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UPPSC - CSE

Combined State / Upper Subordinate Services Examination

Prelims & Mains

Uttar Pradesh Public Service Commission, Prayagraj

General Studies

Paper 1 – Volume 4

Geography of World

SIERRA INNOVATIONS

Uttar Pradesh Public Service Commission

Geography of World

Paper – 1 Volume 4

1 CHAPTER Universe and the Solar System

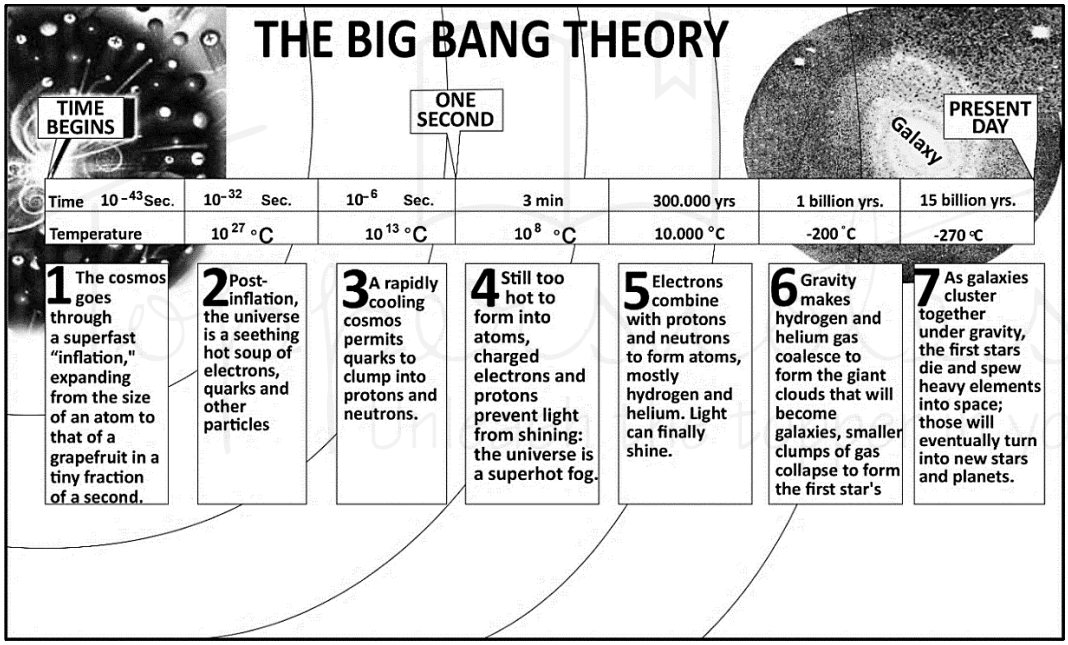
Year		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Pre	Mains	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-

Origin of the Universe

- **Universe: Everything that exists**, including **distant stars, planets, and satellites,** as well as our own planet and all of its people.

Theories about origin of Universe:

1. Big Bang theory



- The most popular argument regarding the origin of the universe .
- aka expanding universe hypothesis.
- Edwin Hubble in 1920 proved that the universe is expanding .
- Took place 13.7 billion years before the present.
- Galaxies move further and further apart with time and thereby, the universe is considered to be expanding.
- Scientists believe that though the space between the galaxies is increasing, observations do not support the expansion of galaxies.

- Stages in the development of the universe:
  - Beginning- All matter forming the universe existed in one place as a "tiny ball" (singular atom) with an unimaginably small volume, infinite temperature and infinite density.
  - Big Bang- "Tiny ball" explodes violently which led to a huge expansion.
    - The expansion continues even to the present day.
    - As it grew, some energy was converted into matter.

    - Rapid expansion within fractions of a second after the bang- later, it slowed down.
    - Within the first 3 minutes from the Big Bang event, the first atom began to form.
    - Within 300,000 years from the Big Bang, temperature dropped to 4,500K and gave rise to atomic matter.
    - The universe became transparent.
- Common misconception:
    - Gives the complete origin of the universe but it does not describe the energy, time and space involved in the creation of the universe.
    - Only explains how the universe emerged from its initial high-temperature state.
    - Only describes the size of the observable universe and not the universe as a whole
- Evidences of Big Bang
    - Expanding galaxies:
        - Hubble in 1929 noted that galaxies outside our own Milky Way were all moving away from us, at a speed proportional to its distance from us.
        - Realized that there must have been an instant in time (now known to be about 14 billion years ago) when the entire Universe was contained in a single point in space.
        - The Universe must have been born in this single violent event which came to be k/a "Big Bang."
- Cosmic Background radiation:
    - Early photons ,the afterglow of the Big Bang k/a cosmic background radiation (CBR) can be observed even today.

2. Pulsating theory
- Universe is believed to be pulsing, expanding and shrinking alternately,
- According to this theory, the universe's expansion may be halted by gravitational attraction at some point in the future, causing it to compress again.
- After it has been constricted to a particular size, it will explode again, and the universe will begin to expand.
- The pulsating universe is created by the universe's parallel expansion and contraction.

Components of the Universe

Galaxy

- Collection of millions or billions of stars, gas and dust, bound together by gravity.
- Mainly divided into four types viz. elliptical, normal spirals, barred spirals and irregular.

Milky Way Galaxy
- Shape- spiral.
- Has a disk-shaped structure - diameter of roughly 100000 light years.
- Around its centre, the Milky Way galaxy rotates gently in a counter-clockwise manner.
- Centre- All stars (including the sun and the solar system) rotate.
- Appears like a river of light flowing from one corner to the other in the night sky, therefore k/a Akash Ganga.

Stars

- Incredibly hot celestial beings that generate their own light.
- Massive clouds of hydrogen gas, helium, and dust.
- 3 types as per their colour and temperature:
    - Red: low surface temperatures
    - White: high surface temperatures
    - Blue: very high surface temperatures
- In the night sky, all stars (save the pole star) appear to travel from east to west- caused by the earth's rotation on its axis.
- The monthly locations of the stars fluctuate- due to interaction between the rotation of the earth around its axis and the orbit of the earth around the sun.

#Birth and Evolution of a Star
- Raw material for star formation- Hydrogen.
- Beginning of a star's life cycle- formation of thick clouds of hydrogen and helium gas (i.e. Nebula) in galaxies.
- Birth - caused by the gravitational collapse of these too thick clouds of gases in the galaxy.

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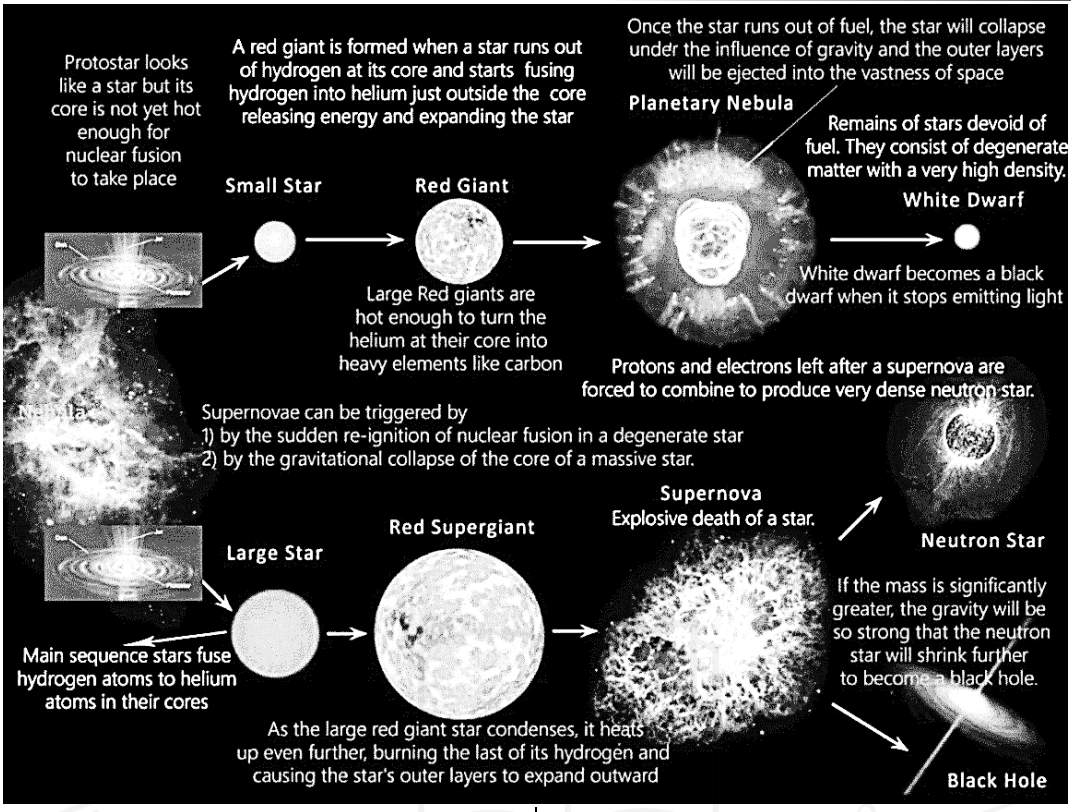


ProtoStar

- Resembles a star, but core not heated enough for nuclear fusion to occur- occurs only when the initial temperatures are very high - hard to achieve and control.
- Difficult to view - frequently covered by dust, which filters the light they emit.

T Tauri Star

- Young (< 10 million years old) , light star experiencing gravitational contraction .
- Intermediate stage between a Protostar and a low-mass main sequence star.

Main sequence stars of fusion ignition

- Hydrogen + helium.
- Make up the vast majority of stars in the universe (about 90%).
- A star like the Sun swells up to become a red giant at the end of its life, before shedding its outer layers as a planetary nebula and finally decreasing to become a white dwarf.

Final Stages of a Star's Life

- Enters red-giant phase- becomes a red-giant star.
- Can then die out by becoming a white dwarf star or exploding as a supernova star development of neutron stars and black holes, depending on its mass.
- White dwarf - tiny hot star that is at the end of its life cycle - leftovers of regular stars that have exhausted their nuclear energy reserves.

NOVA

- Occurs on the surface of a white dwarf.
- If two stars in the system are close enough together, material (hydrogen) from the partner star's surface can be transferred onto the white dwarf.
- When enough material accumulates on the surface of a white dwarf, nuclear fusion occurs, resulting in a dramatic brightening of the star.

Supernova

- Star's rapid death causes it to brighten to the brightness of 100 million suns for a brief period of time.
- The very bright burst of radiation disperses most or all of a star's material at a high velocity, causing a shock wave to propagate into the interstellar medium.
- These shock waves cause condensation in a nebula, opening the way for the formation of a new star.
- Responsible for a large amount of primary cosmic rays.

Black Dwarf

- **Last stage** of star development.
- It is a **white dwarf that has cooled** to the point that **no substantial heat or light is emitted.**
- **No black dwarfs are projected to exist** in the universe yet since the time necessary for a white dwarf to achieve this condition is calculated to be greater than the universe's current age.

Brown Dwarfs

- Objects that are **too big to be planets** but **not big enough to be stars.**
- C**onsidered to develop** from a collapsing cloud of gas and dust in the **same manner as stars do.**
- The **centre** of the cloud, however, is **not thick enough to start nuclear fusion** when the cloud falls.

Neutron Stars

- Stars that **emit neutrons.**
- Mostly **made up of neutrons.**
- F**ormed during supernova** pushing protons and electrons to combine to form a neutron star.
- **High density stars** (A sphere with a diameter of merely 20 kilometres can hold three times the mass of the Sun).
- If it has a **larger mass**,and **intensely high gravity** shrinking it even further, eventually becoming a black hole.

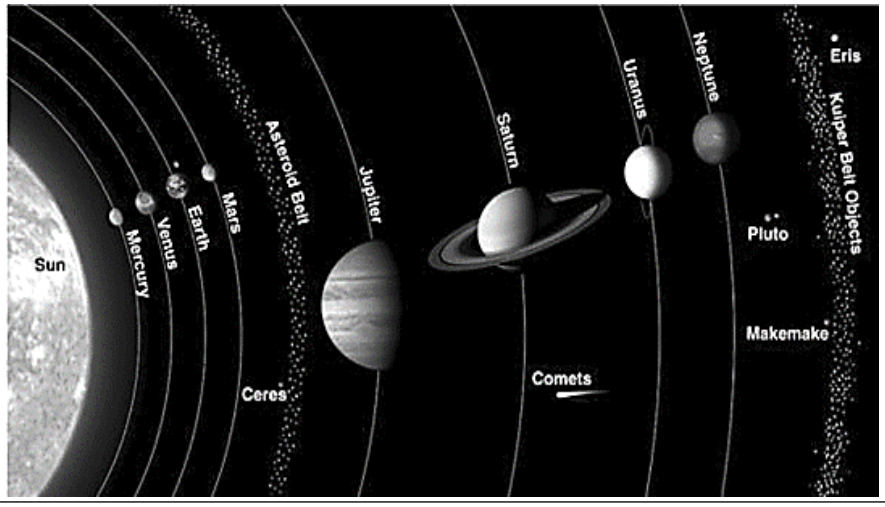
Black Holes

- At the end of their lives, **big stars are believed to create black holes.**
- **Gravitational pull is so strong** that nothing, **not even light, can escape it.**
- A black hole's **matter density can't be measured** (it's infinite!).
- W**arp space around them** and can pull nearby objects, including stars, into them.

Dark matter

- A kind of matter hypothesised in astronomy and cosmology to account for a significant amount of the **universe's mass that appears to be absent.**
- **Invisible to telescopes**- does not emit or absorb significant amounts of light or other electromagnetic energy.
- **A black hole is not the same as dark matter.**
- **Unknown elements** of dark matter.
- Might be a swarm of black holes, a dwarf, or a whole new particle.

Solar System

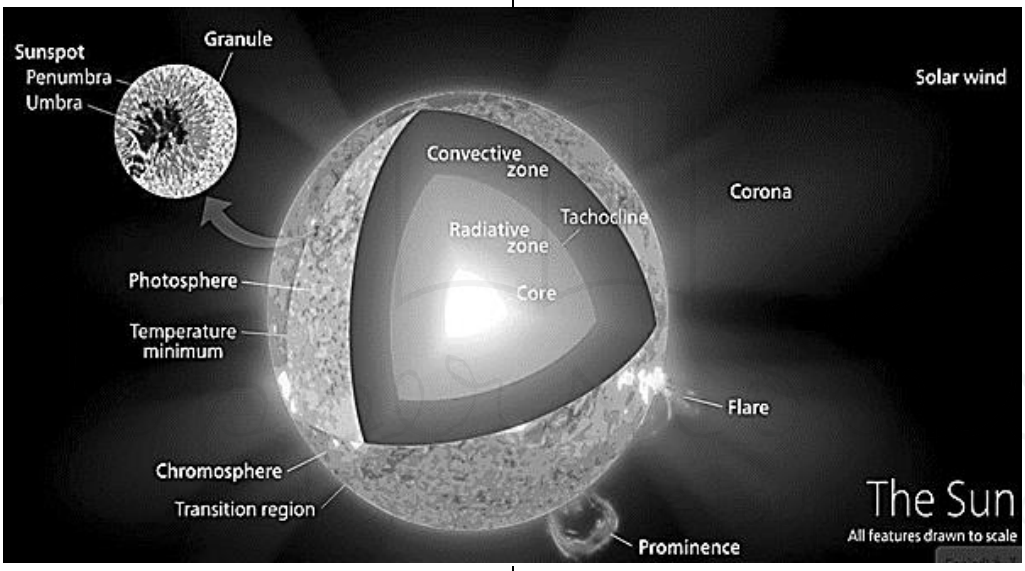


- **Age**: 4.6 **billion years old**
- **Distance:** 27,000 light years from the Milky Way's centre.
- **Components - sun, eight planets and their satellites + asteroids, comets, and meteors.**
- Sun- **centre of the solar system**.
- The sun's **gravitational influence maintains** the whole **solar system** rotating around it sun's **gravitational pull determines velocity** of all solar system **components**.
- ~ **99.9% of the matter in the solar system - from the sun.**

Sun

- **Age**: 4.6 billion years.
- **Diameter**: 1.39 million km.
- **Temperature**:
  - **Surface**- 6000 °C on surface
  - **Core:** 16 million ^{0}C
- **Density**: 1.41 times that of water.
- **Rotation time**: 25 days and 9 hours.
- **Rotational speed:** 7179.73 km/h. (rotates **counter-clockwise)**
  - The **earth's rotational velocity** is 1675 kilometres per hour.
- **Mass**: 3,32,900 times of Earth masses.
- **Distance**: 150 million kilometres away from Earth
- **Time taken by light to reach earth**: 8 minutes and 20 seconds.

Time taken by light to reach Earth from the closest star, proxima centauri : 4.3 light years.



Internal Structure and Atmosphere of the Sun

- **Solar interior - core, radiative zone** and the **convective zone.**
- **Solar atmosphere - photosphere, chromosphere,** and the **corona** (solar wind is an outflow of gas from the corona).
- **Photosphere**
  - **Bright outer layer of the Sun** emits most radiation.
  - Extremely **uneven surface.**
  - **Effective temperature** on the outer side of the photosphere- **6000°C**.
- **Chromosphere**
  - **Just above the photosphere** is the chromosphere.
  - **Relatively thin layer** of burning gases.
  - The chromosphere is **a bit cooler — 4,320°C.**
- **Corona**
  - **Atmosphere of plasma** that **surrounds the Sun** and other celestial bodies.
  - **Stretches millions of kilometres into space** and may be **viewed best during a total solar eclipse.**

Plasma

- **Ionised gas** (atoms and molecules are converted into ions typically by removing one or more electrons from the outer shell)
- **Eg. Lightning and electric sparks** -made from plasma.
- **Neon lights - 'plasma lights'-** light comes from the plasma inside of them.

- **Sunspot**
  - **Dark patch on the surface of the Sun.**
  - **Appear as dark areas** - as **about 500-1500°C cooler than the surrounding chromosphere.**

- Has a lifetime ranging from a few days to a few months.
- Each spot has a black centre or umbra, and a lighter region or penumbra, surrounding it.
- Sun - 1% cooler when it has no sunspot and that this variation in solar radiation might affect the climates of the Earth.

- Solar prominence
  - An arc of gas that erupts from the surface of the Sun.
  - Can loop hundreds of thousands of miles into space.
  - Held above the Sun's surface by strong magnetic fields and can last for many months.
  - Later they erupt, spewing enormous amounts of solar material into space.
- Solar Wind
  - Stream of energised, charged particles, primarily electrons and protons, flowing outward from the Sun.
  - Speeds upto 900 km/s and at a temperature of 1 million degrees (Celsius).
  - Made of plasma (ionised atoms).
- Solar Flares:
  - Magnetic anomalies cause solar flares to form on the sun's surface.
  - Magnetic storms that seem like brilliant spots with a gaseous explosion on the surface.

Impact of Solar winds:

1. Aurora
   - A natural light show in the sky - commonly observed in high latitudes (Arctic and Antarctic). (This is due to the earth's magnetic field lines and the solar wind.)
   - Caused by Charged particles (electrons and protons), entering the atmosphere from above, creating ionisation and excitation of atmospheric elements, as well as visual emissions.
2. Some planets have atmospheres, while others don't.
   - Solar wind particles have a well-developed magnetic field - reach the planet - deflected.
   - Magnetosphere -
     - Region around a planet dominated by the planet's magnetic field- Earth has the strongest magnetosphere of all the rocky planets.
     - Overall shape is determined by the solar wind.
     - Planets with a weak / non-existent magnetosphere - prone to solar wind atmospheric stripping.
     - Side facing the Sun- magnetosphere is generally shaped like a hemisphere,
     - Opposite side- extends in a lengthy trail.
   - Magnetopause -
     - Abrupt boundary between a magnetosphere and the surrounding plasma.
     - Boundary between the planet's magnetic field and the solar wind.

Planets

- A celestial body that orbits a star in an elliptical path.
- 2 groups:
  - Terrestrial Planets-
    - Inner planets (as they lie between the sun and the belt of asteroids)
    - Have smaller and denser bodies
    - Composition- silicates and metals.
    - Dense, rocky compositions, few or no moons, and no ring systems.
- Mercury (Buddh):
  - Smallest and closest to the sun.
  - Distance from Sun: 57.91 million km
  - Orbital period: 87.97 Earth days,(Shortest)
  - Length of day: 58d 15h 30m
- Venus (shukr):
  - Brightest planet in the solar system (morning/ evening star)
  - Rotates in anticlockwise direction
  - The hottest planet in the Solar System- high concentration of CO_2 and thick atmosphere.
  - Distance from Sun: 108.2 million km
  - Orbital period: 225 days
  - Length of day: 116d 18h 0m
- Earth (Prithvi):
  - Only known planet to sustain life.
  - Distance from Sun: 149.6 million km
  - Age: 4.543 billion years
  - Orbital period: 365 days
  - Natural Satellite: MOON
- Mars (Mangal):
  - Red Planet: Presence of iron oxide on surface
  - Length of day: 1d 0h 37m
  - Distance from Sun: 227.9 million km
  - Orbital period: 687 days
  - Natural satellites: Phobos, Deimos
  - Jovian planets / Gas Giants -

- planets of outer circle
- Have a greater size and less dense materials.
- They usually have a thick atmosphere, consisting of helium and hydrogen.

- Jupiter(Brhaspati):
  - Largest planet of the solar system
  - Length of day: 0d 9h 56m
  - Distance from Sun: 778.5 million km
  - Age: 4.603 billion years
  - Orbital period: 12 years
  - Natural satellites:Io, Europa, Ganymede, and Callisto(called the Galilean satellites because Galileo discovered them.)
    - Saturn(shani)
      - Saturn's rings are probably made up of billions of particles of ice and ice-covered rocks.
      - Length of day: 0d 10h 42m
      - Distance from Sun: 1.434 billion km
      - Orbital period: 29 years
      - Moons: Titan, Enceladus, Mimas, Tethys, etc.
      - Titan - second-largest moon in the Solar System (larger than Mercury)
      - Only satellite in the Solar System with a substantial atmosphere (nitrogen-rich).
    - Uranus(arun)
      - Rotates in clockwise direction i;e opposite of the sun's rotation.
      - Length of day: 0d 17h 14m
      - Distance from Sun: 2.871 billion km
      - Orbital period: 84 Years
      - Natural satellites:Miranda, Ariel, Umbriel, Titania, and Oberon.
    - Neptune(Varun)
      - Farthest known planet
      - Uranus and Neptune - Twin planets.
      - Strongest sustained winds (2,100 km/h) of any planet in the Solar System found here.
      - Length of day: 0d 16h 6m
      - Distance from Sun: 4.495 billion km
      - Orbital period: 165 years
      - Natural satellites: Triton, Hippocamp, Proteus, Nereid,etc.

Asteroids

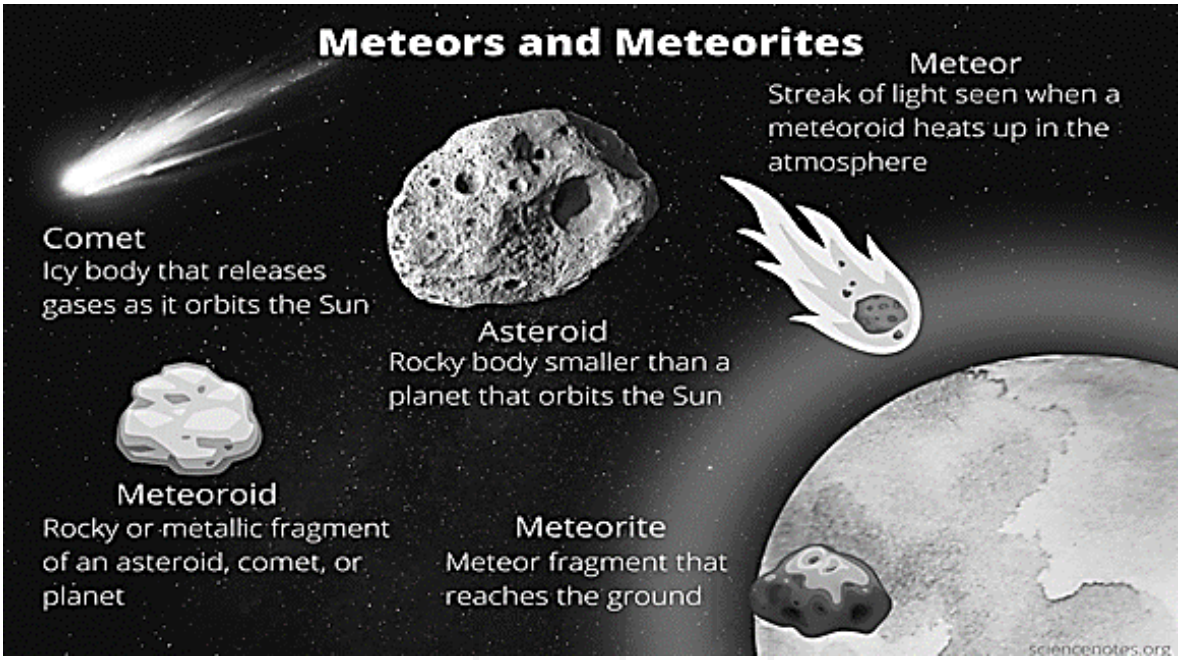
- Rocky remains left over from the formation of the solar system.
- These remains failed to consolidate due to Jupiter's gravitational influence.
- Composition - refractory stony and metallic materials, with some ice.
- Size- microscopic to hundreds of kilometres.
- Ceres - largest asteroid (946 km in diameter), a protoplanet, and a dwarf planet.
- All other asteroids are considered as tiny Solar System bodies.

Kuiper Belt:
- A circumstellar disc in the outer Solar System.
- Spans 30 AU from Neptune's orbit to around 50 AU from the Sun.
- Pluto (39 AU)- largest known object in the Kuiper belt.

Oort cloud
A giant shell of icy bodies that encircle the solar system occupying space at a distance between 5,000 and 100,000 AU.

Comets

- An icy small solar system body- heats up (when passing close to the Sun) due to solar
- radiation and the solar wind - begins to outgas (release gases) - atmosphere and sometimes a tail visible .
- Have highly elliptical orbits.
- Composition- Stony and metallic minerals held together by frozen gases (water, ammonia, methane, and carbon dioxide).
- Types:
- Short-period comets - orbital period - 100 years- generally originate in the Kuiper belt.
- Long period comets - orbital period - thousands of years, come from the more distant Oort Cloud.



- **Meteoroid:** Any **solid debris originating from asteroids, comets, or other astronomical objects that drifts across interplanetary space.**
- **Meteor:** A **flash of light that emerges in the sky when a meteoroid hits the atmosphere** (mesosphere) at a high speed and **burns up due to friction**. Sometimes known as a **'shooting star' or a 'falling star.'**
- **Meteorite:** When a **meteoroid does not burn entirely and lands** on the surface of the Earth.

Meteorite crater:

- A **circular depression generated on the earth's surface** as a result of a **meteorite impact.**
- Most **visible meteorite craters - Moon and Mercury's surfaces** (because they are geologically inactive due to a negligible atmosphere).
- **World's Largest Meteor Crater**: 1,300 metres deep **Arizona(US).**
- **Chicxulub crater (Mexico's Yucatan Peninsula)** - caused by a meteor impact that is **believed to have wiped out the dinosaurs** (mass extinction at the end of the Cretaceous 65 million years ago).
- **Meteorite craters in India**
  - **Lonar Lake (1.8 km in diameter)** in Buldhana District of **Maharashtra.**
  - **Dhala crater (14 km in diameter)** in Shivpuri district, **Madhya Pradesh.**
  - **Ramgarh crater (3.5 km in diameter)** is a potential meteorite crater in **Kota plateau** in **Rajasthan.**

Meteor Showers

- **Occurs when Earth encounters many meteoroids at once.**
- **Comets also orbit the sun.**
- As a **comet gets closer to the sun**, some of its **icy surface boils off, releasing** lots of particles of **dust and rock (meteoroids).**
- This **comet debris gets scattered along the comet's path,** especially in the **inner solar system** (including planets Mercury, Venus, Earth and Mars).
- When **Earth makes its journey around the sun,** its orbit crosses the orbit of a comet i.e. **Earth encounters a bunch of comet debris.**
- **These meteoroids when enter the earth's atmosphere burn up and cause continued lighting of sky for some time** k/a meteor shower.
- **Named for the constellation where the meteors appear to be coming from.**
- **Eg. Orionids Meteor Shower** appears to be **originating near the constellation 'Orion the Hunter'.**

Moon

- **Diameter - one-quarter** of earth.
- **Distance** from earth- **3,84,400 km.**
- Light takes only a second to reach us from the moon.
- **Tidally locked to the earth,** meaning that the **moon revolves around the earth** in about 27 days which is the **same time it takes to complete one spin.**
- Hence, **only one side of the moon is visible from earth.**
- **Without moon, Earth's tilt could vary as much as 85 degrees** (at present the Earth's axis of rotation is tilted at an angle of 23.5° relative to our orbital plane).

Tidal locking - Object's orbital period = rotational period.

Formation of Moon:

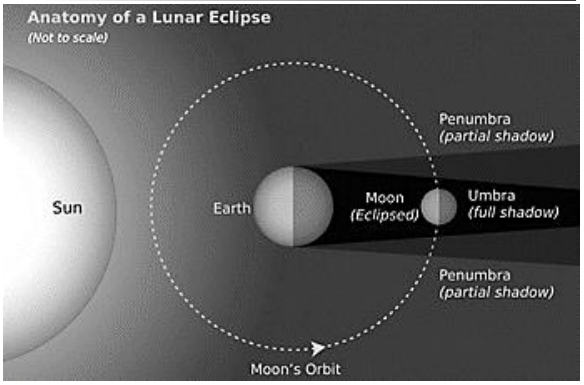
- Formation is an **outcome of 'giant impact'** aka **'the big splat'.**
- A **body of the size 2-3x of mars collided into the earth** shortly after the earth was formed- **blasted a large part of the earth into space.**
- **Part of blasted material -** continued to orbit the earth - **formed into present moon** about 4.44 billion years ago.
- **Moon** used to **revolve much closer to Earth than today.**
- **Earth rotates -> Moon's gravity causes tides.**
- **Little friction between the tides and the turning Earth- earth's rotation slows down** just a little (1.4 milliseconds in 100 years).
- As Earth slows- **Moon drifts away a little** (four centimetres per year).

Types of Moon:

1. **Blood Moon/ Copper Moon**
   - **Total lunar eclipses aka blood moons** because of the **reddish orange glow the moon takes on.**
   - **Total lunar eclipse - Earth** moves **between the Sun and the Moon** - **cuts off** the **Moon's light supply.**
   - **Surface of the Moon takes on a reddish glow** instead of going completely dark.
   - Reddish color during totality **due to Rayleigh scattering.**

Rayleigh scattering
Same mechanism **responsible for** causing **colorful sunrises and sunsets**, and for the **sky to look blue.**

2. **Blue Moon**
   - **Appearance: two and a half years** on average.
   - Blue moon **does not mean blue coloured moon.** It is just **second full moon of any calendar month.**



3. **Super moon**
   - **Full moon occurs at its perigee.**
   - **Rare** event.
   - Has to satisfy **two conditions**
     - **Moon must be closest** to the earth
     - Should be a **full moon.**
   - Moon- **30 % brighter** and **14 % larger.**
   - **Difference** can**not** be **seen with naked eye.**

Dawn and Twilight

- **Dawn:**The period between **sunrise** and full **daylight**.
- **Twilight:** The period between **sunset** and complete **darkness**.
- **Occurrence- Earth receives scattered or refracted light** from the sun **when** it is still **below the horizon** during **dawn and twilight.**
- **Poles- winter darkness** is much **longer**- mostly **merely twilight**.

Eclipse

- **Occurrence:** When the **Sun, the Earth, and the Moon** are in a **straight line**.
- **Types :**

1. Lunar Eclipse

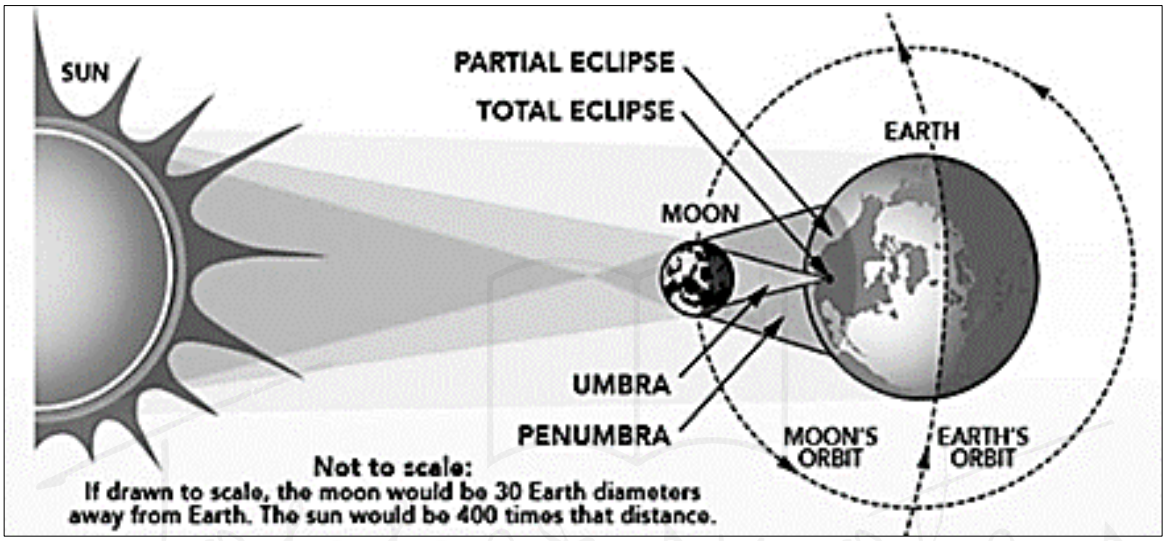
- **Ideal Position:** Only when the Sun, the Earth, and the Moon are in a straight line, and the **Earth is between the Sun and the Moon,**
- Possible only on a **Full Moon day.** However, since these **three bodies must be in the same plane as the ecliptic**, a lunar **eclipse does not occur** on **every** Full Moon day.

- **Total lunar eclipse: Moon exactly in the plane of the ecliptic.**
- **Partial lunar eclipse: Moon close to the ecliptic plane.**
- **No eclipse: Moon much above or far below the ecliptic plane**.

2. Solar Eclipse

- **Ideal Position**: Only when the Sun, the Earth, and the Moon are all in a straight line, and the **Moon is between the Sun and the Earth**.
- Possible on a **New Moon day -**But **does not occur on every New Moon day**.
- **Diamond Ring Effect:** A visual phenomena **can be seen from Earth** when standing in the **umbra of the moon's shadow.**

Total Solar Eclipse: Moon is **exactly in** the **plane of the ecliptic.**
Partial solar eclipse: Moon is **close** to the **ecliptic plane.**
No Eclipse : Moon is **much above or far below** the ecliptic plane.
Annular Eclipse: **Moon covers the sun but** the sun **can be seen around the edges of the moon**.



2 CHAPTER Earth

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Pre	Mains	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Geographical Coordinates: Latitudes and Longitudes

- Shape of Earth- 'Geoid'
- Latitudes and longitudes are **imaginary lines** used to **pinpoint** a **location** on the globe.
- **Eg:** The location of New Delhi is 28° N, 77° E.

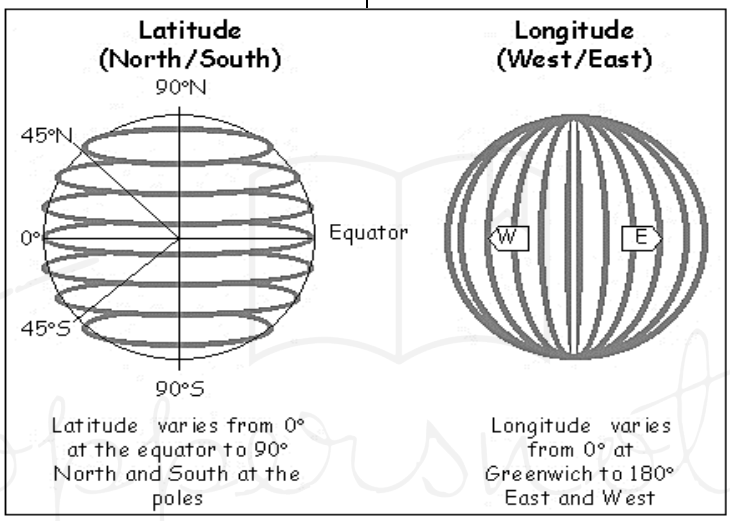
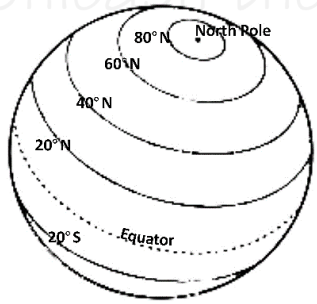


Fig : Latitudes and Longitudes



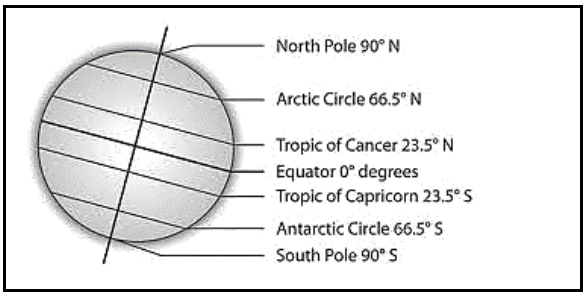
Latitudes

- Angular distance of a place on the earth's surface from the earth's centre.
- **Equator**:Another imaginary line running on the globe; divides it into two equal parts.
  - **Northern Hemisphere:** Upper half of the earth
  - **Southern Hemisphere:** Lower Half of the Earth
- **Parallels of Latitude :** All parallel circles from the equator up to the poles.
- Latitudes are **measured** in **degrees**.
- **Equator- zero** degree **latitude**.

<u>Important Parallels of latitude:</u>

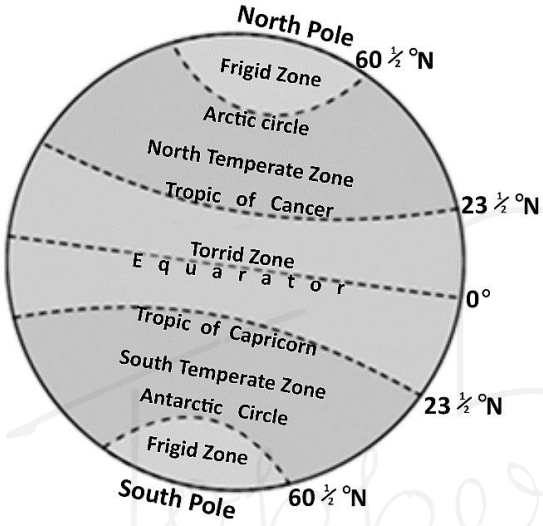
- **Arctic Circle: 66½° N** in the Northern Hemisphere
- **Tropic of Cancer: 23½° N** in northern hemisphere
- **Tropic of Capricorn: 23½° S** in southern Hemisphere

- **Antarctic circle**: **66½° S** in Southern hemisphere



Latitudinal Heat zones of Earth/ Tropics

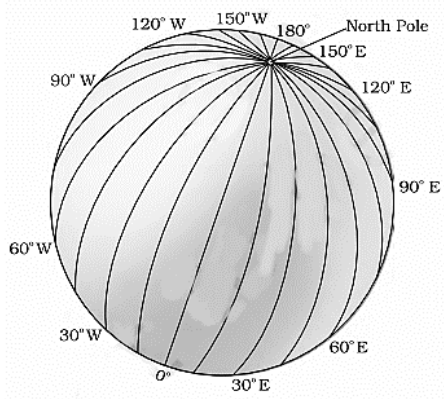
- Receive **maximum heat.**



- **Bordered** on **north** by the **Tropic of Cancer** and on **south** by the **Tropic of Capricorn**
- Define the **northern and southern extremes of places where the sun passes directly overhead seasonally.**
- **On all latitudes between the Tropics of Cancer and Capricorn, the midday sun is exactly overhead at least once a year.**

Longitude

- An **angular distance along the equator** measured in degrees east or west of the Prime (or First) Meridian.
- Represented by a **sequence** of **semi-circles** that go from **pole to pole** and pass **across** the **equator**- aka **meridians**.
- **Function**: to **calculate local time** in relation to G.M.T. or Greenwich Mean Time, often known as World Time.
- **1884** - **meridian passing** through the **Royal Astronomical Observatory** at **Greenwich**, near **London** was chosen as **Zero meridian or Prime meridian**.



Important Meridians

- **Prime Meridian:**
  - **0° longitude,** - count **180° eastward** and **180° westward** from it.
  - The Prime Meridian and 180° meridian **divide the earth into two equal halves,** the **Eastern** Hemisphere and the **Western Hemisphere**

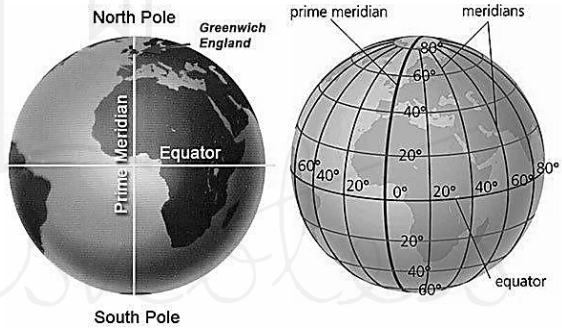


Fig: Prime meridian

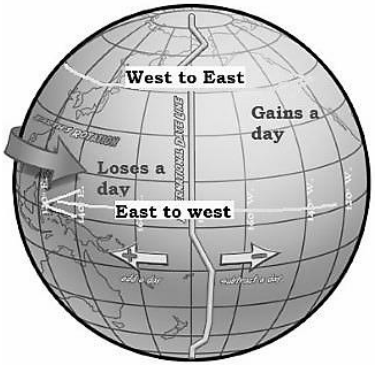
- **International Date Line:**
  - Represented by a **180° longitude**.
  - **Time at this longitude** is exactly **12 hours from the 0 degree longitude, irrespective** of **westward or eastward side** from the **Prime Meridian**.
    - **Eastern side**:Time increases (**12 hours < time at 0° longitude**.)
    - **Western side** : Time decreases (**12 hours > Prime Meridian**)

In the **mid-Pacific**, the International **Date Line bends** from the regular 180° meridian at the Bering Strait, Fiji, Tonga, and other islands t**o avoid day-and-date confusion** in some of the island groupings that are cut through by the meridian.

Longitudes and time:

- **Earth rotates 360 degrees in a day or 24 hours ⍰ 15 degrees in 1 hour** or **1 degree in 4 minutes.**

- Earth **rotates from west to east, local time advances** by **one hour every 15^0 eastward.**
- M**oving westwards delays local time by one hour.**



- **Locations east of Greenwich see the sun sooner and gain time**, whereas **locations west of Greenwich see the sun later and lose time.**

DST (Daylight Saving Time)

- **Change in standard time that allows people to make better use of daylight.**
- **Clocks** are usually **set forward one hour towards the start of spring** and **backward one hour in the autumn.**

Chaibagaan Time

- **150 years ago**, **British colonialists instituted** "chaibagaan time" or "bagaan time," a **one-hour ahead of IST time schedule followed by tea plantations.**
- This was done **in order to increase productivity by making better use of daytime.**
- For the **past 66 years, Assam, along with the rest of India, has followed the International Standard Time (IST).**

Comparison of the Meridians of Longitude and the Parallels of Latitude

Parallels of Latitude	Meridians of Longitude
Angular distance of a point north or south of the equator, measured in degrees.	Angular distance measured in degrees along the equator- measured from 0° to 180° east or west of Greenwich (0°).
Parallel to the equator.	Converge at poles.
Appear as circles on a globe.	Appear as circles running through the poles.
Distance between two latitudes- 111 Km.	Distance varies Equator - 111.3 miles ; Poles- 0 km
Equator at 0 degrees; Poles at 90 degrees.	Total 360 degrees of longitude (180 degrees east and west of the Prime Meridian in each direction).
Used to demarcate temperature zones.	Used to calculate the local time wrt Prime Meridian time.

Motions of Earth

Earth's Rotation:

- **On its axis** (tilted at a **23.5° angle with the normal (90°) ,** or a **66.5° angle with the orbital plane**).
- **1 rotation- 24 hours.**
- The orbital plane is the **plane in which the Earth orbits the Sun.**
- Rotation **from west to east** on its axis resulting in **creation of day and night.**

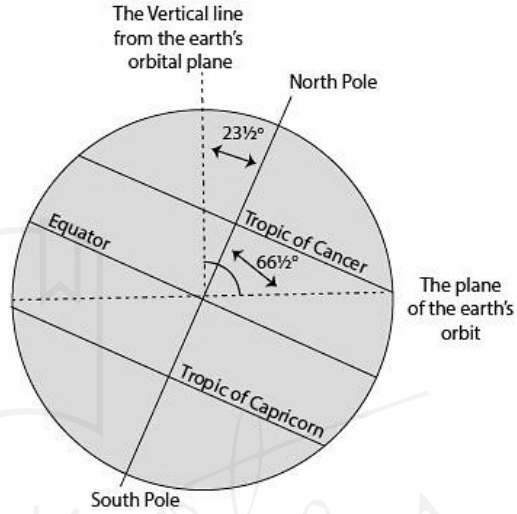


Fig. : Inclination of Earth's axis and the orbital plane

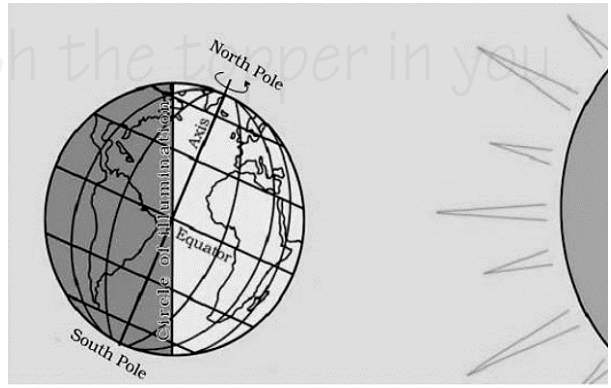


Fig : Day and Night on the Earth due to Rotation

Circle of illumination- circle on the globe that **separates day from night.**

 # Effects of Rotation of the Earth

- Causes **days to turn into nights.**
- **Difference of one hour is created between two meridians.**
- **Change in the direction of wind and ocean currents.**
- Regular **Tides.**

Earth's Revolution

- Revolves in an elliptical orbit as it circles around the sun.
- One complete round takes 365¼ days or a year.

Leap year :
- Six hours saved every year are added to make one day (24 hours) over a span of four years.
- Added to the month of February.
- Thus every fourth year, February is 29 days instead of 28 days.
- Total days- 366.

Effects of Earth's Revolution:

- Seasons change due to the change in the position of the earth around the sun.

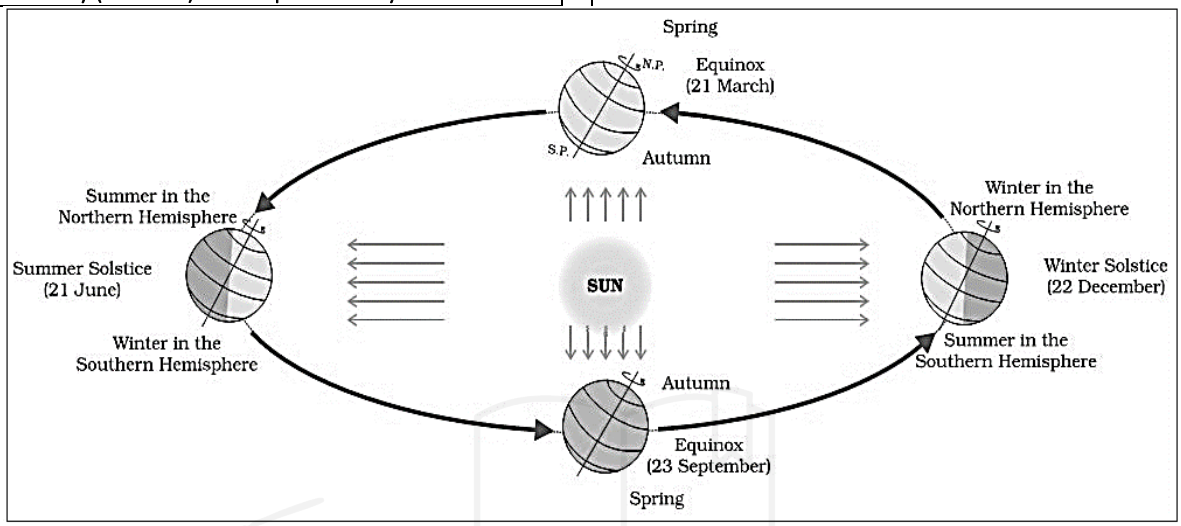


Fig: Revolution of earth and Seasons

Solstice:

1. Summer Solstice:
   - Northern hemisphere is inclined towards the sun on June 21st.
   - Rays of the sun fall directly on the Tropic of Cancer - excessive heat in the region.
   - Poles/ nearby locations receive less heat - sun's beams are slanted.
   - Areas beyond the Arctic Circle - six months of uninterrupted daylight - north pole is tilted toward the sun.
   - 21st June- longest day and shortest night- sun shines on the maximum part of the northern hemisphere;it is summer in the areas north of the equator.
   - Conditions reversed in southern hemisphere. There is a winter season in the area.The days are shorter than the nights.
2. Winter solstice:
   - Tropic of Capricorn receives direct sunlight on December 22nd - south pole tilts towards the sun.
   - Sun's rays fall vertically near the Tropic of Capricorn (23½° s).
   - Southern hemisphere experiences summer, with longer days and shorter nights. In the northern hemisphere, the opposite is true.

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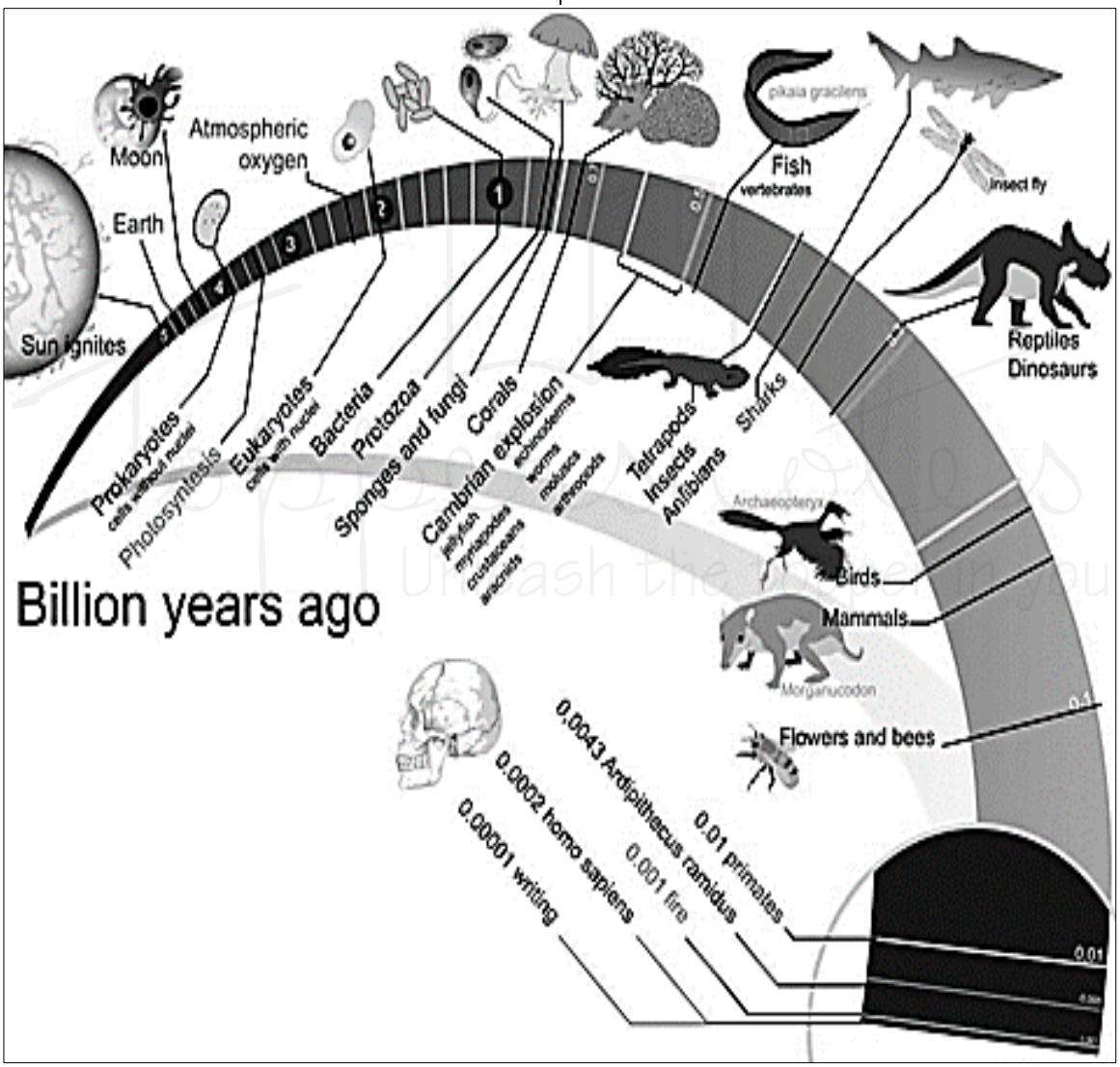
Equinox:

- Equator receives direct sunlight on March 21st and September 23rd.
- Neither poles slant towards the sun in this position, the entire earth has equal days and nights.
- Northern hemisphere- autumn season on September 23rd
- Southern hemisphere - spring season .
- March 21st- spring in the northern hemisphere and Autumn in the southern hemisphere.

3 CHAPTER Geological Time Scale

Geological Time Scale

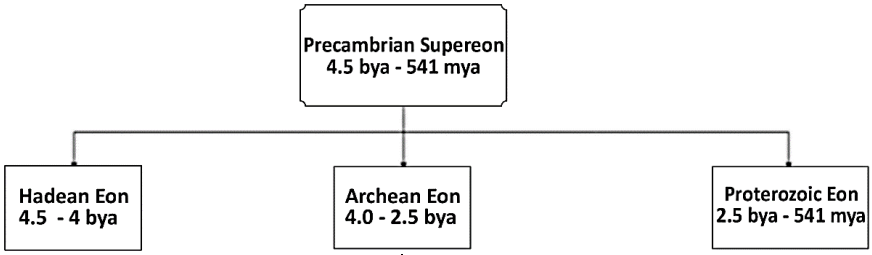
- **System of chronological measurement** that **describes the timing and relationships between events** that have occurred throughout Earth's history.
- Developed by **studying rock layers and fossils** worldwide.
- **Radioactive dating** helped determine the **absolute divisions in the time scale.**



- **Divided** into :
  SuperEon → Eon → Era → Period → Epoch

Table : Geological time scale

Eons	Era	Period	Epoch	Age/years Before Present	Life/ Major Events
Phanerozoic	Cainzoic (from 65 million years to the present times)	Quanternary	Holocene Pleistocene	0-10,000 10,000 – 2 million	Modern Man Homo Sapiens
		Teritary	Pliocene Miocene Oligocene Ecocene Palaeocene	2-5 million 5-24 million 24-37 million 37-58 million 57-65 million	Early Human Ancestor Ape : Flowering Plants and Trees Anthropoid Ape Rabbits and Hare Small Mammals Rats - Mice
	Mesozoic 65-245 million Mammals	Cretaceous Jurassic Triassic		65 – 144 Million 144-208 Million 208-245 Million	Extinction of Dinosaurs Age of Dinosaurs Frogs and Turties
	Palaezoic 245-570	Permian Carboniferous Devonian Silufian Ordovician Cambrian		245 – 286 Million 286 – 360 Million 360 – 408 Million 408 – 438 Million 438 – 505 Million 505 – 570 Million	Reptile dominante replace amphibians First Reptiles Vertebrates : Coal beds Amphibians First trace of life on land Plants First Fish No terrestrial Life Mariane Invertebrate
Proterozoic Archean Hadean	Pre-Cambrian 570 Million – 4800 Million			570 – 2500 Million 2500 – 3800 Million 3800 – 4800 Million	Soft-bodies arthropods Blue green Algae Unicellular bacteria Ocean and Continents form – Ocean and Atmosphere are rich in carbon dioxide
Origin of Starts Supernova Big Bang	5000 – 13700 Million			5000 Million 12000 Million 13700 Millon	Origin of the sun Origin of the universe



Hadean Eon (4.5–4 bya)

- represents the **time before a reliable (fossil) record of life.**
- Extremely **hot temperatures**
- **Earth was molten -** frequent collisions with other bodies, extreme volcanism and the abundance of short-lived radioactive elements.
- **Moon was formed** by a giant impact collision with a planet-sized body named Theia - ~ 4.5 bya.
- **Large number of asteroids** collided with the early terrestrial planets.
- **Volcanic outgassing -** created primordial atmosphere and then the ocean.
- Almost **no oxygen.**
- **Earth cooled-** formation of a solid crust- hot volatiles - **heavy CO_2 atmosphere with hydrogen and water vapour.**

Archean Eon (4.0 - 2.5 bya)

- Beginning of life on Earth - **evidence of cyanobacteria** (3500 mya).
- **Life is limited to simple single-celled organisms** lacking nuclei k/a Prokaryote.
- **No oxygen;** atmospheric **pressure - 10 to 100 atmospheres.**
- Formation of **continents.**
- **Oldest rock formations** during the archean era.
- Numerous **lava eruptions.**
- **Oceans were acidic** due to dissolved carbon dioxide.
- **Liquid water present.**
- The **earliest identifiable fossils- stromatolites-** microbial mats formed in shallow water by cyanobacteria.

Proterozoic Eon (2.5 bya - 541 mya)

- **Last eon of Precambrian "supereon".**
- **Appearance of oxygen i**n Earth's atmosphere .
- Bacteria began producing oxygen, leading to the **sudden rise of life forms.**
- **Eukaryotes** (having a nucleus), emerged, including some forms of **soft-bodied multicellular organisms.**
- Earliest forms of **fungi developed.**
- **First symbiotic relationships** between **mitochondria** and **chloroplasts** (found in plants and some protists only)
- **Early and late phases underwent Snowball Earth periods** (the planet suffered below-zero temperatures, extensive glaciation and as a result drop in sea levels).
- **Tectonically very active .**
- Featured the **first definitive supercontinent cycles and modern orogeny** (mountain building).
- **43% of modern continental crust developed** (39% - Archean, and only 18% in the Phanerozoic).
- Late Proterozoic - **Rodinia supercontinent** (~1000–750 Ma).

Phanerozoic Eon

- **First fossils of** animals such as **trilobites** appeared.
- **Life** remained mostly **small and microscopic.**
- **Plant life appeared on land.**
- **Complex life,** including vertebrates, began to **dominate the Earth's ocean.**
- **Pangaea formed** - later broke into Laurasia and Gondwana.
- **Life expanded to land** - plants, insects, animals, birds and fungi began appearing.
- **Modern animals**—including humans—**evolved** at the most recent phases of this eon (2 million years ago).
- Divided into **three eras:**
  - **Palaeozoic-** era of **arthropods, amphibians, fishes, and the first life on land;**
  - **Mesozoic-** rise, reign of **reptiles**, climactic **extinction of the non-avian dinosaurs,** the **evolution of mammals and birds;** and
  - **Cenozoic**- rise of **mammals**.

4 CHAPTER Earth's Magnetic Field

Year		2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		2023	
Pre	Mains	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

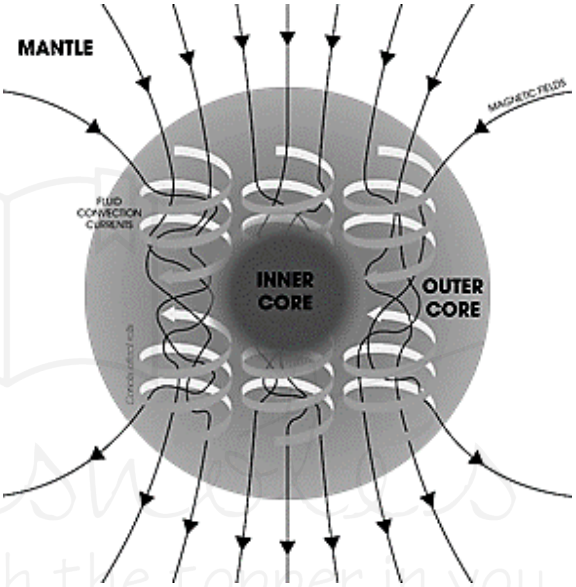
Magnetic fields: Determine how electric **currents with moving electric charges exert a force** on other electric currents.

Dynamo theory of generation of Earth's Magnetic Field

- proposes a **mechanism** by which **a celestial body generates a magnetic field** and **sustains it** over millions of years.
- **Convection in the outer core + Coriolis effect (caused due to the rotation of the earth)= self-sustaining (geodynamo) Earth's magnetic field.**

Mechanism

- **Magnetic field** generated **in the earth's outer core.**
- **Metal in the outer core- fluid due to low pressure.**
- **Temperature - 4400 °C** in the outer regions to 6000 °C near the inner core.
- **Heat sources- energy released by compression of core**+ energy released at **inner core boundary** + **radioactivity** of potassium, uranium and thorium.
- **Differences in temperature, pressure and composition** within the outer core **cause convection currents in the molten iron of the outer core** - as cool, dense matter sinks while warm, less dense matter rises.
- **This flow of liquid iron generates electric currents** ⇒ produces **magnetic fields.**
- **Charged metals passing through these fields go on to create electric currents** of their own, and so the cycle continues. This **self-sustaining loop** is k/a **geodynamo**.
- **Spiral movement of charged particle**s caused by **Coriolis force - separate magnetic fields created are aligned** in the **same direction,** their combined effect adding up to produce **one vast magnetic field of the planet.**



Magnetosphere

- **Region above the ionosphere-** defined by the **extent of the Earth's magnetic field in space.**
- Extends **tens of thousands of kilometres into space.**
- **Protects Earth from charged particles of solar wind and cosmic rays** that can strip away the upper atmosphere, including the ozone layer that protects the Earth from harmful ultraviolet radiation.
- **Many cosmic rays are kept out of the Solar system by** Sun's magnetosphere called **heliosphere**.

- **Magnetopause:** the area where **pressure exerted by solar winds = pressure by Earth's Magnetic field**
- **Bow Shock:** Sunward of the magnetopause where solar winds slow down abruptly
- **Magnetosheath:** the turbulent region just outside the magnetopause
- **Magnetotail:** the long tapered magnetosphere at the **anti-sunward side** of the earth (extends beyond **200 Earth radii** while **sunward side: 10 Earth radii**)