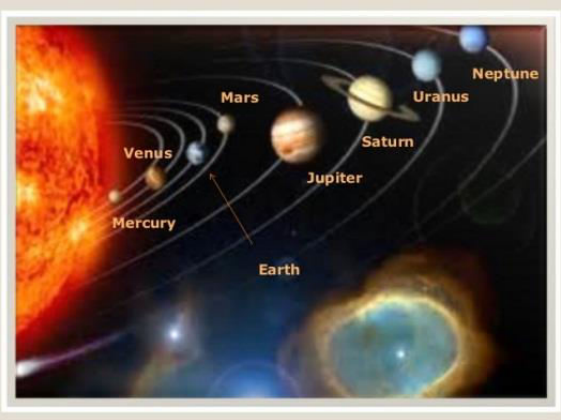
INDIAN GEOGRAPHY

Complete Study Material and 1000 Objective bits
Useful for all SSC, RRB & Group Exams

ORIGIN OF EARTH

Nebular Theory



There are many ideas about the formation and evolution of the Solar System. The accepted idea is that 4.6 billion years ago, there was a very big cloud of gas in our area of space, known as a nebula. The Nebula eventually became so big that gravity pulled all the gas to the center. Eventually because of all the gas it became so hot there that some hydrogen atoms fused together to make helium. As they did this a lot of energy was let out. All this energy eventually made the Sun. The leftover gas and dust made the planets, their moons, asteroids and all other objects in the Solar System. Scientists think now that solar systems are created out of a huge cloud of gas. The process by which the solar sytems are created is called the Nebular Theory.

The formation of Earth occurred as part of the formation of the Solar System. It started as a large rotating cloud of dust and gas.
This cloud, the solar nebula, was composed of hydrogen and helium produced in the Big Bang, as well as heavier elements produced in supernovas. Then, about 4.68×109 years ago, the solar nebula began to contract, rotate and gain angular momentum.
This may have been triggered by a star in the region exploding as a supernova, and sending a shock wave through the solar nebula.

As the cloud rotated, it became a flat disc perpendicular to its axis of rotation. Most of the mass concentrated in the middle and began to heat up. Meanwhile, the rest of the disc began to break up into rings, with gravity causing matter to condense around dust particles. Small fragments collided to become larger fragments, including one collection about 150 million kilometers from the center: this would become the Earth.

THE LAST 2½ BILLION YEARS OR SO

As soon as the oxygen was produced by photosynthesis it was taken out again by reacting with other elements (such as iron).This continued until about 2.1 billion years ago when the concentration of oxygen increased markedly. As oxygen levels built up and then . . . . . The ozone layer was formed which started to filter out harmful ultraviolet rays. This allowed the evolution of new living organisms in the shallow seas.

Earth Solar System

Earth solar system consists of :
• The Sun • The Planets
• Dwarf Planets and countless fragments of left – overs called asteroids, meteors, comets and satellites of the planets (Called small solar system Bodies).

Solar System Some Facts

• **Biggest Planet** : Jupiter
• **Smallest Planet :** Mercury
• **Nearest Planet to Sun** : Mercury
• **Farthest Planet from Sun :** Neptune
• **Nearest Planet to Earth :** Venus

• **Brightest Planet :** Venus
• **Brightest star after Sun :** Sirius
• **Planet with maximum satellites**: Jupiter
• **Coldest Planet :** Neptune
• **Hottest Planet :** Venus
• **Heaviest Planet :** Jupiter
• **Red Planet :** Mars
• **Biggest Satellite :** Gannymede
• **Smallest Satellite :** Deimos
• **Blue Planet:** Earth
• **Morning/Evening Star** : Venus
• **Earth's Twin :** Venus
• **Green Planet** : Neptune
• **Planet with a big red spot** : Jupiter
• **Lord of the Heavens** : Jupiter
• **Greatest Diurnal Temperature**: Mercury

Earth Latitude and Longitude

Earth Latitude

- ✓ Imaginary lines drawn parallel to the equator. Measured as an angle whose apex is at the centre of the earth.
- ✓ The equator represents 0° latitude, while the North Pole is 90° N and the South Pole 90° S
- ✓ 23½° N represents Tropic of Cancer while 23½° S represents Tropic of Capricorn.
- ✓ 66½° N represents Arctic Circle while 66½° S represents Antarctic Circle.
- ✓ There are total 181 latitudes including the equator. Each parallel of latitude is a circle, but they are not equal.
- ✓ The circle becomes smaller towards the poles. Equator is the 'Greatest Circle' that can be drawn on the earth's surface.
- ✓ The distance between any two parallels of latitude is always equal.
- ✓ 1 degree lat. = 111km.

Earth Longitude

• It is the angular distance measured from die centre of the earth. On the globe the lines of longitude are drawn as a series of semicircles that extend from the North Pole to the South Pole through the equator. They are also called meridians.

• The distance between any two meridians is not equal.

At the equator, 1 degree = 111 km. At 30°N or S, it is 96.5 km. It goes on decreasing this way until it is zero at the poles.

• There are 360 meridians of longitude. The prime meridian is a longitude of 00, passing through the Royal Observatory at Greenwich near London.

• This meridian is taken by geographers to divide the earth into the eastern and the western hemispheres.

• Each meridian of longitude is a semi-circle. 180° meridian (International Date Line) lies exactly opposite to 0° meridian. Such points are called Antipodal Points.

• The earth is divided into 24 longitudinal zones, each being 15° or 1 hour apart in time (4 minutes / degree).

Longitude and Time

• Places that are on the same meridian have the same local (sun) time. Since the earth makes one complete revolution of 360° in 24 hours, it passes through 15° in one hour or 1° in 4 minutes.

• The earth rotates from west to east, hence places east of Greenwich see the sun earlier and gain time whereas places west of Greenwich see the sun later and lose time.

• India, whose longitudinal extent is approx. 30°, has adopted only one time zone, selecting the 82.5°E for the standard time which is 5 hours and 30 minutes ahead of GMT (Greenwich Mean Time).

International Date Line

• It is the 180° meridian running over the Pacific Ocean, deviating at Aleutian Islands, Fiji, Samoa and Gilbert Islands. It is a zig-zag line

• Travelers crossing the Date Line from west to east (i.e., from Japan to USA) repeat a day and travelers crossing it from east to west (i.e., from USA to Japan) lose a day.

Important Parallels of Latitude

1. The Tropic of Cancer : It is in the northern hemisphere at an angular distance of 23 1/2° (23°30'N) from the equator.

2. The Tropic of Capricorn : It is in the southern hemisphere at an angular distance of 23 1/2° (23°30'S) from the equator.

3. The Arctic Circle : It lies at a distance of 66 1/2° (66°30'N) north of the equator.

4. The Antarctic Circle : It lies at a distance of 66 1/2° (66°30'S) south of the equator. There are two solstices each year, called the Summer Solstice and the Winter Solstice.

Summer Solstice : The day of 21st June when the sun is vertically overhead at the Tropic of Cancer (23°30'N).

Winter Solstice : The day of 22nd December when the sun is vertically overhead at the Tropic of Capricorn (23°30'S).

Meridians of Longitude

The semi-circles running from pole to pole or from north to south are known as meridians of

longitude and distance between them is measured in degrees of longitude. Greenwich Meridian or Prime Meridian with a value of 0° longitude serves as a common base for numbering meridians of longitude lying on either side of it — east as well as west. There are 360 meridians including Prime Meridian. Each degree of a longitude is divided into sixty equal parts, each part is called a minute. Each minute is again divided into sixty equal parts, each part being called a second.

Local Time : Local time of any place is 12 noon when the sun is exactly overhead. It will vary from the Greenwich time at the rate of four minutes for each degree of longitude.

Greenwich Mean Time : The time at 0° longitude is called Greenwich Mean Time. It is based on local time of the meridian passing through Greenwich near London.

Indian Standard Time : It is fixed on the mean of 82 1/2°E Meridian, a place near Allahabad. It is 5 1/2hours ahead of Greenwich Mean Time.

Facts about earth

• The Earth also called Blue Planet. It is the densest of all planets.

• **Earth Circumference**: 40,232 Kilometers.

• **Earth Area**: 510 million Square Kilometers

• **Average distance from sun:** 149 million Kilometers.

• **Earth Perihelion:** Nearest position of earth to sun. The earth reaches its perihelion on January 3 every year at a distance of about 147 million-Kilometers.

• **Aphelion:** Farthest position of earth from sun. The earth reaches its aphelion on July 4, when the earth is at a distance of 152 million Kilometers.

• The shape of the earth is oblate spheroid or oblate ellipsoid (i.e. almost spherical, flattened a little at the poles with a slight bulge at the centre).

Types of Earth Movements:

1. Rotation or daily movement.
2. Revolution or annual movement.

Earth Rotation

• Spins on its imaginary axis from west to east in 23 hrs, 56 min and 40.91 sec.

• Rotational velocity at equator is 1667 Kilometers/h and it decreases towards the poles, where it is zero.

Earth's rotation results in

i. Causation of days and nights;

ii. A difference of one hour between two meridians which are 15° apart;

iii. Change in the direction of wind and ocean currents; Rise and fall of tides everyday.

iv. The longest day in North Hemisphere is June 21, while shortest day is on 22 Dec (Vice-versa in S.Hemisphere).

• Days and nights are almost equal at the equator.

Earth Revolution

• It is earth's motion in elliptical orbit around the sun. Earth's average orbital velocity is 29.79 Kilometers/s.

• Takes 365 days, 5 hrs, 48 min and 45.51 sec. It results in one extra day every fourth year.

• Revolution of the earth results in

i. Change of seasons

ii. Variation in the lengths of days and nights at different times of the year

iii. Shifting of wind belts

iv. Determination of latitudes.

Earth Eclipses

Earth Lunar Eclipse

· When earth comes between sun and moon.

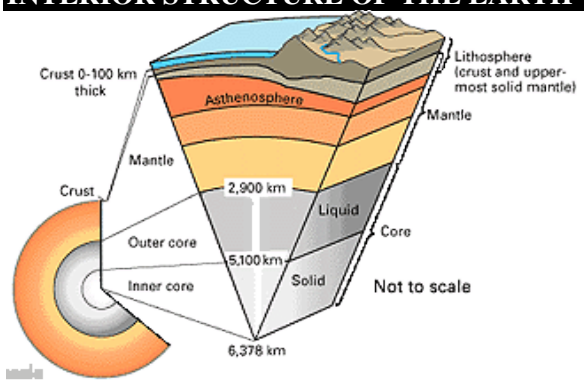
· Occurs only on a full moon day. However, it does not occur on every full moon day because the moon is so small and the plane of its orbit is tilted about 5° with respect to the plane of the earth's orbit. It is for this reason that eclipses do not occur every month.

· This light is red because the atmosphere scatters the other colors present in sunlight in greater amounts than it does red.

Earth Solar Eclipse

A **solar eclipse** is a type of eclipse that occurs when theMoon passes between the Sun and Earth, and the Moon fully or partially blocks ("occults") the Sun. This can happen only at new moon

INTERIOR STRUCTURE OF THE EARTH



The layering of Earth is categorized as Lithosphere, Asthenosphere, Upper mantle, Lower mantle, Outer core, and the Inner core.

The earth's interior has three different layers; they are
i)the crust (ii) mantle and (iii) the core.

a) Earth's Crust:

All of the Earth's landforms (mountains, plains, and plateaus) are contained within it, along with the oceans, seas, lakes and rivers. There are two different types of crust: thin oceanic crust that underlies the ocean basins and thicker continental crust that underlies the continents. These two different types of crust are made up of different types of rock. The boundary between the crust and the mantle is Mohorovicic Discontinuity.

b) Earth's Mantle: It is the thick, dense rocky matter that surrounds the core with a radius of about 2885 km. The mantle covers the majority of the Earth's volume. This is basically composed of silicate rock rich in iron and magnesium. This layer is separated from the core by Gutenberg-Wiechert Discontinuity. The outer and the inner mantle are separated by another discontinuity named Repetti discontinuity.

c) Earth's Core: Earth's Core is thought to be composed mainly of an iron and nickel alloy. The core is earth's source of internal heat because it contains radioactive materials which release heat as they break down into more stable substances. The core is divided into two different zones. The outer core is a liquid because the temperatures there are adequate to melt the iron-nickel alloy. However, the inner core is a solid even though its temperature is higher than the outer core. Here, tremendous pressure, produced by the weight of the overlying rocks is strong enough to crowd the atoms tightly together and prevents changing it to the liquid state.

ARTHQUAKES

a) An earthquake is the sudden release of strain energy in the Earth's crust resulting in waves of shaking that radiate outwards from the earthquake source.

b) The point at the surface directly above the focus is called the earthquake epicentre.

c) When the earth moves in an earthquake, it can cause waves in the ocean, and if a wave grows large enough, it's called a "tsunami".

e) Earthquakes are measured with a seismometer.

The magnitude of an earthquake, and the intensity of shaking, is measured on a numerical scale. On the scale, 3 or less is scarcely noticeable, and magnitude 7 (or more) causes damage over a wide area. The point of origin of earthquake is called Seismic focus. The point on the
earth's surface vertically above the earth's surface is called Epicentre.

f) The passage of earthquake waves is recorded by Seismograph. The magnitude of waves is measured on Richter's scale. For measurement of the intensity of the earthquake (damage caused), the Modified Mercalli Intensity Scale is used.

Distribution of Earthquakes

a) Around the Pacific Ocean along a belt of volcanoes known as the Ring of Fire. 68 per cent of the volcanoes are experienced in this region.

b) From the middle of Asia (Himalayas, Caspian Sea) through the Mediterranean Sea to West Indies. 21 per cent earthquakes are experienced in the region.

c) Mid-Atlantic ridge belt which accounts for 11 percent of the earthquakes.

TYPES OF SEISMIC WAVES

There are two types of seismic waves, body wave and surface waves.

• Body waves travel through the interior of the Earth. They follow ray paths refracted by the varying density and stiffness of the Earth's interior which in turn, vary according to temperature, composition, and phase.

Body waves are divided as

P-WAVES (Primary Waves) are compression waves that are longitudinal in nature. These waves can travel through any type of material, and can travel at nearly twice the speed of S waves.

S-WAVES (Secondary Waves) are shear waves that are transverse in nature. These waves typically follow P waves during an earthquake and displace the ground perpendicular to the direction of propagation. S waves can travel only through solids, as fluids (liquids and gases) do not support shear stresses. S waves are slower than P waves, and speeds are typically around 60% of that of P waves in any given material.

• Surface waves are analogous to water waves and travel along the Earth's surface. They travel slower than body waves.

There are two types of surface waves:

Rayleigh waves, also called ground roll, are surface waves that travel as ripples with motions that are similar to those of waves on the surface of water.

Love waves are surface waves that cause circular shearing of the ground. They are named after A.E.H. Love, a British mathematician who created a mathematical model of the waves in 1911. They usually travel slightly faster than Rayleigh waves, about 90% of the S wave velocity, and have the largest amplitude.

The asthenosphere separates the strong, solid rock of the uppermost mantle and crust above from the remainder of the strong, solid mantle below. The combination of uppermost mantle and crust above the asthenosphere is called the lithosphere. The lithosphere is free to move (glide) over the weak asthenosphere. The tectonic plates are, in fact, lithospheric plates.

Types of Waves Earthquakes

1. Primary Waves (P-Waves):

a) Travel from the point of happening by the displacement of surrounding particles.

b) They are transmitted through solids, liquids and gases.

c) Travels fastest.

2. Secondary Waves (S-Waves):

- Travels through solids only.
- Thus they cannot pass through core.

3. Surface Waves or Long Waves (L-Waves):

a) Travels on earth's surface and causes maximum destruction.

b) They are recorded after the P and S waves.

VOLCANOES

A volcano is generally a conical shaped hill or mountain built by accumulations of lava flows, and volcanic ash. About 95% of active volcanoes occur at the plate subduction zones and at the mid-oceanic ridges. Subduction is the process that takes place at convergent boundaries by which one tectonic plate moves under another tectonic plate and sinks into the mantle as the plates converge. Regions where this process occurs are known as sub-duction zones. The other 5% occur in areas associated with lithospheric hot spots. It is believed that hot spots are caused by plumes of rising magma that have their origin within the asthenosphere.

Types of Volcanoes

Geologists have classified five different types of volcanoes. This classification is based on the geomorphic form, magma chemistry, and the explosiveness of the eruption. The least explosive type of volcano is called a **basalt plateau.** These volcanoes produce a very fluid basaltic magma with horizontal flows. Deposits of these volcanoes can be as thick as 1800 meters. Large basalt plateaus are found in the Columbia River Plateau, western India, northern Australia, Iceland, Brazil, Argentina, and Antarctica. Some basaltic magmas can produce very large slightly sloping volcanoes, 6 to 12°, that have gently flowing magmas called shield volcanoes **Shield volcanoes** can be up to 9000 meters tall. The volcanoes of the Hawaiian Islands are typical of this type.

A cinder cone is a small volcano, between 100 and 400 meters tall, made up of exploded rock blasted out of a central vent at a high velocity. These volcanoes develop from magma of basaltic to intermediate composition. They form when large amounts of gas accumulate within rising magma. Examples of cider cones include Little Lake Volcano in California and Paricuti Volcano in Mexico.

Composite volcanoes are made from alternate layers of lava flows and exploded rock. Their height ranges from 100 to 3500 meters tall. The chemistry of the magma of these volcanoes is quite variable ranging from basalt to granite.

Magmas that are more granitic tend to be very explosive because of their relatively higher water content. Water at high temperatures and pressures is extremely volatile. Examples of composite volcanoes include Italy's Vesuvius, Japan's Mount Fuji, and Washington State's Mount Rainier and Mount St. Helens.

The most explosive type of volcano is the caldera.

Classification on the basis of Periodicity of Eruptions:

Active Volcano:

Volcanoes which erupt periodically. E.g. Maona Loa in Hawaii, Etna in Sicily, Vesuvius in Italy, Stromboli in Mediterranean Sea, etc.

Dormant Volcano:

Volcanoes which has been quiet for a long time but in which there is a possibility of eruption. E.g. Fujiyama in Japan, Krakatoa in Indonesia, Barren island Volcano in Andamans, etc.

Distribution of Volcanoes in the World

About 15% of world's active volcanoes are found along the 'constructive or divergent' plate margins, whereas 80% volcanoes are associated with the 'destructive or convergent' plate boundaries.

Earth Mountains

Types of Mountains

Fold Mountains of the World: They are formed when the rocks of the crust of the earth folded under stress, mainly by forces of

compression (as a result of series of earthquakes). **E.g.** – All big Mountain Systems: Himalayas, Alps, Andes, Rockies, Atlas, etc.

Old Mountains

They belong to pre-drift era, then subjected to denudation and uplift; many faults were formed; occur as relict mountains today. E.g. Pennines (Europe), Appalachians (US), Aravallis (India).

Relict Mountains: Sometimes, the mountains are carved out as a result of erosion of plateaus & high planes by various agents of erosion. E.g., Highlands of Scotland, Sierras of Spain, Catskill mountains of New York and Nilgiri, Parasnath, Girnar, Rajmahal of India.

ROCKS AND MINERALS

About 98 per cent of the total crust of the earth is composed of eight elements like oxygen, silicon, aluminium, iron, calcium, sodium, potassium and magnesium, and the rest is constituted by titanium, hydrogen, phosphorous, manganese, sulphur, carbon, nickel and other.

1) **The three types of rocks are**

a) Igneous rocks (formed directly from liquid rock),

b) Metamorphic rocks (formed by direct alteration of existing rocks), and

c) Sedimentary rocks (formed by eroded materials from other rocks).

a)Igneous Rocks

1) Igneous rocks solidify from a liquid magma as it cools. When magma cools rapidly, mineral crystals do not have time to grow very large. On the other hand when magma cools slowly crystals grow to several millimeters or more in size.

Granite and basalt are the examples of IR. Igneous rocks are classified as

a) Extrusive Rocks

Extrusive igneous rocks solidify from molten material that flows over the earth's surface (lava).

Common extrusive rocks are

i) basalt,

ii) andesite, and

iii) rhyolite.

b) Intrusive Rocks

Intrusive rocks form from molten material (magma) that flows and solidifies underground.

Common rock types within the intrusive category are granite and diorite.

ii. Sedimentary Rocks

These are types of rocks created from deposition of layers upon layers of sediments over time. These types of rocks are formed on the Earth's surface, as well as underwater.

Examples – Sandstone, limestone, stromatolites , oil shale and coal shale, gypsum, shale, and conglomerate.

iii. Metamorphic Rocks

Metamorphic rocks are any rock type that has been altered by heat, pressure, and/or the chemical action of fluids and gases. When igneous rocks, or sedimentary rocks, or even metamorphic rocks get buried very deep under the earth's surface, a process that takes millions of years, they get changed into something else by the enormous pressure and heat inside the earth.

"Some examples of metamorphic rocks are:

• Limestone being changed into marble

• Shale turning into slate

• Granite being changed into gneiss

• Sandstone turning into quartzite

ATMOSPHERE

Atmosphere is a thick gaseous envelope that surrounds the earth and extends thousands of kilometers above the earth's surface. Much of the life on the earth exists because of the atmosphere otherwise the earth would have been barren. Nitrogen and Oxygen comprise 99% of the total volume of the atmosphere.

Structure of the Atmosphere

The atmosphere consists of almost concentric layers of air with varying density and temperature.

a) Troposphere:

• Lowest layer of the atmosphere.

• The height of troposphere is 16 km thick over the equator and 10 km thick at the poles.

• All weather phenomena are confined to troposphere (e.g. fog, cloud, frost, rainfall, storms, etc.)

• Temperature decreases with height in this layer roughly at the rate of 6.5° per 1000 metres, which is called **normal lapse rate.**

• Upper limit of the troposphere is called **tropopause** which is about 1.5 km.

b) Stratosphere:

• The stratosphere is more or less devoid of major weather phenomenon but there is circulation of feeble winds and cirrus cloud in the lower stratosphere.

• Jet aircrafts fly through the lower stratosphere because it provides perfect flying conditions.

• Ozone layer lies within the stratosphere mostly at the altitude of 15 to 35 km above earth's surface.

• Ozone layer acts as a protective cover as it absorbs ultra-voilet rays of solar radiation.
• Depletion of ozone may result in rise of temperature of ground surface and lower atmosphere.
• Temperature rises from -60°C at the base of the stratosphere to its upper boundary as it absorbs ultra-voilet rays.
• Upper limit of the Stratosphere is called **stratopause.**

c) Mesosphere

• Mesosphere extends to the height of 50-90 km.
• Temperature decreases with height. It reaches a minimum of -80°C at an altitude of 80-90 km
• The upper limit is called **mesopause**.

d) Thermosphere

• It lies at 80 km to 640 km above the earth's surface.
• It is also known as ionosphere.
• Temperature increases rapidly with increasing height.
• It is an electrically charged layer. This layer is produced due to interaction of solar radiation and the chemicals present, thus disappears with the sunset.
• There are a number of layers in thermosphere e.g. D-layer, E-layer, F-layer and G-layer.
• Radio waves transmitted from earth are reflected back to the earth by these layers.

e) Exosphere

• This is the uppermost layer of the atmosphere extending beyond the ionosphere.
• The density is very low and temperature becomes 5568°C.
• This layer merges with the outer space. ---------
