

PHYSICAL GEOGRAPHY

- The word 'geography' derives from the greek words 'geo' (meaning '*the earth*') and "graphia" (meaning '*to write*'). Geography is the science that deals with the description of Earth's surface.

Physical geography

Physical geography focuses on geography as an **Earth science** (and is sometimes called Earth System Science).

World Day of Water	March 22
World Environment Day	June 5
Earth Day	April 22
World Meteorological Day	March 23
World Solar Energy Day	May 3
World Environment Day	June 5
World Food Day	October 16
World Forestry Day	March 21
World Habitat Day	1st Monday in October
World Standard Day	October 14
World Animal Welfare Day	October 4



Alexander Von Humboldt, considered to be the founding father of physical geography

Carl Ritter - considered to be one of the founding fathers of modern geography



Gondwanaland

- ▶ For hundreds of millions of years, all the land of Earth was joined together in one large mass or super continent. Scientists call it **Pangaea** (meaning "all lands" in Greek)..
- ▶ Then about 200 million years ago the land began to drift apart. It broke into two pieces, and scientists have called the continent in the **North Laurasia** and the continent in the **South Gondwanaland**.
- ▶ The two large continents continued to break apart into the smaller continents that exist today. Scientists call this movement 'continental drift'.
- ▶ It included most of the landmasses in today's southern hemisphere, including Antarctica, South America, Africa, Madagascar, Australia-New Guinea, and New Zealand, as well as Arabia and the Indian subcontinent.
- ▶ Gondwanaland was named by Eduard Suess, an Austrian geologist.
- ▶ Gondwanaland was a hot and dry place with rainy seasons. The first tree ferns and coniferous trees appeared there. Dinosaurs lived there at one time too.

Physical Geography

Geomorphology studies the Earth's structure, the rocks that make up the earth, relief features like mountains and plains and their evolution.

Hydrology is the study of the movement, distribution and quality of water throughout the earth.

Oceanography is the study of ocean currents, waves and tides.

Climatology is the study of climatic features such as temperature, precipitation and humidity.

Biogeography is the science that deals with the distribution of flora and fauna in different parts of the world.

Pedology is the study of soils and soil formation.

Paleontology is the study of fossils.

Cartography: Deals with the production and study of maps and charts.

Chorology : Study of geographical areas, plants and animal distribution.

Demography : Described as *population geography*, it examines the structure of human populations and their dynamic aspects.

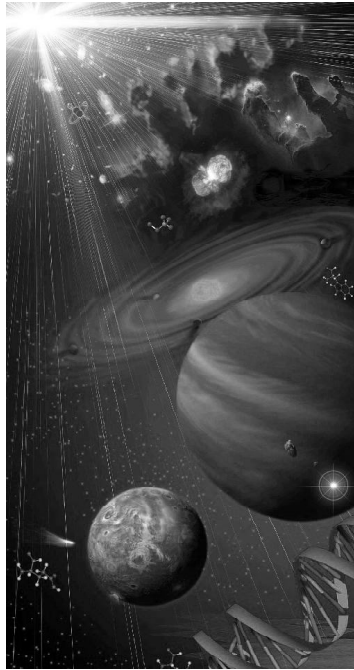
Lithology: Deals with the characteristics of rocks.

Geology: Study of the chemical composition of earth's crust.

Potamology: Study of rivers.

Orology: Study of mountains.

Petrology: Study of the origin, composition and structure of rocks.



The Origin of the Earth

Most of the theories concerned with the origin of the earth emphasise that the planet originated as a hot gaseous mass, which on cooling, turned first into a liquid and then into a solid mass.

Continental drift theory

Continental Drift Theory was put forward by the German scientist **Alfred Wegner** in 1915. According to the Continental Drift Theory, part of the crust are capable of horizontal movement round the globe causing the continents to slowly change their positions in relation to one another.

► The fact that South America is a mirror image of Africa is presented as a proof of the continental drift theory.

Plate Tectonics Theory

Plate tectonics theory was put forward by A.Holmes. According to this theory the lithosphere of earth is considered to be divided into lithospheric plates. Each plate is capable of moving over the asthenosphere carrying oceanic or continental crust alike. At plate boundaries major landforms are created.

- Most theories about the origin of the earth assumes that it began in a gaseous state.
- Life appeared on earth only when the earth cooled from its gaseous state to solid one.
- **Carbon dating** is the most important method for estimating the age of fossils found in the rocks of the earth's crust.
- The age of the earth is estimated to be about 4.6 billion years.



Alfred Lothar Wegener
(1880 – 1930)

Wegener was a German interdisciplinary scientist and meteorologist, who became famous for his **theory of continental drift**.

- ❑ **Crust** is the outermost and thinnest layer of the earth's surface.
- The crust comprises about 5% of the earth body.
- Thickness of the crust is more under the continents and lesser under oceans.
- The outermost layer of the crust is composed of lighter silicates termed as **sial** (Silica + Aluminium).
- Moho or Mohorovicic discontinuity separates crust from mantle.
- The average density of this layer is 2.7
- ❑ **The Mantle** a layer between crust and the core.
- Mantle contains 83% of the total volume and 68% of the total mass of the earth. Average density of this layer is 5.68.

Place of the Earth in the Universe

Two theories have been given to locate the earth's position in the universe. These are Geocentric theory and Helio centric theory.

Geocentric Theory

This theory prevailed in ancient and middle ages. According to this theory, the earth is located in the centre of the universe and all the planets revolves around it.

Heliocentric theory

This theory states that the sun is the centre and all the planets including the earth revolves around it.

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|---|---|
| <ul style="list-style-type: none"> ■ Mantle is separated from the core by Gutenberg discontinuity. ■ It is largely composed of silicon and magnesium called sima. ■ The rocks in this layer may be in the glassy state. ❑ Core is the central region of the earth. ■ It is 3475 km in radius. | <ul style="list-style-type: none"> ■ By volume, it is 16% of the earth body . ■ By mass, it constitutes 32% of the mass of the earth. ■ The temperature of the inner core is 6000°C - 7000°C ■ The inner core is composed of NiFe (Ni for Nickel Fe for Iron.). ■ Density of this part is 17.2. ■ Average density of earth is 5.53. |
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Structure of Earth

1. **Crust** :This is the outer layer of the Earth varying between 5 to 50 km in depth under the surface of the earth.
2. **Mantle**: This portion is made up of iron and magnesium silicates, with temperature ranging up to 1600°C and extends downwards to a depth of about 1000 km. The thickness of the lower mantle is about 1900 km.
3. **Core**: The outer core, approximately 2100 km thick, consists of molten iron and nickel with temperatures ranging between 2000°C and 5000°C. Below this is the solid inner core which has diameter of 2,740 km.

The Earth

Age	: 4.6 billion years
Mass	: 5.976×10^{24} kg.
Volume	: 1.083×10^{24} litres
Mean Density	: 5.518 kg/litres
Shape	: An oblate spheroid or a geoid.
Size	: Polar diameter 12,713.54 km; Equatorial diameter 12,756.32 km; Polar circumference 40,008.00 km and Equatorial circumference 40,075.16 km.
Area	: Total surface area 509,7000,000 sq. km; Land area about 148,400,000 km (about 29 per cent of the total area); Water area about 361,300,000 sq. km. (about 71 per cent of the total surface area).
Motions	: (i) Rotation (spinning motion on polar axis), once every 23 hours 56 minutes and 4.09 seconds (ii) Revolution (around the sun), once every 365 days, 6 hours, 9 minutes and 9.54 seconds.
Surface Features	: Highest point on land - Mt Everest 8,848 m above the sea level. Lowest area on land-shore of Dead Sea (399 m below sea level). Mean height of land 756 m.
Ocean Depths	: Deepest area - Mariana Trench in Pacific Ocean south-west of Guam (11,033 m below the sea surface). Average depth of oceans 3,730 m.
Chemical make up of the Earth's Crust	: (percent by weight): oxygen 46.6, silicon 27.7, aluminium 8.1, iron 5.0, calcium 3.6, sodium 2.8, potassium 2.6, magnesium 2.0 and other elements 1.6.
Mean Surface Temperature	: 14°C, Highest temperature 58°C at Al Aziziyah, Libya and the lowest temperature -89.6°C at Vostok Station in Antarctica.
Inclination of the Polar Axis to the Orbital Plane	: 23 deg. 26 min. 59 second.
Orbital Speed	: 29.8 km/s
About the Sun	
Mean Distance From the Sun	: 149,598,500 km (one astronomical unit). The maximum distance at the time of aphelion between July 2 and 5 is about 152 million km and the minimum distance at perihelion between January 2 and 5 is about 147 million km.

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- **The rotation of the earth causes day and night and the revolution of the earth results in the change of the seasons. Since the path of the earth about the sun is elliptical, the distance between the two keeps changing.**
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Geographic Information Systems (GIS)

- ▶ GIS uses computers for storing and processing information about the Earth's surface and land use.
- ▶ Geographic Information Systems or GIS is a technology that attaches a database to an electronic map.
- ▶ GIS technology can be used for scientific investigations, resource management and development planning.
- ▶ GIS is used to calculate the emergency response in the event of a natural disaster.
- ▶ GIS can help to pinpoint wetlands that need protection from pollution.
- ▶ The map gives detailed data, i.e., every asset in a municipality, town or even a park, primary school, hospital, housing can be shown on the map.

Lithosphere, Asthenosphere & Centrosphere

- ▶ The earth is divided into lithosphere, asthenosphere and centrosphere.
- ▶ **Lithosphere** is the outer portion of the earth, including the crust and the upper mantle.
- ▶ **Asthenosphere** is the upper part of the mantle which is about 250 km thick. The rocks contained in the asthenosphere are partially molten.
- ▶ **Centrosphere** is the central part of the earth which inspite of having a very high temperature behaves like solid due to immense pressure of the overlying rocks.

The National Geographic Society

- ▶ The National Geographic Society (NGS) is one of the largest non-profit scientific and educational institutions in the world.
- ▶ Its interests include geography, archaeology and natural science, the promotion of environmental and historical conservation, and the study of world culture and history.
- ▶ It is located in Washington D.C.
- ▶ *The National Geographic* magazine is currently published in 32 language editions in many countries around the world.
- ▶ National Geographic Channel, is a television channel that airs non-fiction television programs produced by the NGS.

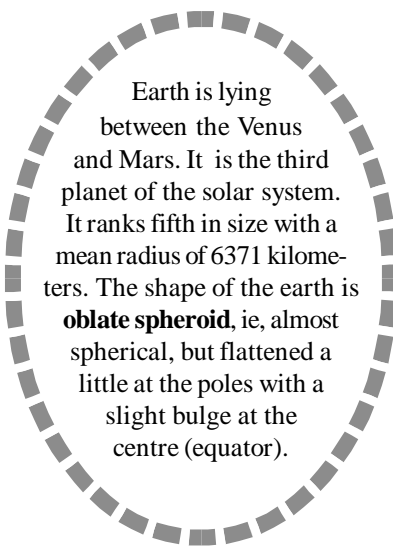
Composition of the Earth's Crust

- Most abundant element in atmosphere is Nitrogen (78%) then Oxygen (21%). But the most abundant element in the universe is hydrogen.
- The crust is made up of rocks. The rocks are made up of minerals in a consolidated form.
- The process of rock formation, consolidation of mineral particles is called lithification.
- A rock can be defined as an aggregate of minerals.
- The ratio between the total amount of light reflected from an object in space and the total amount of light falling on an object is called **albedo**.
- A perfect reflector has an albedo of 1 and earth has an albedo of 0.34 (34%).

Position, Shape and Size of Earth

- Earth moves around the sun in an elliptical orbit. The spinning (rotation) of the earth at a high speed has caused its mass to bulge at the equator and sink in at the poles.

- The bulging of central part (equatorial region) is due to centrifugal force.
- The plane passing through the Earth's orbit is called orbital plane. The Earth's axis is inclined and makes an angle $66\frac{1}{2}^{\circ}$ with the orbital plane.
- The difference between the equatorial diameter (12,755 km) and the polar diameter (12,712 km) of earth is 43 km.
- 71% of the total surface area of earth is water and 29% is land.
- Earth has 40,005 km polar cir-



Earth is lying between the Venus and Mars. It is the third planet of the solar system. It ranks fifth in size with a mean radius of 6371 kilometers. The shape of the earth is **oblate spheroid**, ie, almost spherical, but flattened a little at the poles with a slight bulge at the centre (equator).

The movement of earth can be mainly divided into two as, **rotation** and **revolution**. Rotation is the spinning of earth on its own axis. Earth takes 365 days, 5 hours, 48 minutes and 45.51 seconds for one revolution around the sun. It is called one solar year. Earth has to cover 938 million kilometers along its elliptical orbit to complete one revolution.

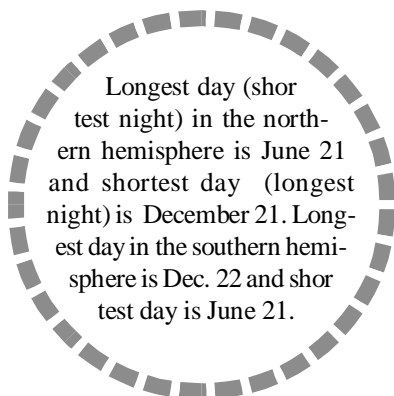
cumference and 40,077 km equatorial circumference.

Motions of the Earth and their Consequences

- The movement of earth can be mainly divided into two as, **rotation** and **revolution**.
- Rotation is the spinning of earth on its own axis.
- Earth spins on its axis at an angle of $66\frac{1}{2}^{\circ}$ to the plane of earth from west to east.
- Earth's rotation takes 23 hours, 56 minutes and 4.091 seconds to complete one rotation.
- Rotation results in the formation of day and night, changes in the direction of wind and ocean currents. The daily occurrence of tides twice is also resulted by the rotation of earth.
- Day and night are not of equal duration throughout the year because of the tilt of earth's axis.
- Earth rotates 1° in 4 minutes. Therefore earth rotates 15° in one hour. It takes 24 hours (one day) to complete one rotation (360°).
- Day and night are equal at the equator throughout the year, because the circle of illumination always divides the equator into two equal parts.
- The duration of day and night at the poles is six months each.
- Rotation also causes coriolis forces (named after the French mathematician Gaspard de Coriolis who first explained them mathematically) which are related to the decreasing rotational velocity with increasing latitude and tend to deflect anything which is moving over the earth's surface.
- Coriolis force is zero at the equator and increases progressively towards either poles.
- **Revolution** is the movement of earth in its orbit around the sun, along an almost circular path (elliptical) called its orbit. The earth revolves approximately one degree in one day. The speed of revolution of earth is 29 km/second.
- The earth's revolution causes a change in seasons. Seasons are classified into four called the **Spring, Summer, Autumn** and **Winter**. The earth's axis is inclined at an angle of $66\frac{1}{2}^{\circ}$ to the plane of its orbit.
- **Equinoxes** are dates when the night and days are equal. During these days the sun shines vertically on the equator. This occurs twice a year. **March 21** is called the *vernal equinox* or *Spring equinox* and **September 23** is called *autumnal equinox*.
- **Solstice** is the time of the year when the difference between

Earth's Plates

- ▶ The Earth's rocky outer crust solidified billions of years ago, soon after the Earth formed.
- ▶ The top layer of the Earth's surface is called the crust (it lies on top of the plates). Oceanic crust (the thin crust under the oceans) is thinner and denser than continental crust. Crust is constantly being created and destroyed; oceanic crust is more active than continental crust.
- ▶ The plates are made of rock and drift all over the globe; they move both horizontally (side-ways) and vertically (up and down). Over long periods of time, the plates also change in size as their margins are added to, crushed together, or pushed back into the Earth's mantle. These plates are from 50 to 250 miles (80 to 400 km) thick.
- ▶ The current continental and oceanic plates include: the Eurasian plate, Australian-Indian plate, Philippine plate, Pacific plate, Juan de Fuca plate, Nazca plate, Cocos plate, North American plate, Caribbean plate, South American plate, African plate, Arabian plate, the Antarctic plate, and the Scotia plate. These plates consist of smaller sub-plates.
- ▶ Type of Plate Movement: Divergence, Convergence, and Lateral Slipping.
- ▶ When two continental plates collide, mountain ranges are created as the colliding crust is compressed and pushed upwards.



the length of days and the length of nights is the largest. During these days, the sun shines vertically over the tropic.

- On or around **June 21**, the North pole tilts towards the sun and the sun shines directly over the tropic of cancer. This is called *Summer Solstice*. On or around **December 22**, the earth is at the end of its orbit. The South pole tilts towards the sun and the North pole away from it, which is called as *Winter Solstice*.
- **Tropics** are the regions circling the earth between the Tropic of Cancer ($23^{\circ} 27'N$) and the Tropic of Capricorn ($23^{\circ} 27'S$). These imaginary lines of latitude, mark the farthest points reached by the sun's vertical rays. The $23\frac{1}{2}^{\circ}$ North parallel is termed as Tropic of Cancer and the $23\frac{1}{2}^{\circ}$ South parallel is termed as Tropic of Capricorn.
- Sun rays fall vertically at the Tropic of Cancer on June 21 and they fall vertically at the Tropic of Capricorn on December 22.
- **Aphelion** is the point in the earth's or other planets orbit

which is farthest from the sun. Earth is at its aphelion on **July 4** every year at a distance of 152 million kilometers.

- **Perihelion** is a point in the orbit of a planet or any other celestial body at which it passes closest to the sun. Earth will be at its perihelion on January 3 every year at a distance of 147 million kilometres.
- **Perigee** is the point in the orbit of the moon at which it is closest to the earth. **Apogee** is the point in the orbit of the moon at which it is farthest from the earth.

Location of Place and Time on the Earth's Surface

- Equator is an imaginary line passing round the earth midway between the north and south poles, dividing the earth into two equal halves.
- **Latitude** is the angular distance in degrees on the earth's surface measured north and south of the equator. The latitude of any point on the earth is most precisely expressed in degrees, minutes and seconds.
- There are about 180 parallel latitudes. The distance between any two parallel latitudes is always equal. One degree of latitude is approximately equal to 111 km.
- A meridian is an imaginary line extending from the north pole to the south pole at right angles to the equator.
- Prime Meridian is the 0° meridian which passes through Greenwich, a place near Lon-

don. It is also known as the Greenwich meridian.

- **Longitudes** are equi-distant lines drawn east and west of the Greenwich meridian. They denote the angular distances of a place due east or west of the Greenwich meridian. There are 360 meridians of longitudes.
- One hour is equal to 15° of longitude.
- Longitude is an important factor in determining the time in all parts of the world. *Local time* of a place is calculated with respect to the mid day position of the sun at that place.
- **Local time** varies from Greenwich time (London) at the rate of four minutes / degree of longitude.
- **Standard time** is the uniform time fixed by each country.
- Standard time in India is the local time of a place near Allahabad at $82\frac{1}{2}^{\circ}E$ longitude.
- Greenwich Mean Time is the standard time of U.K. It is based on the local time of the meridian passing through Greenwich near London.
- If a person going east of Greenwich for 180° , he would put his clock forward by 12 hours. At the same time if another person is going to west of Greenwich for 180° , he would put his clock backward by 12 hours. When they meet on the International Date Line, there would be one day's difference between them.
- Earth is divided into 23 full time zones and two half time zones

each having longitudinal width of 15° and $7\frac{1}{2}^\circ$ respectively.

- ❑ The **International Date Line** is situated at 180° meridian from Greenwich. It runs down the mid Pacific Ocean, veering to keep all of the islands in a group.
- ❑ When one crosses the International Date Line from east to west the date is to be advanced by one day (loses one day). Similarly when one crosses the Date Line from west to east, the date is to be set back by one day (gains one day).
- A ship while crossing the Date Line eastwards gains a day, while it loses a day crossing westwards.
- ❑ The local time of Arunachal Pradesh is two hours ahead of that of Gujarat because Arunachal Pradesh is 30° east of Gujarat.
- ❑ Russia, the largest country in the world, extends 165° from East to West. Therefore it is divided into eleven time zones, each differing in one hour.
- ❑ The distance between any two meridians is not equal. They get closer from the equator to poles.
- ❑ Since earth rotates 15° in one hour, there is a difference of one hour in local time to every 15° .
- ❑ **Sidereal day** is the time between two observed passages of a star over the same meridian of longitude.
- ❑ Sidereal day = 23 hrs. 56 min. 4.09 seconds.
- ❑ **Solar day** is the time between two successive transits of the sun over the same meridian.
- ❑ Mean solar day = 24 hrs.

The difference between the Greenwich Mean Time and Indian Standard Time is $5\frac{1}{2}$ hours. Greenwich Mean Time is the standard time of United Kingdom. Indian Standard time is the local time of a place near Allahabad at $82\frac{1}{2}^\circ$ E longitude.

Volcanoes

- ❑ A volcano is formed when the molten magma in the earth's interior escapes through the crust by vents and fissures accompanied by steam gases (hydrogen sulphide, sulphur dioxide, hydrogen chloride, carbon dioxide etc) and pyroclastic materials.
- ❑ The molten rock material is the most common form of volcanic matter ejected during volcanic activity. This material is called Magma. Upon reaching the surface of the earth, it is called Lava.
- ❑ Volcanic activity is an important process of construction on the earth's surface.
- ❑ *Crater* is a funnel shaped depression having a circular plan



Pinatubo ash plume reaching a height of 19 km, 3 days before the climactic eruption of 15 June 1991.

and a neck at the centre. Craters are formed by explosion or subsidence.

- ❑ Some times, the volcanic material may not be able to reach the surface and it may get deposited in the layers of the crustal rocks. This type of activity is called intrusive volcanic activity.
- ❑ Lava that is rich in silica and poor in metallic minerals is called acid lava.
- ❑ Lava that is rich in metallic minerals has a low melting point and remains liquid for a longer time even with some loss of heat. Therefore such lava is more likely to reach the surface, is called basic lava.
- ❑ Circular deposit of lava may remain higher than the areas surrounding it. Such a feature is called a volcanic plug.
- ❑ Concave Saucer shaped deposits of lava in the crustal rocks are called lopoliths.
- ❑ There are three types of volcanoes - active, dormant and extinct.
- An **active** volcano erupts occasionally
eg: Mount Stromboli in Italy, Barren Islands in India (The only active volcano in India). Mt. Etna in Sicily and Cotopaxi in Ecuador.
- ❑ Mt. Stromboli whose frequent eruptions that resulted in more like a summit glow, have earned it a crown title 'Light house of the Mediterranean.'
- A **dormant** volcano has not been seen to erupt, but it shows evidence of recent activity.

- Mt. Vesuvius and Mt. Krakatau are examples of dormant volcano.
- **An extinct** volcano shows no sign of life.
Eg: Mt. Kilimanjaro
- Fumaroles are fissures in the ground of volcanic areas through which gases including nitrogen, ammonia, carbon monoxide and methane are given off.
- **The Pacific** belt is known as the **Ring of fire** because of the largest number of active volcanoes along the coasts of America and Asia on the ocean.
- **Batholiths** are a large mass of magma which often forms the root of a mountain and is made up of granite.
- Famous volcanoes of the world: Cotopaxi (Ecuador), Mt. Kilimanjaro (Tanzania), Mt. Etna (Italy), Mt. Vesuvius (Italy), Mt. Popa (Myanmar), Mauna Loa, Mt. Kenya, Mt. Stromboli (Italy).
- The volcanic islands of Hawaii in the mid Pacific, the famous hot water geysers of the Yellow Stone region of North America are examples of inland volcanoes.
- Surtsey, is an island born from a series of volcanic explosions from deep within the earth's core culminated in the creation of a barren crest of rock that jutted from the Atlantic Ocean.

Earthquakes

- An earthquake (also known as a quake, tremor or temblor) is the result of a sudden release of energy in the Earth's crust

that creates seismic waves.

- Earthquakes which originate naturally below the surface sending out a series of shock waves.
- Earthquakes are frequently associated with faults. The place of origin of an earthquake inside the earth is called its focus.
- Epicentre is the point on the earth's surface vertically above the focus. On the earth's surface the maximum damage is caused at the epicentre.
- Most of the earthquakes originate at a depth of about 60 km below the surface of the earth. The point of origin of an earthquake in the interior of the earth is called the seismic focus.
- **Seismology** is the study of earthquakes and their impact. There are two corresponding measures of the severity of an earthquake : intensity and magnitude.
- Intensity is the measure of the local effect which varies according to both the distance from the source of the earthquake and the intrinsic strength of the earthquake. The intensity is expressed in **Points**.
- About 68% of all earthquakes are observed in the vast region

Earthquakes are measured with a seismometer; a device which also records is known as a seismograph.

The Aravallis is the oldest mountain range in India.

The Himalayas are the youngest fold mountains in India. The Himalayas, the Alps, the Andes, the Rockies etc. are examples of fold mountains or young mountains. The Pyrenees (Europe), Appalachians (America) and the Aravallis (India) are examples of old mountains. They were formed in the pre-drift area.

of the Pacific ocean as a '**Ring of fire**'.

- Some earthquakes are caused by the movement of lava beneath the surface of earth during volcanic activity.
- The Kutch earthquake (1819), the Assam earthquake (1897), the Kangra earthquake (1905), the Bihar earthquake (1934), the Lathur, Maharashtra earthquake (1993) and the Gujarat (Kutch) earthquake (2001) are the well known examples of earthquakes in India.

Tsunami

- Tsunamis (tidal waves) are long-wave length, long-period sea waves produced by the sudden or abrupt movement of large volumes of water.
- The Japanese word for a great sea wave, 'tsunami', has come into general use to identify a seismically generated sea wave.
- Earthquakes, volcanic eruptions

Richter Scale & Seismograph

- ▶ An earthquake is measured by its Magnitude and Intensity.
- ▶ Magnitude is a measure of the strength of the earthquake at its source (focus). It is assessed in **Richter scale**.
- ▶ **Seismometers** are instruments that measure motions of the ground, including those of seismic waves generated by earthquakes, nuclear explosions, and other seismic sources. It is also used to measure the strength (intensity) and location of earthquakes.
- ▶ Richter Magnitude Scale was developed in 1935 by Charles F Richter of the California Institute of Technology as a mathematical device to compare the size of earthquakes. The magnitude of an earthquake is determined from the logarithm of the the amplitude of waves recorded by seismographs.
- ▶ On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. The Richter magnitudes are based on a logarithmic scale (base 10). What this means is that for each whole number you go up on the Richter scale, the amplitude of the ground motion recorded by a seismograph goes up ten times.
- ▶ The Richter Scale has no upper limit. Recently, another scale called the **Moment Magnitude Scale** has been devised for more precise study of great earthquakes.
- ▶ Earthquakes with magnitude of about 2.0 or less are usually called microearthquakes; they are not commonly felt by people. A magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. The magnitude ranging '7' is severe and magnitude ranging '8' is devastating.

tions and other underwater explosions (including detonations of underwater nuclear devices), landslides and other mass movements, meteorite ocean impacts or similar impact events, and other disturbances above or below water all have the potential to generate a tsunami.

- Tsunamis can also travel thousands of kilometers across open ocean and wreak destruction on far shores hours after the earthquake that generated them. Most destructive tsunamis are caused by earthquakes of magnitude 7.5 or more.

Rocks and Minerals

- Rocks and minerals mainly constitute the upper part of the earth's crust. Minerals are natural substances having characteristic properties and

more or less specific chemical compositions.

- Rocks are solid materials that makes up the earth's crust. On the basis of texture, structure and composition, rocks may be classified into **igneous, sedimentary** and **metamorphic**.
- **Igneous rocks** are formed by the solidification of molten magma from the interior of the earth. About 95% of the earth's crust is made up of this type of rocks generally do not occur in layers. Most of them are crystalline.
eg: Granite, Volcanic rocks and Basalt.

Petrology is the study of the origin, composition and structure of rocks, while

Lithology is the study of the characteristics of rocks.

- Also called primary rocks; they are generally hard, massive, crystalline and contain no fossils.

- Intrusive igneous rocks formed due to solidification of lava under the surface of the earth. They have content of silica and poor in metallic minerals. Also called acid lava rocks.

- If the lava has very high melting point it may get solidified at great depths. Rocks thus formed are called plutonic rocks. Granite is a common plutonic rock.

- Extrusive igneous rocks are formed when the lava reach the surface of the earth and then solidify. It is also called basic lava rocks. e.g., Rhyolite, basalt etc.

- **Sedimentary rocks** are formed from the sediments deposited on the ocean beds. They com-

prise only about 5% of the earth's crust, but covers about 75% of the total land surface.

Sedimentary rocks are generally softer, fossils are commonly found in these rocks. These rocks are also called stratified rocks.

eg: Sandstone, Limestone etc.

- Shale is the most abundant of all sedimentary rocks which is composed of silt and clay.
- Sandstone is a common sedimentary rock which is formed mainly of quartz particles cemented together by silica, lime or iron oxide.
- **Metamorphic rocks** are formed when pre-existing sedimentary or igneous rock is altered as a result of changes in physical or chemical conditions.
eg : Quartzite and Marble
- The process which produces metamorphic rocks is called **metamorphism**.
- Quartzite is the metamorphic form of the sedimentary rock, sandstone.
- **Slate** is formed by the compression of sedimentary rocks like shale and mudstone. **Gneiss** is formed by the metamorphosis of igneous rocks like granite.
- Chalk is a calcareous rock made up of microscopic skeletal elements from a variety of lime secreting organisms.
- Coal and Peat represents the accumulation of vegetation which originated in swamps. Peat is the first stage in the transformation of vegetable matter into coal.

- 'Black Twins' is the name given to iron and coal. 'Black lead' is **graphite**. **Anthracite** is the most superior type of coal.

Classification of Landforms

There are three major landforms - mountains, plateaus and plains.

Mountains:

- An uplifted portion of the earth's surface is called a hill or a mountain.
- In our country, a mountain is differentiated from a hill, when its summit or top rises to more than 900 metres above the base.
- Those with less than this elevation are called hills.
- On the basis of their origin or mode of formation, the mountains are classified as structural or tectonic, residual or dissected and volcanic.

Structural mountains:

- All great mountain systems of the earth are of this type.
- Such systems are hundreds of kilometres wide and thousands of kilometres long.
- Many of them lie near or parallel to continental coastlines.
- Both the fold and the block mountains are included in this type.

(1) Fold mountains:

- The major mountains of the present day including the Alps in Europe, the Rockies of North America, the Andes of South America and the Himalayas of Asia are structural fold mountains.
- The granitic core of such mountains is surrounded by

metamorphic rocks, merging with sedimentary layers along the margins.

- These young fold mountains are still rising under the influence of the earth's tectonic force.
- The Aravallis are considered to be one of the oldest mountains on the earth.

(2) Block mountains:

- These mountains are formed when great blocks of the earth's crust may be raised or lowered during the late stages of mountain building.
- The land between the two parallel faults, either rises forming block mountains or horsts, or subsides into a depression termed as a rift valley or graben.
- An old fold mountain may also be left as block mountains due to continuous denudation.
- The Vosges in France, Black forest mountains in Germany and Salt Range in Pakistan are cited as typical examples of block mountains.
- River Rhine in Europe flows through a rift valley.

(3) Volcanic mountains:

- As these are formed by the accumulation of volcanic material, they are also known as mountains of accumulation.
- The matter is thrown out and deposited around the crater to form a mountain.
If the lava is thin and basic in its composition, it spreads a long distance forming a flatter cone of gentler slope and of low elevation
- If it is thick and of acid

composition a small volcanic cone sharply pointing out is the result.

- Sometimes lava is thrown out along with ash and cinders. Such a volcanic cone is termed as ash and cinder cone.

(4) **Residual or Dissected Mountains:**

- They owe their present form due to erosion by different agencies.
- That is why they are also known as relict mountains or mountains of circumdenu-dation.
- Hills like the Nilgiris, they Parsanath, the Girnar and Rajmahal in India are examples of this type.

Plateaus

- ⊛ A plateau is an elevated area generally in contrast to the nearby areas.
- ⊛ It has a large area on its top unlike a mountain and has an extensively even or undulating surface.
- ⊛ The rocks of the plateau are layered with sandstones, shales and limestones.
- ⊛ But an inclined or a tilted strata many also become flat through continuous wearing down. The great Deccan Plateau with its slope towards east is a tilted plateau in our country.
- ⊛ Very often, rivers and streams cut out deep valleys and canyons in a plateau regions. The plateaus are of four types on the basis of their situation.
 - (1) intermontane plateaus
 - (2) continental plateaus
 - (3) piedmont plateaus
 - (4) lava plateaus

(1) **Intermontane plateaus:**

- ⊛ The plateaus which are partly or fully enclosed by mountains are known as intermontane. Plateaus.
- ⊛ The highest and extensive plateaus of the world such as Tibet, Bolivia and Mexico are of this category.
- ⊛ These are the results of the mountain-building process which was accompanied by a vertical uplift of the adjoining enclosed lands.

(2) **Piedmont Plateaus:**

- ⊛ Situated at the foot of a mountain, they are bounded on the opposite side by a plain or an ocean.
- ⊛ The plateau of Malwa in India, Those of Patagonia in Argentina and the Appalachian in US are some of the examples

(3) **Continental plateaus:**

- ⊛ They rise abruptly from the lowlands or from the sea.
- ⊛ They are the result of a continental uplift producing large tablelands like the plateaus of Brazil, South Africa, West Australia, Chotanagpur and Shillong. Their heights vary from 600-1500 metres.
- ⊛ Sometimes a plain or a low-lying area is vertically uplifted and gives rise to a plateau.
- ⊛ In India plateaus of Kaimur, Rohtas, Ranchi and Karnataka are of this type.

(4) **Lava plateaus:**

- ⊛ When lava spreads out to cover the pre-existing land surface, a lava plateau is formed which is also called a plateau of accumulation.
- ⊛ The horizontal sheets of lava flow have trapped the original topography varying in depth

from 1200-1500 metres over large parts of Maharashtra and the adjoining areas in Deccan.

Plains

- ⊛ A relatively flat and a low-lying land surface with least difference between its highest and lowest points is called a plain.
- ⊛ The plains are usually lowlands.
- ⊛ Plains can be placed according to their position and surface relief but are better classified on the basis of their mode of formation.

They are sub-divided into structural, erosional and depositional plains.

Structural plains:

- ⊛ These plains are formed by the uplift of a part of the sea floor usually bordering a continent, that is the continental shelf.
- ⊛ On the other hand, there are structurally depressed areas which make up very extensive lowlands on the earth.

Erosional plains:

- ⊛ These are formed when an elevated tract of land, for instance, a mountain, a hill or a plateau is worn down to a plain by the process of erosion.
- ⊛ Over long ages, the higher land is levelled down into a sort of plain.
- ⊛ The surface is hardly smooth and forms almost a plain termed as a peneplain.
- ⊛ These are found in river, ice and wind eroded regions.

Depositional plains:

- ⊛ These plains are formed by the filling up of sediments into depressions along the foot hills, lakes and seas.

- ✧ The deposition of sediments, eroded and brought down by large rivers, forms riverine alluvial plains.
- ✧ The Indo-Ganga plains in the Indian subcontinent is an example of alluvial plain.
- ✧ **Pen plains** are formed by the wearing down of land due to weathering and erosion.
- ✧ **Coastal plains** are those parts of the continental shelf which have been uplifted.
- ✧ **Glacial plains** are formed through glacial erosion and deposition.
- ✧ **Lacustrine plains** are old lake beds and are made up of sediments deposited by rivers etc.
- ✧ **Karst plains** are formed in limestone areas mainly by the agency of underground water.
- ✧ **Flood plains, delta plains and alluvial plains** are all formed through the deposition of eroded material by rivers.

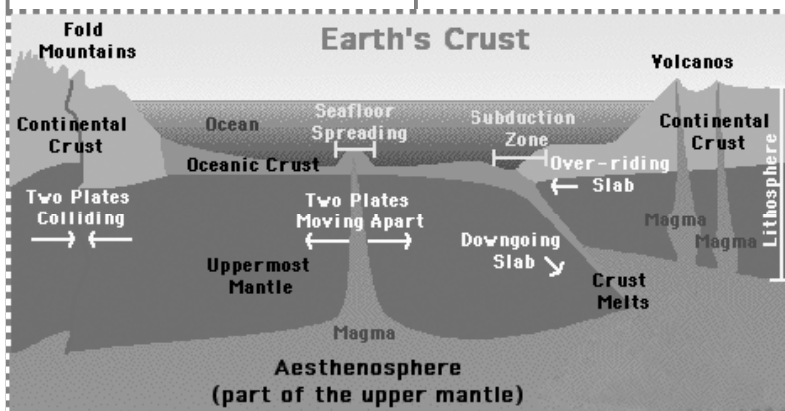
Movements of the Earth's Crust

- ❑ Warping and **Isostasy** constitute vertical movements, while folding, faulting and continental drift constitutes horizontal movement.
- ❑ **Folding** is the process whereby the rock strata are bent into a series of arches (anticlines) and troughs (synclines) as a result of the horizontal earth movements which cause compression within the crust.
- Fold mountains are formed by the crumbling or folding of rocks.
- The Himalayas, the Alps, the

Andes, the Rockies etc. are examples of fold mountains.

- **Faulting** is the process by which the tensional earth movements under the effect of considerable pressure creates a fracture in the earth's crust.
- Faulting gives rise to relief features such as block mountains and rift valleys.
- ❑ Block mountains are formed by the lifting up of land between faults or by the sinking of land outside the faults. They are usually steep sided
eg: The Vosges.
- ❑ A **Rift valley** is a long, relatively narrow depression formed by the sinking of a block of land between two or more or less parallel faults.
eg: East African Rift Valley.
- ❑ **Warping** is the deformation of earth's crust which affects very large areas on the earth's surface. It results in the formation of domes, shields and depressions.
- ❑ **Isostasy** is a condition of gravitational balance between the crustal segments of different thickness.

- ❑ Continental drift refers to the horizontal movements of the continents on a vast scale.
- The Himalayas, The Andes, The Rockies and The Alps are examples of **young mountains**. They came into being after the continental drift.
- ❑ The Pyrenees (Europe), Appalachians (America) and the Aravallis (India) are examples of **old mountains**. They were formed in the pre-drift area.
- ❑ The Rockies are North American mountain ranges while the Alps are European, the Andes belongs to South American range. Mt. Blanc is the highest peak in the Alps.
- ❑ The Vindhyas separates Southern India from Northern India.
- ❑ Satpuras lies in between Narmada and Tapti and Narmada lies in between Vindhya and Satpura.
- ❑ The southernmost tip of Western Ghats is called Cardamom Hills. Sahyadri and Nilgiri are parts of the Western Ghats. Western Ghats and Eastern Ghats meet at Nilgiri Hills.



Earth's Rotation

- Earth's rotation is the rotation of the solid Earth around its own axis. The Earth rotates towards the east. As viewed from the North Star Polaris, the Earth turns counter-clockwise.
- Earth's rotation period relative to the Sun (true noon to true noon) is its true solar day or apparent solar day.
- The velocity of the rotation of Earth has had various effects over time, including the Earth's shape (an oblate spheroid), climate, ocean depth and currents, and tectonic forces.
- Earth's rotation results in the deflection of all moving objects on the earth's surface.
- The primary effect of Earth's ro-

Moment Magnitude Scale (MMS)

MMS was developed in the 1970s to succeed Richter Scale. The magnitude is based on the moment of the earthquake. The MMS is used to estimate magnitudes for all modern large earthquakes by the United States Geological Survey.

Mercalli Scale

The intensity of earthquake is measured using Mercalli Scale. The Mercalli scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures on a scale of 1 through 12. This was developed by Italian volcanologist Giuseppe Mercalli in 1902.

tation is the phenomenon of day and night.

- Due to the rotation of the earth, the stars, the planets, the moon and the sun appear to move in the opposite direction viz., from east to west (e.g. the sun rises in the east in the morning, moves overhead at noon and sets in the west in the evening.)
- If there is no rotation, one side of the earth will always be facing the sun and be excessively hot. The other side will have darkness always and be excessively cold.
- Another effect of spin or rotation placed on weather systems by what is called Coriolis effect.
- The rotation of the Earth also

contributes to the shift of the shape of our home planet. Earth's shape has actually been modified by its rotation, and we describe its shape as that of an oblate spheroid.

- The most celebrated test of Earth's rotation is the **Foucault pendulum** first built by physicist Léon Foucault in 1851.

The Atmosphere

- Atmosphere is defined as an envelope of gaseous mixtures covering the earth held to it by gravitational forces. Atmosphere is essential for the life on earth.
- The principal constituents of the lower atmosphere are
Nitrogen (78.08% by volume)
Oxygen (20.94%)
Argon (0.93%)
Carbondioxide (0.033%)
Besides, there are minute proportions of other gases.
- **Oxygen** is the most important component among atmospheric gases.
- **Nitrogen** which is an important constituent of all organic compounds is relatively inert.
- The main function of nitrogen is to control combustion by diluting oxygen, thus it acts as a dilutant.

- ❑ The amount of carbondioxide varies from place to place, being greatest around the cities and smallest in the country side. Green plants during photosynthesis absorb carbondioxide from the atmosphere and use it to manufacture food and keep other bio-physical processes going.
- ❑ Ozone (O₃) consisting of three oxygen atoms chemically linked is another variable constituent of the atmosphere. In the lowest layers, the proportion of ozone is very low (less than 0.00005 by volume of atmosphere).
- ❑ **Between 20km and 40 km** altitude greater concentrations of ozone are found. At levels above 32 km, it increases forming what is known as the **ozone belt**. It plays a crucial role in blocking the harmful ultraviolet radiation from the sun.
- ❑ **Water vapour** is one of the most variable gaseous substances present in the atmosphere, constituting between 0.02% and 4% of the total volume in cold dry and humid tropical climates respectively. 90% of moisture content in the atmosphere exists within 6km on the surface of earth.
- ❑ Atmosphere also contains huge numbers of solid and liquid particles called **aerosols**. In addition, negligible quantities of other gases such as argon, neon, helium, hydrogen, xenon, krypton, methane etc are present in the atmosphere.

Structure of Atmosphere

- ❑ The earth's atmosphere is made up of a series of layers on the basis of the vertical distribution of temperatures.
- ❑ **Troposphere** is the lowest layer of the atmosphere and extends roughly to a height of 7 to 8 km near the poles to some 16km over the equator. The thickness is greater at the equator, because the heated air rises to greater heights.
- ❑ **Stratosphere** is a region of uniform temperature extending from an altitude of about 11km above the earth to a height of nearly 50km. It is free from water vapour, clouds and dust.
 - ▶ The upper part of the stratosphere has plenty of ozone which affords protection to human beings on the earth against the fatal effects of ultraviolet radiations.
 - ▶ The Stratosphere also provides ideal conditions for flying aeroplanes. The upper limit of this layer is called *stratopause*.
- ❑ **Mesosphere** is a very cold re-

Magnetosphere

Magnetosphere is the area around the earth that extends beyond the atmosphere. The earth's magnetic field operates here. It begins at about 1000 km. It is made up of positively charged protons and negatively charged electrons. This traps the particles that are given off by the sun. They are concentrated into belts or layers called the Van Allen radiation belts. The Van Allen belts trap deadly radiation. When large amounts are given off during a solar flare, the particles collide with each other causing the aurora borealis or the northern lights.

gion above the stratosphere which extends from 50 or 80km above the earth's surface.

- ▶ Within the mesosphere the temperature decreases with altitude from about 0°C at stratopause to about -100°C at mesopause. *Mesopause* is the boundary line between ionosphere and mesosphere.
- ❑ **Thermosphere** is the uppermost layer of the atmosphere

The Atmosphere is divided into layers according to major changes in temperature. 99% of the total mass of the atmosphere is below 32 kilometers. Atmosphere can be classified into five main layers. **troposphere, stratosphere, mesosphere, thermosphere (Ionosphere)** and the **Magnetosphere**. Troposphere - 0 to 12 km, Stratosphere - 12 to 50 km, Mesosphere - 50 to 80 km, Thermosphere - 80 km and up. Thermosphere contains Ionosphere and Exosphere.

extending from the mesopause at an altitude of about 85 kms to the outer limits of atmosphere.

- ▶ **Ionosphere** is that part of the thermosphere which extends above the mesosphere from 65 km to nearly 400 km above the earth's surface. It is an electrically charged layer characterised by the ionisation of atoms.
- ▶ Due to the presence of electric charge in the Ionosphere, radio waves transmitted from the earth are reflected back to the earth by this layer.
- ❑ **Exosphere** is the uppermost region of the atmosphere. It extends beyond the ionosphere above a height of about 400km. The air is extremely rarefied and the temperature gradually increases through the layer. Here the gravity of earth is exceedingly weak.
- ❑ The lowest temperature of air is recorded just before sunrise, because of the predominance of land over water in the north, the northern hemisphere is warmer.
- ❑ The pressure exerted by atmosphere as a result of its weight above a unit area of the earth's surface is called the **atmospheric pressure**.
- ▶ Atmospheric pressure is expressed in millibars (mb) and is measured with a mercury barometer.
- ▶ Two principal types of barometer used are mercury barometer and aneroid barometer.
- ❑ One millibar of atmospheric pressure is equal to the force of one gram on a square centimetre.

- ❑ The normal pressure at sea level is taken to be about 76 centimetres (1013.25 millibars).
- ❑ Auroras are produced by charged particles from the sun captured by earth's magnetic field at a height of about 100km.
- ❑ **Aurora Borealis** is a luminous phenomenon in the northern hemisphere and **Aurora Australis** is a luminous phenomenon in the southern hemisphere.
- ❑ **Insolation** is the radiant energy that reaches the surface of the earth from the sun. Insolation is the most important single source of atmospheric heat.

Winds

- ❑ A wind can be defined as a stream of air in a fairly well-defined direction. Winds are generated due to differences in pressure from one place to the other.

The effect of rotation of earth on the direction of winds is called the **Coriolis effect**. This effect causes deflection in the direction of winds.

- ❑ Wind is 'air in motion' and plays an important role in climatic variations on the earth.
- ❑ Air always moves from a region of **high pressure to a region of low pressure**. The chief cause of winds is the difference in pressures.
- ❑ Winds can be classified into
 - **Regular winds** (Primary)
eg: tradewinds and westerlies.
 - **Periodical winds** (Secondary)
eg: monsoon winds.
 - **Variable winds** (Tertiary)
eg: cyclones and other local winds
- ❑ **Trade winds** refers to the winds that blow from the sub-tropical belts of high pressure towards the equatorial region of low pressure.

International Date Line

This line is a zig-zag line and roughly coincides with the 180th meridian.

- When the date line is crossed from the east to the west, the date must be advanced by one day, when the line is crossed from the west to the east, the date must be set back by one day.
- The International Date Line (the meridian 180°) was chosen because it passes through the mid-Pacific, where there are no land masses.
- It goes zig-zag in some places to avoid land and leaves some island groups wholly on the same side of the line.
- It deflects to the east of 180° the Bering Strait, between Siberia and Alaska.
- It deflects to the West of 180° to leave the Hawaiian group of islands on the East of the line.
- It deflects again to the East, South of the equator to avoid the Fiji and Tonga islands, on the same side as New Zealand. If the date line is drawn exactly North and South, it will cut inhabited islands making what is Tuesday to one man, a Wednesday his next door neighbour.
- The twenty-four hour time is increasingly used by railways, airlines etc. for dispensing with the suffix a.m. and p.m.
- The day begins at midnight, the zero hour and the following hours are numbered from 0 to 23 hours.

- ▶ **A gale** is a strong wind having the speed between 56 and 72 km per hour.
- ▶ **A storm** refers to a strong wind whose speed exceeds 72 to 121 km/hr.

- Trade winds blow towards the equator between 5° and 30° north and south latitude.
- The word 'trade' comes from the saxon word 'tredon' which means 'to tread and follow a regular path.'
- **Trade winds** are also called **tropical easterlies**.
- Trade winds are called so because prior to the steamage; sailing ships carrying goods of trade and cargo depended on these winds.
- **Westerlies** or Anti-Trade winds are regular winds which blow outside the tropics in the temperate zone. These winds blow from the sub-tropical high pressure areas to sub-polar low pressure areas and between 35° and 60° North and South latitudes.
- **Polar Easterlies** constitute the wind system characteristic of the arctic and polar zones. They extend from about 60° north and 60° south latitude to the poles.
- **Monsoon winds** are seasonal winds which blow briefly over India, Sri Lanka, China and north-west Australia.
- Monsoon climate is marked by summer rains and winter droughts.
- The word 'monsoon' derived its name from the Arabic word 'mausin' meaning seasonal winds. Traditionally monsoon has been considered as a result of the differential heating of land and sea.

- According to dynamic theory, monsoon are a result of the shift of the Inter Tropical Convergence Zone (ITCZ) under the influence of the vertical sun.
- **Polar winds** are winds which blow from the high pressure area around the poles towards the temperate regions.
- **Planetary winds** are permanent winds which blow throughout the year from one latitude to the other in response to the latitudinal differences in air pressure. They blow over the vast areas of continents and oceans.
- **Horse Latitudes** are sub-tropical belts of variable winds and columns that lie between the latitudes of 25° and 35° North and South. They coincide with the sub-tropical high pressure belts.
- Horse Latitude winds are weak and shifting. In early days, the sailing vessels with a cargo of horses found it difficult to sail under such calm conditions. They used to throw horses into the sea to save valuable drinking water and this part therefore came to be called as Horse Latitudes.

- **Doldrums** are equatorial belts of low pressure where the north-east and south-east trade winds converge on and meet each other approximately between 5° south and 5° north latitude. The belt is characterised by extremely low pressure with calm conditions.
- **Roaring Forties** are powerful westerly winds that blow throughout the year over the oceans of the southern hemisphere between 40° and 60° south latitudes. They are called Best brave winds and bring storms and heavy rainfall.
- The winds which developed between 45° and 55° are called **Furious Fifties** and that developed between 55° and 65° are called **Shrieking sixties**. These are the dreaded terms used by sailors.
- **Local winds** develop as a result of the local differences in temperature and pressure. They affect the smaller areas and are restricted to the lowest levels of the troposphere.
- **Local winds** includes hot, cold, convectional and slope winds.
- The most famous local cold winds that blow from Alps over France towards the Mediterranean sea is the **mistral**.

The winds blowing in the Northern Hemisphere are deflected to their right and those blowing in the Southern hemisphere to their left under the Coriolis effect. This principle of deflection is called **Ferrel's Law**. Ferrel's law is a law postulated in 1856 by the American scientist

- ❑ **Loos** are very hot and dry local winds that blow from the west in the months of May and June, usually in afternoons in the plains of Northern India and Pakistan. Its temperature invariably varies between 45°C and 50°C. It may cause sunstroke to people.
- ❑ Local convectional winds are of two types - **Land breeze and sea breeze**.
- **Land breeze** is defined as the process by which cold winds blow from the land to sea during night. Land breeze is not as strong as the sea breeze.
- ❑ During the day time, the land gets warmer than the sea producing low pressure over the land into which cooler air moves from over the sea. The local winds that blow from sea to land during the day time are called **Sea breeze**.
- ❑ Valley breeze and mountain breeze are the counterparts of land and sea breeze. During the day time the slopes of the mountain get heated more than the valley floor. As such the air from the valley flows up the slope. This is called the **Valley breeze**. After sunset the process is reversed. Rapid loss of heat through terrestrial radiation along the mountain slopes results in the sliding of cold dense air from higher elevations to valleys. This is called the **mountain breeze**.
- ❑ **Jet streams** are narrow concentrated bands of meandering high velocity geostrophic winds bounded by low speed winds and are a part of upper level westerlies.

Instruments to Measure Wind

- ▶ **Wind Vane** : Instrument for knowing the direction of wind.
- ▶ **Anemometer** : Measures the velocity of the wind.
- ▶ **Beaufort wind scale** is an internationally accepted wind scale which consists of a series of numbers devised by Sir Francis Beaufort in 1805 to indicate different wind strengths.

- The Jet streams have an average velocity of 120 km per hour in winter and 50 km per hour in summer.
 - ❑ A hurricane is a strong wind whose speed exceeds 121 km/hr.
 - ❑ **Cyclones** are irregular wind movements involving closed air circulation around a low pressure centre. Cyclones are associated with destructive and violent disturbances such as heavy squalls and torrential rainfall.
 - Cyclones are called **hurricanes** in the South-east Caribbean region.
 - In the Philippines islands, eastern China and Japan, cyclones are called **Typhoons**.
 - Around South-east African coast, Madagascar, Mauritius islands and North-west Australia they are called **Willie Willies**.
 - If the speed of cyclone is greater than 250 km/hr, it is known as **Super Cyclone**.
 - ❑ **Tornadoes** are violently rotating storms, characterised by a funnel shaped cloud in which winds whirl around a small area of extremely low pressure. They are generally accompanied by torrential rains.
 - **Water Spout** is a tornado occurring in the sea usually in tropical and sub-tropical regions which connects a whirling cone of dense cloud with a cone of spray raised from sea and thus raises a huge column of water.
 - ❑ Anti-cyclone is a high pressure wind blowing outwards from the centre, clockwise in the Northern Hemisphere and anti-clockwise in the Southern Hemisphere.
 - Coriolis force is a 'fictitious' force needed to relate the movement of air masses over the earth's surface to its rotating co-ordinate system (the grid). It was named after the French mathematician Gaspard de Coriolis, who first described it in 1835.
 - **Coriolis force** is absent at the equator and increases towards the poles. The force is **responsible for the formation and direction of movement of anti-cyclones and whirlpools**.
- ### Clouds
- ❑ **Clouds** are a visible mass of small water drops or ice crystals formed by the condensation of water vapour in the atmosphere, usually at a considerable height above the earth's surface.
 - Clouds are caused mainly by the adiabatic cooling of air below its dew point.
 - On the basis of appearance, the clouds can be identified as
 - (i) **Cirrus clouds** are high, white & thin. They are composed of ice crystals. They

The Equator is an imaginary line on the Earth's surface equidistant from the North Pole and South Pole that divides the Earth into a Northern Hemisphere and a Southern Hemisphere.

form delicate patches and give a fibrous and feathery appearance.

(ii) **Cumulous clouds** : have a flat base and have the appearance of rising domes. These clouds are often described as having cauliflower structure.

(iii) **Stratus clouds** : as sheets of layer that covers much or all of the sky.

- ❑ **Stratiform clouds** - These clouds are fairly thin and blanket like. Subdivided into high clouds, medium clouds and low clouds.

- **Alto and Nimbo** are the two prefixes which refer to middle level clouds and low clouds of considerable thickness with dark grey appearance respectively.

For eg:- (1) Low clouds include stratocumulus, stratus, nimbostratus, cumulus and cumulo nimbus. (2) Medium clouds include alto cumulus and alto stratus. (3) High clouds include cirrus, cirro stratus and cirro cumulus.

- ❑ **Precipitation** is the formation of water particles or ice within the cloud that falls towards the earth's surface. It occurs when condensation takes place rapidly within the cloud.

- Precipitation in the form of ice-pellets (hail stones) that develop in and fall from cumulo nimbus clouds, either at a cold front or where intense heating of the surface causes rapidly ascending convection currents called *Hails*.

Climatic zones of the Earth

- ❑ Equator is the biggest circle drawn on the globe.
- ❑ The regions between 5° north and 5° south of the equator is called the Equatorial region. Here the temperature is very high and rainfall is very heavy.
- ❑ **Torrid zone** which is the hottest zone lies between 23½° North and 23½° South. i.e., between the Tropic of Cancer and Tropic of Capricorn.
- ❑ **Temperate zone**: Lies between 23½° north and 66½° north North Temperate zone and South Temperate zone lies between 23½° south and 66½° south. This zone has a marked annual range of temperature.
- ❑ **Frigid zone** lies between 66½° north and 90°N in the case of north frigid zone and 66½° south and 90° south in the case of south frigid zone. They are extremely cold regions.

Climatic Conditions of Earth

The world climate can be classified into Tropical Climate, Dry Climate, Humid Mesothermal Climate, Humid Microthermal Climate, Polar Climate and Highlands Climate.

Tropical Climate

- ❑ Major subtypes of tropical climate are the tropical rainforest, tropical monsoon and tropical savanna climates.
- ❑ Occurs in the tropical zone where the mean monthly temperature remains generally above 22°C.

Dry Climate

- ❑ This climate is characterised by a general water deficit.
- ❑ It can be classified into-tropical and subtropical desert, and tropical and subtropical steppes.

Humid Mesothermal Climate

- ❑ It is subdivided into - Mediterranean type, China type and West European type.

Humid Microthermal Climate

- ❑ Based on the type of forests growing in the region, this climate is also known as '*taiga*'. The summer temperature is higher than 10°C, but the temperatures in the winter season go below the freezing point and remain so for eight months.
- ❑ This type of climate is experienced in North America and Eurasia.

Polar Climate

- ❑ This climate is also known as the *tundra* and is experienced in the polar regions.

- ❑ It is experienced in Arctic margins of North America and Eurasia and the Antarctic continent.

Highland Climate

- ❑ It is significantly modified by the altitude and the aspect of the slope and these regions have a variable climate.
- ❑ This climate is experienced in the mountainous regions of Himalaya, Tibetan Plateau, Rockies, Andes and Alps.
- ❑ **Weather** is a condition of the atmosphere at a certain place and time, with reference to temperature and the presence of rain, sunshine, wind etc.
- ❑ **Climate** is the regular pattern of weather conditions of a particular region.
- ❑ **Humidity** is the degree of water vapour present in the air. For any specified temperature, there is a definite limit to the maximum quantity of moisture that can be held by the air. This limit is known as the *saturation point*.
- *Humidity can be measured by means of a **hygrometer**.*
- ❑ **Relative humidity** is the ratio between the amount of water vapour actually present in an air mass and the maximum amount that the air mass can hold at that temperature. It is expressed in terms of percentage.
- ❑ **Vapour Pressure** - The amount of pressure exerted by a given column of air differs according to the varying amounts of water vapour present in it. That part of barometric pressure due to water vapour alone is known as vapour pressure.
- ❑ Vapour pressure is maximum at

Fog-Smog-Mist

- ▶ **Fog** is made up of droplets of water suspended in the lower layers of atmosphere resulting from the condensation of water vapour around nuclei of floating dust or smoke particles.
- ▶ **Smog** also called smoke fog, is a form of fog that occurs in areas where the air contains a large amount of smoke.
- ▶ **Mist** is the term given for a reduction of visibility between 1 - 2km caused by the condensation, producing water droplets within the lower layers of atmosphere. It is the intermediate between fog and haze.
- ▶ Mist and fog are identical and are formed in the same way. The only difference is that in a fog, the particles of water are smaller and visibility is poorer than in a mist.
- ▶ **Haze** is formed by water particles that have condensed around the nuclei in the atmosphere but may also be a result of particles of smoke, dust or salt in the air.

the equator (about 30 mb) and decreases towards the poles (less than 10 mb).

- ❑ **Dew** is the moisture deposited in the form of water droplets on the earth's surface or on objects near the earth's surface.
- **Dew point** is the temperature at which air is fully saturated and below which condensation normally occurs.
- ❑ **Condensation** is the physical process of transformation from the vapour to liquid state. Condensation occurs when temperature reaches the dew point.
- ❑ **Frost** is a weather condition that occurs when the air temperature is at or below 0°C. The moisture on the ground surface and objects, freezes to form an icy deposit.

Global warming and climate

- ❑ Global warming refers to an average increase in the Earth's temperature, which in turn,

causes changes in climate. A warmer earth may lead to changes in rainfall patterns, a rise in sea level and a wide range of impacts on plants, wildlife and humans.

- ❑ Average global temperatures have risen ($0.6 \pm 0.2^\circ\text{C}$) since the late 19th century. The scientific consensus is that a significant proportion of this past rise, particularly in the last 25-50 years, is due to humanity's emission of green house gases such as carbon dioxide. (CO_2)
- ❑ The impact of climate change. Carbon dioxide emitted mainly by the burning of fossil fuels and the emission of methane, nitrous oxide, CFC's and other green house gases thickens the blanket of greenhouse gases over the earth's atmosphere upsetting the natural flow of energy from the sun.
- ❑ Deforestation accelerates global warming by reducing the absorption of carbon dioxide in the atmosphere.

- ❑ Based on current emission levels, it is estimated that the global temperature will rise by between 1°C and 3.5°C by the year 2100.
- ❑ The mean sea level may rise upto 100 cm by the year 2100, causing flooding and submergence of many islands and coastal cities.

Ozone depletion

- ❑ The Ozone layer is found in the atmosphere between 20-50 km from the Earth's surface.
- ❑ The Ozone layer is region of concentration of the allotrope of an oxygen molecule known as Ozone (O₃) which is produced by the action of Solar radiation on ordinary Oxygen atoms.
- ❑ It filters sunlight and prevents the harmful ultraviolet radiation from reaching the Earth's surface by absorbing most of the ultra violet radiation.
- ❑ If these ultraviolet rays were to reach the Earth's surface in full intensity all exposed bacteria would be destroyed and animal tissues damaged severely.
In this protective role, the presence of the Ozone layer is an essential factor in the life environment.
- ❑ There are certain household and industrial chemicals, having widespread application in refrigeration, air conditioning, fire extinguishing and dry cleaning, that are known to deplete this life-saving layer. These chemical are called Ozone-Depleting substances

and include primarily the Chlorofluoro Carbons (CFCs), Carbon Tetrachloride (CCl₄) and Hydro Chloro fluoro carbons (HCFCs)

- ❑ Molecules of these substances drift upward through the troposphere and eventually reach the stratosphere.
- ❑ As these compounds absorb ultra violet radiation they are decomposed and chlorine is released.
- ❑ The Chlorine in turn attacks molecules of Ozone, converting them in large numbers into ordinary oxygen molecules.
- ❑ In this way, the Ozone concentration within the stratospheric ozone layer can be reduced. With less ozone in the atmosphere, more ultraviolet radiation reaches the earth, leading to a higher incidence of skin cancer (or melanoma) cataracts, destruction of certain forms of aquatic life, reduction in crop yields and damage to the immune system.

Oceanography

- ❑ It deals with the study of oceans and is concerned with elucidation of the physical and biological characteristics of the oceans.

Pacific Ocean

- ❑ This is the largest ocean in the world.
- ❑ One-third of the earth is covered by this ocean. It covers an area of 166 million sq.km. and has a volume of 696 million cubic km.
- ❑ The outer boundary of the

There are five major oceans each encompassing within it a large number of seas, bays and gulfs. They are **the Pacific, the Atlantic, the Indian, the Arctic and the Antarctic or the Southern Ocean.**

deep ocean-type structure is called the *andesite line*, so named after the andesite rock that is found only in the ocean bottoms and not on the continents.

- ❑ The name 'Pacific' was given by Magellan who was the first European to cross it in 1521 to reach Philippines.
- ❑ The Mariana Trench in the Challenger Deep of the Pacific Ocean is the deepest point on the earth.
- ❑ In shape, it resembles a broad triangle with its apex in the north at the Bering Strait and the base to the south.

Atlantic Ocean

- ❑ This is the second largest ocean in the world.
- ❑ It is the busiest ocean route in the world.
- ❑ The Atlantic Ocean separates American continents from Europe and Africa.
- ❑ The greatest depth in the Atlantic is Milwaukee depth in the Puerto Rico Trench.
- ❑ Bermuda Triangle is located in the Atlantic Ocean.

Indian Ocean

- ❑ Indian Ocean is the third largest ocean in the world and the only ocean named after a country, India.

Years, Months & Calendars

- ❑ The days and years are based on solar (sun) time.
- ❑ One day equals to the length of time it takes for the earth to make one complete revolution in its own axis.
- ❑ **One year** is the approximate time taken by the earth to make one complete revolution around the sun.
- ❑ The Sumerians, Babylonians and ancient Egyptians had calendars based on the **lunar month**. The original Roman calendar apparently covers only agricultural months.
- ❑ A calendar instituted in 1582 by Pope Gregory XIII has now been used in most of the world. Its distinguishing feature is that, in a century year is a leap year.
 - ▶ **Leap year** is an year which is exactly divisible by four. But the last year of a century will be a leap year only if it is exactly divisible by 400. Thus 1700, 1800, 1900 are not leap years but 1600, 2000, 2400 etc are leap years. This correction was made by Pope Gregory XIII in AD 1582.
- ❑ A year with **366 days** is called a **leap year**. In a leap year, February will have 29 days.
- ❑ The concept of leap year was introduced in the Roman calendar by Julius Ceasar in 46 BC, on the advice of his astronomer Sosigenes.
- ❑ Britain introduced the Gregorian calendar in 1752.

- ❑ The greatest depth in the Indian Ocean is the Java Trench (7,725 m).
- ❑ Madagascar is the largest island in the Indian Ocean.
- ❑ Indian Ocean is mostly confined to the Southern Hemisphere while in the Northern Hemisphere, it extends only to a few degrees of latitude. Due to this fact, the Indian Ocean is often called *half an ocean*.

Arctic Ocean

- ❑ The Arctic Ocean is connected to the Pacific Ocean through the narrow Bering Strait and to the Atlantic Ocean through large openings of the Barents Sea, Greenland Sea and numerous straits in the Canadian archipelago.
- ❑ This ocean is roughly circular in shape and it surrounds the North Pole.

Antarctic Ocean (Southern Ocean)

- ❑ The Antarctic Ocean flows in the eastern direction.
- ❑ The Antarctica Ocean is the fourth largest among the five main oceans .
- ❑ The current, popularly known as West Wind Drift moves the ocean from west to east all around Antarctica. This current mixes the ends of the Pacific, the Southern ends of the Atlantic, and the Indian Ocean.

Ocean Movements

There are three types of motions in the oceans viz., the tides, the waves and the currents.

- Tides imply a rhythmic rise and fall in the level of water in the oceans and seas. They are caused by the gravitational pull of the moon and the sun on the surface of the earth.
- An earthquake originating on the sea bottom may give rise

to very high magnitude waves called *tsunamis*.

- Both the tides and the waves do not involve large scale movement of water from one region to the other.

Submarine Topography

Ocean Currents

- ❑ General movement of a mass of surface water in a fairly defined direction is known as an *ocean current*.
- ❑ Ocean currents are of two kinds:
 - (i) Warm Currents
 - (ii) Cold Currents
- **Warm currents** which flows from a warmer region to a colder region (equatorial to the polar regions).
- **Cold currents** which flow from a colder to a warmer region (polar region to the equatorial region).
- Ocean currents are caused by

several interacting forces. One of the prime causes, particularly of surface currents is **wind**.

- Florida current and Brazil current are warm currents of the Atlantic ocean.
- Kuroshio current is in the Pacific Ocean.
- **Agulhas current** is a major warm current of Indian Ocean.
- Ocean currents change their direction annually in the Indian Ocean.
- Labrador, Canaries, Benaguel and Falkland are cold currents of Atlantic Ocean.
- Alaska, Peruvian or Humboldt and California are cold currents of the Pacific Ocean.
- Ocean currents influence the climate of the regions they pass through.

Tides

- Tide is the periodic rise and fall of sea water. The tides are caused by gravitational pull of the moon and sun on earth's sea water.
- The time period between a high tide and a low tide is approximately six hours. Each of them happens twice a day.
- Highest tidal amplitude and range was found in Bay of Fundy.
- Highest tides recorded in India is at Okha, Gujarat.
- Generally, tides occur twice a day. But in **Southampton**, along the southern coast of England, experiences tides **4 times a day**.
- A rise in the water level is called high tide and a fall is called low or ebb tide. Tides are of two types, Spring Tides and Neap Tides.

- **Spring Tides** are caused as a result of the moon and sun pulling the earth gravitationally in the same direction. They occur twice a month around the full moon and new moon. It is the tide of maximum rise.
- **Neap Tides** are caused when the moon and the sun pull the earth gravitationally in opposite directions. These tides are produced when the moon and the sun are at right angles to the earth. It is the tide of minimum rise, occurring twice a month. They occur on half moon days.

Waves

- A wave is an undulation that moves across the surface of the sea caused by the transfer of energy from the wind to the sea.
- Standing waves or stationary waves are caused by storm or sudden disturbances in water or atmosphere.
- Tidal waves or seismic waves or **tsunamis** are waves which are formed by underwater earthquakes in volcanic eruptions at the sea bottom. They have a long tidal period and a very high speed.
- A **canyon** is a deep narrow valley with almost upright sides formed by the denudation of soft rocks by rivers and rain water.
eg : Grand canyon on the Colorado River in U.S.A
- **Coral reef** is a ridge of rock in the sea that is composed chiefly of the skeletons of small animals called reef-building coral polyps.

- The most extensive of all the barrier reefs is the Great Barrier Reef of Australia.
- **Atoll** is a circular or horse-shoe shaped coral reef surrounding a lagoon either having an island or submerged plateau in it. They are found chiefly in the Pacific Ocean.
- **Lagoon** is a shallow stretch of water separated completely or partly from the sea by a narrow strip of land.
- **Isthmus** is a narrow strip of land joining two larger areas of land that would otherwise be separated by water. The isthmus of Panama joins North and South America.
- **Strait** is a narrow passage of water connecting two seas or two large areas of water.
- A bay is a part of the sea or of a large lake enclosed by a wide curve of the shore.
- **Gulf** is a part of the sea almost surrounded by land. Gulf streams are warm currents flowing across the Atlantic Ocean from the gulf of Mexico towards Europe.
- High seas are the open seas or oceans outside any territorial waters of countries. They are also known as International waters.
- ▶ The laws binding the territorial right over the sea have been fixed by the UN and have been accepted since 1974. Within the Exclusive Economic Zone (EEZ) the coastal state has the right to exploit all economic resources - fish, minerals, oil and gas and energy production.

- ❑ **An estuary** is the single v-shaped mouth of a river when it merges into the sea. It is widest near the sea.
- ❑ **A delta** is a triangular tract of alluvium, usually fan shaped at the mouth of a river where it deposits more material than can be carried away. The river gets divided into two or more channels (distributaries), which may further divide and rejoin to form a network of channels.

The world's largest delta Sunderbans, is formed by the Ganges and the Brahmaputra in India and Bangladesh. Its area is nearly 75,000 sq.km.

- ❑ **Beach** is the shore of a sea, consisting of a strip of pebbles, sand or mud lying between low and high water marks.
- ❑ **Shoal** is a shallow region in a sea, river or lake.

Waterbodies

- ❑ Hydrosphere - The mass of water that covers about 71% of the earth's surface. Oceans are the largest single constituent unit of the hydrosphere.
- ❑ Average depth of the ocean is about 4 km.
- ❑ Oceans contains more than 97% of the total water on the earth.
- ❑ The study of various aspects of oceans is called oceanography.
- ❑ Oceans predominate over land areas in southern hemisphere.
- The greatest depth in Indian ocean is the **Diamantina Trench**.
- ❑ **Arctic ocean** is the smallest

The Suez Canal

- ▶ The Suez Canal is an artificial sea-level waterway in Egypt, connecting the Mediterranean Sea and the Red Sea.
- ▶ Opened in November 1869, it allows water transportation between Europe and Asia without navigating around Africa.
- ▶ The canal was nationalised by Col. Nasser on July 26, 1956.
- ▶ Suez Canal is an artificial water way from Port Said to Suez. It is 169 km long (105 mile). It separates Asia from Africa. It was opened in 1869 and nationalised in 1956. Suez Canal has shortened the distance between Southampton and Mumbai by about 6500 km.
- ▶ Ferdinand de Lesseps, the French architect designed it.

ocean in the world.

- ❑ The two most abundant elements in sea water are chlorine and sodium.
- ❑ **Peninsula** is a piece of land almost surrounded by water. Southern India is a peninsula.
- ❑ The sea with the highest degree of salinity is the Dead Sea. No fish live in this sea, hence it is called Dead Sea.

The Panama Canal links the Pacific Ocean with the Atlantic Ocean. The length of Panama Canal is 82 km (50 miles). It was built by the USA during 1904-14. Now the control of the canal is with Panama.

- ❑ **Kiel canal**, an international canal linking the North Sea with the Baltic sea was built by the Germans in the years before first world war. It is 96 km long. It was declared an international waterway by the Treaty of Versailles in 1919.
- ❑ **Berring Strait** connects the Pacific Ocean and the Arctic Ocean in the north, which separates Asia and North America. The International Date Line passes through the Berring Strait.

- ❑ Baffin Bay lies in between Greenland and Canada.
- ❑ The **Grand Banks** are the famous fishing grounds in the North-West Atlantic.
- ❑ Abyssal Plain - The deepest and most extensive part of the ocean floor and it accounts for the largest proportion of the total area of the oceans.
- ❑ **A waterfall** is simply the fall of an enormous volume of water from a great height. Jog or Gersoppa Falls on Sharavati (a tributary of Cauvery) in Karnataka is the highest waterfall in India.
- ❑ **A glacier** is a moving mass of ice at a speed averaging between 30 to 40 cm and 15 to 18 metres per day. It originates at high altitudes due to low temperatures and high orographic precipitation.

Rivers

- ❑ The **Nile** (6670 km) which is the longest river in the world drains into the Mediterranean Sea.
- ❑ **The Amazon**, flowing into the South Atlantic, is the largest river in terms of size and volume of water discharged. It is

6437 km long. It makes the largest river basin in the world covering an area of 7,045,000 sq.km.

- ❑ The longest river in Europe is the **Volga**, 3690km.
- ❑ The longest river of Oceania is the **Murray** in Australia (3220km).
- ❑ **The Indus** (2900km) is the longest river of the Indian subcontinent. The longest river of India is the Ganges (2640km).
- ❑ Indus river system is the most extensive river system in the Indian subcontinent. It includes - Indus, Ravi, Beas, Sutlej, Jhelum, Chenab.
- ❑ **The Brahmaputra** (2688km) is bigger than the Ganges; but only a small part of it flows through India. It originates from Manasarovar Lake in Tibet. In Tibet, its name is Tsangpo.
- ❑ The only river that crosses the equator twice is river **Congo**.
- ❑ Victoria falls are in river **Zambezi**.
- ❑ The only river to cross the Tropic of Capricorn twice is river **Limpopo** in South Africa.
- ❑ City at the confluence of Blue and White Nile is Khartoum, capital of Sudan.

Desert

Antartic Deserts, Arctic, Sahara (Africa), Arabian Desert (Middle East), Gobi Desert (Asia), Kalahari Desert (Africa), Pantag nian Desert (South America), Great Victoria Desert (Australia), Syrian Desert (Middle East), Great Basin Desert (North America) are the ten largest deserts in the world .

Longest river of Asia	Yangtze (Chang Jiang)
Longest river of Europe	Volga
Longest river of North America	Missisipi-Missouri
Longest river of South America	Amazon
Longest river of Australia	Murray
Longest river of Africa	Nile
Longest river of South East Asia	Mekong
Longest river of South West Asia	Euphrates
Longest river of Russia	Ob
Longest river of Sri Lanka	Mahaweli Ganga
World's longest rivers in descending order of length are Nile, Amazon, Chang Jiang and Missisipi-Missouri.	

- ❑ Hot deserts have sparse vegetation often found in clumps over small patches of land.
- ❑ Cacti are the most typical plant. In some places, dwarf trees like Accacia, Date palms etc are also found.
- ❑ **June 17** : World day to combat desertification
- ❑ **The Takla Makan** (32,000 sq.km) is the largest desert in China; Gobi (Mongolia) is the coldest desert in the world. Largest Desert in India is **Thar Desert**.
- ❑ Camel is known as the ship of the desert.
- ❑ **Atacama Desert** in Northern Chile is the driest place on Earth. It is virtually sterile be-

cause it is blocked from moisture on both sides by the Andes mountains and by the Chilean Coast Range.

- ❑ Kalahari Desert lies in Southern Africa. The Bushmen are the aborigines of Kalahari.
- ❑ **Hottest Place** - Denakit Depression, Ethiopia, 34.4°C
- ❑ **Hottest inhabited place** - Dji Buti.

Islands

- ❑ **Greenland** (Kalaait Nunait), which is the largest island in the world, is in North Atlantic (2, 176,000 sq.km). It is a territory of Denmark.
- ❑ Archipelago is a group of is-

Lakes

- ▶ Lake Superior (North America) is the largest freshwater lake in the world.
- ▶ The Caspian Sea is the largest salt water lake. It borders with Russia, Kazakhstan, Azerbaijan, Iran and Turkmenistan.
- ▶ Lake Baikal (Russia) is the deepest freshwater lake (depth 1620 m).
- ▶ The highest navigable lake in the world: Lake Titicaca in Peru and Bolivia.
- ▶ The saltiest lake in the world : Lake Van (Turkey)
- ▶ Great lakes arranged from west to east are Lake Superior, Lake Michigan, Lake Huron, Lake Erie, Lake Ontario.
- ▶ Great lake lying entirely in USA is Lake Michigan.

The Sahara (8,400,000 sq.km) is the largest desert in the world. It spreads over nearly 6% of world's total land area and 28% of the land area of Africa.

- lands. **Indonesia** is the largest archipelago in the world.
- ❑ Ireland is known as the Emerald Island. Bahrain is known as the Pearl Island.
- ❑ The second largest island is New Guinea.
- ❑ Malagasy (Madagascar) is the largest island in the Indian Ocean (588,000 sq.km).
- ❑ Andaman and Nicobar Islands is the biggest union territory in India. It lies in the Bay of Bengal. Its capital is at Port Blair. There are 223 islands in the group.
- ❑ Lakshadweep is in the Arabian Sea. There are 27 coral islands in the group.
- ❑ Japanese archipelago of over 4000 islands.
- ❑ Japan comprises 4 islands - Honshu, Hokkaido, Kyushu, Shikoku. Among this Honshu is the biggest island.

❑ **Types of Island**

1. Continental Islands
2. Oceanic Islands
3. Tropical Islands
4. Desert Islands

- ▶ Greenland is the example of Continental Island.

Natural Vegetation

- ❑ Natural vegetation refers to a plant community that has been left undisturbed over long time.
- ❑ Flora denotes the plants of a particular country or region.
- ❑ Fauna denotes the animal kingdom found in a particular geographical region.
- ❑ The world climate types have been classified on the world's climatic / temperate zones.
- ❑ The major climatic types of the world have been classified as
 - (i) Equatorial
 - (ii) Tropical Monsoon
 - (iii) Tropical Desert

- (iv) Mediterranean type
- (v) Cool Temperate (Continental or Ocean)

- ❑ Teak is the most valuable timber, which is used for furniture making and is found in tropical monsoon climate.
- ❑ **Savannah** is a region which lies on both sides of the equator roughly between 5 degrees and the tropics. Here summers are hot and moist and winters are warm and dry.
- ❑ Deciduous forests are forests with trees which shed their leaves seasonally.
- ❑ Tundras is the belt of treeless, cold desert which remains under heavy snow during most of the year. Eskimos live there. Igloos are dome shaped huts of Eskimos which are dug half underground and covered with blocks of ice. Eskimos are also called Inuits.
- ❑ Natural resources are classified into biotic and abiotic resources.
- **Biotic resources** are renewable resources consisting of living things such as forests and their products, agricultural crops, fodders, wild and domestic animals etc.
- **Abiotic resources** consists of non-living things like minerals and fuels which are mostly non-renewable.
- ❑ Reserved forests are forests reserved for commercial exploitation.
- ❑ **Wettest place - Mawsynram India - 1187 cm.**
- ❑ Valley of moon is the Atacama desert.
- ❑ Tropical monsoon forest is the typical vegetation of monsoon land, like that of India.

Important Straits

Ten Degree Channel	----- Little Andaman and Nicobar
Duncan passage	----- South Andaman and Little Andaman
Cape of Good Hope	----- Located at the southern tip of African continent.
Cape of Horn	----- Located at the southern tip of South America.
Strait of Malaca	----- Between Malaysia and Sumatra
Barents Strait	----- Between Scandinavian countries and Arctic Ocean.
Palk Strait	----- Between India and Sri Lanka
English Channel	----- Between England and France
Berring Strait	----- Russia and the USA
Florida Strait	----- Cuba and USA
Strait of Gibraltar	----- Spain and Morocco
Strait of Magellan	----- Tip of South America
Bass strait	----- Separates Australia from Tasmania