

Earth's Structure

Introduction

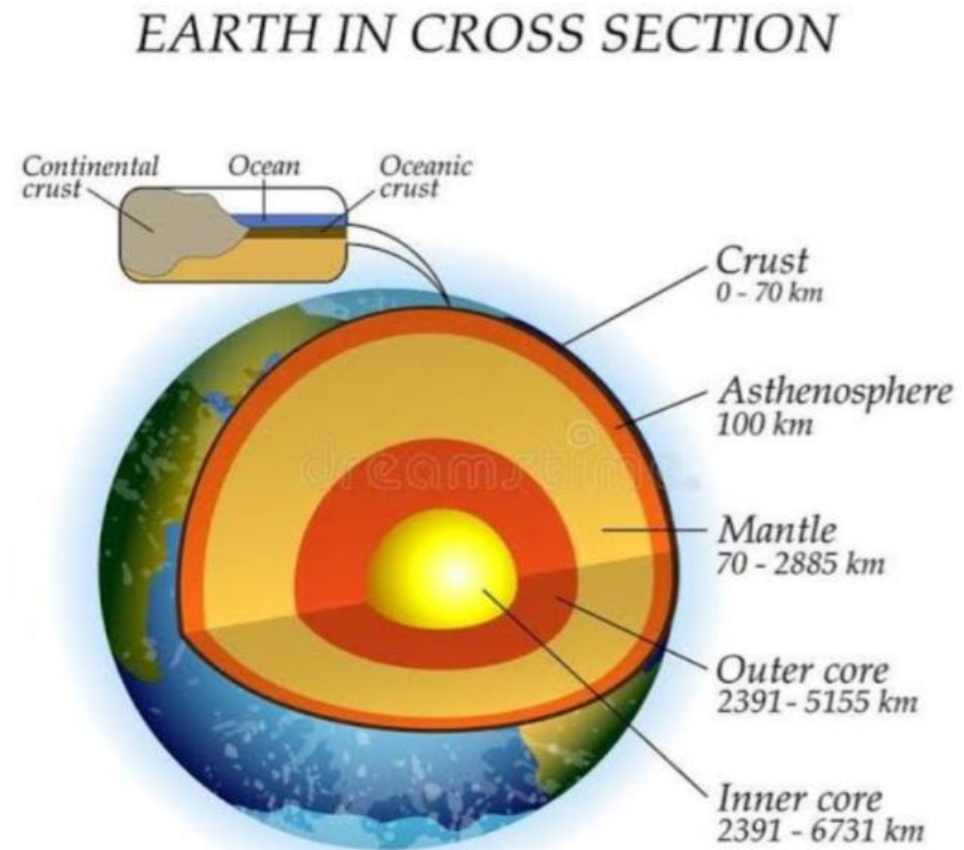
- Earth is a member of the planetary system of sun.
- The Earth is presented as a moving and terrestrial planet, which was formed 4.5 billion years ago.
- Earth's internal structure is layered.
- And its outward appearance is dynamic and formed by both internal and external forces.

Shape and Size of Earth

- The study of the earth structure is based on the layered structure and the density and temperature differences, at the sample depths.
- The earth is shaped like a spheroid with mean equatorial radius of 6378 -388 km. and polar radius of 6356-912 km.
- In short, the earth is a globe with a radius of 6371 kilometres.

Internal Structure of Earth

- One cannot directly view the inside of the earth because the inside grows hotter the deeper one goes into the earth as was convincingly shown by the volcano eruptions.
- Other valuable sources of information, although indirect, logically demonstrate that the earth body contains a number of layers, which are like shells overlapping each other, and this is in addition to the seismological studies.
- These layers are differentiated by their physical and chemical characteristics, especially, their thickness, depth and density, temperature, metallic content and rocks.
- The stratified arrangement of the earth-acquired in the course of its evolution out of a hot-gaseous condition to the form it now has.
- In the processes, the denser material sunk and the lighter one floated up and due to the inequality of the densities of the constituent materials that make up the earth, they were separated and formed layers of varying densities. In general, the interior of the earth has been subdivided into three large sections:



Internal Structure of Earth

The Crust

- It is the uppermost layer of the earth.
- It is 5 to 10 kms thick on the over the oceanic areas and on the continental area, it is 35 kms with 55 to 70 ks in orogenic .
- The crust of the earth is broken down to sub layers: (i) Sial (ii) Sima
- (1) Sial. It is also referred to as the Upper-Continental-Crust. It is a combination of all sorts of rocks such as igneous, sedimentary and metamorphic rock that are brought about at the land-surface. It contains a lot of silica and aluminium. It is normally granitic or grano-dioritic in composition. On the ocean-basins, they are capped by a basaltic-horizon richer in aluminium and poorer in potassium than the basalts of the land-surface and are known as 'Oceanic-tholeiites'. Conrad Discontinuity separates the sial-layer with the under-lying sima-layer. This is a second-order discontinuity, and it occurs at the depth of 11 kms.
- (ii) Sima. It is referred to also as Lower-Continental crust. Its thickness is about 22 kms. It includes two parts: (a) Outer Sima (b) Inner Sima. Together they are formed out of basaltic nature and it is a layer that contains silica and magnesium. (a) Outer sima, this expands to depth of 19 kms and is made of rocks of intermediate composition. (b) Inner sima is found at the depth of 19 kms and is spread up to the depth of 33 kms. It is basic to ultra basic in composition.
- The topmost horizon of the crust is comprised of lithosphere.
- Asthenosphere is the layer of the earth below the lithosphere that does not have strength to resist deformation practically.

Internal Structure of Earth

The Mantle

- The Mohorovicic -Discontinuity is a first-order discontinuity that separates it with the over-lying crust. Its thickness is about 2865 kms.
- Assuming that forms 83 percent of the earth in terms of volume and 68 percent in terms of mass.
- Most of the internal energy of the earth and forces that cause ocean-bottom spreading, continental drift, orogeny and major earthquakes have their origin in it.
- The composition of mantle are mainly olivine, pyroxene, peridoite and garnet
- The upper mantle is believed to consist of 3 parts of ultramafic rocks and 1 part of basalt and the mix has been called Pyrolite.
- The lower mantle lies between 1000km and core-boundary. In the mantle, various second-order discontinuities have been identified and these are the following: (i) Density break at 80 km depth; density is 3'36 its density above level is 3.87 below level level, respectively. At the point of (ii) depth of 150 km the gravity is broken; the gravity is no longer 984 cm/sec but 974 cm/sec and then up to 1200 kms. (iii) The depth of the 700 km, we have the alteration of the ability of the materials to store quantity of elastic-strain energy. The capability up to 700 kms is more.
- Repetiti discontinuity. At 950 km depth. It indicates the weak end of the extremely rapid increase in the speed of the seismic vibrations. (v) Gravity-break. The minimum value of gravity in the depth of 1200 km i.e. 974 cm/sec increases to 1068 cm/sec at the core-boundary.
- D" layer : This is just above the core-mantle boundary in the very bottom of the lower mantle. Characteristics: An uneven and geologically active transition zone that is of variable thickness. It is thought to be a remnant of the primitive earth, possibly consisting of a giant collision that resulted in the formation of a magma ocean on Earth. Has layers of great electrical conductance and ultra-low velocity zones. Significance: It is one of the areas where the subducting tectonic plates can end. It is believed to be the origin of deep mantle plumes, the upwellings of hot rocks of the mantle. Recent studies have indicated evidence of the existence of water and a distinct iron-peroxide enriched phase in this layer which changes the mineral composition of the layer.

Internal Structure of Earth

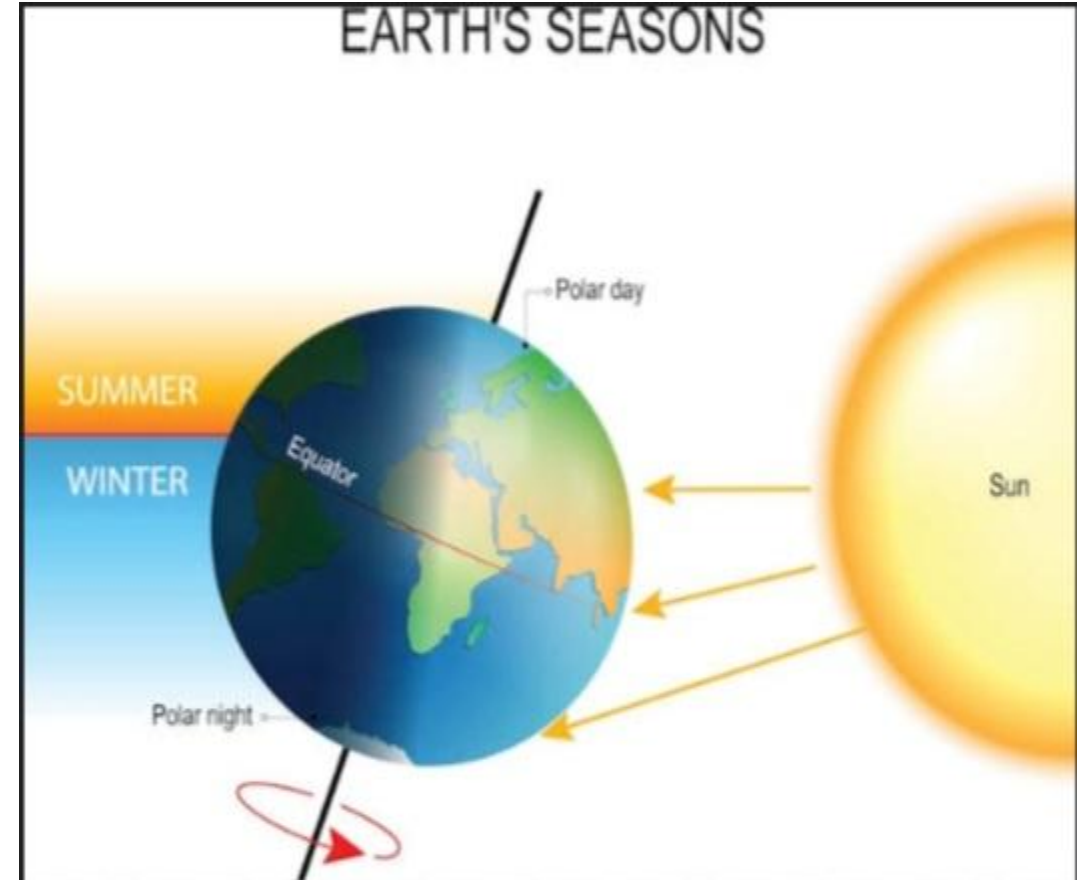
The Core

- It is subdivided by the Guttenberg Weichert Discontinuity between it and the mantle and fuses to the centre of the earth.
- It consists of three parts: (1) Outer-core, (ii) Middle-core, and (iii) Inner-core.
- (i) Outer core. It extends from 2900 to 4982 kms. It is assumed to be in the state of homogeneous fluid and does not transmit S-Waves.
- (ii) Middle core. It is a transient layer which has a length ranging between 4982 kms to 5121 kms. It is a fluid-semi-fluid material.
- (iii) Inner core. They have metallic nickel and iron and it is known as nife. It is likely solid and is likely to have a density of approximately 18. Its thickness is 1250 kms.
- Other Important Facts It is estimated to have a central-temperature of 6000degC. The 392×10 bars of C.G.S unit is the central-pressure.
- Density at the centre is 18 gm/cm³. up to a depth of about 16 km.
- The composition of core are Nickel and Iron.

Effects of Earth Structure

Seasons

- Varying intensity of sunlight: The earth rotates around the sun and therefore one side of the Earth faces the sun at an angle at some point in the year and the sun is on the other side.
- Summer: When one hemisphere is bent up to the sun, that hemisphere will get more direct sunlight, thus, it will have longer days and be hot.
- Winter: As the same hemisphere becomes tilted so as to face the sun, fewer direct rays of sunlight reach it and consequently, days are shorter and the weather is colder.
- Solstices: The longest (summer) and shortest (winter) days of the year are these when one hemisphere is the most inclined to the sun (longest day) or inclined to the other (shortest day).
- Equinoxes: These are the two points of the orbit where the two hemispheres are neither tilted towards nor away the sun and hence, have approximately equal amounts of daylight or darkness across the earth.

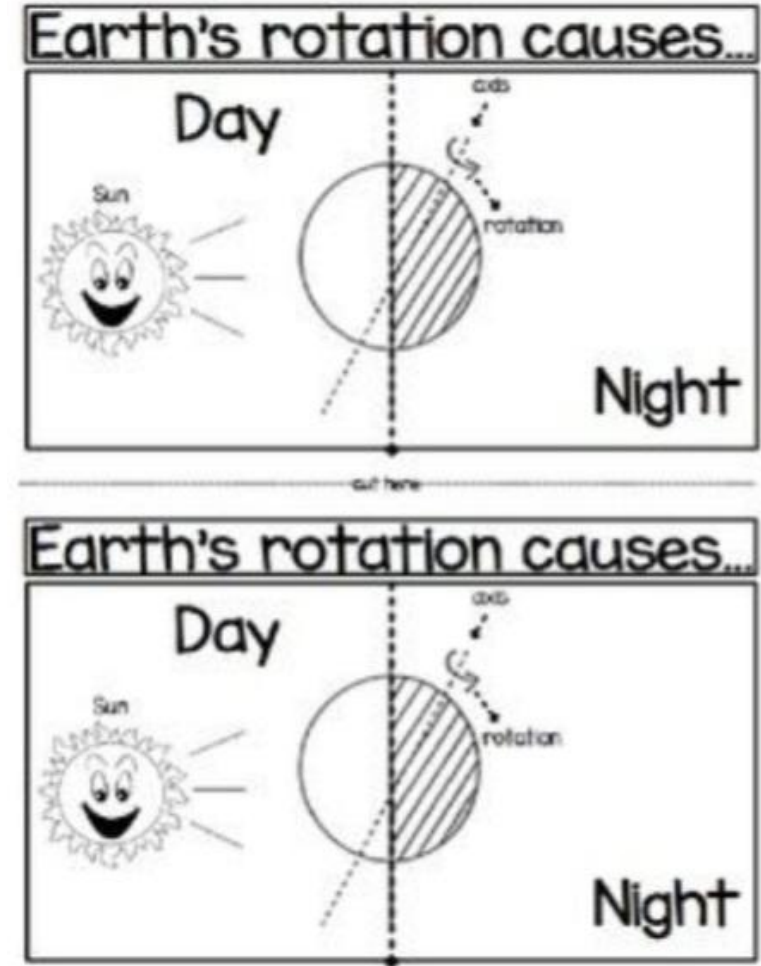


Effects of Earth Structure

Day n night - The rotation of the Earth provides the day-night cycle as the planet is rotated and one side is turned towards the Sun during the day and the other side turned away during the night. Seasons are not due to day-night cycle, but it is the axial tilt of the Earth of about 23.5 degrees, which causes the difference in the duration of days and nights during a year.

Magnetic field- The magnetic field of the Earth is produced due to the flow of molten iron and nickel in the outer core of the earth a phenomenon that is referred to as the geodynamo. The rotation of the inner core may vary and hence influences the magnetic field and may lead to variations in the position of the magnetic pole. The variations of core spin may also vary the length of a day slightly

Pic - google



Effects of Earth Structure

- **Coriolis effect:** Directional movement of air and water that surrounds the earth is changed by its rotation, this affects the development of prevailing winds, ocean currents and storms. Heat circulation: It is the winds and ocean currents which because of the Coriolis effect contribute to the distribution of heat in the equator to the poles, and with global temperatures balanced.
- **Climate Zones:** The regular distribution of solar radiation and temperature due to the tilt and revolution establish the general climatic zones (tropical, temperate, polar) all over the earth.
- **Wind and Ocean Currents:** The Coriolis effect is responsible as to why the masses of air and water are deflected in the directions of right and left respectively in the Northern and Southern Hemisphere to cause large-scale circulation patterns such as trade winds, westerlies, and gyres in the oceans. This re-distributes heat and moisture on the planet.
- **Weather Systems:** Cyclones and hurricanes move in opposite directions between the two hemispheres as a result of Coriolis effect (anti-clockwise in the North, clockwise in the South).
- **Tides:** As our planet starts rotating, its gravitational force, coupled with that of the Moon and the Sun, results in tides that rise and fall (in most locations, the ocean waters rise and fall twice a day).
- **The Shape of the Earth:** Rotation means that the centrifugal force causes the Earth to become a little bulky at the equator and flatten at the poles, which causes the Earth to take the shape of an oblate spheroid form.

THANK YOU