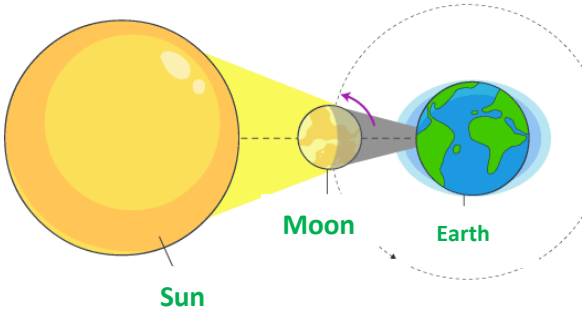
Crust, Core, Mantle of Earth, Lunar and Solar Eclipse, Tides

Solar Eclipse

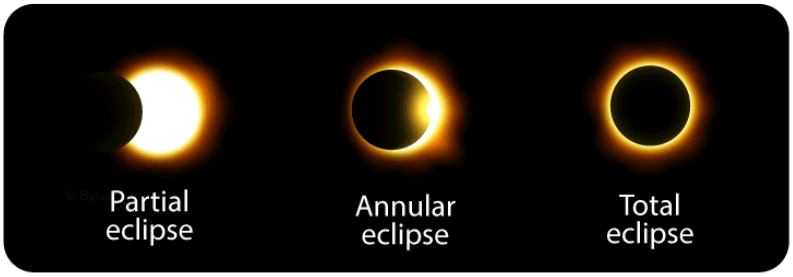
Also known as the eclipse of the sun, it occurs when the moon comes in between the sun and the earth. As a result, the moon blocks the light of the sun from reaching the earth's surface and casts a shadow on it. This occurs on a new moon phase. We can observe up to 5 solar eclipses per year.



Solar Eclipse

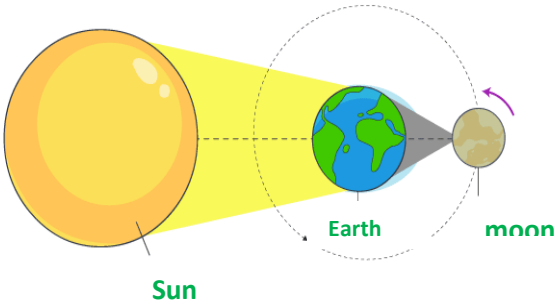
Depending on the distance of the moon from the earth during the event, different types of solar concealment can be observed. They can be categorized as:

- **Partial:** When the moon does not align completely with the sun and so only a portion of the sunlight is blocked from reaching the earth.
- **Annular:** When the moon covers the sun but the sun can be seen around the edges of the moon giving an impression of the sun is a bright ring surrounding the dark disc of the moon.
- **Total:** When the sun is completely covered by the moon. The sky becomes so dark that it appears to be night. Only a small area on the earth can witness it.



Lunar Eclipse

Also known as the eclipse of the moon, it occurs when the earth comes in between the sun and the moon. As a result, the earth blocks the light of the sun from reaching the moon's surface and casts its shadow on the moon. It occurs on a full moon day. We can observe up to 3 lunar eclipses per year.



Lunar Eclipse

Depending on how the sun, the moon, and the earth line up, lunar eclipse too can be categorized as:

- **Partial**: When only a part of the moon moves into the shadow of the earth.
- **Total**: When the earth passes directly in front of the moon and casts its shadow on the full moon.

Tides

- Tide are the **periodical rise and fall of the sea levels**, once or twice a day, caused by the combined effects of the gravitational forces exerted by the sun, the moon and the rotation of the earth.
- They are a vertical movement of waters and are different from movements of ocean water caused by meteorological effects like the winds and atmospheric pressure changes.
- Note: The water movements which are caused by the meteorological effects like the said above are called as **surges** and they are not regular like tides.
- The moon's gravitational pull to a great extent is the major cause of the occurrence of tides (the moon's gravitational attraction is more effective on the earth than that of the sun).

- Sun's gravitational pull and the centrifugal force due to the rotation of earth are the other forces which act along with the moon's gravitational pull.

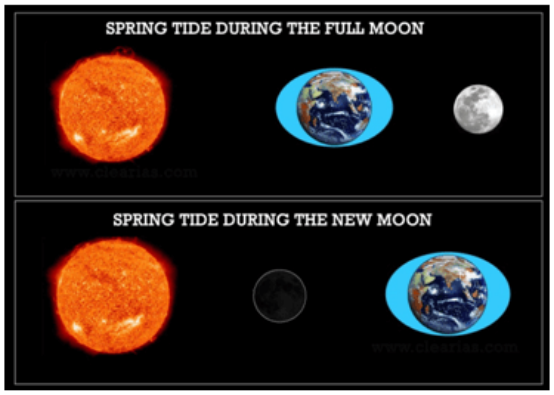
Types of Tides

A. TIDES BASED ON THE FREQUENCY

1. **Semi-diurnal Tide**: They are the most common tidal pattern, featuring two high tides and two low tides each day.
2. **Diurnal Tides**: Only one high tide and one low tide each day.
3. **Mixed Tide**: Tides having variations in heights are known as mixed tides. They generally occur along the west coast of North America.

B. TIDES BASED ON THE SUN, THE MOON, AND THE EARTH'S POSITIONS

1. **Spring Tides**: When the sun, the moon, and the earth are in a straight line, the height of the tide will be higher than normal. These are called as a spring tides. They occur twice in a month-one on the full moon (Poornima) and the other on the new moon (Amavasya).



2. **Neap Tides**: Normally after seven days of a spring tide, the sun and the moon become at a right angle to each other with respect to the earth. Thus, the gravitational forces of the sun and the moon tend to counteract one another. The tides during this period will be lower than the normal which are called as the neap tides. They also occur twice in a month- during the first quarter moon and the last quarter moon.

The Crust

The crust is the outermost layer of the earth making up 0.5-1.0 per cent of the earth's volume and less than 1 per cent of Earth's mass.
Density increases with depth, and the average density is about 2.7 g/cm3 (average density of the earth is 5.51 g/cm^3).
The thickness of the crust varies in the range of range of 5-30 km in case of the oceanic crust and as 50-70 km in case of the continental crust.
The continental crust can be thicker than 70 km in the areas of major mountain systems. It is as much as 70-100 km thick in the Himalayan region.
The temperature of the crust increases with depth, reaching values typically in the range from about 200 °C to 400 °C at the boundary with the underlying mantle.

The temperature increases by as much as 30 °C for every kilometre in the upper part of the crust.
The outer covering of the crust is of sedimentary material and below that lie crystalline, igneous and metamorphic rocks which are acidic in nature.
The lower layer of the crust consists of basaltic and ultra-basic rocks.
The continents are composed of lighter silicates — silica + aluminium (also called sial) while the oceans have the heavier silicates — silica + magnesium (also called sima) [Suess,1831–1914 — this classification is now obsolete (out of date)].
The continental crust is composed of lighter (felsic) sodium potassium aluminium silicate rocks, like granite.
The oceanic crust, on the other hand, is composed of dense (mafic) iron magnesium silicate igneous rocks, like basalt.

core of earth

The Outer Core

The outer core, surrounding the inner core, lies between 2900 km and 5100 km below the earth's surface.
The outer core is composed of iron mixed with nickel (nife) and trace amounts of lighter elements.
The outer core is not under enough pressure to be solid, so it is liquid even though it has a composition similar to the inner core.
The density of the outer core ranges from 9.9 g/cm3 to 12.2 g/cm3.
The temperature of the outer core ranges from 4400 °C in the outer regions to 6000 °C near the inner core.
Dynamo theory suggests that convection in the outer core, combined with the Coriolis effect, gives rise to Earth's magnetic field.

The Inner Core

The inner core extends from the centre of the earth to 5100 km below the earth's surface.
The inner core is generally believed to be composed primarily of iron (80%) and some nickel (nife).
Since this layer can transmit shear waves (transverse seismic waves), it is solid.
(When P-waves strike the outer core – inner core boundary, they give rise to S-waves)
Earth's inner core rotates slightly faster relative to the rotation of the surface.
The solid inner core is too hot to hold a permanent magnetic field.
The density of the inner core ranges from 12.6 g/cm3 to 13 g/cm3.
The core (inner core and the outer core) accounts for just about 16 per cent of the earth's volume but 33% of earth's mass.

Scientists have determined the temperature near the Earth's centre to be 6000° C, 1000° C hotter than previously thought.
At 6000°C, this iron core is as hot as the Sun's surface, but the crushing pressure caused by gravity prevents it from becoming liquid.

The Mantle

It forms about 83 per cent of the earth's volume and holds 67% of the earth's mass.
It extends from Moho's discontinuity to a depth of 2,900 km.
The density of the upper mantle varies between 2.9 g/cm3 and 3.3 g/cm3.
The lower mantle extends beyond the asthenosphere. It is in a solid state.
The density ranges from 3.3 g/cm3 to 5.7 g/cm3 in the lower mantle.
The mantle is composed of silicate rocks that are rich in iron and magnesium relative to the overlying crust.
Regarding its constituent elements, the mantle is made up of 45% oxygen, 21% silicon, and 23% magnesium (OSM).
In the mantle, temperatures range from approximately 200 °C at the upper boundary with the crust to approximately 4,000 °C at the core-mantle boundary.
Because of the temperature difference, there is a convective material circulation in the mantle (although solid, the high temperatures within the mantle cause the silicate material to be sufficiently ductile).
Convection of the mantle is expressed at the surface through the motions of tectonic plates.
High-pressure conditions ought to inhibit seismicity in the mantle. However, in subduction zones, earthquakes are observed down to 670 km (420 mi).