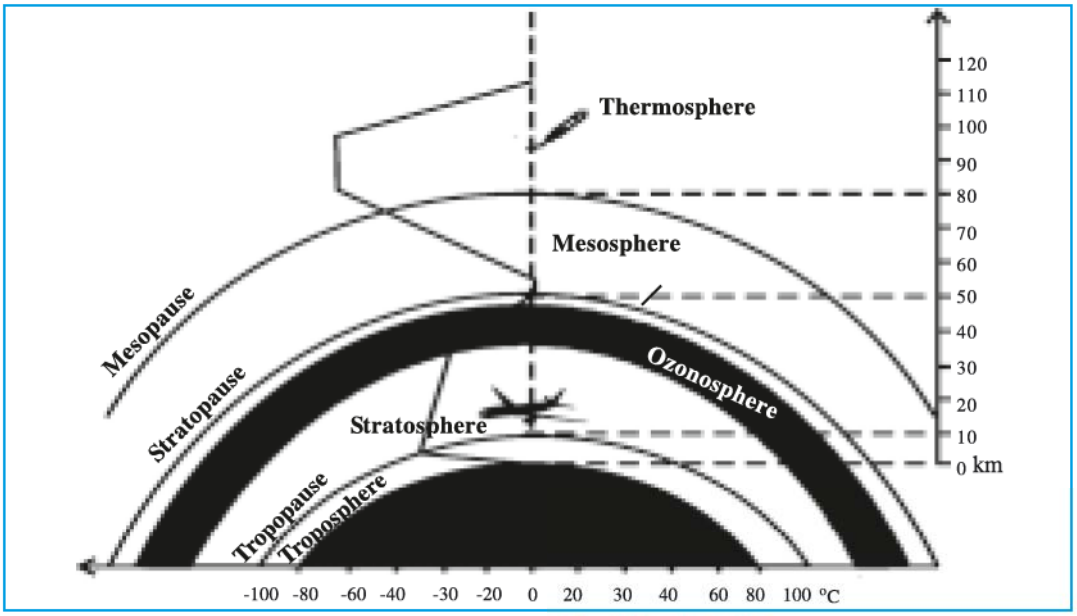
the atmosphere. Vapour is present in the atmosphere up to a height of about 10 to 12 km only. Amount of vapour in the atmosphere varies from 0 to 4%. Water vapour is an important component of atmosphere that absorbs Suns heat. Clouds, fog, rain, etc. are various forms of vapour in the atmosphere.

There are innumerable particles in the layer of atmosphere close to the earths surface. They enter the atmosphere from open land, smoke from factories, vegetation, volcanic eruptions, meteor shower, etc. Dust and salt particles being hygroscopic and moisture retaining,, increase the atmospheres density. Dust particles are responsible for picturesque sunrise and sunset, fog and clouds formation process, etc.

Structure of the Atmosphere

Depending on the variations in temperature with height, the atmosphere is divided into four layers :

(1) Troposphere
(2) Stratosphere
(3) Mesosphere
(4) Thermosphere



8.1 Layers of the Atmosphere

(1) Troposphere : The very first layer of the atmosphere surrounding the earths surface is the Troposphere. It extends upto a height of 16 km over tropics, 12 km over temperate regions and 8 km over polar regions. The height also varies with season. During the hot summer season, the troposphere extends to a greater height, while during cold winters it extends to a lesser height.

Life on the earths surface is influenced by the Troposphere. Atmospheric disturbances, air movements, thunder and lightning, clouds, rain, storm, etc. are experienced in this layer. Troposphere plays a major role in determining the weather and climate of the earth. Almost 75 % of the atmospheres gaseous component, water vapour and dust particles are present here. Temperature decreases with height, i.e. for every increase in height of 1 km temperature falls by about 6.5° Celsius.

The upper surface of the Troposphere where fall in temperature ceases is called the **Tropopause**. In this transitional zone air temperature becomes steady. Air movement calms down. This zone is highly beneficial for flights of aircraft.

(2) Stratosphere : This layer extends from where the Troposphere ends and up to a height of 50 km. Here Temperature remains almost stable, hence it is known as Stratosphere. Seasons are not experienced in this layer. It is free of clouds, rain, storm, snow, etc. Here the air is clean and thin, hence jet planes can fly speedily with less barrier.

In this layer, up to a height of 20 km air temperature almost remains stable. Further up temperature gradually rises. At an altitude of 50 km temperature stops rising. The height at which temperature stops rising is known as Stratopause.

A slight change is seen with height in the Stratosphere. Ozone is present at heights between 20 and 40 km. Hence this part of Stratosphere is known as the **Ozonosphere**. Ultraviolet rays of the Sun are absorbed here. Also meteors are burnt and end up in this layer. Ozone is a germicidal gas, keeps the air fresh and is healthy for humans.

(3) Mesosphere : Above the Stratosphere at a height of about 50 to 80 km, the layer is known as Mesosphere. In this layer, temperature decreases with height. Temperature stops decreasing at a height of about 80 km. This height is known as the Mesopause. Here the air temperature ranges from 90 ^{o} to 100 degree Celsius.

(4) Thermosphere : The layer above the Mesosphere is the Thermosphere. Starting from a height of 80 km, this layer extends up to the limits of the atmosphere itself. Here the air is very hot and thin. In this layer temperature is about 900^{o} degree Celsius at a height of 350 km. Due to the Suns ultraviolet radiation, air in the Thermosphere is ionized. Hence this layer of the atmosphere is also known as the **Ionosphere**.

The radio waves are reflected back to the earth by the electrically charged air in this layer. Hence this layer is important for radio broadcasting. Due to the ionization process in this layer, sometimes in skies high up above the polar regions aurora is seen. Sometimes it is seen as flashes of light, sometimes as colourful fringe of pandal. Developed countries are trying to know more about the upper atmosphere through various experiments with the help of spacecraft. Thus the atmosphere is divided into four different layers.

Weather

Prevailing conditions of the atmosphere for a short duration is **Weather**. Weather can be of any time period such as morning, noon, evening, night or day. Weather depends on temperature, humidity, rain, air pressure, fog, amount of clouds, etc. Countries of the world record daily weather of their regions, prepare its report and weather maps and broadcast them on TV and radio. The headquarters of meteorological department in India is located in New Delhi. It publishes Weather Reports twice in a day and weather maps indicating the weather for the entire country.

Climate

The average conditions of weather over a longer period of time is **Climate**. Normally climate is determined on the basis of weather conditions of a region over a period of 35 years or more.

Elements of Climate

(1) Insolation and Temperature : The heat received from the Sun is known as Insolation. Amount of insolation varies with latitude. In tropical regions, Suns rays fall vertically, so temperature remains high. In polar regions, Suns rays fall oblique, so temperature remains low. On the basis of insolation and temperature, a regions climate may be hot or cold, moderate or extreme.

(2) Pressure and Winds : Latitude, distance from the sea, physical features, location, altitude, forest regions and such other factors result in formation of low and high pressure areas. Low pressure is experienced in equatorial regions due to heat, while in cold polar regions, high pressure is experienced due to the cold. Thus, under the influence of various factors, low and high pressures are formed. Air moves from areas of high pressure to that of low pressure. When there is high pressure over the sea, moist winds from here blow towards the low pressure areas over continents and bring rain. As winds coming from sea are cool, sea coast has a moderate climate. In areas where dry winds blow, there

is scanty rain and climate becomes extreme. Thus, pressure and winds play an important role in changing climate of a region.

(3) Humidity and Rain : Water present in the atmosphere in the form of vapour is Humidity. Amount of humidity depends on the rate of evaporation. In dry desert regions due to less rain and in polar regions due to less evaporation, humidity is low. Hence there is low rainfall. In equatorial regions, Suns rays fall vertically throughout the year and so there is highest evaporation. Worlds heaviest rainfall is recorded here. Air moisture makes the weather steamy. Hence the humid climate of equatorial region is not healthy for humans. Thus humidity and rain determine whether climate is dry or humid.

Factors of Climate

Elements and factors of climate are different. Elements of climate contribute to making of a particular climate, while factors of climate influence its elements. Factors that influence climate are as follows :

(1) Latitude : Latitude is an important factor influencing climate. As the Suns rays fall vertically in equatorial region, there is more heat. There is more evaporation and hence more rain also. Hence climate in this region becomes hot and humid. As we go from the equatorial region to the polar regions, Suns rays become more oblique. In polar regions Suns rays become most slanting. There is less evaporation and also less rain. Hence, very cold climate is experienced here throughout the year. In 30 and 45 degree latitudes belt of Mediterranean region, there is dry climate in summer while winters are warm and humid.

(2) Altitude : Temperature decreases as we go higher above the sea level. For every 1 km height, temperature of atmosphere falls on an average by 6.5^{o} degree celsius. Along with temperature, pressure also decreases with height. Some places although located in tropical regions enjoy a pleasant and stimulating climate. Quito city of Ecuador in South America, although located on the equator, its climate remains pleasant because of its height. That is why people travel to hill stations located at higher altitudes to escape the summer heat, such as Shimla, Manali, Darjeeling, Mount Abu, Saputara, Pachmadhi, Mahabaleshwar, Ooti, etc.

(3) Distance from sea : Land and water have different heat absorbing and heat transfer capacities. This effect can be clearly seen on the oceans and continents of the Earth. In areas close to the sea coast, the climate is moderate because of the effect of sea, while in continental areas located away from the sea, temperature remains higher and rainfall is less. Cities like Mumbai, Singapore, London, Shanghai, Rio de Janeiro, etc. located on sea coast enjoy moderate climate, while Delhi, Moscow, Winnipeg, Amritsar, Lahore, etc. located away from the sea coast experience extreme climate.

(4) Ocean currents : Warm and cold currents in oceans influence climate. Where warm and cold currents flow near sea coast, there climate remains warm and cold respectively. The east coast of Canada and the northern part of Western Europe lie almost on same latitudes. But due to different types of ocean currents that flow near these two regions, there is a difference in their climate. Cold Labrador current flows near the east coast of Canada. Hence there the climate is very cold. In winter it becomes icy frozen. While warm Gulf Stream of north Atlantic passes near the northern part of Western Europe. Hence there the climate remains warm throughout the year.

(5) Type of Soil : Soil is a minor factor of climate. Sandy soil rapidly becomes hot as well as cold. To some extent such soil is responsible for extreme climate of desert regions. Black lava soils or silty soil does not heat nor cool rapidly. To some extent its effect is seen on climate.

(6) Amount of forest : In regions with vast forest cover, amount of rain is more and temperature remains below average. In deserts or regions with open land surface, temperature remains higher and

rain is scanty. In east India, more rain is received due to vast forest areas. Hence here, climate is hot and humid. In dry and barren regions of Kachchh and west Rajasthan, temperature remains high, rain is very scanty. Thus, here climate is of extreme type.

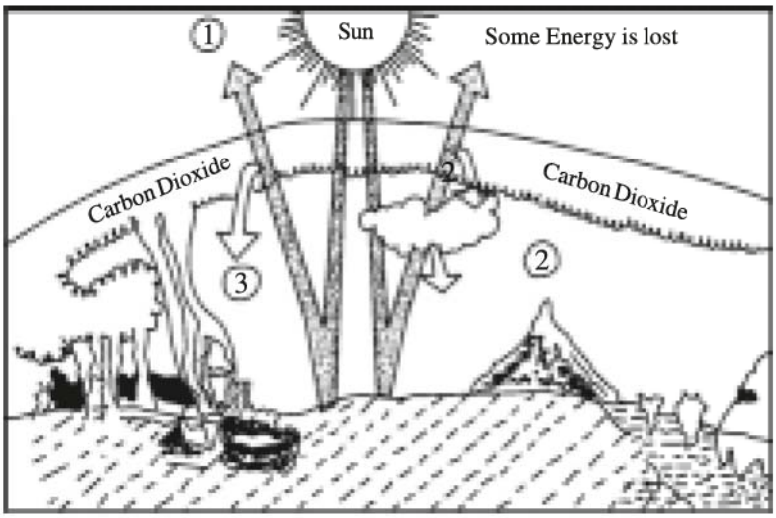
(7) Winds : Wind direction and its velocity influence climate. Winds coming from cold regions are cold. When they blow over warm regions, they lower the temperature there. Winds coming from hot regions are hot. When they blow over cold regions, they increase the temperature there. Warm and moist winds blowing from the sea bring rain. Dry winds blowing from land areas do not give rain. This influences their climate.

(8) Direction and slope of mountain range : The time for which insolation persists and the direction of slope, determine the temperature and rain. Normally, on a mountain slope, insolation persists for a longer time on west facing slope compared to east facing slope. Accordingly, temperature remains higher on west facing slope. The south facing slopes of the Himalayas remain free from the effect of cold northerly winds. Hence temperature of southern slopes does not fall as much as that of northern slopes.

If a mountain range comes in way of moist winds coming from sea, the winds climb upslope and give more rain on the windward side. The same winds after crossing over the mountain range on reaching the leeward side have less moisture and hence give less rain.

Global Warming

The atmosphere surrounds the Earth. Since past several years, a rise in temperature of atmosphere has been recorded. This phenomenon of global rise in temperature is known as **global warming**. The Sun rays pass through the atmosphere and directly reach the Earths surface. Thus the Earths surface is heated up first. Thereafter the atmosphere heats up slowly.



8.2 Green house Effect

When Sun rays reflected from the Earths surface pass through the atmosphere, carbon dioxide present in the atmosphere absorbs the long wave length infrared radiation and is reflected back to the Earth. Thus the Earth and its atmosphere are heated. This effect is the **'Green house effect'**. Carbon dioxide gas produces such effect and hence is known as Green house gas. Mehtane (CH_4), Nitrous oxide (N_2O), chloroflorocarbon (CFC), etc. are other Green house gases.

From figure 8.2, we find that

(1) A part of heat is lost. Amount of carbon dioxide increases due to fossil fuels and deforestation.

(2) Evaporation increases due to increase in heat, hence excess heat is absorbed. Increase in heat causes melting of ice resulting in a rise in sea-level.

(3) Carbon dioxide is the maximum absorber of heat reflected from the Earth's surface.

Due to various human activities, green house gases are being added to the atmosphere day by day. Smoke produced from industries, gases emitted by means of transport, burning of fossil fuels, deforestation, burning fuelwood and organic waste, wars, etc. are such reasons by which carbon dioxide is being added to the atmosphere. Also, due to some human activities, amount of other green house gases such as methane, nitrous oxide, chlorofloro carbon increases leading to global warming.

Following steps can be taken to control global warming :

- To decrease the burning of fossil fuels.
- Use of natural gas as a substitute source of power.
- Use solar power, wind power, tidal power, etc.
- Encourage afforestation
- Care should be taken so that more green house gases are not emitted into the atmosphere.
- Students should be made aware at school, high school level, proper management should be done for this.

Climate Change

The structure of atmosphere over the Earths surface is wonderful. However, this structure of atmosphere is never stable. According to the study of scientists, during the Pre-Cambrian Period, (about 60 crore years before) a major part of the Earths surface was covered with ice. Within a period of lacs of years, four major ice ages were experienced on the Earth. Except the ice ages, most of the remaining time the climate was hot and humid. At that time the mean temperature of the Earth was about 22 degree Celsius. Hence, the poles were free of ice. Today the mean temperature of the Earth is estimated to be about 14 degree Celsius.

During the past ten thousand years, many changes have occurred in climate. Climate of the Earth was hot and humid about 8000 years before. Sahara, Arabian and Indo-Pakistan deserts were green areas and human civilizations had developed there. Around 3000 BC to 1700 BC, periods of dry and hot climate converted these areas into deserts. Today remains of ancient civilization are found from there.

During the period 1885 to 1940, the Earths climate, particularly that of the northern hemisphere was hot. However, after 1940, climatologists believe that the Earths mean temperature is decreasing. During the decade 1930 a severe famine occurred in the dust bowl region of south-western USA. During the period 1950 to 1966, the length of crop season in UK decreased by 9 to 10 days.

According to a study of climatologists, from 1850 till date, due to mans various activities such as smoke from industries, gases emitted from means of transport, deforestation, urbanization, wars, etc., amount of gases such as carbon dioxide, methane, chlorofloro carbon, nitrous oxide, etc. has increased. This is responsible for change in climate.

Evidences of major changes in past climates have been obtained from the Earths surface. Rocks that bear imprints of past climate change have been found from the Earths surface. Remains of animals that thrived in various climates and of past vegetation also point to changes that occurred in past climates. Also annular rings that develop in stems of trees according to climatic changes, river and glacial deposits, fossils of human settlement discovered from barren and desert areas, eustatic changes, changes in areas of perma frost, and its imprints left on land surface, etc. indicate notable changes that occurred in past climates.

Results of climate change

- Because of rise in global temperature, the areal extent of snow cover is decreasing, resulting in a rise of sea level.
- Some regions of the world are experiencing uncertainty in rainfall e.g. some regions are experiencing floods due to excessive rains while some regions experience drought due to scanty rains. Sometimes there is unseasonal rain also.
- Climate change has resulted in adverse effects on planting and harvesting of crops. Hence negative effects are seen on agricultural production. This indirectly affects the entire economy of the region.
- Due to the thinning of ozone layer, a rise in level of Suns ultra violet radiation increases incidence of diseases such as cancer, skin diseases, cataract, etc.
- Some natural phenomena such as flood, famine, cyclone, landslide, snowfall, hail, etc. have become uncertain and excessive.

EXERCISE

1. Answer the following questions in detail :

(1) What is an atmosphere ? Mention the different components of the atmosphere.

(2) Explain structure of atmosphere with the help of a diagram.

(3) What is climate ? Give information about elements of climate.

(4) Mention the names of factors affecting climate and discuss any two factors.

2. Write to-the-point answer of the following questions :

(1) Troposphere

(2) Thermosphere

(3) Explain the difference between weather and climate.

(4) Discuss the outcome of climate change.

(5) Write a short note on global warming.

(6) Highlight the evidences for past changes in climate.

3. Answer the following questions in brief :

(1) Tropopause is favourable for aircraft flights Explain.

(2) Define weather and climate.

(3) How does latitude affect climate ?

(4) Explain insolation and temperature as elements of climate.

(5) Highlight the steps to control global warming.

4. Answer the following questions in one-two sentences :

(1) Which are the four main layers of the atmosphere ?

(2) Ozone is found in which layer of the atmosphere ?

(3) What is Tropopause ?

(4) What is weather ?

(5) What is climate ?

(6) Which are the elements of climate ?

(7) Which are green house gases ?

5. Select the correct option from the options given and write the answer :

(1) Which gas is present in the highest amount in the atmosphere ?

(a) Oxygen (b) Carbon dioxide

(c) Nitrogen (d) Ozone

(2) Which is the heaviest gas in the atmosphere ?

(a) Nitrogen (b) Oxygen

(c) Helium (d) Carbon dioxide

(3) Aurora is seen in which layer ?

(a) Stratosphere (b) Thermosphere

(c) Mesosphere (d) Troposphere

(4) In which city is the headquarters of the Indian Meteorogical Department located ?

(a) Mumbai (b) Chennai

(c) Kolkata (d) Delhi

(5) Which is a major gas among the green house gases ?

(a) Methane (b) Nitrous oxide

(c) Ozone (d) Carbon dioxide

(6) What is the Earths mean temperature at present ?

(a) 12^0 C (b) 18^0 C

(c) 22^0 C (d) 14^0 C

Activity

- Visit any industrial estate of Gujarat, and prepare a note on pollution from industries and resulting climate change.

9 Temperature

The Earth receives both heat and light from the Suns rays. This is known as solar radiation. The Suns heat energy reaches the Earth in the form of radiation. Hence it is known as solar radiation or solar energy. When Suns rays reach the Earth, they pass through the atmosphers first pass on insolation to the Earths surface. Hence the Earths surface gets heated up first. Thereafter, atmosphere and water masses get heated through processes such as radiation, convection and conduction.

Insolation

The main source of the heat received by the Earths surface and atmosphere is the Sun. The Sun is approximately 15 crore km away from the Earth. Because of extremely high temperature and pressure in the Suns core, there the nuclear reaction occurs naturally. In this reaction fusion of hydrogen nuclei of the Suns matter occurs, releasing light and tremendous amount of energy. Hence the Suns surface temperature is estimated to be 6000 degree Celsius while that of its central part is about 1.5 degree Celsius. Out of the total heat emitted from the Sun, only two-billionth part reaches the Earth. The heat or heat energy received by the Earths surface and the atmosphere is called Insolation. Insolation is measured by Pyranometer and expressed in calories per minute per square cm. or kW/ square metre.

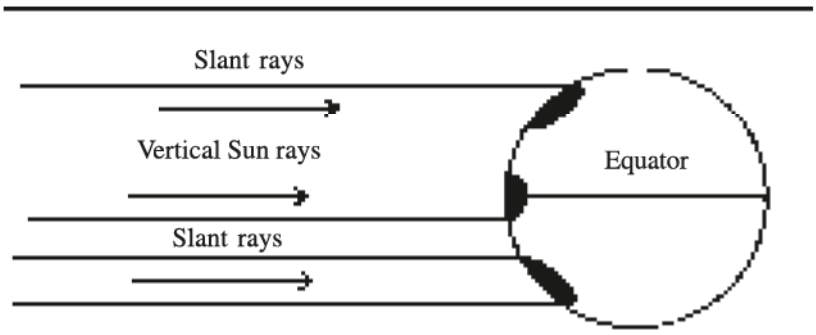
Factors affecting distribution of Insolation

Due to the unequal distribution of continents and oceans, diverse physical features and also as we go from the equator to the poles, there is variation in the amount of insolation. Factors responsible for this are :

(1) Angular length of the Sun's rays : Our Earth being almost spherical, angular length of the Suns rays is not the same everywhere. Hence insolation received is also not the same everywhere. The Suns rays fall vertically in tropical regions. Hence more amount of insolation is received here. In the mid-latitude regions as compared to low latitude regions and even more so in high (polar) latitude regions, the Suns rays fall more slantingly, and accordingly receive less insolation.

The Suns rays fall vertically on some slopes of mountainous regions, while there is shadow over opposite slopes. Hence slopes of mountainous regions influence distribution of insolation. In day time amount of insolation is more at noon while in morning and evening as the Suns rays are slanting, amount of insolation is less.

(2) Length of day : The duration of sunlight directly influences amount of insolation. Insolation is more where length of day is greater. Length of day is more in summer than in winter. Hence in summer season, amount of insolation is more, while it remains less in winter.



9.1 Vertical and Slanting Sun rays

(3) Density of atmosphere and height : The Suns rays pass through the atmosphere and directly reach the Earths surfare. When the Sun rays are passing through the atmosphere, 40 to 50 % insolation is absorbed in the atmosphere. A part of insolation is also reflected. Less insolation is absorbed in thin atmosphere while more insolation is absorbed in dense atmosphere. Atmosphere is thin at the equator, hence more insolation is received there, and it is dense at the poles, hence less insolation is received. Hence amount of insolation decreases as go from the equator to poles.

Slanting rays pass through greater area of the atmosphere, hence more insolation is absorbed. As a result, less insolation is received in middle and high latitude regions. In low latitude regions, Sun rays pass through less area of the atmosphere, hence less heat is absorbed and such regions receive more insolation. Also factors such as amount of clouds, water vapour and dust particles in the atmosphere influence insolation.

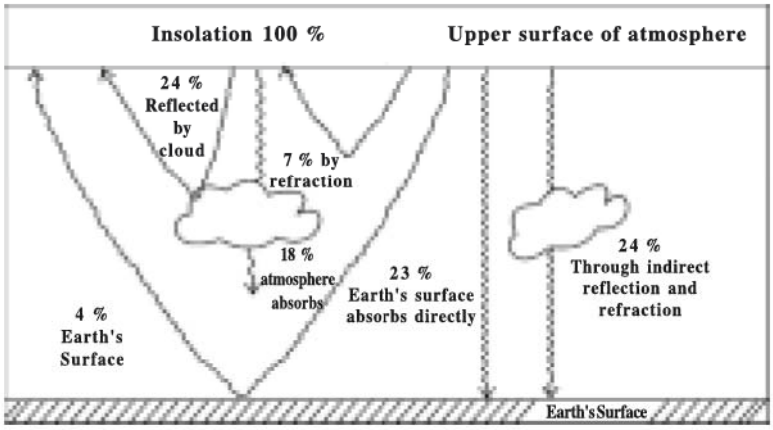
(4) Land and water : The Earths surface is made of land and water areas. Both surfaces receive same amount of heat from the Sun, still because of difference in matter, they dont heat up equally. Water being a liquid, solar heat received by it gets widely dispersed through ocean currents, waves, tides, etc. Also water being transparent, Sun rays can penetrate deep inside. The shiny water surface also partly reflects Sun rays. Hence water heats up slowly. Land being solid, heat received from the Sun does not get evenly distributed over entire surface. The opaque land surface fully receives the Suns heat. Hence land heats up rapidly. Hence, land and water have different heat absorbing capacities. Land and water areas being unevenly distributed over the Earths surface, this causes much variation in distribution of insolation.

(5) Amount of Sun spots : Black spots are seen on the Suns surface. They are known as **'Sunspots'**. When there are more Sunspots, more insolation is received by the Earth, and when they are less, less amount of insolation is received.

Heat Budget of the Earth

Of the Suns heat received at the upper surface of the atmosphere, about 18 % insolation is directly absorbed by the atmosphere. The Earths surface receives about 47 % insolation of the remaining. About 35 % insolation collides with clouds, dust particles, snow covered areas of Earths surface, areas of water bodies and returns to space without being absorbed. This **reflected insolation** is known as **'Albedo'**.

The atmosphere is not directly heated from the Suns direct heat. Heat from the Sun reaches the Earths surface as short wave radiation. These Sun rays first give heat to the Earths surface. As the surface heats up, its heat is dissipated in atmosphere in the form of long wave radiation. Hence, first of all, part of the atmosphere close to the Earths surface is heated up. Later on the heat spreads upwards in atmosphere. Due to this reason, as we go upwards from the surface in the Troposphere, air temperature falls.



9.2 Distribution of insolation in Atmosphere and at the Earth's surface

Heat of the Earths surface dissipates into the atmosphere through the processes of radiation, conduction and convection. In case of radiation, heat of the Earths surface dissipates in atmosphere in the form of long wave radiation. In conduction, heat flows from hot body to cold body and it continues till both bodies are equally heated. Similarly, the cool air in contact with the Earths surface obtains surface heat through the process of conduction. The air that has become hot due to conduction, becomes light and rises upwards. The sideways or cool upper air takes its place. It also heats up and rises. Thus, heat of the Earths surface dissipates up in the atmosphere. These are also known as convection currents.

Water vapour also plays an important role in heating the atmosphere. The water vapour formed by evaporation at the Earths surface possesses latent heat. Condensation of this moisture releases this latent heat which warms the atmosphere. The amount of Suns heat received by the Earths surface and its atmosphere through different processes after being used in various processes, remaining heat is returned back to space. Thus heat balance is maintained on the Earth.

Temperature

The level of atmospheric heat is temperature. It is measured in units of Celsius or Fahrenheit. Air temperature is measured by various kinds of thermometers and thermograph. In these days of modern technology temperature is measured by digital thermometer. Factors affecting temperature are as follows :

(1) Latitude : The Sun rays are always vertical in equatorial region. Hence temperature remains high throughout the year. As we go from equatorial to polar regions, the Sun rays become more slanting. Also, they have to pass through a larger part of the atmosphere. Hence in polar regions, less heat from Sun rays is experienced. In June, Sun rays are vertical over Tropic of Cancer (northern hemisphere), while in December, they are vertical over the Tropic of Capricorn (southern hemisphere). Hence these areas experience highest temperatures in respective months. In polar regions, Sun rays being very slanting temperature remains low.

(2) Height above sea level : Sun rays are first incident on the Earths surface, hence it heats up. Thereafter, the atmosphere in contact with the surface heats up. Hence, temperature falls with altitude.

(3) Distance from sea : Land heats and cools faster compared to water. Hence, summer temperatures of coastal areas remains lower while winter temperatures are mild. In continental areas far from the sea coast, winter temperatures are low, while summer temperatures are high.

(4) Distribution of land and water : Distribution of land and water is not uniform on the Earths surface. Also water heats and cools slowly compared to land, due to difference in physical properties. Hence vast continents and oceans spread across the Earths surface, do not experience uniform temperatures. Thus, continents and water bodies influence distribution of surface temperatures.

(5) Ocean currents : Warm and cold currents flow in oceans. They influence temperatures of respective coasts. Cold currents (Labrador, Benguela, California) flowing in lower latitudes, lower temperatures of coastal regions. Warm currents (Gulf Stream, Kuroshio) flowing in higher latitudes raise temperatures of coastal regions.

(6) Winds : Hot and dry winds blowing from deserts raise temperatures, while cold winds blowing from polar regions, lower temperatures in regions from where they blow. Besides local winds (sea and land breezes, loo, Norwester, Harmattan) influence temperatures of respective areas.

(7) Relief : Relief also influences temperature e.g., temperature remains high in areas with open rocks and desert regions. Temperature remains low in snow covered regions and those with vegetation cover.

Distribution of Temperature

There are oceans and continents on the Earths surface. There are deserts, snow covererd regions, plains, forests, mountains and such other natural regions on the continents. Different types of surfaces receive insolation in different amounts. Thus, atmospheric temperature also remains varied. Distribution of temperature can be studied in two ways :

(1) Horizontal distribution of temperature (2) Vertical distribution of temperature

(1) Horizontal distribution of temperature : Horizontal distribution of temperature on the Earths surface depends on factors such as latitude, distance from sea, ocean currents, wind direction and height of place, etc.

As we go from equator towards the poles, the Suns rays become slanting and hence temperature decreases. Areas near the sea coast have moderate temperature and continental areas away from the sea coast have extreme temperature. In case of continental land areas, diurnal and annual range of temperatures are higher, while temperature of land areas near the sea coast remains moderate.

Cold and warm ocean currents influence the temperature of adjoining coastal regions. Temperature of coastal regions from where cold currents flow gets low, while those from where warm currents flow goes high.

Also temperature is high in areas from where hot and dry winds blow, while it is low in those areas where cold and dry winds blow. Besides, amount of forest, altitude, types of soil, amount of clouds and such other factors also influence distribution of temperature.

(2) Vertical distribution of temperature : Under normal conditions, as we move upwards from the Earths surface, temperature falls by 6.5 degree Celsius for every one km ascent. This is known as **'Lapse rate'**. This decrease in temperature is observed in the Troposphere only. The Earths surface is first heated by the Suns rays and then the atmosphere heats up gradually. Thus the atmosphere is heated by various processes (convection, radiation, conduction). Thus temperature decreases upwards from the Earth's surface. Hence hill stations in mountainous regions have developed as tourist places. Hill stations like Shimla, Manali, Srinagar, Nainital, Darjeeling, Saputara, Pachmadhi, Mahabaleshwar, Mt. Abu, etc. are good examples.

Inversion of Temperature :

Sometimes temperature of atmosphere increases instead of decreasing as we go upwards. This is temperature inversion. It is experienced under influence of factors such as long winter nights, stable air, clear sky, windless night, snow covered regions, etc. Atmosphere nearer the Earths surface rapidly cools down and during this time, upper layers of atmosphere are relatively warm. Such conditions are known as inversion of temperature. Such temperature inversion is experienced in snow covered regions of north and south poles, high mountainous regions and valley regions.

EXERCISE

1. Answer the following questions in detail :

(1) Explain the effect of angular distance and length of day on distribution of insolation.

(2) Explain heat budget of the Earth.

(3) Mention the factors influencing distribution of temperature and explain effects of latitude and distance from sea.

(4) What is distribution of temperature ? Discuss the horizontal distribution of temperature.

2. Write to the point answer of the following questions :

(1) Solar radiation

(2) Inversion of temperature

(3) Density of atmosphere

(4) Vertical distribution of temperature

3. Answer the following questions in brief :

(1) There is less heat in polar regions_ Give reasons.

(2) Which are the factors influencing distribution of insolation ?

(3) Continental regions experience extremes of temperature Why ?

(4) Temperature decreases as we go above the Earths surface. Give reason.

4. Answer the following questions in one-two sentences :

(1) What is insolation ?

(2) Mention names of local winds.

(3) What is the unit of measuring insolation ?

(4) What are Sun spots ?

(5) What is lapse rate?

5. Select the correct option from the options given and write the answer :

(1) Which instrument is used to measure Insolation ?

(a) Thermometer (b) Barometer (c) Pyranometer (d) Lactometer

(2) Temperature of the Suns surface is estimated to be ?

(a) 5000° C (b) 6000° C (c) 1.5 crore ° C (d) 1000° C

(3) Which of the following is not a factor influencing temperature ?

(a) Longitude (b) Relief (c) Wind (d) Distance from sea

(4) Which of the following is not a factor influencing distribution of insolation ?

(a) Height above sea (b) Length of day

(c) Ocean currents (d) Distribution of land and water

Activity

- Collect figures for temperature broadcast on TV and display them on the School Board

10 Winds

Atmospheric Pressure

The sphere of air which is spread over thousands of kilometres above the surface of the earth is called Atmosphere.

The air in the atmosphere is a physical matter and so it has its own weight. This layer of air in the atmosphere exerts some pressure according to its weight on the earths surface, which is called Atmospheric Pressure. Earths gravitational force is responsible for the atmospheric pressure. Polar regions experience more gravitational force than the equator, so the weight of the matter is more on poles.

Among the elements deciding the weather and climate of any region, atmospheric pressure is very important. Its direct impact is not felt on human life but a slight difference in the pressure changes the velocity and direction of winds. It directly affects the distribution of temperature and humidity. Thus the atmospheric pressure indirectly controls the life of living organisms. It is necessary to know about atmospheric pressure to understand the cyclones and other phenomena associated with atmosphere.

Recording of Pressure

Atmospheric pressure is recorded in centimetres or inches or millibars. However the unit millibar is more used to show atmospheric pressure for recording at the weather stations and in weather maps. The atmospheric pressure at mean sea level is either 76 cm or 30 inches or 1013 millibars. (This is mentioned as mb in the maps.)

[1 cm = 13.32 millibars, and 1 millibar = 0.295299 inches]

Atmospheric pressure can be recorded by instruments such as Barometer, Anaroid Barometer and Barograph. It can be recorded more precisely by Fortins Barometer which uses mercury.

Factors affecting Atmospheric Pressure

Atmospheric pressure is perceived differently at different places on the earth. Altitude, temperature, humidity etc. are major factors responsible for the distribution of atmospheric pressure.

(1) Altitude : Air is prevalent upto many kilometres in the atmosphere from the surface of the earth. Due to gravitation force of the earth, every upper layers exerts pressure on the lower layer. So, the air at the lower strata remains compressed and dense while it is thin in the upper layers.

Higher the place the air will be thinner. The thin air is lighter and exerts less pressure. The air pressure decreases @ 1 cm or 13.32 mb for every 165 metres. Everest in Himalayas is 8848 metres high. The air there is very thin so the pressure there decreases by about 54 cm or 320 mb.

Air Pressure at different altitude according to Chrichfield

Altitude (metres)	Air Pressure (in Millibars)
Sea Level	1013
1000	899
3000	710
5000	540
10000	265

(2) Temperature : Air expands due to heat and occupies more space. So the pressure decreases. Air contracts due to cold and occupies less space. Such air becomes heavy so the air pressure becomes high.

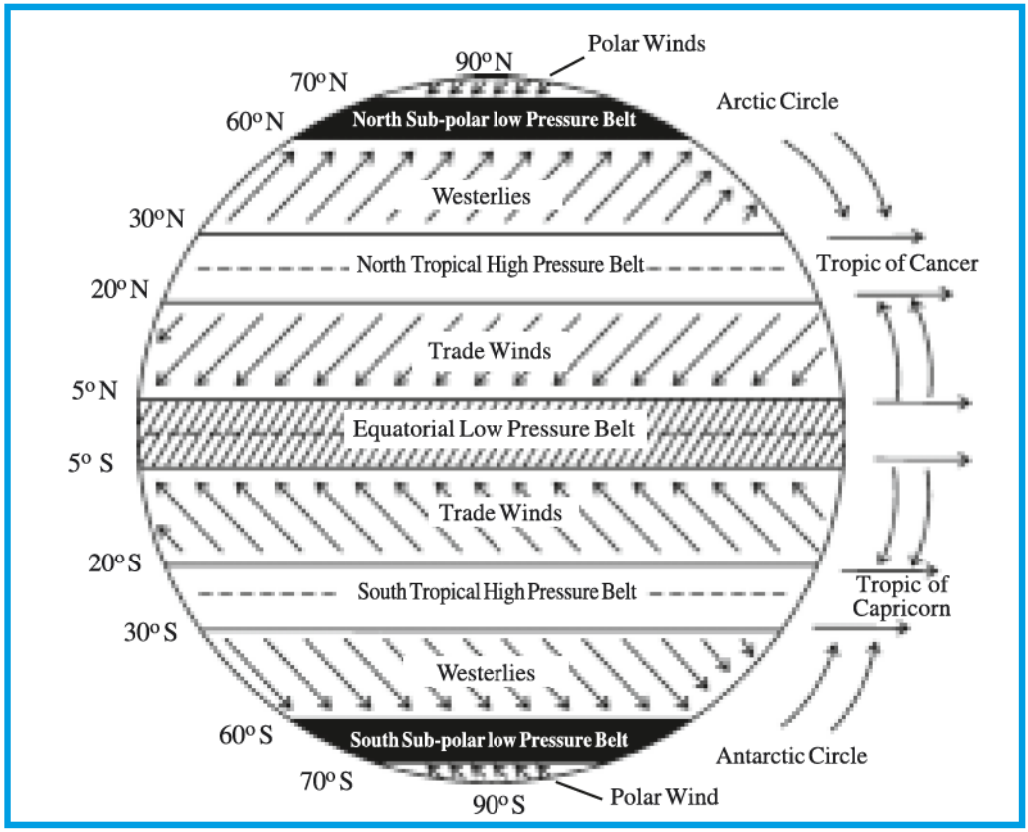
Due to the difference in temperature , the day time pressure is less while the pressure is more during night time. The pressure is less over landmass during summer and is high during winter. Similarly, the temperature in equatorial region is high so the pressure is low, while the polar regions feel more pressure due to very low temperature. Thus, the atmospheric pressure depends on the temperature of respective places.

(3) Humidity : Water vapour is lighter than the air. So, if the humidity increases lower will be the air pressure. When the humidity in the air decreases its pressure increases.

During rainy season, there is more humidity in the air so the pressure is low. The air over the oceans contains more humidity. As a result the air pressure remains low over oceans compared to landmass. The air over equatorial region is more humid so the low air pressure develops over there.

Pressure Belts

Due to the factors bringing changes in the atmospheric pressure, different regions on the earth experience low or high air pressure. Such pressure which is restricted over certain area on the earths surface is called **Pressure Cells**. Low and high pressure formed over the earths surface are pressure cells in their initial stage, expand eastwards or westwards under favourable situation and then become Pressure Belts. Thus the pressure belts are pressure cells arranged in the same latitudinal boundary and having identical pressure. If the east-west latitudinal zone has high pressure area, it is called High Pressure Belt. Similarly, in the east-west latitudinal zone, the low pressure area is called Low Pressure Belt. These belts are clearly shown in figure 10.1 below.



10.1 Pressure Belts and Permanent Winds

There are a total of seven pressure belts on the earths surface. These are as follows :

Sr. No.	Pressure Belt	Amount of Pressure	Hemisphere	Latitudes
1.	North polar High Pressure Belt	High	North	80° N. to 90° N.
2.	North sub polar Low Pressure Belt	Low	North	60° N. to 70° N.
3.	North Tropical High Pressure Belt	High	North	20° N. to 30° N.
4.	Equatorial Low Pressure Belt	Low		5° N. to 5° S.
5.	South Tropical High Pressure Belt	High	South	20° S. to 30° S.
6.	South Sub-polar Low Pressure Belt	Low	South	60° S. to 70° S.
7.	South polar High Pressure Belt	High	South	80° S. to 90° S.

Equatorial Low pressure Belt :

The sun rays fall almost vertical between 5^0 North latitude to 5^0 south latitude around equator. The region gets more insolation throughout the year, so the air remains warm consistently. The warm air expands and becomes light so the low air pressure develops here. There is more moisture in the air so it reduces the pressure. As a result, a low pressure is created in the east-west belt in the region of hot and humid climate around equator. This belt is called **Equatorial Low Pressure Belt**. With changing seasons, this belt shifts up to 10^0 latitudes in respective hemisphere. There is hardly any wind in this region, so this region is also called **Doldrums**.

Tropical High Pressure Belt : A Tropical High Pressure belt is developed between 20^0 to 30^0 latitudes in both hemispheres. The thin and light air of Equatorial Low Pressure belt rises high, reaches an altitude of about 3 to 7 km, bifurcates due to coriolis force and flows in the horizon direction towards North Pole and South Pole. Some volume of this air descends down towards the surface between 20^0 to 30^0 latitudes. It accumulates there and a high pressure zone is developed. These belts are known as **North Tropical High Pressure Belt** in northern hemisphere and **South Tropical High Pressure Belt** in southern hemisphere.

Sub-Polar Low Pressure Belt : Polar Low Pressure Belt develops between 60^0 to 70^0 latitudes in both hemispheres. The Coriolis Force is responsible for this development. Air in the form of Polar winds from Polar High Pressure Belt and as Westerlies from South Polar belt have different characteristics. It rises high near the polar latitudes in the form of a cyclone. Due to a large scale circulation of air, which rises high in a cyclonic pattern, low pressure pockets spreading east-west develop near polar latitudes. In northern hemisphere it is called **North Sub- Polar Low Pressure Belt** in northern hemisphere and **South Sub - Polar Low Pressure Belt** in southern hemisphere.

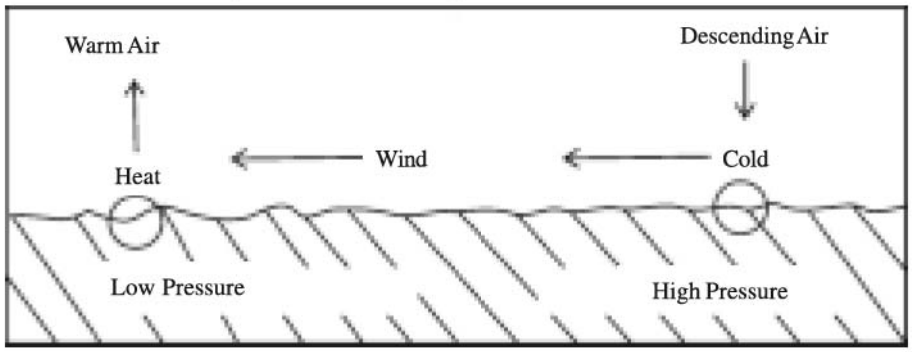
Polar High Pressure belts : Sunrays are slant over both the poles so the temperature there is very low. There is no evaporation here and so the air does not have any moisture. Most of this region is snow clad throughout the year. Due to these reasons a high pressure belt develops over polar regions. These are known as **North Polar High Pressure Belt** in northern hemisphere and South Polar High Pressure Belt in southern hemisphere.

Winds

The air sphere around the earth is very unstable. It constantly circulates horizontally as well as vertically. **A Wind** is the air which moves in horizontal direction while the air rising in vertical direction

is called **Air Currents**. Winds and air currents decide the atmospheric circulation. Winds blowing from hot deserts circulate the heat and winds blowing from over the humid oceanic regions circulate humidity.

The direction of the wind and its velocity depend on the pressure gradient. A pressure Gradient is the difference between the pressure of two places.



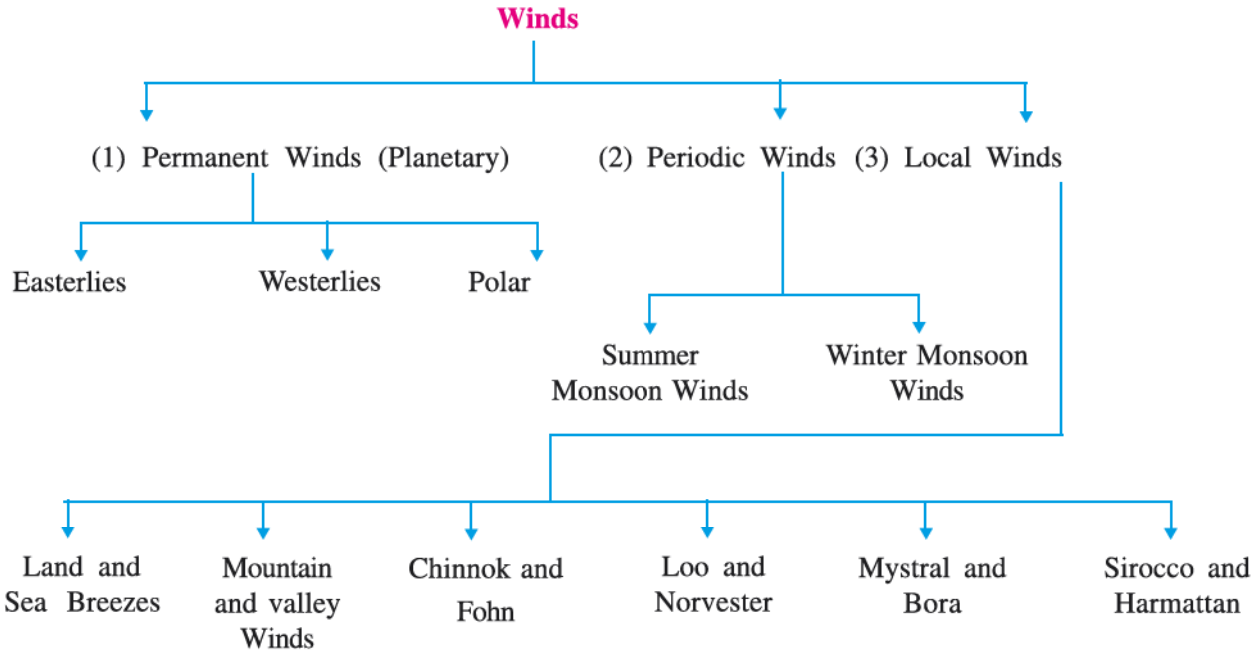
10.2 Origin of Winds

Winds always move from high pressure to low pressure area to supplement the low pressure. If the gradient is less then the wind will blow with lesser velocity, and if the gradient is more it will blow faster. It originates cyclones such as hurricane, typhoon, norvesters etc.

American scientist Ferrell (1856) studied the effects of coriolis force on the winds and air currents. According to Ferrells Law, Winds are deflected to their right in Northern Hemisphere and to their left in Southern Hemisphere. (Fig. 10.1)

Wind Wane and Anemometer are used to record the direction and velocity of wind respectively. Wind velocity is measured in kilometres, mile or in knots per hour.

Types of Wind :



(1) Permanent (Planetary) Winds : As these winds blow from the same direction throughout the year, these are called Permanent winds. These winds, blowing from high pressure area to low pressure area cover a large part on the surface of the earth. That is why these are also known as Planetary Winds. There are three sub types of these winds.

Easterlies : In both hemispheres, these winds blow from Tropical High Pressure belt towards the Equatorial Low Pressure Belt in the Torrid zone (i.e. from Tropic of Cancer` Capricorn to Equator). Easterlies blow in the same direction continuously with the same velocity. These winds deflect towards east due to coriolis force, so these are called Easterlies. As these winds blow in a stable velocity, they were used for trade by sea routes, so these are also called as **'Trade Winds'**.

As per **Ferrell's** Law, these winds deflect to their right in northern hemisphere. These are seen coming from north-east direction and hence are also called **'North-East Trade Winds'**. In southern hemisphere, these winds blow from south-east direction and are called **'South-east Trade Winds'**. As these winds come from warm region, their capacity to retain moisture increases but capacity to shower rain decreases.

Westerlies :

These winds blow towards temperate zone from Tropical High Pressure belt to Sub-Polar Low Pressure belt. These winds deflect and come from western direction, so these are known as Westerlies. These winds blow from south-west to north-east in northern hemisphere, and from north-west to south-east in southern hemisphere. These are also called South-West Westerlies in northern hemisphere and are called North-West Westerlies in southern hemisphere.

The direction of Westerlies is opposite to the direction of Trade Winds, so these are also called **Anti-Trade Winds**. As these winds blow from hot regions towards cold region, they become cooler, and give rain on the western part of Europe, Canada, Chili etc. which are situated on the western side of the continents.

Like to know :

Southern hemisphere is a Water Hemisphere. There is no obstruction of any landmass between 40^0 S to 80^0 S latitudes so these winds blow at very fast velocity making blast sound. Due to the high intensity sound made by these winds, the sailors call these Westerlies as Roaring Forties on 40^0 south latitudes, Furious Fifties on 50^0 south latitudes and Screeching Sixties on southern 60^0 latitudes.

Polar Winds : These winds blow from Polar High Pressure Belt towards Sub-Polar Low Pressure Belt in both hemispheres. These winds blowing from poles are known as Polar Winds. These winds blow from north-east to south-west in northern hemisphere and from south-east to north-west in southern hemisphere.

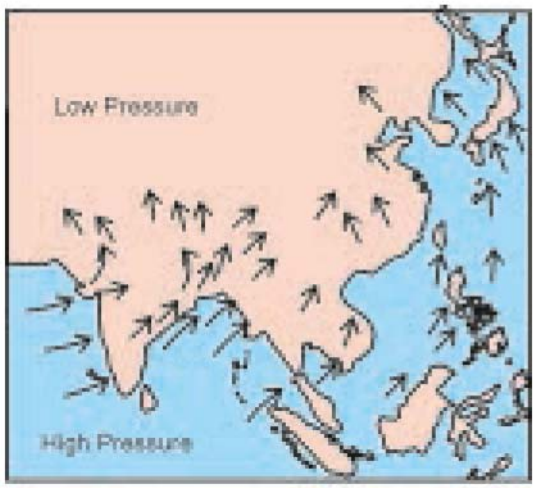
These winds are extremely cold as they happen to come from polar regions. A cold wave grips the area wherever they blow. These cold waves do not have the capacity to hold moisture, so they hardly give any rain.

When there is a confluence of cold winds from poles with the warm winds from temperate zone, it develops cyclonic and anti cyclonic conditions.

(2) Seasonal Winds : At some places on the earth season changes according to the prevailing winds. These winds which change their direction according to the season are called Seasonal Winds, and are also called Monsoon Winds. India, Pakistan, Bangladesh, Myanmar, Sri Lanka, China, Korea, Japan, Taiwan etc. experience seasonal winds. Besides, Australia, Madagascar, Nigeria, Ghana and southern U.S. also feel slight effects of seasonal winds. These Monsoon winds can be divided into two parts :

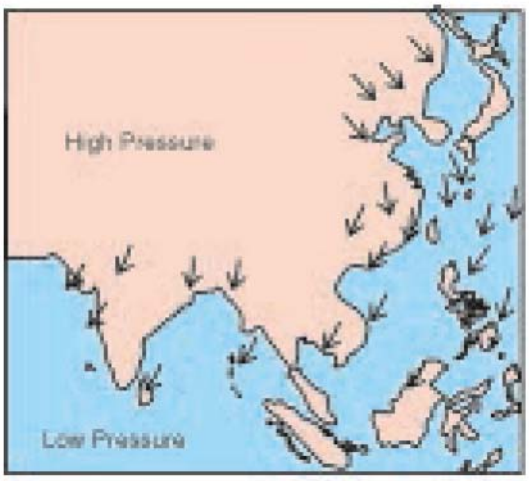
(1) Summer Monsoon winds (2) Winter Monsoon Winds

(1) Summer Monsoon Winds (South-West Monsoon Winds) : In summer, a low pressure develops over the north-western landmass due to high temperature. Over the water mass of Arabian Sea and Bay of Bengal, low temperature results in the development of high pressure. Under these circumstances, the Easterlies Trade Winds from the south of equator serge ahead towards north to maintain the pressure equilibrium. After crossing equator these winds change their direction and become South-West monsoon winds. These are known as Summer Monsoon Winds.



10.3 Summer Monsoon Winds

As these winds happen to blow over a vast water mass they contain abundant moisture and so give heavy rains near coastal area. Heavy rainfall occurs on the windward side of the mountains which obstruct these winds, e.g. due to Western Ghats, Malabars on the western coast gets more than 200 cm rainfall.



10.4 Winter Monsoon Winds

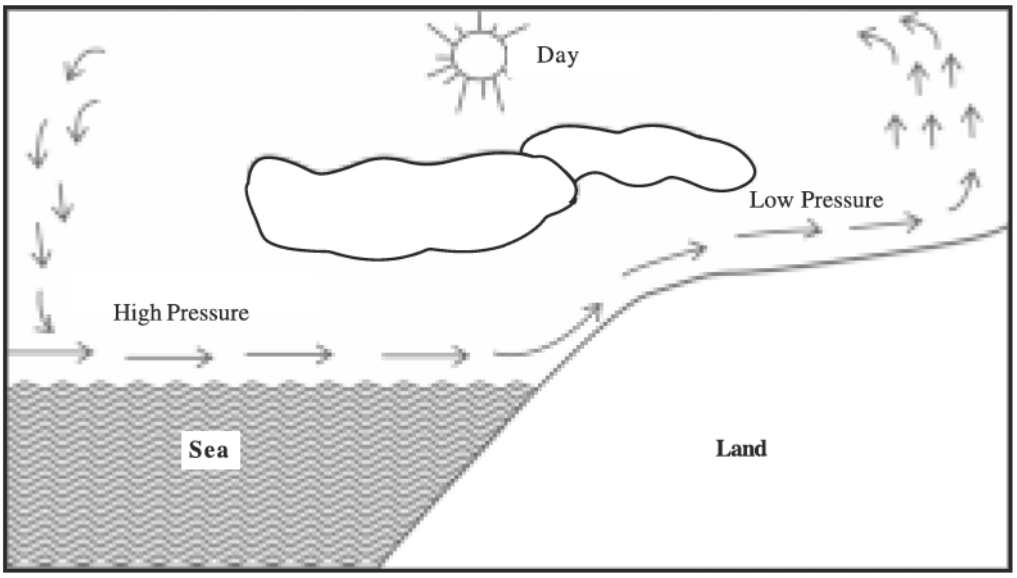
(2) Winter Monsoon Winds (North-East Monsoon Winds) : Some Asiatic landmass cools faster in Winter. So high pressure pockets develop here. At this time the nearer water mass is a little warmer, so low pressure pockets develop there. As a result, winds blow from landmass towards oceans. These winds blow over South and South-Asian countries from north-east direction, so these are called North-East Monsoon Winds.

As these winds blow over from landmass, they contain less moisture and do not give much rain. When some of their branches pass over the ocean, they hold moisture. In December January, the North-East Monsoon winds shower most of the annual rains over Coromandel coast on the eastern sea coast of India and to northern parts of Sri Lanka.

Rains caused by these monsoonal winds is irregular and uncertain. The rainy season starts earlier sometimes and ends also earlier. It starts late sometimes but ends earlier. Sometimes these monsoon winds cause very heavy rains or occasionally cause droughts. That is why the farmers of this region believe in fate. In India, monsoon winds are responsible for uncertainty of rainfall.

(3) Local Winds : Often winds blow over a limited area. These winds originate due to special characteristics or some factors of the area. Unequal relief features, nearness to water and land area, unequal heating and cooling of water etc. give rise to local winds. These winds affect very limited local area only. Details of the local winds is as follows :

(a) Sea breezes :

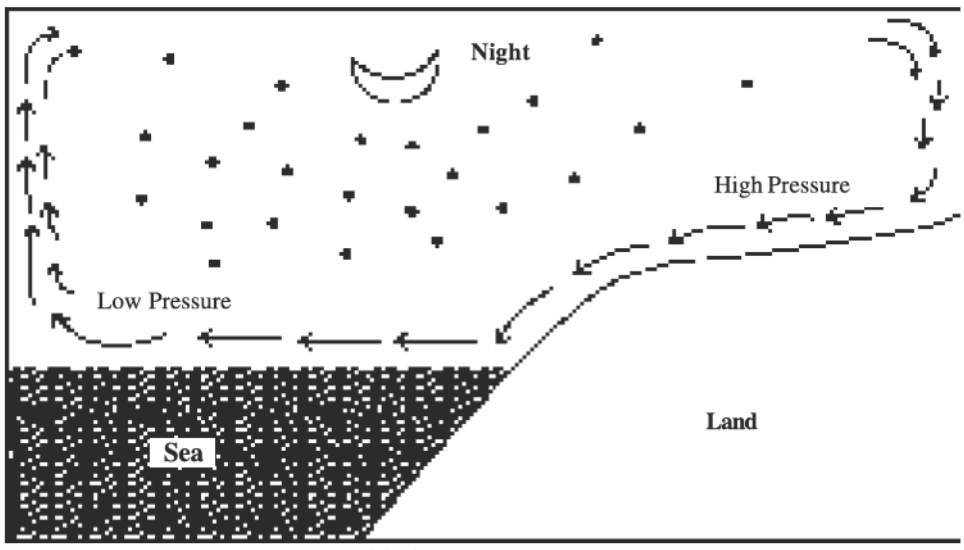


10.5 Sea Breezes

Land area heats up faster than sea during day time, so a low pressure develops over land and a high pressure over the sea, and so winds blow from sea to land during day. There are called Sea Breezes.

Due to sea breezes, temperature of coastal land area lowers down by 5^0 to 7^0 C. Coastal areas feel less heat during summer than the continental area. This region experiences temperate climate.

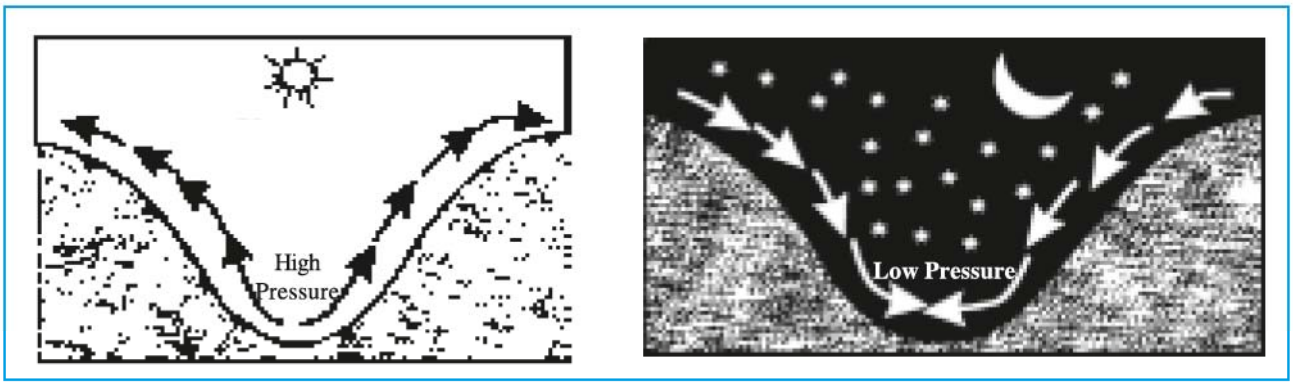
Land breezes :



10.6 Land Breezes

During night land cools down faster so a high pressure develops over land. Compared to land, the sea is comparatively warmer and so low pressure develops over seas. As a result, winds blow from land to sea during night. These are called **Land Breezes**. Due to these land breezes, temperature in coastal does not fall very much during winter.

(b) Mountain and Valley Breezes : These winds originate due to unequal temperature and pressure

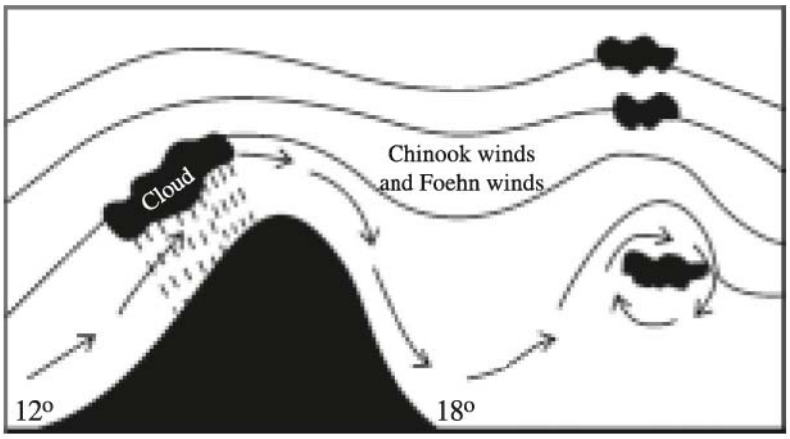


10.7 Valley and Mountain Breezes

between a mountain and a valley. During the day, mountain slopes become warmer faster than the valley. So the warmer air on the slopes becomes lighter and rises high. To fill up this blank the air in the valley rushes towards the higher slopes. Thus winds blow from valley to mountain slopes during day which are known as Valley Breezes.

Contrary to this, the peaks and mountain slopes cool faster during night while the valley area is relatively warmer. So winds blow from mountain slopes to the valley area during night, which are called **Mountain Breezes**.

(c) Chinook and Foehn :



10.8 Chinook Winds

In North America, warm and dry winds coming over from Pacific Ocean descend down on the eastern slopes of Rocky mountains in cold season and raise the temperature in Prairie Plains by 15^0 to 25^0 C within two hours. The snow in the Prairie melts due to this warm winds. This enables the farmers and shepherds living in the eastern side of Rocky to procure some agricultural land and grass for animals. People feel comfort against the cold. Due to this characteristics, the Red Indians call them Chinook, which means snow-eater winds.

Foehn winds are also dry, warm and stormy winds like Chinook which blow towards the European (Switzerland) plains after crossing the Alps from south. These are known as Foehn there. While descending from the mountain slopes these winds become warmer due to the friction and melt the snow. This helps to carry out animal husbandry here. These warm winds help the plantation of citrus fruits like grapes, sweet lime (mosambi) etc.

Like to know :

The increase in temperature by 22^0 C within 24 hours for Chinook is a common thing. Temperature increased by 19^0 C within 7 minutes at Kipp in Montana State of U.S. Similarly, temperature increases by 21.3^0 C within 4 minutes at Pincher Creek in Alberta State on 6th January, 1966

(d) Loo and Norwester :

In the SindhuGanga plain of India and Pakistan, the warmer and dry winds coming from western direction in the afternoon in May and June are called Loo, which raise the temperature up to 50 ^{0} C. in North India. This loo often causes deaths of people and animals. In May, 2015 more than 1000 people died of loo in Andhra Pradesh, Telengana and Odisha States.

With the onset of monsoon, dry and warm winds with sand storms rush down over West Bengal from north-west. These winds are known as Norwester. These winds blow during the Vaishakh month and cause devastation, so these are also called Kal-Baisakhi.

(e) Mistral and Bora : Cold and dry winds descending from snow covered mountains are known as **Mistral** on the Mediterranean coast and as **Bora** on the Adriatic coast of croatia. As these winds are cold and dry, they damage the crops.

(f) Sirocco and Harmattan : Warm and dry winds blowing over from Sahara desert are known as **Sirocco** in Italy, Sicily and Spain along the Mediterranean coast. People in Guinea fall sick due to hot and dry winds, and then the **Harmattan** winds bring some solace to them. That is why the local people know these winds as **Harmattan** i.e. Doctor Wind.

Air Mass

An Air Mass is a part of the larger atmosphere where there is a horizontal homogeneity in the temperature and humidity. A large mass of the air showing equality in temperature and humidity is called Air Mass. The temperature and humidity are almost uniform in horizontal direction at various altitude. When the air remains stationary over a level land for a considerable time, it receives its heat, cold and humidity, then it becomes an Air Mass. Those regions where such air masses are formed on the earths surface, are the source regions of air masses.

Characteristics of Air Masses :

- One air mass can be wide spread upto hundreds of kilometres.
- Sometimes, it is as large as one continent.
- From altitude point of view, it can exist up to Troposphere.
- An air mass travels towards another region in the direction of pressure gradient.

The glacial plains of Canada, cold Siberia during winter, vast oceans in torrid zone, hot Sahara desert during summer etc. are source regions of air masses. These air masses are formed due to extreme heat or cold over these source regions. These are divided into two parts :

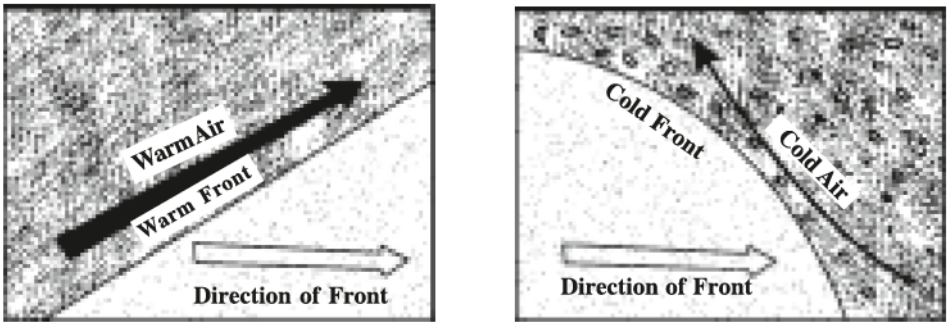
(1) Tropical Air Masses (2) Polar Air Masses

Fronts

The confluence zone between two air masses is called **'Fronts'.**

When two different air masses having different characteristics of temperature, humidity and other characteristics come closer, they do not merge within each other, but they create a separate surface where they meet. This surface is called Fronts.

A front is about 5 to 80 km wider area. The air of the warmer air mass from the slopes of the fronts is pushed in the upper atmosphere over the cold air mass. Condensation of the humidity takes place in this rising air, forms clouds and gives rains. Air pressure decreases near the front so the area becomes stormy. The cyclones on the earth are formed in the frontal zones. This way front is important in determining the weather and climate of any region.



10.9 Types of Fronts

There are two types of fronts :

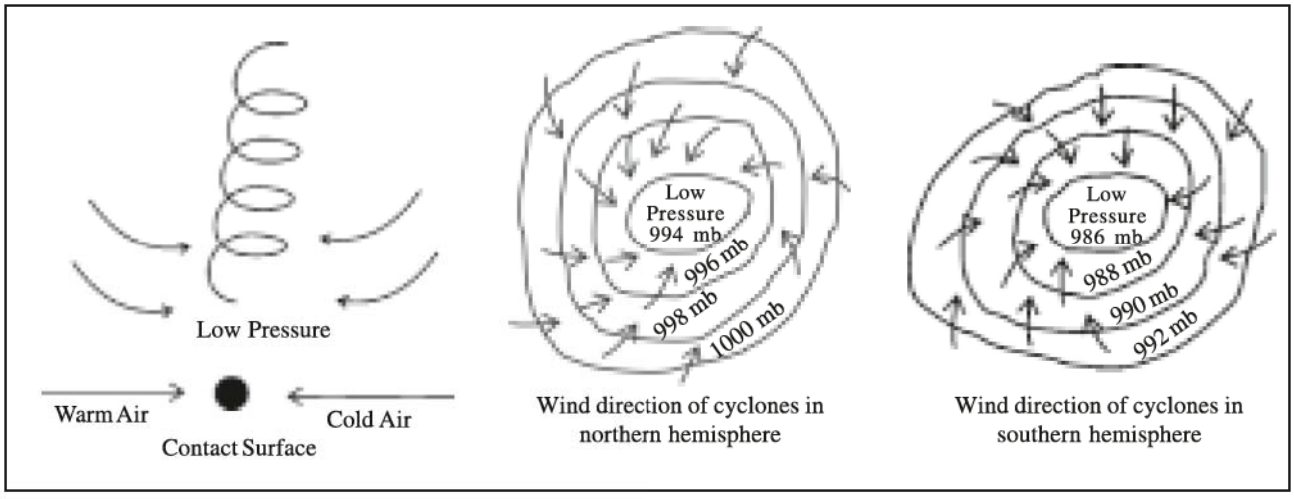
(1) Warm Front (2) Cold Front

Warm front has a gentle slope while the slope of cold front is curved. (see fig. 10.9).

In Europe and U.S., weather changes frequently due to cyclones. Front are shown along with the isobars in the weather maps there.

Variable Winds : Cyclones and anti cyclones are the result of atmospheric disturbances. Generally, cyclones are devastating and have more velocity.

Cyclones : When two air currents having different temperature are confronted, they collide instead



10.10 Wind Directions in Cyclones

of merging with each other. The air pressure near their meeting surface reduces suddenly and so the cyclone starts.

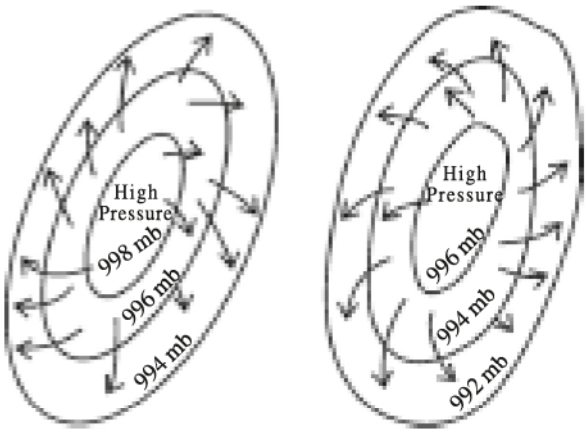
Low pressure prevails at the centre of the cyclone and it increases outwards. Due to coriolis force, winds rush towards the central low pressure and rises high in a circular motion above the surface. Winds move in anti clockwise direction in northern hemisphere and clockwise in southern hemisphere.

Cyclones bring large scale changes in weather of Europe and North America. It causes heavy damage to lives and property. Most devastating cyclones in the world blow over Antarctica continent. Some times, such stormy cyclones blowing over from sea contain much humidity, bring rains and cause heavy damage near sea coasts. In 1999, a cyclone over Kachchh (Gujarat) caused very heavy devastation. On 29th October, 1999, the cyclone which hit the Odisha coast was the most devastating. Its velocity was 260 km per hour. Cyclones are known by different names in different countries. These are known as Hurricane in West Indies and in Gulf of Mexico, as Typhoons in Japan and Philippines, as Tornado in U.S. and as Willie Willi in Australia.

Anticyclones : In Anticyclones, a high pressure prevails at the centre and the surrounding area in under low pressure. Winds blowing away from the centre spread out. These winds have less velocity, so they do not cause any damage.

In anticyclones, wind move in clockwise direction in northern hemisphere and move anticlockwise in southern hemisphere. Winds descend down in anticyclones thereby increasing the temperature so do not bring rain. If the anticyclone passes over any sea, it may give some rain.

In recent times RADAR and artificial satellites help to predict the arrival of cyclones-anticyclones. People can be alerted by informing them through TV, Radio and Newspapers and precautions can be taken in advance.



Northern Hemisphere Southern Hemisphere

10.11 Wind Directions in Anticyclones

EXERCISE

1. Answer the following questions in details :

(1) What is meant by wind ? State the types of wind and give information about Monsoon winds.

(2) Explain illustratively the Sea and Land Breezes.

(3) Draw a figure showing pressure belts and describe Equatorial Low Pressure Belt.

(4) Factors affecting the atmospheric pressure Explain in details.

2. Write short notes :

(1) Cyclone (2) Loo and Norwester

3. Give geographical reasons :

(1) Coromandel coast in Tamil Nadu gets rain in winter.

(2) Malabar coast gets heavy rain.

(3) Low pressure prevails over equatorial region.

4. Answer in one or two sentences :

(1) What is meant by atmospheric pressure ?

(2) State the instruments to record atmospheric pressure.

(3) Describe the Ferrells Law.

(4) In which countries are the effects of monsoon winds felt ?

(5) Which winds are known as Kal-Baisakhi ?

(6) In which two parts can the air mass be divided into ?

5. Select a correct option from the following options and write the answer :

(1) What is the average atmospheric pressure at mean sea level ?

(a) 1023 mb (b) 1013 mb (c) 1003 mb (d) 1031 mb

(2) While going above the sea level, for how many metres does the pressure decrease by 1 cm ?

(a) 265 (b) 365 (c) 165 (d) 465

(3) By which name is a cyclone known in U.S. ?

(a) Hurricane (b) Typhoon (c) Willie-Willie (d) Tornado

(4) What is the pressure at the centre of a cyclone ?

(a) Low (b) Heavy (c) Medium (d) Negligible

(5) Which winds are snow-eaters ?

(a) Loo (b) Chinook (c) Harmattan (d) Norwester

(6) Which pressure belt is also known as Doldrum ?

(a) Equatorial Low Pressure Belt (b) Tropical High Pressure Belt

(c) Polar High Pressure Belt (d) Sub Topical Low Pressure Bel **t**

11 Humidity in Atmosphere

Water in the atmosphere exists in three physical forms. It is seen as snow particles in the cloud in Troposphere. The water drops in the clouds at medium or low altitudes is its liquid form, and the water vapour in the air near the earths surface is its gaseous form.

Water vapour is devoid of colour, taste and smell. The volume of other gases except water vapour is uniform in the atmosphere. The humidity fluctuates according to place, season, time and temperature. Humidity decreases as we go up in the atmosphere. There is hardly any humidity beyond the altitude of 10 to 12 km from the surface.

Seas and oceans, spread over 71 % of the earths surface, are major source regions for humidity. Besides, wet lands, rivers, lakes etc. are also supplementary sources. Constant evaporation from these water bodies adds water vapour in the atmosphere. This water vapour rises high due to winds and air currents. Due to cold, condensation takes place and the water vapour turns into clouds, and finally returns to earth in the form of rain. This is how the water cycle works constantly between the earth and the atmosphere. Hygrometer is used to know the amount of humidity in the air.

Importance of Humidity

Water vapour comprises only two per cent of the atmosphere, yet plays an important role in deciding the weather and climate on earth. Humidity contributes decisively to warm up and to cool down the atmosphere. Humidity absorbs solar heat and restrains the heat on earth. It also works as a driving force for the atmosphere. The **latent heat** in the water vapour is released when condensation takes place, so air temperature rises and creates disturbances in the atmosphere. Humidity is responsible for the formation of the atmospheric disturbances, cyclones etc.

Atmosphere absorbs the humidity from the surface of the earth, stores and returns under proper conditions. We know them as dew, mist, cloud, rainfall, hails etc. Humidity in the atmosphere is also important for entire biotic world which gets its required amount of water due to the condensation of humidity and precipitation.

Evaporation

The process in which the water turns into vapour due to solar heat is known as **'Evaporation'**. The evaporation becomes faster with increasing temperature and more vapour is added to atmosphere. The humidity mixes with the atmosphere till the air has the capacity to hold moisture. So the evaporation process continues till the air becomes saturated.

Intensity of evaporation depends on temperature, aridity of the air and wind velocity. Hot and dry air has more capacity to hold more moisture, so it intensifies the evaporation. Winds blowing over the upper surface of water masses peak up moisture and move ahead. Thus, wind also intensifies evaporation. The evaporation exceeds in summer than in winter. Maximum evaporation takes place in equatorial region while polar regions experience least evaporation.

Absolute Humidity and Relative Humidity

In a given volume of air at any given time, the actual amount of humidity present in the atmosphere is known as **Absolute Humidity**. It changes with place and time. It is maximum over equator and minimum over poles.

Relative Humidity

Relative Humidity is the proportion of amount of humidity present in a given volume of air at a specific temperature with its saturation capacity. Relative Humidity is measured in percentage (%) and can be found by the formula given below :

$$\text{Relative Humidity} = \frac{\text{Moisture present in specific volume of air at specific temperature}}{\text{Saturation capacity of the same volume of air at the same temperature}} \times 100$$

With the fluctuations in temperature, the relative humidity also fluctuates. Temperature is low at night and during early morning so the relative humidity is more. At noon, it is less due to increased temperature. Relative humidity in the air is more over the seas than on the land mass and more over forests compared to open land.

Condensation and its forms

(1) Dew : When water vapour near the surface of the earth condenses in the form of a drop over the cold area on the surface, it is called **Dew**. Land area cools faster at night, so the air in its contact also cools. If the temperature of the cooled air drops below freezing point, the additional vapour condenses in the form of drops over the solid substance on earths surface.

Sufficient water vapour, clear sky, calm weather and longer winter night etc. are ideal conditions for dew formation. Dew is seen over the tree leaves, grass and over the buildings in the early morning in winter. Dew is useful for Rabi crops like wheat, grams and vegetables.

(2) Frost : Conditions for the formation of dew and frost are identical. When some substance on the surface becomes extremely cold, the temperature of the air in its contact falls below freezing point. So the additional vapour condenses into snow crystals instead of dew. This is called **Frost**.

In countries like India, when frost occurs during winter, crops like cumin seed, isabgul, fennel seed, tobacco, cotton etc. are heavily damaged.

(3) Fog : Fog is a form of condensation near the surface of the earth. It is stationed mostly over one area. When the temperature of the air near the surface of the earth falls below freezing point, the vapour condenses. It forms very minute water particles or snow particles which float in the air for a longer time and creates a cloud like shape. This is called **Fog**.

Just like dew, the favourable conditions for the formation of fog are sufficient humidity in the air, clear sky, calm weather, longer winter nights and minute dust particles.

The atmosphere looks smoky due to fog. Visibility of the air is also reduced. In some countries of the world, fog becomes obstacle for transportation. Flights cannot take off due to dense fog. In December 1952, thousand of passengers at Hithrowair port at London were stranded for four days continuously due to dense fog.

(4) Clouds : The fog at a higher altitude can be called a cloud. As the light moist air rises, it becomes cooler and the vapour within it condenses. When the temperature of the rising air falls below freezing point, the excess vapour condenses and many water drops are formed over the dust particles. If the temperature falls below 1^0 c, then snow particles are formed over the dust particles. These snow crystals float in the air because these are light weighted.

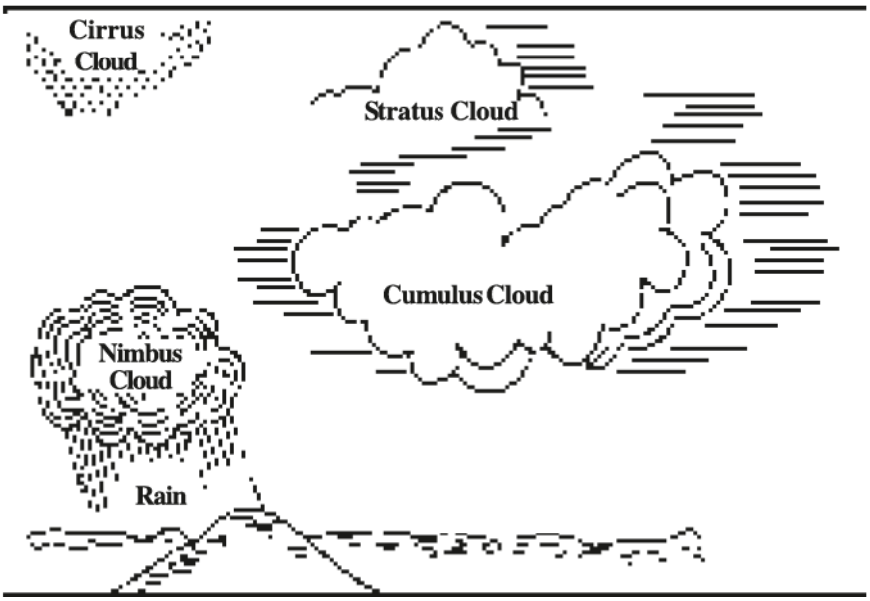
So a group of many water drops or snow particles which are very close to each other is called Cloud. According to height and the form, clouds are divided into four types :

(1) Cirrus Cloud (2) Stratus Cloud (3) Cumulus Cloud (4) Nimbus Cloud

(1) Cirrus Cloud : Cirrus clouds are seen at an altitude of about 10 km or more. These clouds are made up of minute icy crystals so they appear as white silver in sunlight and coloured at sunset.

When Cirrus clouds are spread like scattered feather, they indicate good weather, but if these are arranged in regular belts it suggests bad weather or approaching cyclonic condition. These clouds do not give any rain.

(2) Stratus Clouds : These clouds are seen within an altitude of 10 km from the surface. There are layers in this cloud just as the layered salted biscuits. Due to this peculiar appearance where the layers are seen over one another, these clouds are known as Stratus Clouds. In the upper layers of the air, if the warm and cool air come from opposite directions over each other, they form the shape of a stratus cloud. These clouds forecast the atmospheric disturbances. Low lying stratus clouds give slow drizzle, but the high altitude stratus clouds which are spread like a bed sheet in the sky do not give any rain.



11.1 Types of Cloud

(3) Cumulus Clouds : These clouds are seen between 500 metres from the surface up to an altitude of 10 to 12 km. They appear like a cotton heap so these are known as Cumulus Clouds. Its broad base is seen towards the earth and narrow apex towards the sky. The distance between its base to apex may be hundreds of metres. These cumulus clouds expand during day time due to convectional thermal currents but disappear at night.

When very large cumulus clouds turn into Nimbus clouds, they give heavy showers with thunders.

(4) Nimbus Clouds : These clouds are seen up to a maximum altitude of 2 km from the surface. Compared to other types, these are lowest clouds. These clouds give heavy rains with thunders. They are very close to each other and are dark coloured. During rainy season, the sky becomes overcast sometimes with such clouds. Viewing the stark black clouds makes us feel about the rainy season.

Precipitation

Due to evaporation of the water on the surface of the earth, the moisture mixes with the air. This vapour is condensed and returns back on the surface of the earth in various forms. These forms are called as Precipitation.

Generally the precipitation is recorded in inches, centimetres or millimetres. (1inch = 2.54 cm = 25 millimetres.). Various instruments are used to record precipitation.

There are four major types of precipitation received by the earth :

(1) Snowfall (2) Hails Stones (3) Slit Pallets (4) Rainfall. (Water rain)

(1) Snowfall : When the air temperature falls below 0^{o} c the vapour condenses. The vapour is transformed into small snow particles or snow pallets. When these snow particles or snow pallets grow larger, they precipitate on the surface which is called **snowfall**. Snowfall is very common over Canada, Greenland and polar regions. Heavy snowfall also occurs over the high peaks in Himalayas, Andies, Rockys and Alps.

Snowfall cools down the temperature of respective places and the cold is spread towards the remote areas. When there is heavy snowfall over Himalayan region, a severe cold wave spreads over entire North India, Rajasthan and upto Gujarat.

(2) Hail Stones : Water drops coming down from the clouds are pushed back in the colder upper air due to convectional air currents. They condense and transform into snow particles. When these snow particles come down, more vapour condenses over them and the snow particles become larger. Sometimes, before the snow particles fall down, they are sent up and down many times by the convectional current. This enlarges their size and finally fall on the earth in the form of a small piece of ice. This is called **Hail Stones**. Sometimes, such hail stones damage agricultural crops and other living organisms.

(3) Sleet Pallets : Sleet Pallets may be called half frozen rain. Water drops get frozen while passing through very cold winds in between before they fall on the surface. They fall in the form of snow pallets, which is called **Sleet Rains**.

In sleet rains the snow particles falling down are very soft or half frozen, and also have water particles. Sleet rain takes place when cold air from polar region gushes towards middle latitudes. Whenever there is sleet rain in few areas of the world, road accidents increase.

(4) Water Rain : When the water vapour from the clouds fall on the ground in the form of small water particles it is called **water rain**.

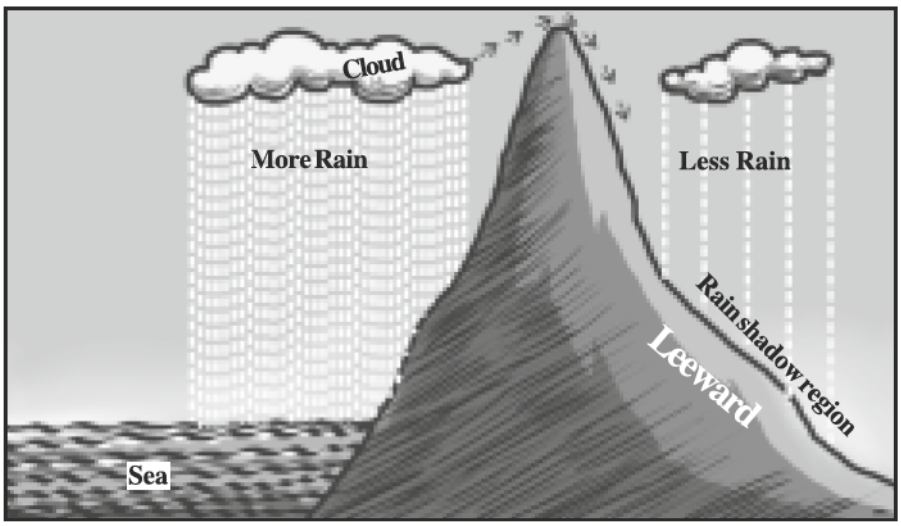
About 5 to 10 lakh minute water particles from the cloud mingle with one another, then a water drop is formed capable to fall down. These water drops are smaller than 5 millimetres or less.

Types of Water Rain

All precipitation falling on the earth is formed when the rising air becomes cool. On the basis of the cooling process, there are three types of rain.

(1) Orographic (Relief) Rain (2) Convectional Rain (3) Cyclonic Rain

(1) Orographic (Relief) Rain : If there is any obstruction like a mountain or a high land in the direction of the humid winds coming from over sea, these winds dash against the windward side of the mountain and rise. The rising air becomes cool and clouds are formed from the vapour, which cool and give rain on windward side. This is called Orographic or relief Rain.



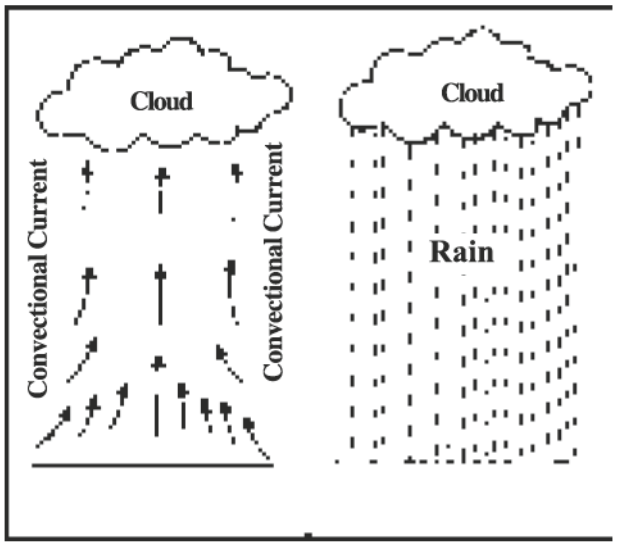
11.2 Orographic Relief Rain

After showering some rain these winds become less humid. They cross the mountain and descend on the leeward side of the mountain. Air pressure increases of the descending winds and they become warmer. As a result, these winds give less rainfall on the other side of the mountains. This area on the leeward side is called **Rain shadow** area. Konkan and Malabar coast on the western side of Western Ghats are windward regions so there is more rainfall, while the Deccan Plateau on the eastern side of Western Ghats is a rain shadow area so there is less rainfall.

On the windward side of Western Ghats, Mumbai gets about 200 cm rainfall annually, while there is hardly 80 cm of rain in Pune which is on the Leeward side of the Western Ghats.

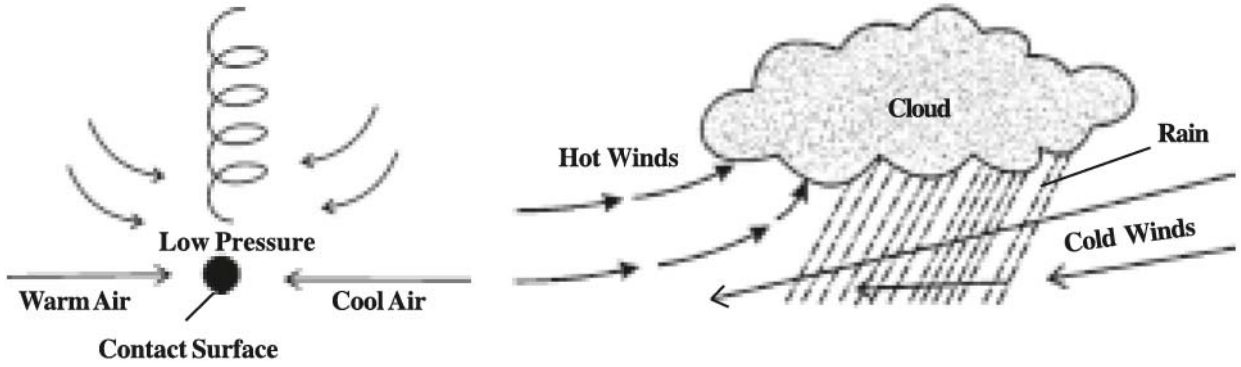
(2) Convectional Rain : Hot, humid and light air on the surface rises high due to convectional current. Due to the cold at higher altitude the water vapour condenses, forms clouds and gives heavy rain with thunders. This is called Convectional Rain.

As this rainfall occurs in heavy downpour, it causes heavy soil erosion. There is more surface runoff than the leaching and so it is less useful for agriculture.



11.3 Convectional Rain

(3) Cyclonic Rain : Cyclone develops at the confluence of cold and warm air masses. There is low pressure at the centre of the cyclone. So the air from high pressure in all sides gushes towards the centre of the cyclone with much velocity. These winds rise in circular motion due to the coriolis force. The water vapour cools due to lower temperature at higher places and then condenses. Finally, it gives much rain at the centre of cyclone and nearby places. This is known as Cyclonic Rain.



11.4 Cyclonic Rain

In middle latitudes, most of the rain during winter is cyclonic rain. In North India also such rain occurs during winter.

Besides these types, man to-day experiments for **artificial rain** by scientific means.

When crops are dried up due to shortage of water even during rainy season, the sky is overcast by rainy clouds and yet there is no rain, then scientific means are implemented to get rainfall. This is known as **Artificial Rain**.

Indian Institution of Tropical Meteorology and other private agencies work on artificial rainfall. In these experiments a mixture of sodium chloride and soft stone in the proportion of 9:1 is sprinkled on the rainy clouds from air plane or a helicopter from 2 to 3 kilometres height. Sometimes a fume of silver iodide is also used.

Before sprinkling the chemicals, the humidity and the density of clouds are examined. With artificial rain, the drying crops can be saved for some time. The experiment of artificial rain is very much successful in western countries. In 1978-79 the experiments of artificial rain had yielded 3 to 10 cm of rain in Bhavnagar district.

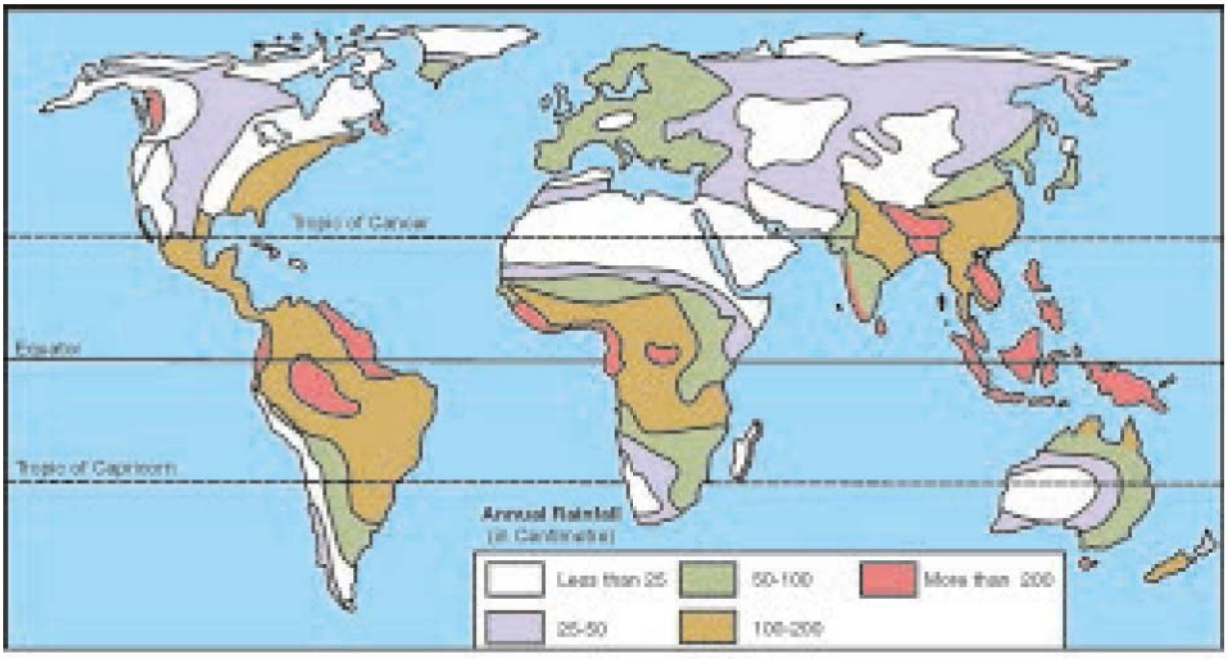
Distribution of Rainfall

Distribution of rainfall differs from place to place in the world. Latitude distance from sea, relief, winds, ocean currents, amount of forests etc. affect the volume and the distribution of rainfall.

Maximum rainfall occurs in the belt between 10^0 to 20^0 latitudes near equator. As per one estimate, about 150 to 300 cm rainfall occurs here annually. Rainfall decreases towards north in both the hemispheres. High pressure belts exist between 25^0 to 35^0 in both hemispheres, so there is less rainfall there. In Tropical High Pressure belt an average of 80 to 90 cm rain falls. In the deserts here, the rainfall is less than 10 cm. In polar regions, no evaporation takes place due to cold, so less than 10 to 30 cm rainfall occurs there. In the middle latitudes between 40^0 to 60^0 latitudes in both hemispheres, an average rainfall occurs between 100 to 200 cm.

Oceans and continents affect the distribution and amount of rainfall. As per one estimate, out of the total rain falling on the surface of the earth, 22 % rain falls over landmass and 78 % rain falls over oceans. Rainfall decreases with increasing distance from sea. Monsoon winds give more rain over either coasts of India. The same winds loose moisture and give less rain in the interior parts. Moisture bearing winds coming from Bay of Bengal give heavy showers over Meghalaya and nearby mountainous regions. Cherrapunji, located in Khasi Hills of Meghalaya receives about 1200 cm rainfall which is maximum in the world. Viewing from the volume of annual rain, the equatorial regions, coastal area of monsoon

regions, torrid zone and some mountainous areas of temperate zone receive more than 200 cm rainfall. These are regions of maximum rainfall. The nearby regions of less rainfall, such as the interior parts in Torrid zone and hot temperate coastal areas get 100 cm to 200 cm rainfall.



11.5 World : Annual Rainfall

Besides this, rainfall is negligible in leeward areas of mountains, western parts of tropical landmass and in interior parts of temperate zone. Sahara (Africa), Sonoran (North America), Kachchh-Rajasthan (India), Saudi Arabian Desert (West Asia), Atacama (South America), kalahari (Africa), West Australian Desert (Australia), Gobi Desert (Mongolia), Colorado desert (North America) etc. are regions which receive much less rainfall.

The area between 5^0 latitudes around equator receive convectional rain throughout the year. Some regions get summer rain while some get rainfall during winter. Most of the monsoon regions and some parts of torrid and temperate zones also get summer rain. These are the regions of summer rainfall.

Mediterranean regions, located on the western side of the continents between 30^0 to 40^0 latitudes in both hemispheres receive rain during winter season. Moreover, the North-East Monsoon Winds coming from Bay of Bengal shower rain over Tamil Nadu and Sri Lanka in winter. Thus, the types of wind and their direction affect the distribution of rainfall.

EXERCISE

1. Answer the following questions in details :

(1) What is meant by condensation ? State the forms of condensation and explain any two of them.

(2) What is a cloud ? Explain various types of clouds with figures.

(3) State the types of precipitation and explain orographic rain in details.

2. Write short notes on :

(1) Importance of humidity (2) Artificial Rain (3) Convectional Rain

3. Give geographical reasons :

(1) Evaporation is faster in summer.

(2) The distance between Mumbai and Pune is less, however Mumbai gets more rainfall.

(3) A cold wave sometimes grips Gujarat and Rajasthan during winter.

4. Answer the following questions in brief :

(1) Which factors affect the distribution of precipitation ?

(2) Write the formula to find Relative Humidity.

(3) Which substances are used in artificial rain ?

(4) What are the forms of condensation ?

(5) State the favourable conditions for dew formation.

(6) Where does the maximum rain fall in the world ?

(7) What is meant by Rain Shadow region ?

(8) Which crops are damaged due to snowfall in winter in India ?

5. Select the correct option from the following options and write the answer :

(1) What is the fog at higher altitude called as ?

(a) Cloud (b) Dew (c) Snow (d) Precipitation

(2) By which of the following names is the instrument to record amount of humidity known as ?

(a) Thermometer (b) Pyrenometer (c) Hygrometer (d) Barometer

(3) In which Indian State does the rain occur in winter ?

(a) Gujarat (b) Madhya Pradesh (c) Uttar Pradesh (d) Tamil Nadu

(4) In which season does the Mediterranean region get its rain ?

(a) Winter (b) Summer (c) Rainy (d) None of them

(5) In which state is Cherrapunji situated ?

(a) Assam (b) Meghalaya (c) Arunachal Pradesh (d) Nagaland

(6) After how many km of altitude there is almost no humidity in the atmosphere ?

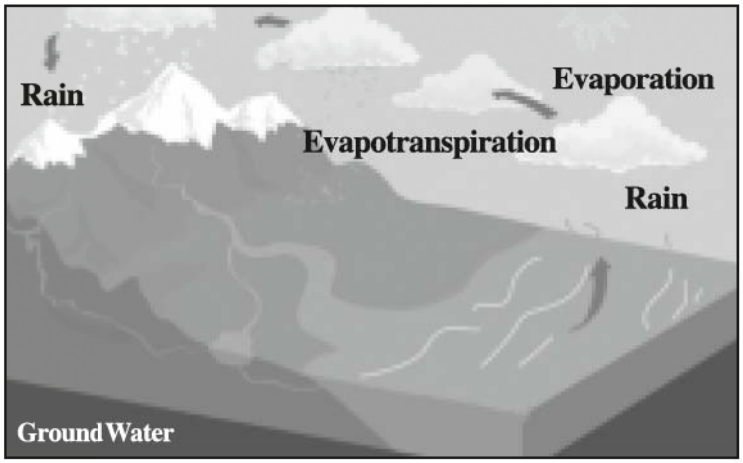
(a) 10 to 12 (b) 11 to 22 (c) 21 to 32 (d) None of these

12 Hydrosphere

If we look at the surface of the earth, we can see more of water area than the land. Most of the earth is covered by water. That is why earth is also called a water planet. About 71 % of the earths surface is covered by water.

Water Cycle

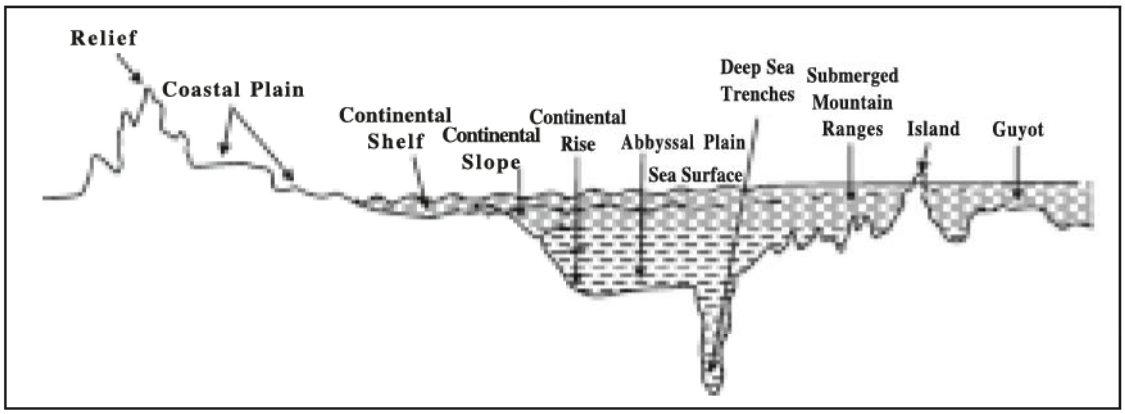
Water is found on the earth in solid, liquid and gaseous forms. Its form and location change according to favourable relief. Due to solar heat, the water from seas, lakes, rivers etc. turn into water vapour and clouds are formed. Condensation takes place under favourable conditions and these clouds give rain in more or less amount on all areas. Most of this water is emptied into seas and oceans through rivers. Ground water which is absorbed by the tree roots, merges into atmosphere through evapotranspiration. The process in which the ocean water is distributed in different areas as rain water and returns to the ocean is called **Hydrological Cycle.** Thus water circulates in atmosphere, lithosphere and hydrosphere.



12.1 Hydrological Cycle

Relief Features of the Ocean Floor

Ocean floor is not uniform everywhere. Just as there are major landforms like mountains, plains, plateaus and valleys on land, the ocean floor also has identical landforms. These are divided into four parts : (1) Continental Shelf (2) Continental Slope (3) Abyssal (Deep Sea) Plains (4) Deep Sea Trenches



12.2 Relief Features of the Ocean Floor

(1) Continental Shelf : The plain region up to a depth of 200 metres (100 fathoms) near the coasts of seas and oceans is known as **Continental Shelf**. It covers about 8 % of the ocean floor. Slope from the coast towards the sea gradually increases. Continental shelves are found having different width. It is about 15 to 20 km wide on the western coast of South America, is 80 to 120 wide on

the eastern coast of Africa and has a width of about 500 km in Arctic Ocean. An average width of continental shelf on the entire ocean floor is 65 km and the depth is about 130 metres. Continental shelf starts from the coast and terminates at the continental slope. As sunshine can reach up to a depth of 200 metres (600 feet) many marine vegetation and animal life have flourished in the continental shelf. Many fishery centres also have developed in continental shelves.

Like to know :

Depth of the ocean is measured in fathoms.

1 fathom = 6 feet abovt 1.8 meters

(2) Continental Slope : When the continental shelf ends, the depth of the ocean suddenly increases. This slope which starts from the edge of continental shelf is called **Continental Slope**. It extends up to deep sea plains. It is a transition between continental shelf and deep sea plains. According to geologists, continental slope is formed due to either faulting or folding processes.

(3) Deep Sea Plains : At the end of continental slope, a vast plain of the sea floor starts. Here the submarine relief becomes more smoother. These vast plains are formed at a great depth from the sea surface, so these are called Deep Sea Plains. These plains cover about 76 % area of the sea floor. Average gradient here is 1^0 and an average depth is 6000 metres. These plains are located very far from the sea coast and also at a greater depth. Maximum plain area is in Pacific Ocean. In Atlantic Ocean, there are more continental shelves, so plains occupy lesser area. As deep sea plains are located many km away from the coast, the alluvial deposits cannot reach there. So most of the deposits on these plains are the residues of marine life and volcanic substances.

(4) Submarine Trenches : Deep Sea Trenches are the deepest area of ocean floor. They are of arc shape and are narrow. They have a wall like slopes. At some places in deep sea plains, the slope becomes steep suddenly, so narrow, deep and long valleys are formed there. There is a deep sea trench known as **Mariana Trench** in Philippines Islands in Pacific Ocean and it is more than 11000 metres deep at its maximum.

Temperature of Sea Water

Temperature of sea water is an important physical property. Sea water warms up due to solar radiation. Sunrays cannot penetrate below 200 metres in sea. So generally the upper surface of the sea is warmer and most of the lower part remains cool. Average surface temperature of oceans water is 17^0 C.The sea surface temperature of Pacific Ocean is 19^0 C and that of Indian Ocean is 17^0 C. The average surface temperature of Atlantic Ocean is 16.9^0 C.

Factors affecting the temperature of sea water :

Angular height of sun, geographical location, area and shape of oceans, winds, ocean currents, relief of sea floor etc. affect the temperature of sea water.

(1) Angular Height of the Sun : The surface temperature of oceans in equatorial region is more because of lower angle of sunrays, while the angular distance is more over polar regions, the sunrays cross more distance to reach the sea surface. This results in lower sea surface temperature on polar

regions. Generally, the sea surface temperature decreases from equator to poles. The decrease is @ 0.5^0 C for every latitude.

(2) Geographical Location, Area and Shape of sea : The temperature of landlocked and marginal seas is either more or less than the open seas. It is dependent on the sub-merged mountain ranges and coastal land. There is an impact of nearby continents on Baltic Sea and Hudson Bay, so their temperature is lower than the open seas. Red Sea is surrounded by deserts and so high temperature prevails over there.

(3) Winds : Due to the cold winds blowing over from continents, there is an annual difference of about 18^0 C in the temperature of North Pacific and North Atlantic Oceans. The South-Western Monsoon winds blowing over India in summer raise the sea water temperature, while the North-East Monsoon winds blowing during winter decrease the sea water temperature. Thus winds change the sea water temperature.

(4) Ocean Currents : Currents have a dominant effect over the sea temperature, e.g. the warm Gulf Stream current increases the sea surface temperature of Atlantic Ocean, while the cold Labrador current reduces the temperature.

Salinity of Ocean Water

Sea water tastes salty and this salinity is due to the salts dissolved in it. These salts include salt, calcium, magnesium etc., wherein there is an excess of salt. The ratio of the dissolved salts in sea water is called Salinity. The salinity is the weight of the solid substance in the 1000 th part of sea water. Salinity is shown in $^0/_{00}$ (per one thousand gram) unit. The average salinity of sea water is 35 $^0/_{00}$, i.e. there is 35 gram of salt in every 1000 gram of sea water.

Factors affecting the salinity of sea water :

The salinity of sea water depends on its density, temperature, addition of fresh water, evaporation, ocean currents, melting of glaciers, rivers etc.

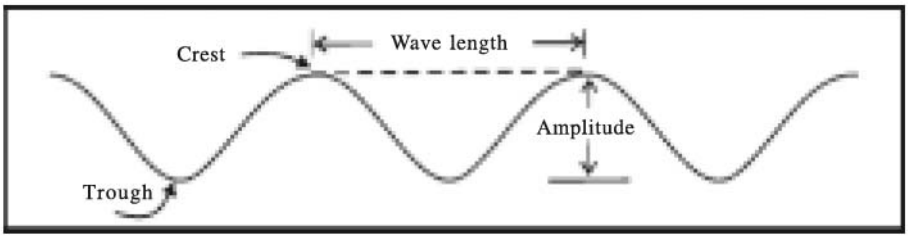
If the sea water is more dense, the salinity is also more. Higher temperature means more of evaporation, which will increase the salinity. Milder the evaporation lesser will be the salinity. In tropical regions there is more salinity. Dry and hot winds increase the evaporation in Red Sea and Mediterranean Sea, so salinity of Red Sea is 41 $^0/_{00}$ while the salinity is 39 $^0/_{00}$ in Mediterranean sea.

The salinity of sea water near the mouth of rivers Congo, Amazon, Sindhu, Ganga etc. decreases due to the addition of fresh water. In some seas in Temperate zone and Polar region, fresh water from melted glaciers is added to the sea water so the salinity of sea water is decreased. Cold currents reduce the salinity while warm currents increase it. Salinity in sea water of Western Europe increases due to the warm current of North Atlantic Ocean while cold Labrador Current reduces the salinity of eastern coast of North America.

Movements of Sea Water

Sea water is dynamic constantly. We can see its movements in the form of currents flowing in a specific direction or through its oscillation. Due to the oscillations, sea water moves to and fro as well as up and down. Such movements of sea water may be termed as **Motions** of Sea Water. On the basis of volume, extent etc. the movements of sea water can be divided into three forms : (1) Sea waves (2) Tides and Ebbs (3) Ocean Currents.

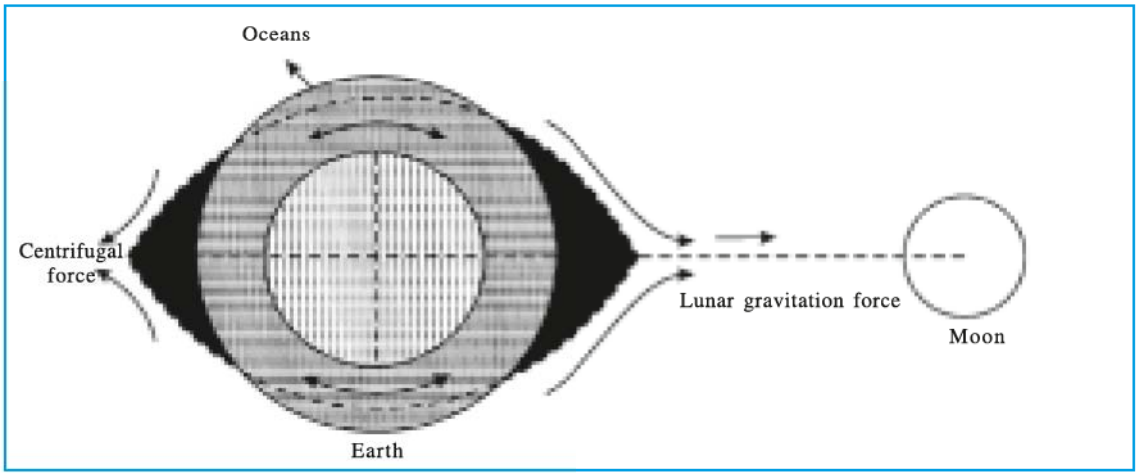
(1) Sea Waves : Surface water of the sea moves to and fro as well as up and down and is constantly active. This to and fro and up and down movement of sea water is called sea waves.



12.3 Sea Waves

Sea waves are created due to winds. These waves originate because of small breezes to stormy thunderstorms. Factors like coriolis force of the earth, gravitational force by sun and moon, earthquakes taking place on ocean floors, volcanic eruption etc. affect the sea waves.

(2) Tide and Ebb : Systematic rise and fall of sea surface is called **Tide and ebb** . The gravitational forces of sun and moon are major factors for tide and ebb. At the time of tide, the sea water dashes towards the coast and the water level rises. The sea water moves back towards the sea during ebb and so the water level recedes. Generally, tide and ebb happen twice during one day. The time duration between two successive tides and two ebbs is 12 hours 25 minutes. So for two tides and ebbs, it takes about 24 hours and 50 minutes. Every day, a tide or an ebb occurs late by 50 minutes than the previous day. However, this daily phenomena of tide and ebb is not experienced uniformly in all seas. There is only one tide-ebb in Gulf of Mexico during 24 hours 50 minutes.



12.4 Tide–Ebb

Types of Tide

Spring and Neap Tide : On every full moon and new moon, the sun, earth and moon happen to be in a straight line. Due to the gravitational force of the sun and the moon, very high waves are formed so a large tide occurs. This is called Spring Tide. On the eighth day of Lunar month, the sun and the moon happen to be at right angle so they exert less gravitational force. As a result, a small tide occurs which is called Neap Tide

Along most of the sea coasts, tides and ebbs occur twice a day. These are called **Semi Diurnal Tides**. If a tide occurs only once a day, then it is called **Diurnal Tide**. Such diurnal tide occurs in Gulf of Mexico and along the West Australian coast.

Along the sea coast near Okha in Gujarat, tidal waves rise up to 2.5 metres height. Tidal waves in the Bay of Fundi rise up to about 15 to 25 metres height, which is highest in the world.

Tidal Bore : In some river estuaries sea waves rush against the riverflow like a wall. This is known as Tidal Bore. Hongzou in Qiantang river of China experiences greatest tidal bore of the world. The greatest tidal bore in India is on Ganga (Hugli) river near Kolkata.

Importance of Tide : Tide is very much useful to man. At many places, large ships can be brought near the shore during spring tide. The ships can come inside during tide and go out during ebb at some estuarine ports. Fishermen plan their visit to seas according to the time of tide and ebb. Ports and harbours remain clean due to tide and ebb. Tidal waters have tremendous power. Electricity can be generated from them. France, U.S. and Russia generate much electricity from tidal power. Tidal water is diverted toward smooth coast to produce salt.Thus tide is useful to man in many ways.

(3) Ocean Currents : A vast water mass which flows continuously in a definite direction at a specific temperature is known as an **Ocean Current** . It flows like a river in the ocean. Its course of flow is definite and permanent. These currents flow up to a certain depth from the surface and also from the sea floor to the surface. These currents are distinct at few places in the oceans. Ultimately, these currents are a large scale movement of water in the oceans. Currents are either cold or warm.

Reasons for the Origin of Ocean Currents

Solar heat, prevailing winds, coriolis force are main reasons for the origin of ocean currents. Solar heat brings changes in temperature, salinity and density of ocean. The solar radiation on the equator is vertical throughout the year. So the water in equatorial regions is warmer than on the poles. This warm water expands and so its surface is raised near equator compared to polar regions and forms a slope towards the poles. This enables the equatorial water to flow towards north and south pole. This is how the warm current starts. The water of polar regions is cold and more dense, so it flows towards equator as sub-surface current. This initiates cold current. This way, the difference in the temperature and density of surface water of the oceans give rise to warm and cold currents.

Permanent winds blowing from over the oceans give speed to currents. The currents sometimes deflect due to winds. Generally, warm currents flow from equator to poles and cold currents flow from poles to equator.

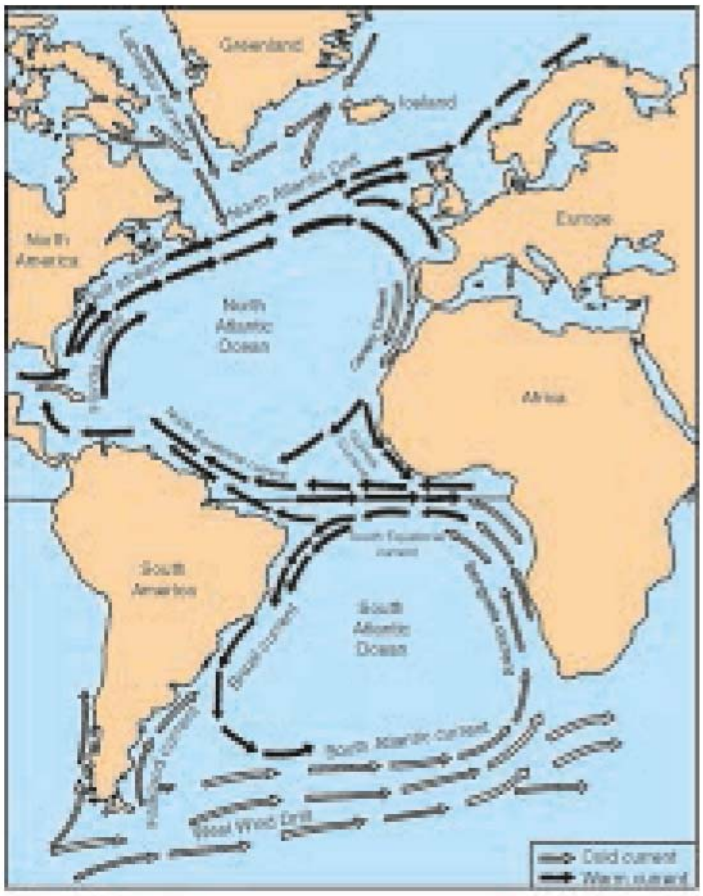
Major Ocean Currents

Warm and cold currents flow in every ocean. Independent and identical current systems are formed on either side of the equator in Pacific and Atlantic Oceans. An independent current system has developed in Indian Ocean also.

Currents of Atlantic Ocean

In Atlantic Ocean, North Equatorial Warm Current and South Equatorial Warm Current originate near the equator. Both these currents flow westwards.

(1) North Equatorial Current : This warm current initially flows east to west. It deflects near Florida and surges ahead in north-east direction. Here it enters the Gulf of Mexico and then is known as Gulf Stream. Near Canada, a cold Labrador current coming from north polar region meets Gulf Stream. One branch of Gulf Stream flows to east after Newfoundland. It bifurcates near west European coast. One branch flows towards Iceland and Norway in north. Other branch touches U.K. coast and flows along Spain and North-West African coast. It is known as **Canary Current** there. Finally it merges into North Equatorial current and completes a circle. This is a cold current.

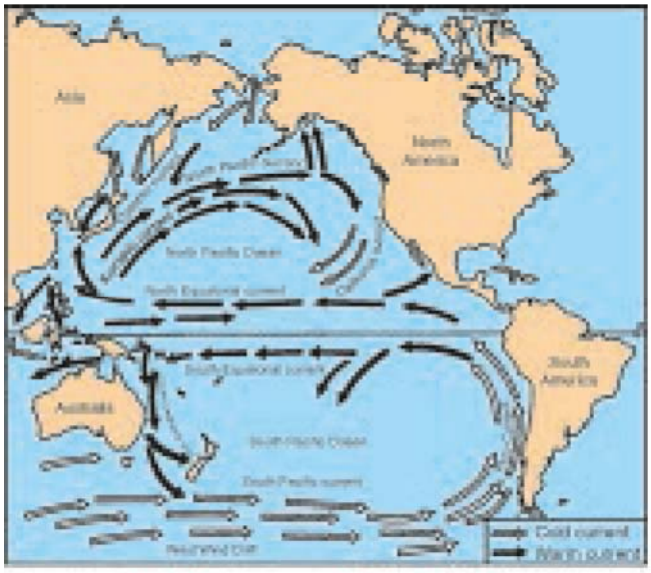


12.5 Currents of Atlantic Ocean

(2) South Equatorial Current : This current flows in anti-clockwise direction to the south of equator. It has again two branches : One branch moves northwards and merges into North Equatorial Current, while the second branch moves ahead in south-west direction and flows along the eastern coast of South America as Brazilian Current. The West Wind Drift crosses Atlantic Ocean and flows northwards as cold Benguela Current, merges with South Equatorial Current and completes the circle.

Currents of Pacific Ocean

The current system of this ocean resembles to that of Atlantic ocean. Here also, North Equatorial Warm Current flows to west. Near the western coast of Pacific ocean, it branches into two currents. One branch turns to north and surges ahead on the eastern coast of Taiwan and Japan. Here it is known as **Kuroshio** current. It flows further eastwards and reaches western coast of Canada, where it is divided into two branches near Vancouver. Its northern branch is called **Aleutian** Current and the other current going to south is known as Californian Current. This cold current ultimately meets the North Equatorial Current.

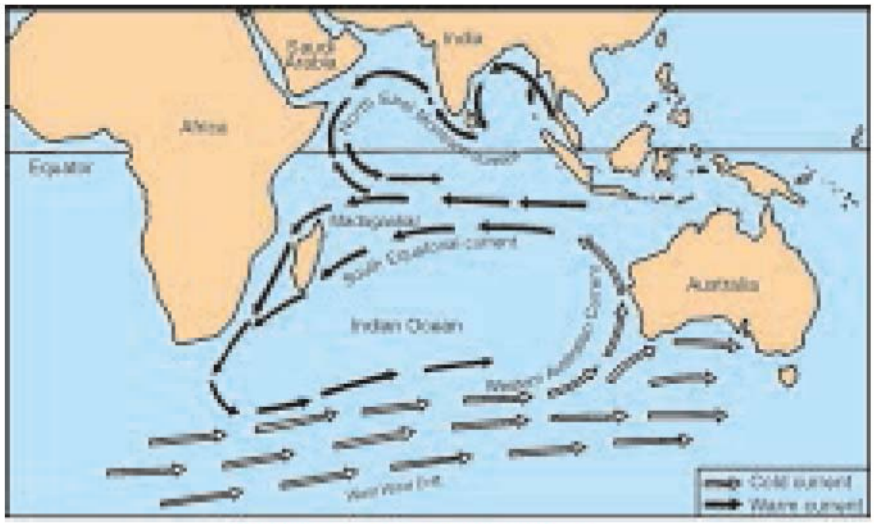


12.6 Currents of Pacific Ocean

There are innumerable islands in South Pacific Ocean. So the South Equatorial Warm Current does not flow uninterruptedly but is scattered into many small and large currents. Its main current flows southwards and is known as East Australian Current. This warm current meets the cold Western Current from south. Flowing eastwards, this current reaches up to Chilean coast of South America, where it is known as Peru Current or Humboldt Current.

Currents of Indian Ocean

Greater part of this ocean lies in southern hemisphere. It has less area in northern hemisphere. So there is more impact of the shapes of the continents which surround the Indian Ocean.



12.7 Currents of Indian Ocean

Here, the North Equatorial current flows westward and its counter current in winter flows in eastern direction. During summer, these currents become almost stationary, and in its place a north-east monsoon current starts from the east. Monsoon winds have a clear impact over these currents.

In Indian Ocean, South Equatorial Warm current flows westwards throughout the year. On reaching Africa, this current branches into two currents. One branch merges in the north with the **Somali** Current near Somaliland. The southern branch again bifurcates into two branches. One of this branches flows through Mozambique Channel where it is known as **Mozambique** Current. The other branch flows in the east of Madagascar Island and is known there as **Agulhas** Current and reaches up to western Australia. Here it is known as **West Australian** current. After flowing parallel to the coast it merges with South Equatorial Current.

Impact of Ocean Currents

Ocean currents hold much importance for man. Warm currents carry away the heat of equatorial region to much distance in north and south, while the cold currents transform the cold of polar regions to equatorial area. This way, ocean currents maintain the equilibrium of sea water temperature. Warm currents bring rain to some regions. Warm currents keep the temperature of cold coastal regions of higher latitudes warmer. Western European ports can operate even during winter due to the warm Gulf Stream. The confluence of warm and cold currents have become ideal regions for fisheries. Thus, ocean currents are useful to man in many ways.

EXERCISE

1. Answer the following in details :

(1) State the factors affecting the temperature of sea water and discuss in details.

(2) Explain in details the currents of Atlantic Ocean.

(3) State the relief of sea floor and explain each of them.

2. Write short notes :

(1) Hydrological Cycle (2) Abyssal Plains

(3) Spring and Neap Tide (4) Importance of Tide

(5) Impact of Ocean Currents (6) Salinity of Ocean Water

3. Give geographical reasons for the following :

(1) Temperature of Red Sea remains higher.

(2) Ocean currents affect the temperature of sea water.

(3) European ports remain busy even during winter.

4. Answer the following in one-two sentences :

(1) Due to which reason is the continental slope formed ?

(2) Where in the world are the maximum deep sea trenches located ?

(3) State the factors affecting the temperature of sea water.

(4) Where and how much high do the waves rise in the world ?

(5) Where in the world does the biggest Tidal Bore occur ?

5. Select the correct option from the following options and write answer :

(1) How much of the earth does the hydrosphere cover ?

(a) 21 % (b) 78 % (c) 71 % (d) 50 %

(2) On which relief feature of the ocean floor can the sunshine reach ?

(a) Continental Slope (b) Abyssal Plain (c) Sea Trenches (d) Continental Shelf

(3) Which ocean coast has the widest continental shelf ?

(a) Indian Ocean (b) Arctic Ocean (c) Atlantic Ocean (d) Pacific Ocean

(4) Which is the deepest ocean trench in the world ?

(a) Mariana Trench (b Tonga Camdic (c) Puerto Rico (d) Andaman

(5) What is the average surface temperature of Atlantic Ocean ?

(a) 17° C (b) 19° C (c) 16.9° C (d) 19.9° C

(6) Which is the main factor causing the origin of sea waves ?

(a) Ocean current (b) Temperature (c) Wind (d) Salinity

13 Biosphere

The total solid material on the earths surface is called **Lithosphere**. Similarly, the area covered by water mass is called **Hydrosphere** and the air cover around us is known as **Atmosphere**. All these three spheres are natural.

The sphere where life exists over the earth and in the atmosphere around it is called **Biosphere**. A diversified life exists in lithosphere, hydrosphere and atmosphere. It includes man, microorganisms, insects, animals, birds, vegetation etc. All these are collective components of biosphere. According Huchinson, that part of the earth where life can exist is called Biosphere.

Ecosystem

Lithosphere, hydrosphere, atmosphere and biosphere collectively create the **Eco System** of the earth.

Biosphere is spread up to an altitude of 26 kilometres. Most of the living animals are found up to an altitude of 9 km from sea level. There are many types of fish, shark, whale, octopus, marine vegetation and other aquatic animals. Biosphere is spread up to few km deep below the land surface also.

In nature, few biotic components such as animals, vegetation and micro organisms combine with few abiotic components like water, gases, land, light etc. and form an autonomous system which is called **Ecosystem**

There are two major parts of Ecosystem as follows :

(1) Terrestrial Ecosystem, and (2) Aquatic Ecosystem.

Grasslands, arid regions, deserts, islands etc. are included in terrestrial eco system, while pond, lake, watershed, river, river delta, sea etc. are a part of aquatic eco system.

Energy flow in ecosystem

In every ecosystem, there are many interrelated constitutions. Ecosystem is governed by hydrogen cycle, carbon cycle, oxygen cycle, nitrogen cycle, energy cycle etc. However, biotic and abiotic characteristics of every ecosystem is different from one another.

Working of ecosystem is related with the increase of species of vegetation and animals and their reproduction process in one way or other. These interlinked processes can be described as various cycles. All these activities are dependent on the solar energy. Vegetation absorbs carbon dioxide from air through photosynthesis process and releases oxygen in the air. Animals inhale oxygen. Hydrogen cycle depends on water which is inevitable to vegetation as well as animals. Energy cycle mixes humus contents back to the soil on the basis of which the vegetation flourishes. Every living organism is completely connected with the proper capacity of these life cycles.

Bio-geochemical cycle

Vegetation absorbs abiotic or chemical elements through its roots and converts them into biotic elements. These elements are transferred into different living organisms through the food chain. With the death of these living organisms, the biotic element again transforms into abiotic or chemical element.

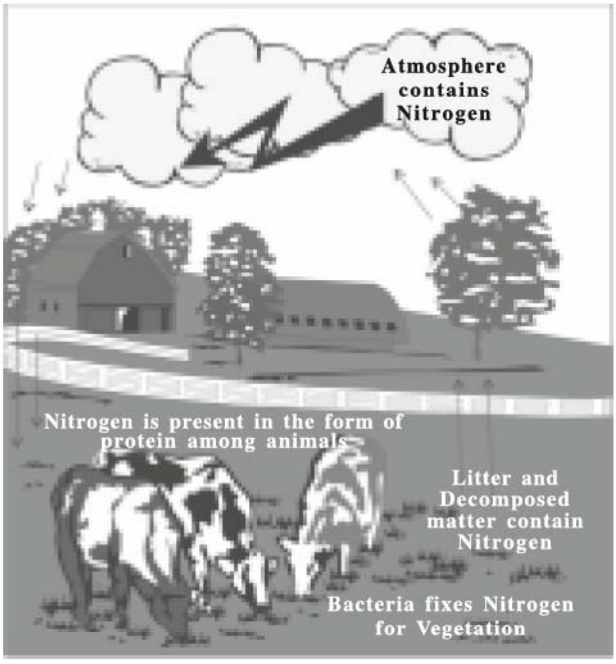
The transformation of abiotic or chemical elements into biotic element and the re-transformation of biotic elements into abiotic forms is called Biogeochemical Cycle. Hydrogen cycle, carbon cycle, oxygen cycle, nitrogen cycle, phosphorous cycle, rock cycle etc. are studied in bio-geochemical cycle. Here we shall study nitrogen cycle, oxygen cycle and carbon cycle.

The Nitrogen Cycle

Nitrogen is important to every living species because it is an inevitable component of amino acid. Protein is formed due to amino acid. Nitrogen mixes with the soil when lightening strikes.

Nitrogen is converted into ammonia by bacteria and ammonia is converted into nitrate by bacteria. Vegetation utilises the nitrate from the soil. This vegetation is used by animals and micro organisms. When animals die and vegetation is destroyed, it is decomposed and merges back into the soil. Some of the nitrogen from the soil mixes with the atmosphere.

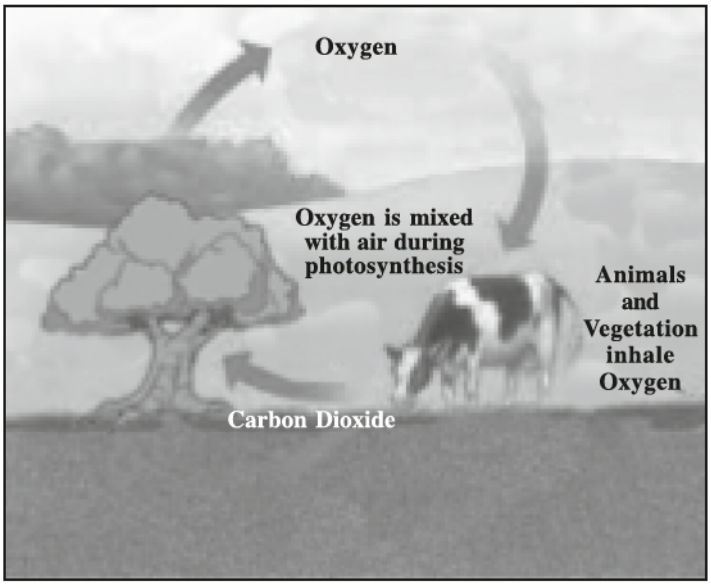
Thus, nitrogen moves from atmosphere to land and vice versa in various components.



13.1 Nitrogen Cycle

Oxygen Cycle

The role of oxygen in biosphere is very important. It is an important element for animates. During respiratory process, vegetation and animals inhale oxygen from the air and exhale carbon dioxide. Vegetation, during their process of food making in the presence of sunshine, uses carbon dioxide from the atmosphere through photo synthesis process, and finally releases oxygen in the atmosphere. This way the carbon cycle joins the oxygen cycle.



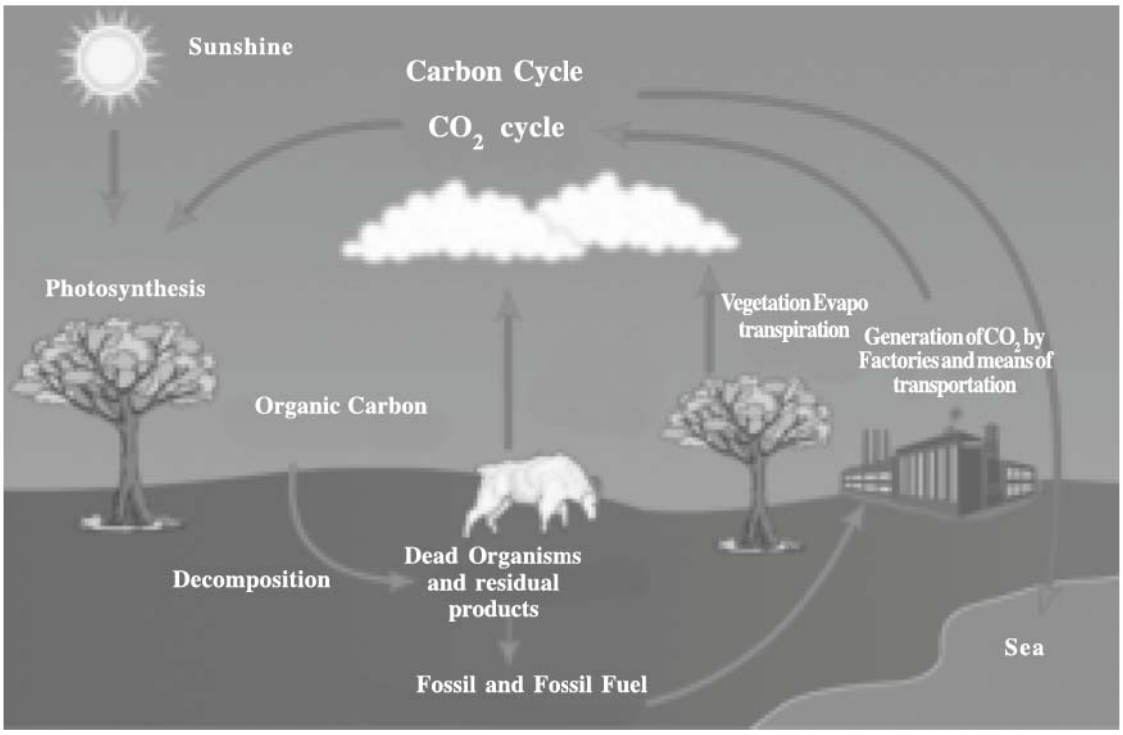
13.2 Oxygen Cycle

Carbon Cycle

Carbon is present in solid, liquid or gaseous form in the biosphere or the eco-system. It is in the form of carbon dioxide (CO^2), carbon hydrates, calcium carbonate and carbon. The transformation of carbon takes place in biosphere along with energy. Man and other living organisms inhale oxygen during respiration process and exhale carbon dioxide which merges into the atmosphere. Vegetation

consumes carbon dioxide from the atmosphere and forms carbohydrates. Dead vegetation decomposes into carbon dioxide and merges with atmosphere.

Carbon dioxide is generated when fossil fuel (coal, petroleum etc.) and wood are burned and merge with the atmosphere. Thus, a carbon cycle is completed after different stages are attained.



13.3 Carbon Cycle

Food Chain

Biosphere is a global system. It contains two components viz. Biotic and Abiotic components. Every species requires energy to endure and also needs some material to maintain physiology. Every living organism needs food in specific quantity.

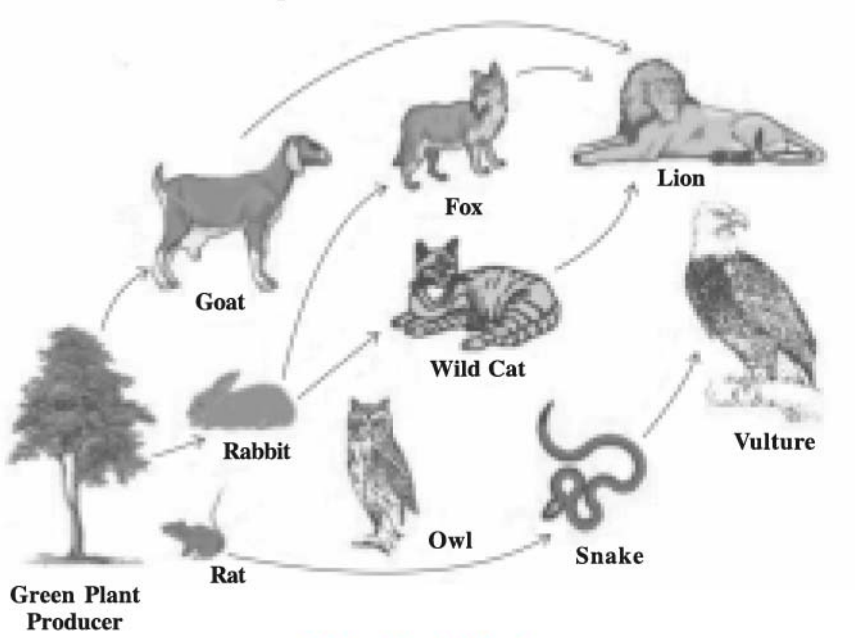
Green plants use sunshine. They produce necessary quantity of carbohydrates with the help of photo synthesis process. Thus, green plants are first to produce energy from the sunshine. So these are called **primary producers** or **autotrophs** and are dependent on the energy which is produced by themselves.

Some micro organisms and animals use green plants as their food but they do not produce their food. These are dependent on the food produced by other component. The energy produced by green plants is utilised by other animals and thus the form of energy changes. Animals which use green plants as their food are called **herbivores or primary consumers**. Cow, buffalo, deer etc. are such herbivores or **'primary consumers'**.

Animals which eat only meat are known as carnivores. Lion, tiger, leopard, python etc. are carnivores. These carnivores thrive on herbivores. These animals are placed in the category of **secondary consumers**. Thus, the energy produced from sunshine is transferred first into green plants, then to herbivores and then to carnivores.

Those animals which thrive on the residues of dead animals and putrefied food are called **'decomposers'**. Vulture, kites, termites etc. are decomposers. Thus the solar energy is transferred in a chain of herbivores-carnivores-decomposers. This is called **Food Chain**.

Every level in this chain is called a **trophic level.**



13.4 Food Chain

Bio Diversity :

Every animal and vegetation on this earth is different from one another. There are innumerable animals having different shape, size and colour, mankind, vegetation and micro- organisms on this earth. Their number and their life style show a special balance. The differences seen among the living organisms is called **'Bio-diversity'**. The word bio-diversity gives a picture of diversity among vegetation and animals.

India is included among 12 mega bio- diversity countries. In India, there are 10 bio-diversity regions. : These are (1) Trans Himalayas (2) Himalayan Region (3) Indian Deserts (4) Semi-Arid regions (5) Western Ghats (6) Southern Peninsula (7) Ganga Plains (8) North-East India (9) Islands (10) Coastal Regions

Of these 10 bio-diversity regions, four regions viz. desert, semi-arid region, part of western Ghats and coastal region are located in Gujarat.

Ecological imbalance and its impacts

The arrangement of bio-geochemical cycle and energy flow is set very meticulously. Changes occur within them periodically. A living organism lives according to this arrangement. It has no direct interference on physical or biotic factors. With rational thinking power, man has been able to create settlements, mining, industries, transport routes etc. in adverse conditions. While doing this, man has directly interfered with the natural cycles. By constructing Panama Canal, man has damaged the marine ecology. The cricket stadium at Sharjah has damaged desert ecology.

Human needs increase with population explosion. With developing technology, man expands his residential and industrial area. This deprives the wild animals of their abodes and their area is either reduced or destroyed. Deforestation for getting fuel and timber, to hunt wild animals for getting hide, skin and meat, to kill musk deer for getting musk, to kill rhino for getting its horn and to kill elephant for its ivory are carried out by man. Many other animals are killed for different purposes. This is a

matter of concern. Moreover, the excessive use of pasture land causes reduction in the diversity and abundance of herbivores and the carnivores dependent on them.

Generally every living organism has the capacity to acclimatize with environmental changes in the atmosphere. But wild animals cannot adjust to the speedy and non-natural i.e. man-made changes in the environment, and hence they become extinct.

Bio-conservation is not the work of Government only. The work cannot be successful by making laws. For this, associations of nature and animal lovers should be formed and their guidance and encouragement should be sought. Only then such associations can be successful. Many associations in our country are working to save wild animals. Government as well as non-government help is available.

Conservation of Bio–Diversity

Bio-diversity only can enrich the human life. For the conservation of the environment, it is important to develop understanding about them in order to preserve them. Bio-diversity in all ecosystems is in danger only because of only one living organism, and that is Man.

Come, get together and we can certainly do this to conserve bio-diversity.

- Shall plant local species of trees and preserve them, so that the number of living organisms like birds, butterfly and small insects increases.
- Shall grow local vegetables and encourage local fruit growers.
- Will form association to bring awareness among people about local bio-diversity.
- Will avoid to our best the use of commodities made from animals.
- Will use renewable energy like wind energy, solar energy etc. and encourage it.
- Eco clubs will be established at school level; shall visit forest department and other institutions working for bio-diversity, join these institutions and will actively participate in such activities.

EXERCISE

1. Write detailed answers to the following questions :

(1) Explain the ecosystem in details.

(2) Write about food chain.

(3) Explain the remedies to conserve bio-diversity.

2. Write short notes :

(1) Biochemical cycles (2) Nitrogen Cycle

(3) Carbon Cycle (4) Oxygen Cycle

3. Answer the following questions in one or two sentences :

(1) State the Bio-geographical regions of Gujarat.

(2) Prepare a list of bio-geographical regions of India.

(3) Which spheres are included in ecosystem ?

(4) Which are the primary producers ?

(5) Which are the primary consumers ?

4. Select the correct option given for the following questions and write the answer.

(1) Up to how many kilometres does the biosphere exist in the atmosphere ?

(a) 25 km (b) 26 km (c) 28 km (d) 29 km

(2) With which bio-chemical cycle is the lightening phenomena associated ?

(a) Nitrogen (b) Oxygen (c) Carbon dioxide (d) Phosphorus

(3) Which gas is released by vegetation in atmosphere during photosynthesis ?

(a) Nitrogen (b) Phosphorus (c) Oxygen (d) Carbon dioxide

(4) Solar energy is transferred into a chain of grass herbivores carnivores decomposers.

What is it called ?

(a) Energy resource (b) Trophic level (c) Food chain (d) Ecosystem

(5) What is the number of countries which are rich in bio-diversity ?

(a) 12 (b) 15 (c) 10 (d) 13

Activity

- During your school trip convince the pilgrims coming to holy places to reduce the use of plastic and to dump the litter at a proper place.

14 Disaster Management

Since the beginning of the earth changes have been taking place on its surface. This process is very slow at some places and is very rapid at other. Sometimes, these changes become destructive while sometimes it is constructive as well. Natural phenomena such as volcano, earthquake, drought, floods, cyclone, landslides etc. are responsible for such changes. Mostly such phenomena bring destruction only, hence these are called **Natural Hazards** also.

In earlier time it was believed that natural hazard is the result of mans interference in the natural process. Some hazards come abruptly and create devastation in short time. This does not leave any time for any relief work. Impact of some hazards is felt over a longer time. Here, there is enough time for relief work to save human life and property. Natural hazards and disasters are phenomena which cause damage to human life and economy.

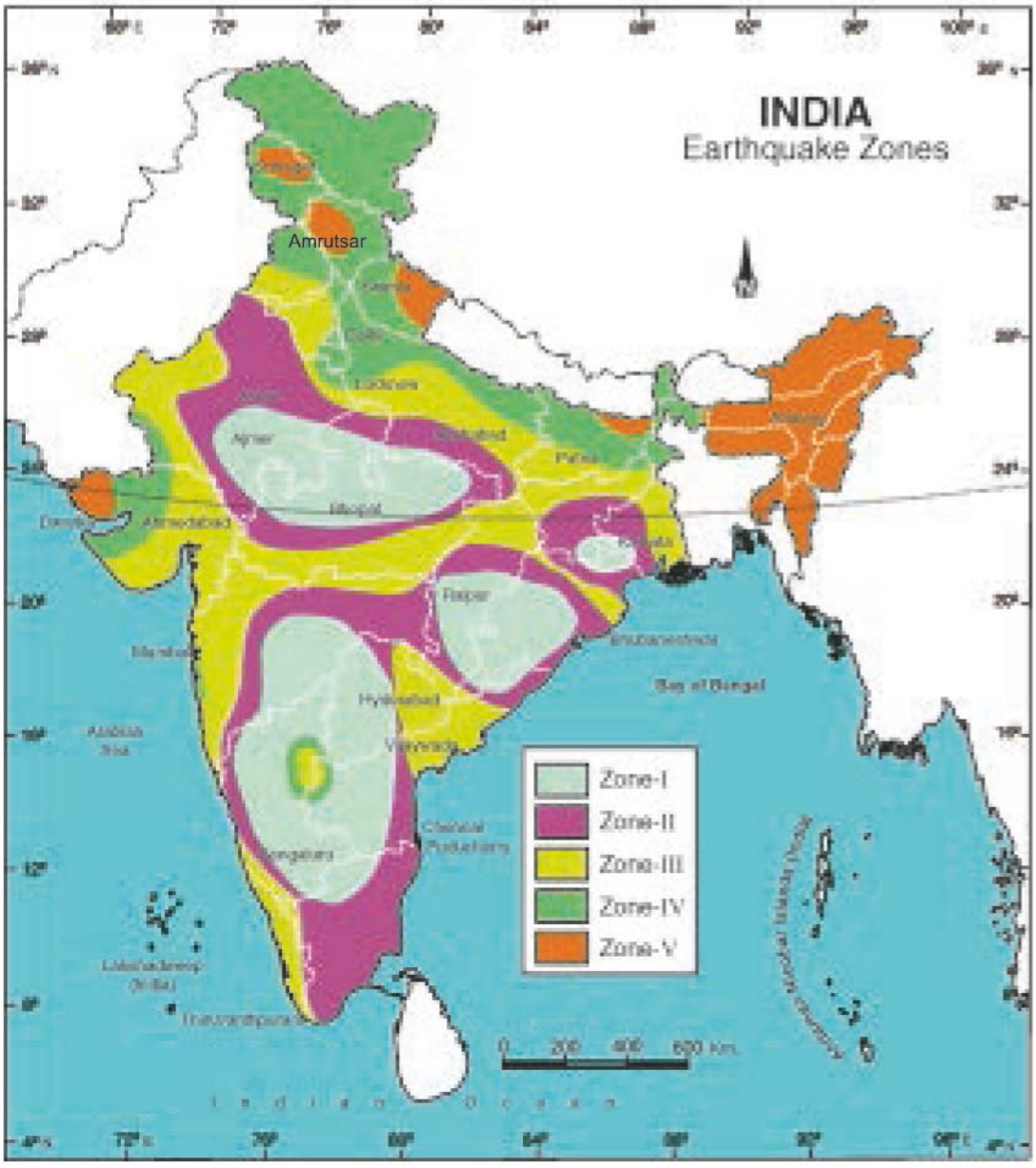
Technically advanced countries are successful in preventing the effects of hazards. In this scientific age, there is a total change in transportation and telecommunication. As a result, the relief work during hazards and disasters can be carried out in time. Advanced forecast can be had about some phenomena. This helps to reduce the damage to human life, animals and other property. For this, **Disaster Management** has become necessary.

Classification of Hazards

Hazards	Phenomena
1. Geophysical	Earthquake, landslide, volcanic eruption
2. Meteorological	Cyclone, storms
3. Climatological	Heavy rain, drought, heat wave, cold wave, hailstones, cloud burst
4. Biological	Grasshoppers attack, plague, sars disease, ebola
5. Hydrological	Flood, snowfall
6. Man-induced	Atomic disaster, industrial disaster, war, atomic explosions

Earthquake

Detailed information about earthquake is given in 4th chapter. Himalayas in the north of India is a young folded mountain of the world. Her interior part is still very active and experience crustal movements periodically. On the basis of possibilities and intensity, India is divided into five earthquake zones which are called **'Seismic Zones'**. The area where earthquakes are most likely and more intense are placed in Zone V. Himalayan mountain system, North Eastern States and the Kachchh region of Gujarat are placed in Zone V.



14.1 Probable earthquake zones of India

A vast area of peninsular plateaus falls in Zone III and IV. Delhi, Mumbai and their surrounding areas are also included in Zone IV. The rest of the regions are included in Zone I & II.

Impact of Earthquake on human life

An earthquake has manifold effects. Mostly it is destructive, but somewhere its constructive effects are also experienced. Fissures develop at some places and hot gases and water are ejected out. Sometimes sand is also thrown out. Courses of small rivers and streams change. Sea waves and tides become more devastating. Tidal waters gain momentum and erode the shore rapidly. Somewhere an island is also formed. Due to an earthquake, the subsurface strata change and that changes the saline water into fresh water and vice versa.

There is a large scale devastation in urban areas. Trees are uprooted, Electric poles overturn and are broken. This exposes the electric current. So many people and animals are electrocuted. Buildings develop cracks. Multi storeyed buildings collapse and weak structures fall. Damage is also caused to railways and roads, so the routine is disrupted. Walls of dams and reservoirs develop cracks and may cause devastating floods. In Gujarat, the earthquake of 26th January, 2001 did much devastation.

The earthquakes which occur at night are more destructive. India has experienced earthquakes many times in past. Following is the information of some earthquakes experienced during last 10 years.

Date	Place	Intensity on Richter Scale
20th October, 1991	Uttar kashi (Uttarakhand)	6.6
30th September, 1993	Latur (Maharashtra)	6.3
22nd May, 1997	Jabalpur (Madhya Pradesh)	6.3
29th March, 1999	Chamoli (Uttarakhand)	6.8
26th January, 2001	Bhuj (Gujarat)	7.9

About 8000 people lost their lives in the earthquake of 7.8 intensity which occurred in Nepal on 25th April, 2015. There was some damage in Bihar also. Its effects were felt all over India.

On 26th December 2004, a tsunami occurred in the Indian Ocean near Sumatra-Indonesia marine region, and its impact was felt on the eastern sea coast of India. During this tsunami, about 9000 people died and a heavy damage was done to property on eastern coast and in Andaman-Nicobar Islands.

An earthquake is an unexpected disaster. In India, some areas feel the earthquake tremors at a specific interval. In Gujarat, especially in Kachchh, about 500 tremors are felt every year due to which heavy damage is done. In this area, all buildings should have similar set up of construction. Sufficient knowledge about earthquake and awareness is necessary. After gathering information about an earthquake, it is necessary to know as to what precautions should be taken at the time of the earthquake. Our first target should be to save the life.

Precautions to be taken when an earthquake takes place :

- Lie down on your stomach if you are in open ground.
- If you are inside a school/ college building, sit below a strong table or a bench.
- When tremor starts, stay away from the heavy furniture and glass.
- Stay under a strong cover till the tremors stop. When the tremor stops, leave immediately considering the safety.
- If you are coming out of a multi-storey building, do not attempt to push others while coming out. Stand very near the wall. Do not use lift to get down.
- Stay as much away from electric poles, trees, multi-storeyed buildings as possible.
- If you are in a stadium, theatre, school or an auditorium at the time of earthquake do not rush to come out. More deaths can occur due to pushing than earthquake. Do not leave the safe place till the tremors stop. Give priority to children, old people, handicapped person and women to come out safely.
- In case the services of T.V., internet are discontinued, contact can be made through Hem radio.

Steps to be taken after the tremors stop :

- Be comfortable mentally and help others.
- If family members get separated during the earthquake, try to get them together.

- If somebody is severely injured and if there is no danger, leave him/her there. When the situation sets right, do the needful remedy.
- If you get information about persons buried below the debris, inform the relief party.
- Use internet. Communicate proper and true information.
- Implement the instructions, official announcement or a Government advertisement given on radio, television or other media.
- Instead of joining a crowd to know what has happened, avoid the crowd.
- Get first aid service in casual injuries.
- Do not re-enter in the damaged building.
- Make sure that the house is safe for entry. If gas leakage is suspected then do not switch on the electric light, and avoid use of other electric gadgets.
- In case of fire, dial 101 for fire brigade and 100 for police control room.

Volcano

The process in which the magma from below the surface of the earth, hot gases, rock material, soil, mud, ash vapour etc., come out towards the surface of the earth with great thrust or gradually , is known as volcanic eruption. Serious impact is felt during as well as after a volcanic eruption. Disaster management is necessary in areas of active and dormant volcanoes. As soon as the signs of an eruption are sensed, the administration becomes alert. It is not easy to inform people who live scattered or in a group in mountainous area near a volcano.

Estimate of the damage is made after the eruption stops. Sometimes, the volcano becomes active again.

Safety measures to be taken during volcanic eruption :

- Follow the orders of the Administration at the time of eruption.
- Stay as much away as possible from the site of eruption.
- Avoid watching the eruption very closely with naked eyes.

Landslide

Landslide means the sliding of a large portion of land or a cliff or a part of it from the mountain downwards. Landslides generally occur in mountainous regions. Various settlements in such area become their victim. When such places are in remote areas, their contact is lost and help cannot reach them immediately. It is also difficult to reach inaccessible areas.

Reasons for landslide :

(1) Geographical (2) Structural (3) Physical (4) Human induced

Landslides generally take place in Himalayas in India. About 200 people died in the landslide at Maalpa - Pithoragadh on 18th August, 1998. Such phenomena also occur in South India. About 150 people died in the landslide which occurred in Malin village of Pune district on 30th July, 2014. In June 2013, a heavy cloud burst and the resultant floods at Kedarnath in Uttarakhand caused heavy devastation to human life, roads, bridges and other property.

Precautions at the time of landslide :

- Keep life saving commodities while passing through a probable landslide area.
- Follow the instructions given on the Notice Board while passing through a landslide area.
- Avoid visiting the landslide area during rainy season.
- Do not make haste to cross the area while the landslide is in progress.

Snowfall

Many a times, a snowfall causes much damage in Himalayas. In himalayas, which are snow-clad and lofty in the world, such phenomena are felt occasionally. Landslide is caused generally by tectonic movements, ice skating, (skiing), adventure sports like snow skating, mountaineering, excessive pressure due to heavy snowfall etc. Sometimes, mountaineers become victims of such phenomena. Human life is lost due to this natural as well as man induced phenomena over limited area.

Precautions at the time of snowfall :

- Implement the instructions given by the authorities while going through snowfall hit area.
- Avoid going to areas where stormy winds blow and rains heavily in snowfall region.
- Keep your life saving things with you while going through snowfall hit areas.

Cyclone

This is a meteorological hazard and it has its own geographical area. Here, the air moves towards centre where atmospheric pressure is very low and a high pressure exists around all sides. The winds in centrifugal direction rise high in circular movements due to the coriolis force. This phenomena is called Cyclone. The cyclone originates mostly over the oceans and after the contact with the coast, they gradually get extinct.

What happens during a cyclone ?

Powerful waves in the vast oceans rise very high. Coastal area submerges into the water. If the cyclone develops during spring tide, then its combined effect becomes very devastating. Coastal area gets heavy showers which result into floods. Cyclones uproot the trees and demolishe buildings. Electric poles are also uprooted. Mangrove forests near the sea coast protect the region from the devastating and powerful waves.

Entire eastern coast (Coromandel and Circar) of India is a cycloneprone area. West Bengal, Andhra Pradesh, Odisha and Tamil Nadu experience frequent cyclones. On Arabian Sea coast, Gujarat and Maharashtra states are frequent victims of cyclones.

Advanced information about cyclones can be obtained through satellites. Its intensity, velocity and direction can be known through the satellites. On this basis, action can be taken for the protection of people of any area. Evacuation of all people was possible due to the advanced information from cyclone named as Failin. Indian Weather Office remains active for such occasions. Cyclonic Detection Radar are placed at 10 places in the country. Insat satellite and these detection centres provide information constantly.

Steps to be taken before a cyclone :

- Do not spread rumours. Do not get panicky.
- Attend to the authentic news and warnings.
- Fishermen should not leave for sea. Boats should be anchored at safe place.
- Coastal inhabitants should shift to a safer place.

- Keep in mind the places at a height where refuge can be taken.
- Keep dry breakfast, water, clothes and a first aid kit with you.

During the cyclone :

- Do not take shelter below an old worn out building or a tree.
- If possible, use mobile internet and get latest information.
- Keep on listening radio and follow instructions.
- Do not stand near sea, below a tree or an electric pole or the power line.
- Disconnect the electricity and gas connections.

After the cyclone :

- Do not attempt to enter a damaged house.
- Stay in the house only if it is totally safe.
- Before leaving the house, confirm that the cyclone has passed by.
- Wait for the all clear message on radio or television in your home.
- Stay away from the debris of buildings, glass pieces etc.
- Check whether there is any leakage in the gas connection. If the leakage is traced, Open all windows and doors and go out of your house.
- If evacuated, return only when the instructions are received and by the route suggested.
- To save the electric gadgets from damage, turn off the main switch of the house.
- For safety measures, contact Fire Brigade, Police, NGOs etc.
- Use safe food only.

Flood

Flood is a natural hazard. When the river flow increases abruptly and heavily, river water spreads over large area along both banks and the deep impact of that water remains for a short time, then such a situation is called Flood. When cracks develop or if there is a break in the dams, the water stored in the reservoir gushes out very rapidly and causes flood. On 11th August, 1979 Morbi flood disaster took place due to the bursting of the Machchhu Dam2. Due to tectonic movements, when the slope of the relief features changes, river changes its course and that also may result into unexpected flood.

In the North-Eastern states, every year, flood problem becomes very grave. There are frequent floods in Brahmaputra, Ganga and Kosi rivers. Due to heavy rainfall in the upper valley, flood problem exists in rivers Narmada, Godavari, Tapi, Krishna and Kaveri. Punjab, Haryana and Himachal Pradesh also get frequent floods. When there is a sudden heavy rainfall in the catchment area of a river, the water level in the dams rises, so the gates of the dams have to be opened. Under the circumstance, flood like situation is created in the lower valley regions.

Flood Management :

Flood is a natural hazard but we can prevent it from becoming a local disaster. A **Disaster Management Team (DMT)** is formed by the states concerned. This team is trained to carry out relief work at the time of flood. A common man needs to know some primary information from it. This is as follows :

Precautionary measures before the floods :

Floods can now be forecast easily. The work has expedited by satellites. Sometimes, floods can be forecast even before a week. When a confirmed information about the flood is received, following steps can be taken :

- Gather information about higher places and know about the short route to reach there.
- All valuable luggage of the house should be shifted to a safe place so that the flood waters do not reach there. Moreover, Disconnect water, gutter and gas connections.
- In case of shifting to a safer place, park your vehicles at a safer higher place. A special arrangement is made over the roofs of the buildings in Surat.
- If you are travelling, avoid to cross the flooded area or a low bridge on a river.
- If your vehicle fails, then leave the vehicle and reach a safer place without any delay.
- Keep the First Aid kit ready with you. Medicine for snake bite and diarrhoea should be kept in ample quantity.
- Keep ready thick ropes to tie up various goods and to carry them.
- Keep an umbrella ready and use strong plastic bags to save goods from getting wet in the flood. Keep extra plastic bags with you.
- A small torch and a radio should be kept handy.
- Keep long bamboos or batons to keep away the snakes and other animals which are drifted in the flood water.
- Manage for woollen clothes, drinking water and durable snacks.

What to do during and after the flood :

- Keep in constant touch with radio, TV, internet and newspapers.
- If you have to evacuate collect your important documents and life saving drugs with you.
- Leave the address of the place where you are going to the DMT.
- Do not plunge into unknown water.
- Drink only boiled water during flood.
- Keep the food covered. Do not eat stale or wet food.
- Be helpful to Government administration and NGOs.

What to do after the floods :

- Do not enter into deep and unknown water.
- Sprinkle insecticide / pesticide over small water pools of dirty water.
- Know about your house. If it is not habitable, do not take the risk to stay.
- If flood waters have entered your house, then it is not advisable to stay in the house.
- Sometimes, there is a break in the gutter and water pipelines. So the polluted sewage water merges with drinkable water. Do not drink such water.
- Get your gutter, electricity, water lines checked by authentic persons.
- Drink boiled chlorinated water.
- There is a possibility for spread of contagious disease, so seek doctors advice.

Drought

On hearing the word drought, words like dry land, failure of crops, inadequate rainfall, starvation etc. come to our mind. Collective characteristics like inadequate rainfall, acute water shortage, no possibility of farming, shortage of fodder for animals is called drought.

Inadequate rainfall is the main reason for drought. If a region gets much less rain and if this happens continuously for two-three years, the severe effects of drought is felt. Such a condition creates many problems. Decrease in rainfall is a gradual process. So a drought can be considered to be a hazard which develops very gradually and leaves a long term impact.

Many places in India experience drought periodically. Every year, there is at least one region in India facing a drought. Due to weak monsoon season, many places in Gujarat and Rajasthan face drought frequently. Drought is a common phenomenon in many places in Western Odisha, Rayalsima and Telangana regions of Andhra Pradesh, Chhattisgarh, Jharkhand, Central Maharashtra, interior Karnataka, West Bengal and Tamil Nadu. Besides, few places of Haryana, Punjab, Bihar and Uttar Pradesh which have abundant water, experience drought occasionally. In India, there are 191 drought prone districts.

Environmental Degradation :

Quality of the environment reduces during a drought. This is called Environmental degradation.

- Deforestation increases.
- Soil is eroded.
- Surface water and ground water are used excessively. Biodiversity is lost.
- Global warming increases.
- Drought occurs due to excessive rainfall also. Due to excessive rain, crop is destroyed, epidemic spreads. Excessive rain is also called wet drought (Lilo dukaal).

Effects of Drought :

Drought has a long term effects and it affects all fields in the society. Due to crop failure, a shortage of food grains, fodder for animals, water shortage in rural and urban areas are created. Agricultural labourers loose their income, so they have to divert to other sources of income. Children suffer from under nourishment.

Drought Management :

Ultimate reason for a drought is water shortage. If the water sources are utilised reasonably and if modern technology is used then the drought impact can be reduced to some extent. Israel gets about 53.7 mm rainfall only, but it implements modern technology in farming. So even with inadequate rainfall, they are prosperous in agriculture. Trees control the rain. Due to more forested area, South Gujarat does not experience drought.

Infestic Diseases

Some insects, virus, bacteria etc. spread diseases. Diseases like anthrax, bird flue, swineflue, chikungunia, aids etc. are spreading fast. Of these most of the diseases are the result of human actions. In Gujarat, swine flue creates some problem for some years during winter.

Information about the diseases, cleanliness, proper disposal of litter, disposal of **'medical waste'** through proper way etc. are remedies to control the infestic diseases.

Human acts like industrial pollution, dropping of litter in the ocean, chemicals used to get more production may prove dangerous for human life in long term.

Industrial disasters and Atomic Explosions

In industrial plants, accidental disasters take place during any chemical process. Gas Tragedy in Bhopal (1984) is a well known phenomena, where many people died due to leakage of poisonous gas due to human negligence. Chernobil Atomic Disaster of Russia (1986) has become famous world over.

A war also can be called a man-induced disaster. It starts abruptly. Many lives are lost. In recent times, a domestic warlike situation among Arab countries is a painful man-induced disaster .

Atomic Explosions

Atomic explosion is perhaps the most terrible and long lasting disaster which causes loss of human lives. In 1945, more than two lakh people died when America dropped two atomic bombs over two Japanese cities Hiroshima and Nagasaki. It is in the hands of man to be safe from the man-induced atomic, biological and chemical disasters.

Remedies of Safety Against Industrial Disasters

Accidents are associated with the establishment of an industrial unit. Let us understand how safety can be assured under extra ordinary circumstances.

- Avoid as much as possible residing near the industrial units producing poisonous chemicals.
- Know about the general characteristics of the dangerous chemicals through different media.
- Citizens should know about the dangerous and poisonous chemicals. Enthusiastic youths should take training for safety measures in case of emergency, so that it could be used timely.
- Participate in the training programmes organised by Government / NGOs / industrial units,
- Try to create awareness in the society.
- Know beforehand about the direction of evacuation and safe refuge.
- Plan a disaster management scheme for the affected people and inform all of them.
- If the disaster information is not reachable from the industrial unit concerned, as a citizen, inform immediately to fire brigade, police and Government authorities.
- Observe the direction of the chimney smoke and go in the opposite direction.
- Keep wet piece of cloth or a handkerchief on your mouth at the time of industrial accident.
- If gas is found to be excessive, take a vehicle and reach a safer place.
- Do not try to go near the place of disaster; avoid unnecessary crowding.
- Life is more precious than goods. Do not worry about the goods but save yourself.
- Listen the siren, necessary instructions on TV and follow them.
- Cooperate fully to the persons who help you.
- If the proportion of poisonous gas is less in your area, keep the windows and doors tightly closed, and stay inside.
- Provide protection to those patients who are unable to leave and to weak, helpless and handicapped persons. Close the windows and doors and confirm about their safety.

Precautions

- Get health related and life insurance beforehand.
- Keep the first aid box handy and keep the material inside updated. Get trained for first aid.
- Keep important phone numbers handy.

EXERCISE

1. Write a detailed answer to the following questions :

(1) Write a detailed explanation about natural hazards and disasters.

(2) Explain the effects of earthquake on people.

(3) Discuss the effects of drought.

(4) Discuss the industrial disasters.

2. Write short notes :

(1) Flood

(2) Rescue operations during an earthquake

(3) Cyclone

(4) Natural Hazards

(5) Remedy for safety against industrial disasters

(6) Disaster Management

(7) Atomic explosion

3. Answer the following questions in one-two sentences :

(1) By which other name a disaster is known as ?

(2) Which factors are responsible for the changes on the earth ?

(3) How many countries have been successful in controlling the effects caused by disaster (hazards) ?

(4) Into how many parts can the hazards be classified ?

(5) Write two examples of biological disasters.

(6) Write two examples of geo-physical hazards.

(7) On the basis of probabilities and intensity or risks, into how many seismic zones is India divided ?

4. Select the correct option for the questions given below and write :

(1) Which of the following is a man-induced hazard ?

(a) Storm (b) Drought (c) Atomic explosion (d) Earthquake

(2) In which seismic zone does Kachchh fall ?

(a) V (b) IV (c) III (d) II

(3) If you are in a building and the earthquake tremors start, what is to be done ?

(a) Come out immediately. (b) Stand in a safe corner of the house.

(c) Disconnect the electric connections. (d) Ask others for help.

(4) In which year, did the Morbi disaster take place ?

(a) 1980 (b) 1989 (c) 1979 (d) 1981

(5) Advance and live information about a cyclone can be gathered through

(a) Satellite (b) Radio (c) Newspapers (d) TV

15 Maps : Meaning and Types

You know that many foreign tourists visit tourists places of our country. Even though they are not acquainted with the geographical region of our tourists places, they easily reach their destinations. What is the reason ? Only reason is that they have the map of the tourist spots. By reading the maps, they can fulfil their purpose of their tour. In recent times, map has become useful tool not only for tourism but for other purposes as well. So, come friends, let us get some useful information about maps in this chapter.

Geography cannot be studied without maps. Different maps are used for geographical study of different countries of the world. It is impossible to carry out a comparative or a direct study of all places in the world. But a map is such a tool which provides complete information of all places. That is why a map is an encyclopaedia for geographers. Every information on the surface of the earth can be depicted easily on a map. Natural elements (mountains, river, plain, plateau, lake, vegetation, sea etc.) and cultural elements (settlements, transport routes, industries, agriculture, irrigation, telecommunication facilities etc.) are interrelated. So these elements are scrutinised while preparing a map. Geography is a practical science where maps occupy a larger coverage. Cartography, a specialised branch of Geography, studies the process of map making in details. Besides tourists, a map guides the soldiers, traders, vehicle drivers, founders of industrial units and also a common man. For this it is necessary to know the script of the map.

Meaning of Map

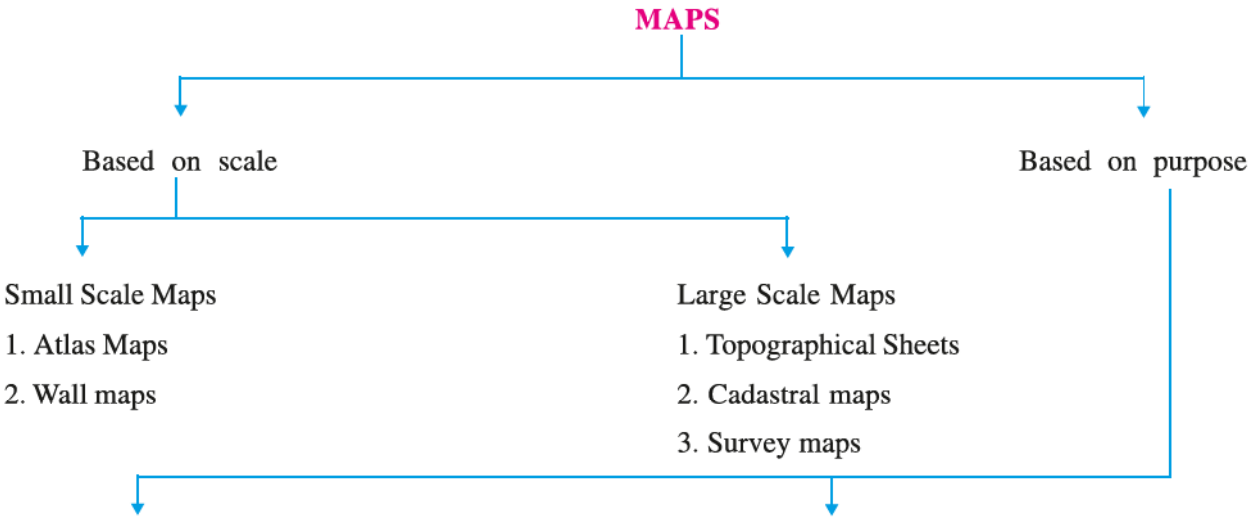
The word map is derived from the original Latin word **'Mappa Mundi'**. It means a small piece of cloth which can be kept in hand. In 840, a Christian Missionary Mikon popularised the word Mappa Mundi. In general, a map is a small scale conventional representation of the curved surface of the earth or a part thereof as seen from space. In Geography, maps are prepared for a geographical region on the surface of the earth. Map includes an area much larger than its size. Following is the definition of a map.

A map is a small scale conventional representation of the earth or a part thereof as seen from above. Or A map is a conventional representation of the curved surface of the earth or a part of it, drawn with proportional scale, projection and conventional signs, as seen from above. A map can be prepared on a flat paper, cloth, plastic, film strips or plaster of paris. Scales, conventional signs and projection are chief components of a map.

Types of map

Maps are prepared to provide supplement to various requirements. So there are many types of maps, e.g. atlas maps, wall maps, maps for newspapers or books, survey maps, astronomical charts etc.

According to the scale and the purpose, maps are divided into two types : (1) Maps based on the scale (2) Maps based on the purpose.



Physical Maps

- Relief maps
- Geological maps
- Weather and Climate maps
- Soil maps
- Natural resources maps
- Natural vegetation maps
- Wild life resources maps
- Hydrological maps
- Other

Cultural Maps

- Agricultural maps
- Industrial maps
- Transport maps
- Demographic maps
- Military maps
- Settlement maps
- Political maps
- Space maps
- Other

(1) Maps based on the scale : According to the scale, there are two types of maps : (1) Small scale maps and (2) Large scale maps.

We have two maps. One of the maps is in the scale of 1 cm : 50 km and scale of other map is 1 cm : 100 km. If we have to compare these two maps on the basis of their scale, then the map which has smaller denominator, which shows the distance on the ground, is a **large scale map**. When this figure is larger, the map is a **small scale map**.

In large scale maps, limited area of the earth is shown with more details. Maps for city, village, taluka, district etc. are of this type.

In small scale maps, a large area of the earth is shown. Maps of different countries are of this nature. Atlas maps, wall maps fall under this category.

(2) Maps based on the purpose : Such maps are prepared according to the requirements. Maps which are prepared according to the purpose can be divided into two parts, according to the physical or cultural facts to be shown in the map. : (1) Physical Maps, and (2) Cultural Maps.

Physical Maps :

The maps which show physical or natural elements are called Physical Maps. Such maps hold more importance in Geography.

- **Relief Maps :** Mountains, plains, plateaus, river systems etc. are shown in these amps.
- **Weather Maps :** Here, short term or daily conditions of the elements of climate like temperature, rainfall, winds, atmospheric pressure etc. are shown.
- **Climate Maps :** Here, long term (monthly, yearly) conditions of the elements of climate like temperature, rainfall, winds, atmospheric pressure etc. are shown.
- **Soil Maps :** Here the characteristics of the soil like type, use, distribution etc. are shown.
- **Wild Life Maps :** Here the distribution of National Parks, sanctuaries are shown.

Besides, the maps showing the natural resources like minerals, vegetation, grasslands, drainage pattern, geological structure, oceanic regions, astronomy etc. are also known as Physical Maps.

Cultural Maps :

In these maps, man made features are shown. Different economic activities of man are depicted in these maps. These include farming, transport routes, industrial centres, cities, ports, administrative divisions of the nation, state capitals, villages, settlements etc. On the basis of man induced elements, such cultural maps like agricultural maps, industrial maps, population maps etc. are prepared.

In recent times, satellite maps are prepared using modern computer techniques for the details received from artificial satellites.

Components of a map

It becomes necessary to know about the components of a map for map reading and its interpretation. More the information about the components of map, its reading and interpretation becomes clear and meaningful. There are three components of a map : (1) Scale (2) Projection, and (3) Conventional signs.

(1) Scale : Areas shown in the map are drawn at a specific scale. While deciding the scale, it is necessary to establish relation between two points on the map and their corresponding distance on the ground. Thus, the ratio between the reduced distance between two points shown on the map and their corresponding actual distance on the ground is called SCALE.

Method to show scales on the map

Three methods can be used to show scale on the map : (1) Statement scale (2) Numerical or Representative Fraction scale (3) Linear or Graphical scale.

Statement Scale : This is most simple and easy method to show the scale. A common man also can understand and can calculate the distance between two points on the surface.

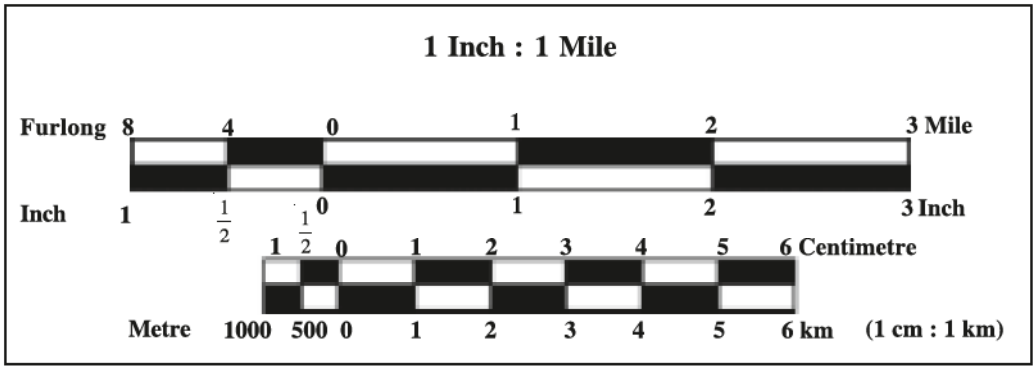
In this method, the details of the scale are shown by words or by a statement. Signs signifying the unit of the scale or ratio are not used. It is written as 1 cm : 10 km. As a statement is written here, this type of scale is known as Statement Scale.

Numerical Scale / Representative Fraction : In this method, the units depicting the unit of the distance are not mentioned. The distances are shown only by numerical figure or in arithmetic fraction, e.g. 1 : 10,00,000 or 1 / 10,00,000. Here the figure on the left side, or numerator, shows the distance on the map, while the figure on the right side or the denominator, shows the distance on the ground.

This method is also known as Representative Fraction method because the scale here is shown in the form of a ratio. In this method, no unit like cm or km is mentioned in the scale after the numeric figures. So in any country this scale can be used for calculation.

(3) Linear (Graphical) Scale :

In this method a line is drawn to show the scale, so this is known as Linear or Graphical Scale. Even though this method is easy, it is also slightly complicated and so is used little less. On the scale (Foot rule) which we use, inches or centimetres are shown, but on this scale the units showing distances like metre, furlong or mile are also shown. In this method, a linear scale is drawn in any part of the body of the map which enables us to read directly the distances on the surface. This is called Graphical scale. A line is used to show the scale so this is also known as Linear Scale. Generally, a small line of proper length according to requirement is drawn in any part of the map. In a small scale map, the scale is drawn by a line of even 1 centimetre or 1 inch. In this scale, major divisions (km or mile or other) of the scale are shown on the right side of zero. On the left side, the main division is subdivided into required number of divisions which show the smaller divisions of metre or furlong etc. This fact can be understood from the figure given below :



15.1 Linear Scale

(2) Projection : While transferring the curved surface of the earth on a flat surface, its area, location, distance, relative direction, shape or size may change. To avoid this a map projection is used. A projection is an attempt to transfer the curved surface of the earth on paper. A map projection is drawn by geometric method on any surface . The method in which the latitudes and longitudes on the curved surface of three dimensional globe are transferred on a two dimensional flat paper is known as Projection.

A projection is a process to project. The method to show the curved surface of the earth on flat paper is known as projection. Three things are required for this. (1) A wire globe (2) A flat surface on which the projecting process is to be done (3) Source of light.

With the combination of these three things and on the basis of the properties retained by them there can be many projections.

(3) Conventional Signs : Many physical and cultural things are shown in the map. In order to show these two things easily, few conventional signs and symbols are used. It is not possible to show all the details on the surface of the earth in the same form as they exist. In physical features, relief, landform, drainage pattern, natural vegetation, climate, soil types etc. are shown by conventional signs. Colours and symbols are used to show the cultural features like human settlements, transport routes, agriculture and irrigation facilities etc. In the topographical maps of India contours, layer tint

method, and hachures are used frequently to show relief features. In coloured maps, different colours are used to depict physical and cultural features.

Elements	Colours
• Landforms	• Brown/almond
• Water bodies	• Blue
• Vegetation region	• Green
• Railways	• Black
• Landroutes	• Red
• Human Settlements	• Red
• Agriculture	• Yellow

Some specific symbols or initial words are used for certain settlements, e.g. RH for Rest House, PTO for Post and Telegraph office, CH for Circuit House, PO for Police Station etc. For specific buildings like temple, mosque, church etc. a small replica of their shape is used in the map. This way, such conventional signs are used to shorten the verbal interpretation of cultural features. So these conventional signs are also known as the shorthand language of maps.

'The Survey of India' institute, located at Dehra Dun (Uttarakhand), prepares and publishes the survey maps of India wherein the internationally accepted conventional signs and symbols are used.

The signs which are used in the survey maps, topographical maps are known as conventional signs. A detailed study of these conventional signs and symbols is necessary for reading and interpretation of topographic maps.

Importance of Maps :

Since early times till to-day, maps have been inseparable part of human life. In geographical studies, map is an important tool. Besides maps have been useful to History, Political Science, Economics, Biology, Engineering, Military Science etc. also. A general and common use of maps is to know the geographical location of any place. Whether it is a travel or a thing of exchange of goods for trade purpose, maps are required to know the distances. Now a days, maps given in television, news papers and periodicals give very accurate and effective information about the daily events, weather information and forecasts, polotical or social problem etc. maps are needed for national or institutional planning of new settlements and their expansion. Map can give us information much in advance about the Maps that are needed by all. In modern period of research, maps have become a blessings to ocean explorers, space explorers and land explorers. There is hardly any field which does not use a map.

EXERCISE

1. Write answers to the following questions in details :

(1) State the types of maps.

(2) What is a scale ? Explain its necessity.

(3) Describe the importance of the map.

2. Write to-the-point answers for the following questions :

(1) Projection Write short note.

(2) Linear Scale Explain.

(3) Conventional Signs are the shorthand language of maps Give reasons.

3. Answer the following questions in brief :

(1) Which are the three methods to show scale in the map ?

(2) Which things are necessary for projection ?

(3) What are the major components of a map ?

4. Answer the following questions in one-two sentences :

(1) What are the conventional signs ?

(2) Where in India is located the institution preparing topographical maps ?

(3) Which colour is used in maps to show railways ?

(4) What is shown by yellow colour in maps ?

(5) What is meant by a map projection ?

(6) Define a map.

(7) Which things are shown in a relief map ?

5. Select the correct option from the options given for the questions and write answer.

(1) By which colour are the water bodies shown ?

(a) Blue (b) Green (c) Black (d) Red

(2) Which symbol is used to show Rest House ?

(a) PTO (b) CH (c) RH (d) PS

(3) Which of the following maps is not included in Cultural Maps ?

(a) Agricultural maps (b) Transportation maps (c) Settlement maps (d) Soil maps

Activity

- Find the distances between the capitals of different states in the political map of India.

16 Geographical Information and Map Making

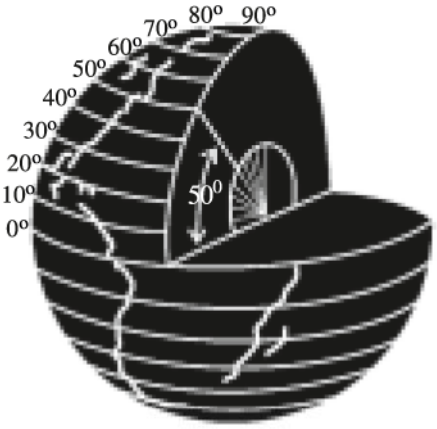
Man studies the earth as a home of mankind. Practical work is at the base of the subject matter of Geography. Fieldwork and the laboratory work are the soul of practical work. In fieldwork, the area has to be observed in person and collect necessary information for actual study. Authentic literature and Reports are consulted. Inclination to research work and capacity are necessary for a researcher. With this information and with modern cartographic techniques, a geographical report of an area along with the maps and diagrams is prepared in the laboratory. Some basic information is necessary for preparing a map of a specific geographical region. In this chapter we shall know as to what information is needed beforehand in map making.

Parallels of Latitudes and Meridians or Longitudes

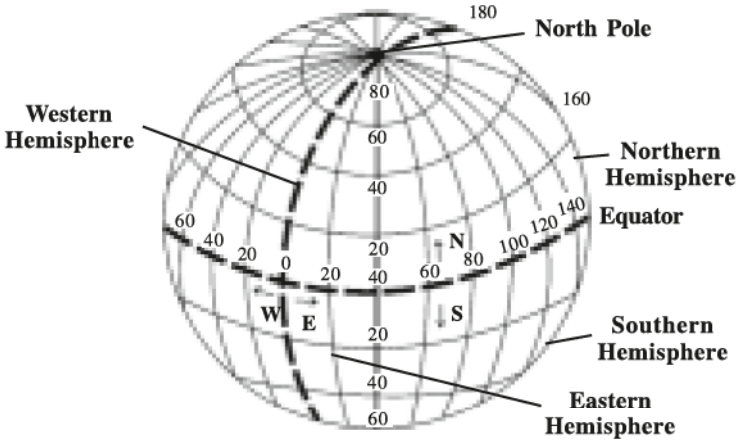
Parallels of latitudes : The earth completes one full round on its axis in twenty four hours. This is called the **daily motion** of the earth. Any place on the surface of the earth, e.g. Ahmedabad, completes one full round in twenty four hours and forms an imaginary circle. This circle is known as **parallel of Latitude**. Equator which is zero degree latitude is the main and the largest latitude. Other important latitudes are Tropic of Cancer (23.5^0 North latitude), Tropic of Capricorn (23.5^0 South Latitude), Arctic Circle (66.5^0 North latitude), Antarctic Circle (66.5^0 South latitude), North Pole (90^0 North) and South Pole (90^0 South).

Equator is the largest latitude and divides the equator into two equal parts. Latitudes are parallel to each other. The distance between two consecutive latitudes on the surface is 111 km. There are 90 latitudes to the north of equator and 90 to the south.

If any place on the surface of the earth is joined by a straight line with the centre of the earth, then the angle formed by this straight line and the imaginary equator is the latitude of this place. A circle joining all places situated at 45^0 north of equator is called 45^0 North latitude.



16.1 Measurement of latitude from angular distance



16.2 Latitudes and Longitudes on the Globe

Meridians of Longitudes : An imaginary half circle passing through both the poles and forming an arc of earths circumference is called Longitude. Equator is a full circle which has 360 degrees. If a semi-circle is drawn passing through each degree joining North Pole and South Pole, then **every semi-circle**

is called a Longitude. Main longitude is called zero degree or Greenwich Longitude. It shows how many degrees a place is located to the east or to the west of main longitude. There are 180 longitudes to the east and 180 longitudes to the west of Greenwich Longitude, thus making it 360 longitudes totally. As we go towards the poles from the equator, the distance between longitudes decreases.

If any place on the surface of the earth is connected to earths axis by a straight line, it forms an angle with the axis, and that angle is called the Longitude of that place.

Latitudes and Longitudes intersect each other and the point where they intersect is the geographical location of that place. Delhi is located at 28^0 38 North Latitudes and 77^0 12 East Longitudes.

Time

The earth rotates from west to east on its imaginary axis. It takes 24 hours to complete one rotation. There are 360 imaginary longitudes on the earth. Thus, the earth crosses 360 longitudes in 24 hours, 15 longitudes ($360/24 = 15^0$) in 1 hour and 1 longitude in 4 minutes. Thus, the time measurement has been possible due to the daily movement of the earth.

Local Time :

Due to the daily movement of the earth, every place on the surface comes in front of the sun once in every 24 hours. So the sun will shine overhead on all places on the same longitude, so all these places will have a mid-day simultaneously, and that time is 12-00 noon. This is the **'Local Time'** for all places on that longitude. All longitudes come in front of the sun alternatively, so local time of all of them is different. A longitude of a city can be known if its local time is given.

Standard Time :

Places on different longitudes have different local times. If villages, cities, mega cities on different longitudes act according to their own local time, then severe problems will be created in road, railway and air travel, trade activities, telecommunication etc. To overcome this problem, every country decides a common time for the entire country from the local time of a longitude which is centrally located in that country. This time is called **'Standard Time'** of the country and that longitude is called **Standard Meridian**.

The Standard Time of India is decided from the 82.5^0 longitude which passes through the middle of the country though there is no big city of India located on this longitude. Allahabad lies to its west and Varanasi to the east of this longitude.

Indian Standard Time :

Due to the longitudinal range of India, there is a difference of two hours in the local times between Arunachal Pradesh and Gujarat (Kachchh). Arunachal Pradesh is situated to the east of Gujarat, so sunrise will be earlier there. There is difference of 30 longitudes between Gujarat (Kachchh) and Arunachal Pradesh, So there is a difference of two hours in the local times, because one longitude on the earth passes in front of the sun within 4 minutes. (30^0 x 4 minutes = 120 minutes). So when it is sunrise in Arunachal Pradesh, it is still night time in Kachchh. That is, compared to Kachchh, the sunrise in the NorthEastern States is earlier by two hours. The local time of 82.5^0 east longitude is considered as the Indian Standard Time (I.S.T.), which is ahead of Greenwich by 5 hours 30 minutes. This is the reason why Dibrugadh, Imphal and Lohit in the east, Bhuj in the west, Bhopal in Central India

and Chennai in south show the same time in the watch. It should be remembered that the Standard Meridian longitude of India passes by Mirzapur district of Uttar Pradesh (Kharavada village, 82^0 30 east longitude) and Champa (Chhattisgarh, 82^o 29 east longitude). It does not pass over Allahabad (81^0 55 east longitude). The Local time of Greenwich (0^0) in U.K. (United Kingdom) which is prime meridian, is taken as a base to decide the time for the whole world. The 180^o longitude is known as **International Date Line**. While crossing this line, one day is either added or repeated according to the direction.

Countries like U.S.A., Canada, Russia etc. have more east-west span. If a standard time is decided from the central meridian for each of these countries, it will result in the difference of 3 to 4 hours in the local times of few cities. In Russia, this difference could be of 12 hours. So, in the countries with wider east-west distance, more than one **Time Zones** are decided. There are five time zones in U.S.A. and Canada, eleven in Russia, three each in Europe and Australia.The difference between every time zone is not more than 1 hour.

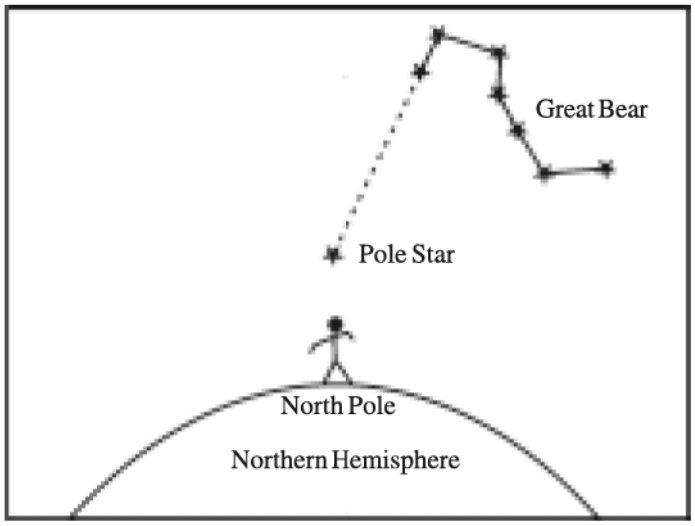
Directions :

Every day, the sun rises in the east. If we face the sun in the morning, west direction happens to be at our back, north to our left hand and south to our right hand. Direction is a relative term. The direction of any point or a place is expressed in relation to another point. Srinagar is situated to the north of Delhi and Kolkata is in the east of Mumbai.

If a map of the earth or a part of it is to be prepared, it is necessary to show north direction in the map. Direction in a map is shown by two ways : (1) By latitudes and longitudes and (2) By an arrow. While interpreting a map, if the north of the map is kept towards the North Pole, correct directions can be known. When the North Pole of the map and the North Pole of the earth are in one line, it is said that the map is oriented correctly.

North direction means the direction of North of the earth. There are some methods to know the North.

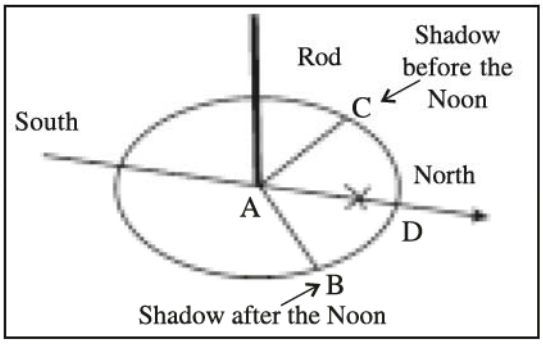
(1) With the help of Pole Star : This is a very easy and clear method of knowing the North. At night, a bright star is seen right above the North Pole. It is called North star or Pole Star.



16.3 To know Geographical North with the help of Pole Star

See the figure 16.3 attentively. Pole Star is shown at the bottom. Above it is a group of seven stars arranged in a peculiar shape. This is called Great Bear. The last two stars on the left side are called Pointers. If both the stars of the Pointer are joined by a line and is extended further, this line meets the Pole Star. This method is useful to ascertain the position of the Pole Star. The location of the Pole Star helps to know the North direction.

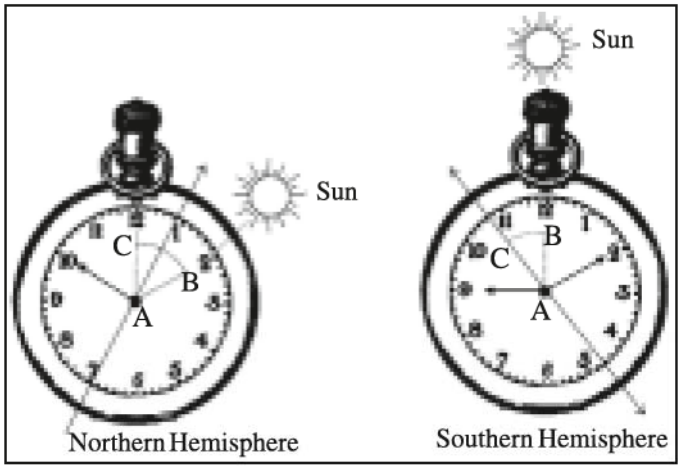
(2) With the help of a Rod or a Pencil : Keep a large paper on the ground. In its centre, keep a pointed stick or a pencil. Show the shadow of the rod at 11-oo by a line A. Take a radius equal to this line and draw an arc. After 12 at noon the shadow of the rod will touch on a point on the arc. Bisect the /_BAC, formed from AB and AC lines. This bisector AD will show North direction.



16.4 To know Geographical North through a rod

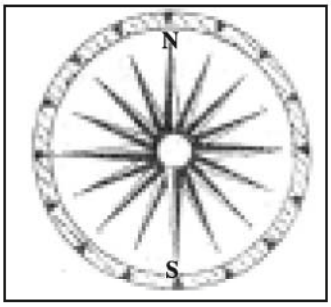
(3) Finding direction with the help of a watch : Set your watch according to the local time. Now put the watch on your palm in such a way that the shorter hour hand faces the sun. (Line AB)Draw a line touching the centre of the watch and the figure 12. Draw a bisector AD of the angle formed by lines AB and AC. When extended this line will show south direction in the northern hemisphere.

In southern hemisphere, draw a line AB connecting centre of the watch and the figure 12. Draw the bisector AD of the /_ ABC, formed by line AB and AC. This line will show North direction.



16.5 Finding North direction through a watch

(4) With the help of Magnetic Compass : As shown in the figure 16.6 the magnetic north of any place can be known by a compass. But there is a difference in the magnetic north and the geographical north of the earth. This is called Magnetic Declination. The North direction can be known by deducting the magnetic declination.



16.6 Finding North through Prismatic Compass

Modern techniques of map making

Information technology is a combined form of many techniques. It includes electronics, computer (hardware and software), telecommunication broadcasting, optic electronics etc. Use of information technology has added a new chapter in technology. Information technology has brought total changes in Medical diagnosis, health, transportation, teaching, map preparation , industries, agriculture and

in many other fields. Knowledge, information and telecommunication are more important which create them. With the arrival of Internet, the whole world has turned into a global village. Internet is the largest system in the world to-day. With micro computers and modems, any person by using internet facility can connect himself with the cyber space and can know latest information related to it. Cyber space is the world of electronic computers which is run by World Wide Web (WWW) technology. India has progressed very much in the field of Remote Sensing Satellites which includes IRS (Indian Remote Sensing) series of satellites. With application of satellite services, cartographic work has become easier and perfect. As a result of the collective use of satellites, computers, internet etc., new cartographic techniques have become available. This includes :

- Global Positioning System - GPS
- Geographic Information System - GIS
- Land Information System - LIS
- Space Information Technology - SIT

Besides, with Remote Sensing, Mobile Mapping, Satellite Imagery and other techniques, cartography has become a specialised science.

Let us know about modern cartographic techniques.

(1) Global Position System (GPS) : This Radio Navigation System works in all seasons. This is developed by US army. Here, 24 satellites constantly revolve around the earth. Revolution time of every satellite is 12 hours. These satellite transmit radio waves which are called **'Signals'**. These signals are received by the Ground Control Stations and are re-transmitted. These re-transmitted signals can be received by any individual user at his position. Here a person can see his location on the surface of the earth on the computer screen and can plan his work conveniently. This tool also shows the exact altitude from sea level. Due to this new technique it is being used in motor cars and cell phones as well and so it serves as a guide in real sense. This technique is used to manage the timing and location of BRTS in Ahmedabad.

(2) Geographic Information System (GIS) : In this system data base of many field observations of different levels are stored. GIS is a powerful tool to retain database related to the world, its reproduction whenever desired, its transformation and presentation. This is a computer based system. GIS provides opportunity for spatial analysis of physical, social, economic aspects of any region. The System is divided into two divisions : (1) Vector (2) Raster. It requires special training to use it.With this system, statistical data can be perfectly mapped.

(3) Remote Sensing Technique (RST) : Remote Sensing is a technique to acquire information about the physical properties of any matter or a phenomena with the help of tool and without coming into physical contact with it. The word **'Remote Sensing'** was first coined by **Evelyn pruit**, a geographer, in 1960.

The beginning of remote sensing process can be considered with the origin of living organisms. Our five sense organs experience different sensations. Any one organ cannot sense the feelings of other organ. An eye can only see but cannot hear anything. An auditory sense organ is necessary to hear.

Whatever all organs sense, it is sent to the brain which is like a processor. It compiles the sensations of all sense organs and decides the ultimate result. Thus, every sense organ is a Sensor. This is at the base of the modern **Remote Sensing** technique, and here the objective is to gather information about the earth.

Information about the earth can be procured through ancient and modern travel descriptions, the paintings, sketches, photographs, maps, films etc. The photographs taken by satellites are called **Satellite Imageries**. These imageries are based on the photographs taken from aircrafts and planes, known as Ariel Survey, in the remote sensing technique.

The photographs taken by the cameras, fitted in a balloon or an aircraft, are called **Ariel Photographs**. Remote Sensing Satellites have two types of orbits : (1) Geo-Stationary orbit and (2) Near Earth orbit.

Mobile Mapping

16.7 Mobile mapping Van

The process of preparing maps from the information gathered from the automatic high-tech tools on a mobile van, to gather and transmit the information is called Mobile Mapping.

During last 20 years, mobile mapping process is progressing very slowly. During last two three years, some global companies have made this process very fast.

High-tech digital cameras are set on a Mobile Van. Other techniques like On-Line Mapping system, Navigation system, Computer system, Ground Profile Radar are connected to the Mobile Van thus the Mobile mapping System is made very modern.

With this system, it has become possible to prepare maps based on the survey of extensive land area, skyscrapers, much longer roads, railways, traffic, national and international boundaries, electric poles, settlements etc. This also helps to prepare GIS and GPS information, digital maps, landscape imagery etc.

EXERCISE

1. Answer the following questions in details :

(1) What is Standard Time ? How is the Standard Time of India decided ?

(2) Explain latitudes and longitudes with figures.

(3) State the modern cartographic techniques and describe Global Positioning System.

2. Write to-the-point answers of the following questions :

(1) Write Short Notes : 'Local Time'

(2) Explain the Pole Star method to find North direction.

(3) Describe Geographic Information System (GIS).

3. Answer the following questions in brief :

(1) State the methods to find directions.

(2) What is Great Bear ?

(3) State two characteristics of Longitude.

(4) State four uses of Remote Sensing Technique.

4. Answer the following questions in one or two sentences :

(1) What is the distance (in km) between two consecutive latitudes ?

(2) Which is the largest latitude ?

(3) By which English name is the science of map making known as ?

(4) What is a Mobile Mapping ?

(5) What is a Satellite Imagery ?

(6) What is meant by Ariel Photograph ?

5. Select the correct option from the options given for all questions and write the answer :

(1) What is the distance between two consecutive latitudes ?

(a) 139 km (b) 122 km (c) 111 km (d) 211 km

(2) Who was first to use the word Remote Sensing ?

(a) Evelyn Pruit (b) Mikon (c) Ptolemy (d) Aryabhatt

(3) By which name is the 0^0 latitude known as ?

(a) Tropic of Cancer (b) Tropic of Capricorn (c) Greenwich Line (d) Equator

17 Topographical Sheets

Topographic sheets (toposheets) hold an important place in cartography. Topographic sheets are included in the large scale maps. We knew about the maps, their components and types in earlier chapters. In this chapter, we shall know more about toposheets. Information is given about the physical elements (mountains, rivers, plains, lakes etc.) and cultural elements (settlements, population, agriculture, river projects, cities, transport routes etc.) seen over smaller area on the surface. In other words, a complete description of an area is given in such maps. The interpretation and evaluation of the interrelations between human life and geographical conditions is made in distinct way. Toposheets become extremely useful in deciding regional planning and regional development. Such maps which give a complete account of the natural resources help to solve the problems of social development. In short a complete information is given in the toposheets with precise survey of an area.

A need for this type of maps was first suggested by **Penck** in 1891. Many countries have published different series of the toposheets of their areas. In India, topographic sheets are prepared by **The Survey of India (Uttarakhand).**

Stages in the preparation of toposheets :

First Stage : Areas spanning 4^0 latitudes and 4^0 longitudes of India is covered in each toposheet. Its scale was 1 : 10,00,000 and were given numbers 1, 2, 3, 4 etc. (The method of giving numbers is given in fig. 17.1).

Second Stage : In this stage, every map is again divided into 16 parts. The range of this division is 1° latitude and 1° longitude. Every division here is named from A to P according to English alphabet. Alphabets are written in north-south direction. An area of 1° is covered in such sheets, so these are also known as Degree Sheets.

Third Stage : In this stage, each map covered in stage two is further divided into 16 parts. The range of each map at this stage is 15 latitudes to 15 longitudes . Every sub-division is numbered from 1 to 16. Calculating 16 maps of A, 16 maps of B, 16 maps of C etc. there would be 256 maps of every degree sheet. Earlier, the scale of such maps was 1 inch : 1 Mile, so these maps were also called ONE INCH maps. This way the number given to toposheets is known as Index Number. Study the fig. 17.1 on the basis of these stages.

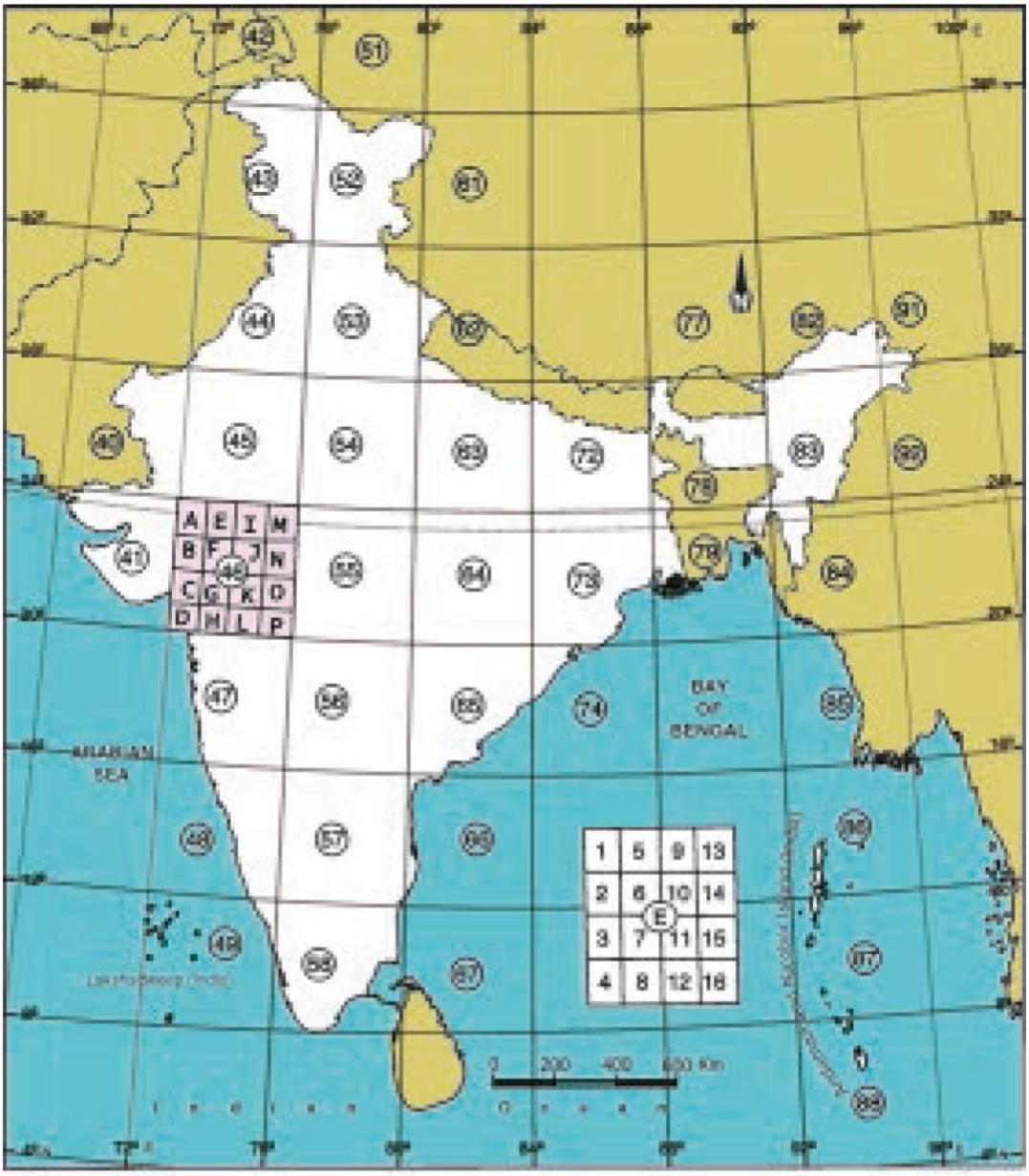
In every toposheets much information is given about many elements. It is necessary to understand them. Certain symbols are decided to identify natural and man-made elements. Toposheets can be read with these symbols and also can be interpreted. Certain points are taken into consideration for interpretation.

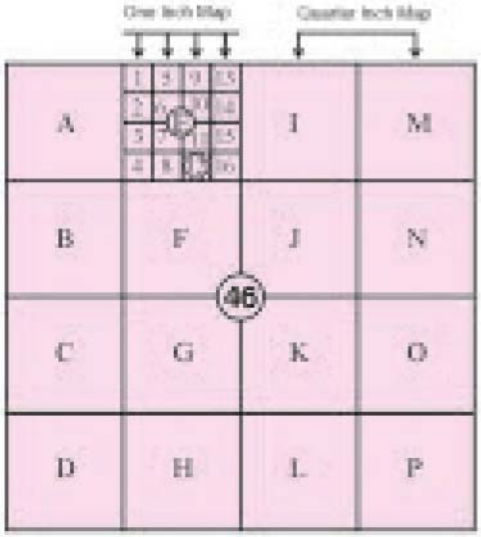
(1) Marginal Information
(2) Physical Features
(3) Cultural Features
(4) Conclusion

In Marginal Information, there is some general information about the map. These include the Index Number of the map, main and sub divisions of the area, survey and publication year, latitudinal and longitudinal extent, magnetic declination, unit showing the altitude etc. All these and other information are given in the map.

In Physical Features, relief of the area is described. An idea is given about the undulated areas, slope of the land, peaks, plateaus, plain and other landforms. It is followed by the information on drainage system, vegetation region etc.

In Cultural Features, urban and rural settlements, transportation, telecommunication facilities, agricultural regions, irrigation etc. are described. The elements on the surface of the earth are described with the help of conventional signs and symbols. Colours and geometric figures are also used.





Location of E/12 in sheet No. 46

Thus, Each map has been divided into 16 sub-divisions from A to P.

17.1 Method of giving Index Number to Toposheets

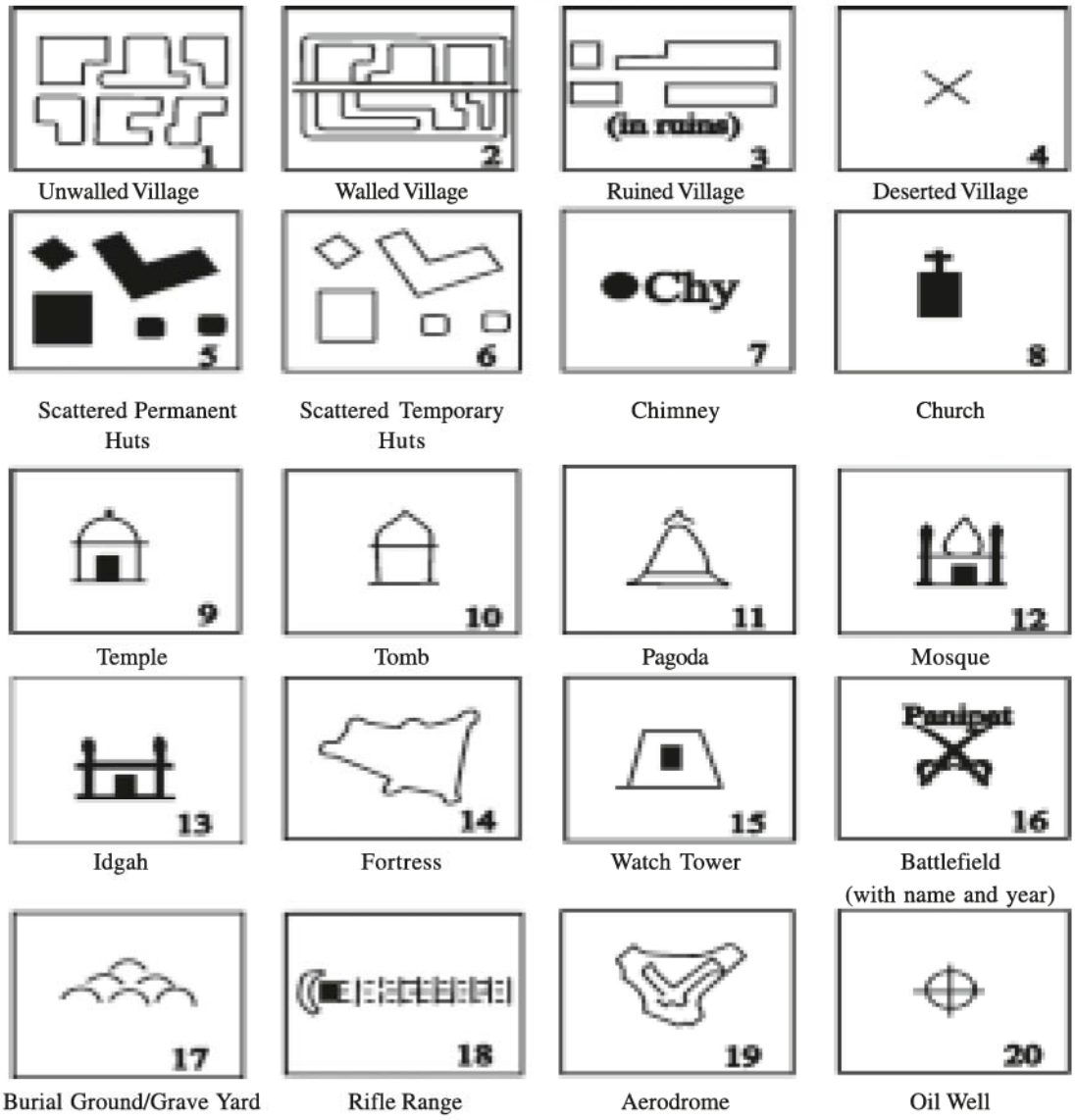
In toposheets, both Mathematical and Pictorial methods are used to depict relief features. The Pictorial method gives a generalised view of the relief of the area, while the exact height of a place can be known by mathematical methods. In **Spot Height** method, height is shown along with a small dot. Bench Mark and Triangulation Point methods also show exact height of any spot individually. Exact idea of the undulation of the surface can be obtained by **Contour Lines**. A **Contour Line** is an imaginary line which joins places of equal heights from a recognised sea level. These contour lines are drawn in the map at a specific interval. Mostly these lines are drawn at a difference of 20 or 50 metres.

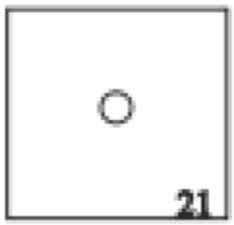
Conventional Signs

Specific symbols are used to show many physical and cultural elements on the map. The symbols used in topographic sheets are universally recognised. The topographic sheets of Indian territory are prepared by the Government of India.

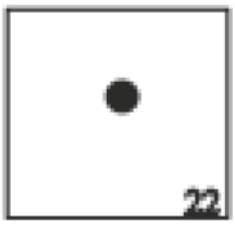
Settlement and transportation patterns of any area can be known from the toposheets. Settlements are shown by red colour. A small or a large settlement is identified by its irregular shape. Some rural settlements are situated near transport routes. These are longer and hence also known as Linear settlements. There are other settlement patterns like compact, scattered and ring type.

Conventional Signs used in the Topographical Maps of India
(Certified by Survey of India)

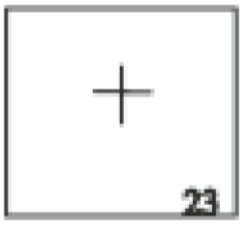




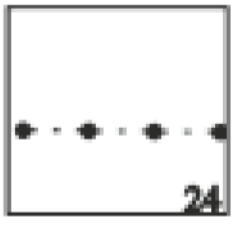
Unlined (Kachcha) Well



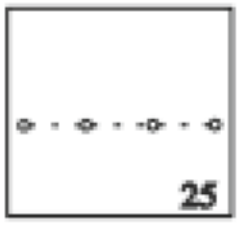
Lined (Pakka) Well



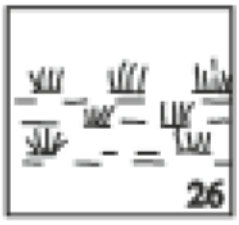
Spring



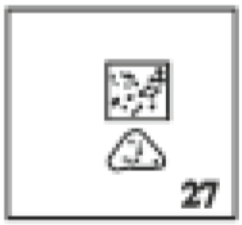
Pipeline for water



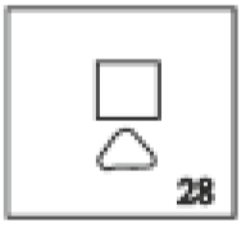
Oil Pipeline



Swamp or Marshy Land



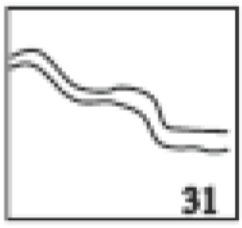
Non-Perennial Tank



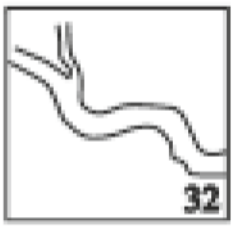
Perennial Tank

Stone Mine (Quarry)

Stream (Water current with Narrow bed)

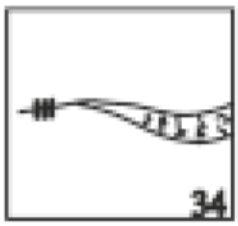


Non-perennial River with broad bed



Perennial River with broad bed

Waterfall



Rapid

Canal

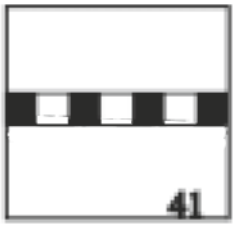
Dam

Telephone Line

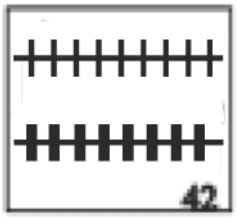
Rope Way

Wireless station

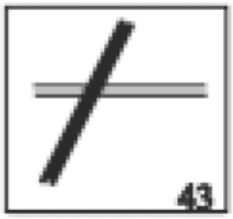
Broad Gauge Railway (Double Line)



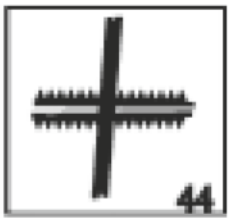
Broad Gauge
Railway
(with station)



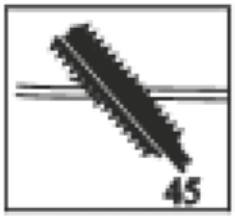
(A) Narrow Gauge
(B) Metre Gauge
(Double Line)



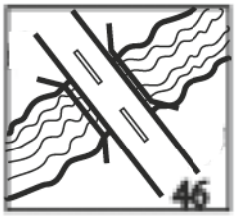
Level Crossing



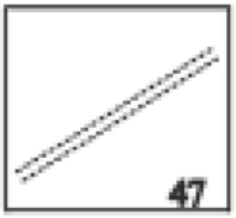
Road over Railway



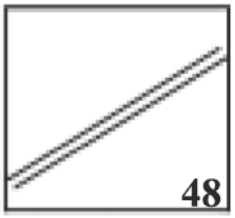
Railway over Road



Bridge over River



Unmetalled Road
(With Mile Stone)

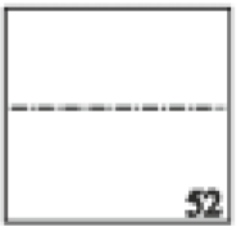


Metalled Road

Cart Track

Foot Path

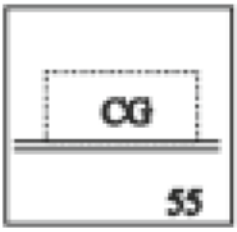
International Boundary



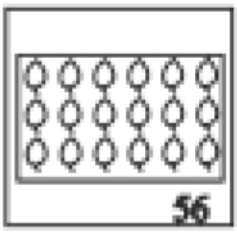
State Boundary

District Boundary

Taluka Boundary

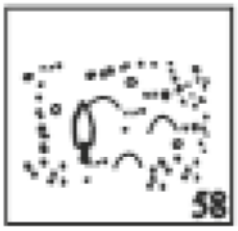


Camping Ground

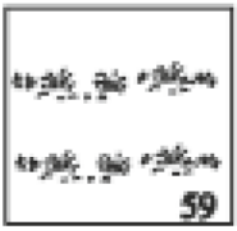


Orchard

Scattered Trees

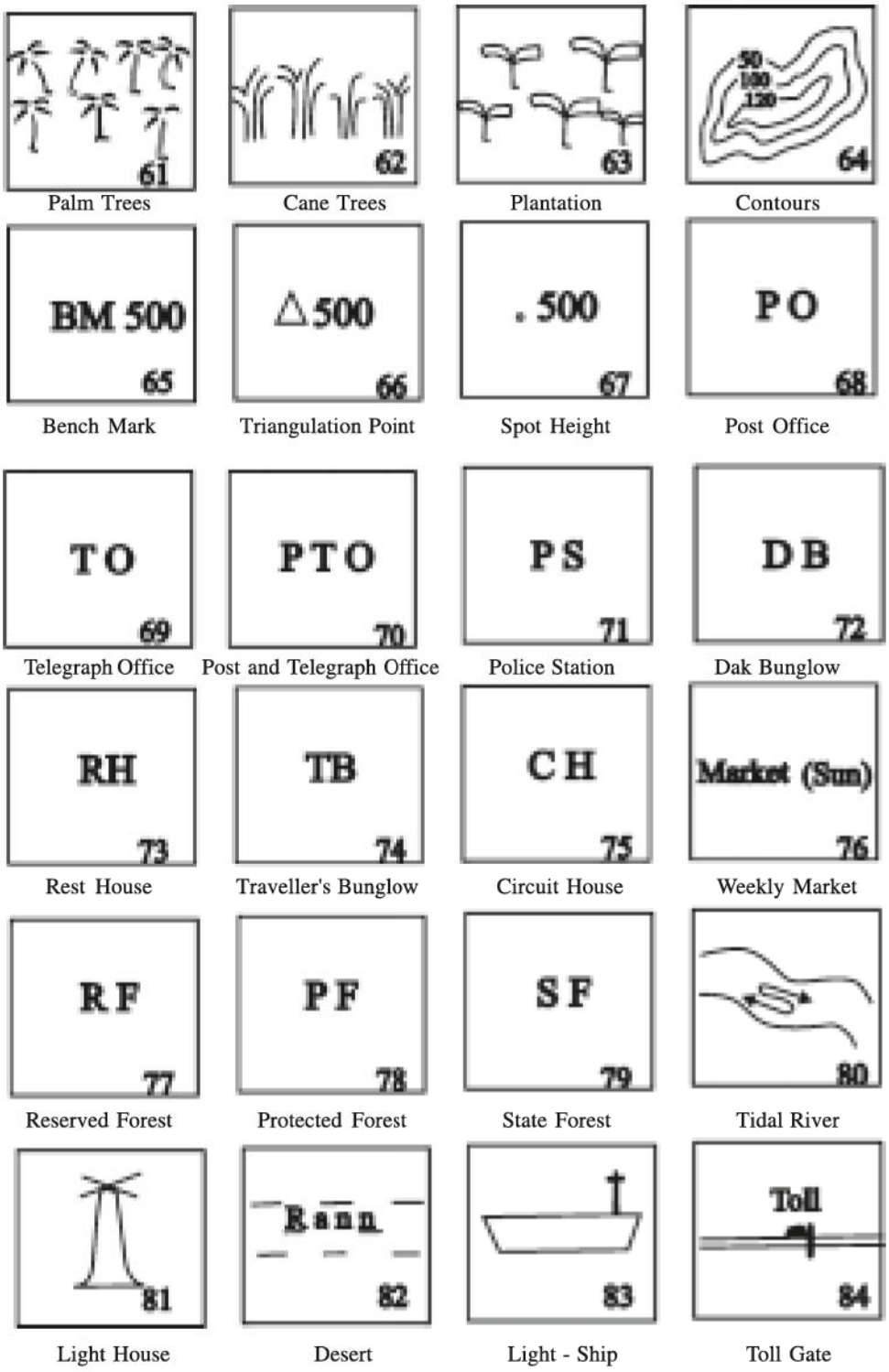


Land with Scrubs



Pasture Land

Coniferous Forests



17.2 Conventional Signs

The transport routes shown in the toposheets give important information about the area. They also gives estimate of the density of population.

Topographic Sheet : Its reading and interpretation

A topographic sheet is given **at the end of this textbook**. Here its interpretation is given. This is in accordance of the points given for the interpretation.

Marginal Information : This is a topographical map of India. Its Index Number is 46 A/5. It shows some area of Banaskantha and Mahesana districts of North Gujarat. It covers an area between 23^0 45' North to 24^0 North latitudes and 72^0 15' east to 72^0 30' east longitudes. It is prepared in the scale 1 cm : 500 metres, i.e. 1 : 50,000. This area was surveyed in the year 1961 62. This map was published in 1966 under the guidance of Brigadier Shri Gambhirsinghji, Surveyor General of Survey of India.

Physical Features : In the physical features of the area, the major elements (1) Relief (2) Drainage System and (3) Natural Vegetation are depicted by respective colours and suitable conventional signs.

(1) Relief : Except for the rocky terrain and scattered sandy hills in the east and north-east, overall relief of the area is a level land and plain region. This is corroborated by the contours. These contour lines can be studied easily by the figures in brown colour given in the margin. The height of respective places is also shown by Bench Mark, Triangulation Point or Spot Height methods. Examining these informations about the heights in the map, the northern and north-eastern area is higher by 40 to 80 metres than the western and south-western area. So the overall slope of the area is from north-east to south-west. The direction of the river flow of this area also conveys about the slope of the land. Rivers Sarasvati, Mayani and Pushpavati have carved out noteworthy gorges created due to the erosion in the upper valley region. In the north - eastern part scattered sand hills (sand dunes) are shown by the shade of dots of brown colour and in the extreme north-east, the sandy land shown in the same colour are important landforms. This conveys about the semi arid desert type sandy landform of Banaskantha. Most of the land of this area is covered under agriculture, and that is suggestive of the level relief of this region.

(2) Drainage System : Sarasvati, Amardasi, Mayani and Pushpavati are small rivers flowing through this region. Of these Sarasvati and Amardasi (Locally also known as Umardasi) are larger rivers. In the northern part, River Sarasvati flows in a continuous belt and has created many gorges. In Central part, Siddhpur on its northern bank, is an important city. To the east of Siddhpur, the river is perennial, so the River Sarasvati is considered to be perennial for that much portion. This river becomes ephemeral as it is not perennial to the west of Siddhpur. Amardasi, Mayani and Pushpavati rivers are also ephemeral rivers. Amardasi is a tributary of Sarasvati river. Mayani river starts from near Gharewada village in the north, flows in south-west direction and meets Amardasi, which again flows north-eastwards and meets River Sarasvati in the west. In the middle-eastern part of the region, Pushpavati river comes from the eastern rocky terrain and flows to south. Gorges are seen on its either banks in its upper valley region. This land with many gorges is less suitable for agriculture.

Bala Sarovar in the extreme north is the only large and perennial lake of this region. Its circumference is about 2 sq. kilometres. There are many smaller ponds in this region. Considering the amount of water in all water bodies of this region, the provision of water supply seems to be very weak. So for the year-long water supply, the area depends on water of wells. There are many Lined Wells and few tube-wells in this area.

(3) Natural Vegetation : Scattered trees and Scrubs bushes are main vegetation of this region. Scattered large trees are seen in agricultural area and in inhabited villages. Gorges and the Government-owned pastureland are shown by Open scrubs symbols.

(4) Cultural Features : In this topographical map, cultural elements like (1) Human Settlements (2) Transport routes and (3) Agricultural and Irrigation facilities are shown.

(1) Human Settlements : There are Rural and Urban settlements in this area. Most of the settlements are of centered type. Siddhpur and Unjha are main settlements here. These cities are famous also as holy (religious) places. These two cities are connected with each other by met lled roads and

metre guage railway trakes as well as with other farther areas. Facilities like Hospital, Police Station, Post Office and Telegraph Office, Rest House etc. are available in these cities.

Rural settlements are spaced at about 5 kilometres from one-another and are connected by cart track. There are few rural settlements in the east due to the rocky terrain. One village among four six villages has the facility of Post office. Siddhpur, Unjha and Unava, connected by highways have Post office and telegraph Office. There are temples in every village. Some of the rural settlements are Sander, Balisana, Dabhi, Tundav, Brahmanvada , Der in south-west, Kunvara, Metrana, Sedrana, Teniwada, Barsila, Dethli in north - west, Nandotra, Nanosana, Pasvadal, Dalvana, Lunava etc. in north-east and Tarabh, Eithor, karli, Dasaj, Bhunav etc. in south-east.

(2) Road Transportation : There are two tracks of meter gauge railway. The metre gauge railway track of Western Railways, passing through the middle in north-south direction is very important. It connects Mahesana 17 km in the south with Palanpur 20 km in north. Siddhpur and Unjha are important railway stations on this track. Another railway track connects kakosi about 3 km in the extreme north - west with Ghanavada, about 2 km in the east, and connects with Patan in further west. A Highway runs along with the north-south railway track in the middle of the area. This road also connects big centres like siddhpur, Unjha and Unava. Another metalled road passes east-west through the middle part of this region. This road does not connect any big settlement, yet it joins Patan, 15 km in west , with Kheralu, 13 km in the east. Third metalled road connects Unjha with a new pond in the west. There is a motorable metalled road ahead upto Balisana. There are important cart tracks (locally known as nelia) joining all the villages and also the nearby villages. A telegraph line is seen joining Unjha and Siddhpur in the north to Unava in the south.

(3) Agriculture and Irrigation facilities : Excluding the rocky terrain of east and north west area and the sandy land with gorges along the river banks, almost total land is covered under agriculture. It so seems that agriculture is their only activity. Along with agriculture, Animal Husbandry is possible here. It is developed more in the non-agricultural regions of east and north-west.

Well and Tube wells are available for irrigation. More arable land is available. It is presumed that farming is practiced by rain water during rainy season and by irrigation through wells during winter summer.

Trade seems to have developed in the towns of Siddhpur and Unjha. Yet, the region seems to thrive mainly on agriculture and animal husbandry. In comparison with the developed region of Central and South Gujarat, the distribution of cultural elements over this region conveys that the economic development of this region is less.

Conclusion

In this topographic sheet, the physical and cultural elements of this region are shown by proper signs and symbols and with proper colour pattern. This makes its interpretation easier. Overall, it projects a rural landscape.

EXERCISE

1. Answer the following questions in details :

(1) What is a topographic sheet ? Write a detailed information.

(2) Which points are included for the interpretation of topographical maps ? Explain.

2. Answer the following questions to-the-point :

(1) State the stages of the production of toposheets and write notes on the first stage.

(2) State the utility of toposheets.

3. Answer the following questions in brief :

(1) Define Topographic Map.

(2) What is an Index Number ?

(3) Which things are included in cultural elements in toposheets ?

(4) What are the physical elements in toposheets ?

4. Answer the following questions in one or two sentences :

(1) By which name is the map having 1 Inch : 1 Mile scale known as ?

(2) Which method is used to show relief in toposheets ?

(3) By what name is the institute producing topographical maps of India known as ?

(4) By which colour is agriculture shown in toposheets ?

(5) Which symbol is used for Reserved Forests ?

(6) Which colour is used to show water features in maps ?

(7) Mention the symbol to show a temple.

(8) What is the difference of height between contours ?

5. Select the correct option from the options given for the following questions and write the Answers.

(1) Conventional sign used for Post Office

(a) CH (b) PH (c) PO (d) PS

(2) Which element is shown by green colour in the maps ?

(a) Water bodies (b) Mountainous area (c) Agricultural land (d) Vegetation

(3) Which convention sign is used for oil well ?

(a) x (b) + (c) ⊕ (d) O

(4) What does the sign '+' in the map indicate ?

(a) Church (b) Mosque (c) Spring (d) Pagoda

(5) In which State is the Survey of India located ?

(a) Haryana (b) Uttarakhand (c) Himachal Pradesh (d) Punjab

Practical Work

- Prepare a chart of conventional signs used in maps. In the map of your town or village, find out the locations of water bodies, vegetation and prepare a note.

Appendix

Aesteroids	લઘુગ્રહો
Aesthenosphere	એસ્થેનોસ્ફિયર
Air Mass	વાયુરાશિ
Alluvial Cone (Fan)	પંખાકાર મેદાન
Antarctic Circle	એન્ટાર્ક્ટિક વૃત્ત
Anthropology	નૃવંશવિજ્ઞાન
Anticline	ઊર્ધ્વવળાંક
Anticyclone	પ્રતિચક્રવાત
Antipodal	પ્રતિધ્રુવીય
Apehelion	ઉચ્ચબિંદુ
Aqueous	જળકૃત (જળનિર્મિત)
Arctic Circle	આર્ક્ટિક વૃત્ત
Artificial Rain	કૃત્રિમ વરસાદ
Astronomy	ખગોળવિજ્ઞાન
Atlas	નકશાપોથી
Atmosphere	વાતાવરણ
Auto Troph	સ્વઉત્પાદક
Axial Inclination	ધરીનમન
Axis	ધરી
Barkhans	ઢૂવા (રેતીના)
Barometer	બૅરોમિટર
Bench Mark	બેંચમાર્ક
Bio-Geography	જૈવિક ભૂગોળ
Biosphere	જીવાવરણ
Bora	બોરા
Bore	ઘોડા ભરતી
Calcarious Rocks	ચુનાળું ખડકો
Carnivore	માંસાહારી (પ્રાણીઓ)
Cartographer	નકશાવિદ્
Celsius	સેલ્સિયસ
Centrifugal	કેન્દ્રગામી
Centripetal	કેન્દ્રોત્સારી
Chinook	ચિનૂક
Circular	વલયાકાર
Circumference	પરિઘ
Climatology	આબોહવા વિજ્ઞાન

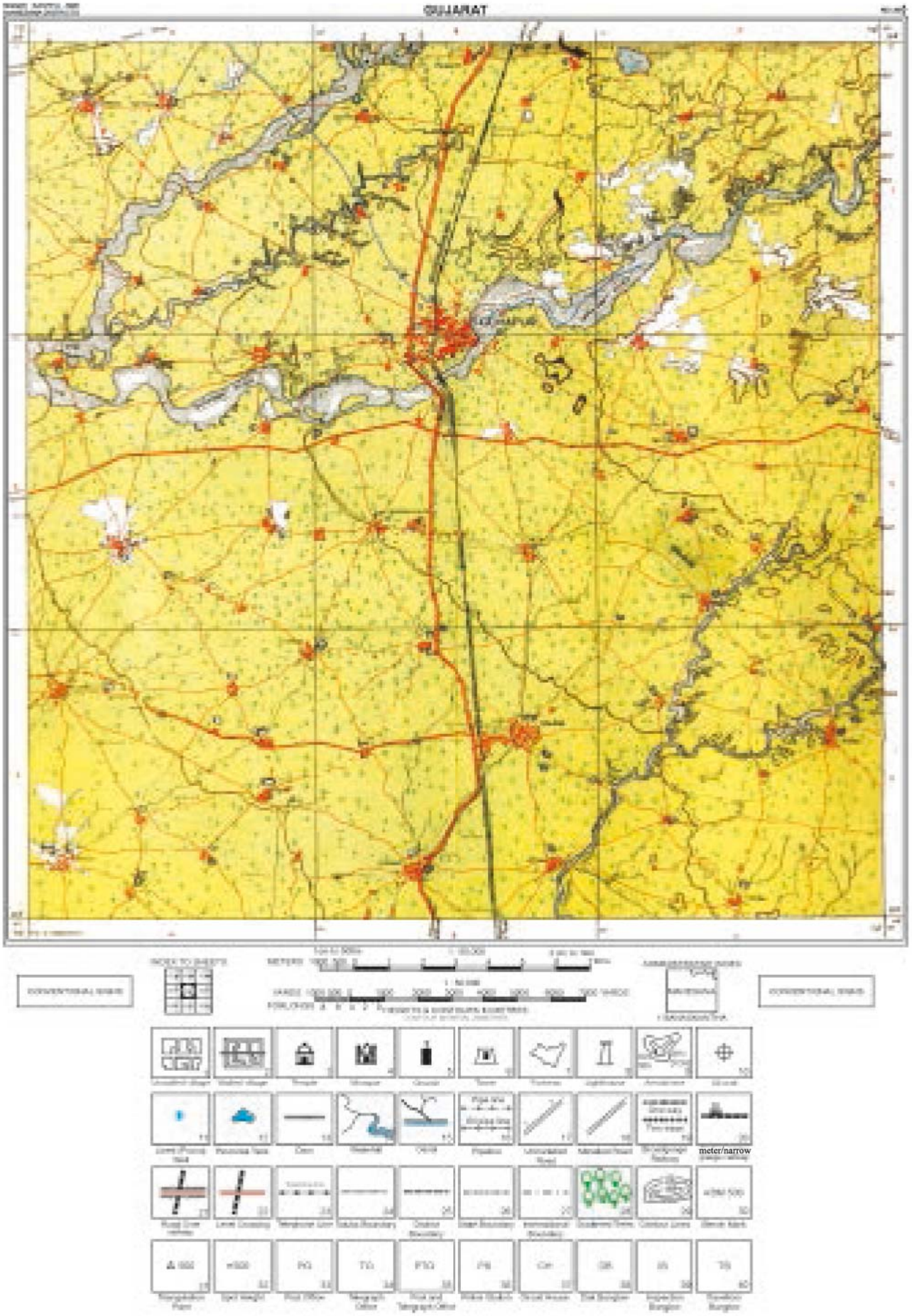
Compact	સુગ્રથિત
Condensation	ઘનીભવન
Conduction	ઉષ્ણતાવહન
Contact	સંસ્પર્શિત
Continental Shelf	ખંડીય છાજલી
Continental Slope	ખંડીય ઢોળાવ
Continentality	ખંડીયતા
Contour Lines	સમોચ્ચતા રેખાઓ
Convection	ઉષ્ણતાનયન
Coriolis Force	અક્ષભ્રમણ વેગ
Crater	જ્વાળામુખ
Creeck	ખાડી
Crustal Movements	ભૂસંચલન
Crystal	સ્ફટિક
Cyclone	ચક્રવાત
Cyclonic Rain	વંટોળનો વરસાદ
Decomposers (Detrious)	વિઘટકો
Decomposition	વિઘટન
Degree	અંશ
Delta	ત્રિકોણ પ્રદેશ
Dendritic	વૃક્ષાકાર
Denudation	ધોવાણ
Deposition	નિક્ષેપણ
Dew Point	ઝાકળબિંદુ
Disintegration	વિભંજન
Divergent	અપસરણ
Dome Mountain	ઘુમ્મટાકાર પર્વત
Easterlies	પૂર્વીય પવનો
Eco-System	પારિસ્થિતિક તંત્ર
Epeirogenic	ભૂખંડ નિર્માણકારી બળ
Epeirogeny	ભૂખંડ નિર્માણ
Equator	વિષુવવૃત્ત
Erosion	ઘસારણ
Eruption	પ્રસ્ફોટન
Evapotranspiration	બાષ્પનિષ્કાસન
Exogenetic Forces	સમથળ સ્થાપક બળો
External Forces	બાહ્ય બળો
Fahrenheit	ફૅરનૂહીટ
Fault	સ્તરભંગ
Fog	ધુમ્મસ

Fohn	ફન
Folded Mountain	ગેડ પર્વત
Folding	ગેડીકરણ
Food Chain	આહારશૃંખલા
Freezing Point	ઠારબિંદુ
Front	વાતાગ્ર
Geo Stationary Orbit	ભૂસ્થિર કક્ષા
Geomorphology	ભૂસ્વરૂપ વિજ્ઞાન
Global Positioning System	ભૂસ્થિતિ તંત્ર
Hachures	ઢાળદર્શક રેખા
Hardness	સખતાઈ
Herbivore	તૃણાહારી
Hermitton	હરમિટન
Homosphere	સમજાતીય
Horizontal	ક્ષૈતિજ
Humidity	ભેજ
Hurricane	હરિકેન
Hypabyssal Rocks	મધ્યસ્થ ખડકો
Igneous	આગ્નેય
Index Number	સૂચક અંક (સૂચકાંક)
Infra-red	અધોરક્ત
Isolation	સૂર્યાઘાત
Isostacy	ભૂસંતુલન
Land Hemisphere	સ્થળ ગોળાર્ધ
Land Information System	ભૂસૂચનાતંત્ર
Landforms of First Order	પ્રથમ શ્રેણીનાં ભૂમિસ્વરૂપો
Landforms of Second Order	દ્વિતીય શ્રેણીનાં ભૂમિસ્વરૂપો
Landforms of Third Order	તૃતીય શ્રેણીનાં ભૂમિસ્વરૂપો
Land-locked Sea	બંધિયાર (ભૂમિબંધિત) સમુદ્ર
Laterite	લેટેરાઇટ
Latitude	અક્ષાંશ
Layer Tint	રંગસ્તર
Leaching	ભૂક્ષરણ
Lihosphere	ઘનાવરણ
Linear	રૈખિક
Local Winds	સ્થાનિક પવનો
Longitude	રેખાંશ
Loo	લૂ
Lustre	ચમક (ખનીજની)
Magnetic Declination	ચુંબકીય નમન

Mesopause	મધ્યાવરણ સીમા
Mesosphere	મધ્યાવરણ
Metalic Nucleus	ધાતુપિંડ
Metamorphism	સ્વરૂપાંતરણ
Meteorology	ઋતુવિજ્ઞાન
Meteors	ખરતા તારા
Milibar	મિલિબાર
Mountains of Accumulation	સમાહિત પર્વત
Mystral	મિસ્ટ્રલ
Nebula	નિહારિકા
North-East Winds	ઈશાનકોણીય પવનો
Norvester	નૉર્વેસ્ટર
Numerical Scale	અંકાત્મક પ્રમાણમાપ
Observatory	વેધશાળા
Oceanography	સમુદ્રવિજ્ઞાન
Orbit	કક્ષા
Organic	સેન્દ્રિય
Organic Rocks	સેન્દ્રિય ખડકો
Orientation	દિક્‌સ્થાપન
Orogenic Force	ગિરિનિર્માણ બળ
Orogeny	ગિરિનિર્માણ
Orographic Rain	ભૂપૃષ્ઠનો વરસાદ
Ozonosphere	ઓઝોન આવરણ
pangaea	આદિ મહાખંડ
Panthalassa	આદિ મહાસાગર
Pedology	જમીનવિજ્ઞાન
Peninsula	દ્વીપકલ્પ
Perihelion	નિમ્નબિંદુ
Photogrammetry	ફોટોગ્રામેટ્રી
Piedmont	પર્વતપ્રાંતી
Plate Tectonics	ભૂતક્તિ
Plateau	ઉચ્ચપ્રદેશ
Plutonic (Rocks)	પાતાલીય (ખડકો)
Plutonic (Rocks)	અંતઃસ્થ (ખડકો)
Polar Winds	ધ્રુવીય પવનો
Porocity	છિદ્રાળુતા
Power Resources	ઊર્જાશક્તિ
Precipitation	વૃષ્ટિ
Pressure Belts	દબાણપટા
Pressure Cell	દબાણકેન્દ્ર

Primary Producer	પ્રાથમિક ઉત્પાદક
Pyranosphere	પાઇરેનોસ્ફિયર
Pyrosphere (Mantle)	મિશ્રાવરણ
Radiation	ઉષ્ણતાગમન
Reduction	આકુંચન
Refraction	વક્રીભવન
Regional Metamorphism	પ્રાદેશિક રૂપાંતરણ
Remote Sensing	દૂર સંવેદન
Representative Fraction	પ્રાતિનિધિક અપૂર્ણાંક
Residual Soil	સ્વસ્થાનીય (અવશિષ્ટ) જમીન
Rift Valley	ફાટખીણ
Rotation	ધરીભ્રમણ
Sand Stone	રેતીનો ખડક
Satellite Imagery	સૅટેલાઇટ ઇમેજરી
Scattered	પ્રકીર્ણ
Sea and Land Breeze	દરિયાઈ અને જમીનની લહેર
Secondary Consumer	દ્વિતીય ઉપભોક્તા
Seismic Waves	ભૂકંપમોજાં
Seismograph	ભૂકંપ-આલેખયંત્ર
Sial	ભૂકવચ
Sirocco	સિરોક્કો
Sketch	રેખાચિત્ર
Soil Profile	પાર્શ્વચિત્ર (જનીનનું)
Soil Structure	જમીનકણ ગોઠવણી
Soil Texture	કણરચના (જમીનપોત)
Solar Constant	સૌર અચલાંક
Solar Energy	સૌરઊર્જા
South-East Winds	અગ્નિકોણીય પવનો
Specific Gravity	વિશિષ્ટ ઘનતા
Spot Height	સ્થળ ઉચ્ચાંક
Stalactite	અધોસ્તંભ
Stalagmite	ઊર્ધ્વસ્તંભ
Standard Time	પ્રમાણસમય
Statement Scale	વિધાનમાપ
Strait	સામુદ્રધુની
Stratified Rocks	પ્રસ્તર ખડકો
Stratopause	સમતાપ સીમા
Stratosphere	સમતાપ આવરણ
Subsidence	નિમજ્જનસબસિડન્સ
Sub-strata	ઉપસ્તર

Syncline	અધોવળાંક
Tectonic Forces	ભૂગર્ભિક બળો
Tectonic Mountains	ભૂગર્ભિક પર્વતો
Temperature	તાપમાન
Thermocline	થરમોક્લાઈન
Thermometer	થરમોમિટર (તાપમાપક)
Thermosphere	ઉષ્માવરણ
Three Dimension	ત્રિમિતિ (ત્રિપરિમાણીય)
Time Zones	સમયપટા
Topo Sheet	સ્થળવર્ણન નકશા
Tornado	ટૉર્નેડો
Trade Winds	વ્યાપારી પવનો
Transportation (Sediments)	સ્થળાંતરણ (કાંપ બોજનું)
Triangulation Point	ત્રિકોણમિતીય સ્થાન
Trig Point	ટ્રિગ પૉઇન્ટ
Trophic Level	પોષણકડી
Tropic of Cancer	કર્કવૃત્ત
Tropic of Capricorn	મકરવૃત્ત
Tropopause	ક્ષોભસીમા
Two Dimension	દ્વિમિતિ (દ્વિપરિમાણીય)
Typhoon	ટાઈફૂન
Ultraviolet	પારજાંબલી
Upliftment	ઊંચકાવ
Volcanic Rock	જ્વાળામુખીય ખડક
Volcano	જ્વાળામુખી
Wall Maps	ભીંત-નકશા
Warm Layer	સમોષ્ણતા સ્તર
Water Cycle	જળચક્ર
Water Hemisphere	જળગોળાર્ધ
Weather	હવામાન
Weathering	વિદારણ (ખવાણ)
Westerlies	પશ્ચિમિયા પવનો
Willy Willy	વિલી વિલી


GUJARAT
meter/narrow

CERTIFICATE OF THE MAPS

(1) © Government of India, Copyright 2016

(2) The responsibility for the correctness of internal details rests with the publisher.

(3) The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

(4) The external boundaries and coastlines of India agree with the Record/Master Copy certified by Survey of India.

(5) The state boundaries between Uttarakhand & Uttar Pradesh, Bihar & Jharkhand and Chattisgarh & Madhya Pradesh have not been verified by the Governments concerned.

(6) The spellings of names in this map, have been taken from various sources.