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Content List

World Geography

1. Geography: An Introduction	1
2. Universe	2–3
3. Solar System	4–7
4. Rotation and Revolution	8–10
5. Latitude, Longitude and Standard Time	11–12
6. Origin and Evolution of the Earth	13
7. Internal Structure of the Earth	14–15
8. Rocks	16
9. Earthquakes, Tsunamis and Volcanoes	17–20
10. Geomorphic Processes	21
11. Landforms / Relief Features	22
12. Mountains and Plateaus	23
13. Plains, Islands and Deserts	24
14. Rivers, Lakes and Waterfalls	25–26
15. Atmosphere	27–29
16. Air Pressure and Winds	30–31
17. Humidity, Precipitation and Clouds	32–33
18. Air Mass, Cyclone and Anti-cyclone	34
19. Major Climatic Regions of the World	35
20. Hydrosphere	36–38
21. Ocean Currents and Waves	39
22. Soils and Natural Vegetation of the World	40–41
23. Agriculture and Animal Husbandry	42–43
24. Minerals and Energy Resources	44–45
25. Major Industries of the World	46
26. Transport	47
27. Population and Urbanization	48

28. Human Races, Tribes and Languages	49
29. Continents of the World	50–56

Indian Geography

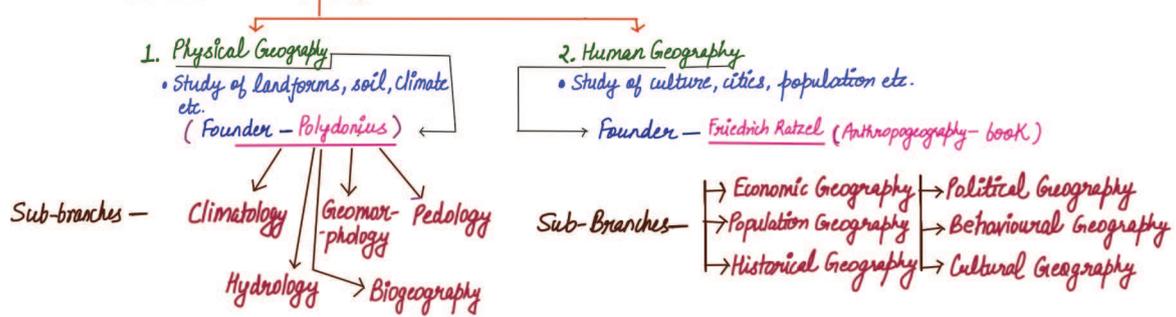
1. General Introduction	57–60
2. Geological Structure of India	61–62
3. Physical Divisions of India	63–70
4. Rivers of India	71–76
5. Lakes and Waterfalls of India	77–79
6. Multipurpose Project	80–82
7. Climate	83–86
8. Soils	87–88
9. Natural Vegetation	89–90
10. Agriculture and Animal Husbandry	91–95
11. Mineral Resources	96–98
12. Energy Resources	99–100
13. Industries	101–103
14. Transport and Communication	104–108
15. Population and Urbanization	109–111
16. Races and Tribes of India	112
17. States and Union Territories of India	113

Environment and Ecology

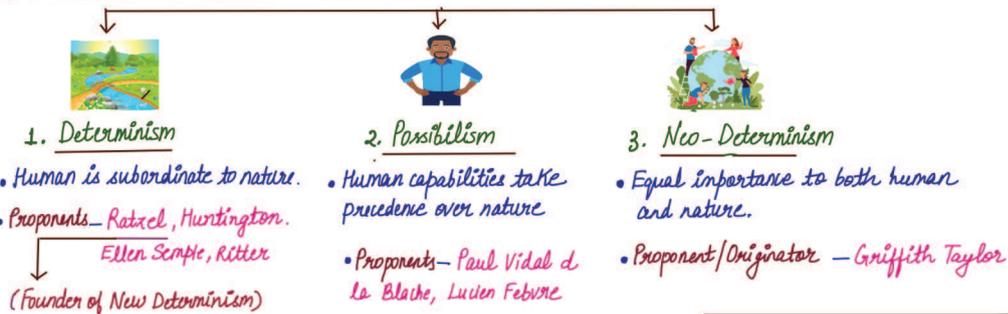
1. Environment	114
2. Ecosystem	115–116
3. Biodiversity	117
4. Wildlife Conservation	118–119
5. Climate Change	120–121
6. Environmental Pollution	122–123
7. Sustainable Development	124
8. Disaster and Disaster Management (Scan the QR Code for Chapter)	

- **Geography** : Geo (Earth) + Graphas (Description) → Description of the Earth
- First use of the term Geography: By **Eratosthenes** (Greek Scholar) (276-194 BCE)

• Branches of Geography



• Philosophies of Geography :-



Prominent Geographers / Founders

- Father of geography - **Hecataeus**
- Father of Systematic Geography / Geophysics - **Eratosthenes**
- Father of Modern Geography / Sequential Geography - **Alexander von Humboldt**
- Father of cultural Geography - **Carl O-Sauer**
- Founders of Mathematical Geography - **Thales and Anaximander** (World map makers)

Prominent Books and Authors	
Books	Authors
• A Brief History of time	Stephen Hawking
• The theory of Everything	Stephen Hawking
• The world As I see it	Albert Einstein
• The Mathematical Theory of Black Holes	Subrahmanyan Chandrasekhar

Important Lines

Line Imaginary lines connecting places of equal

- **Contour line** - elevation
- **Isobar line** - air pressure
- **Isohyets line** - rainfall
- **Isotherm line** - temperature
- **Isoneph line** - cloud cover
- **Isosismal line** - earthquake intensity
- **Isotaline line** - salinity
- **Isochronal line** - travel time from a point.



• **Hachure line** - Disconnected short lines showing slope in Maps

NOTE : In maps, railway lines and telephone lines are represented in black colour.

02 Universe

- The collective form of microscopic molecules to countless galaxies.  (group of countless stars).
- Study : *Cosmology*
- Diameter : 10^8 Light years → Unit of Distance (3.26 light years = 1 parsec)

Origin of the Universe - 13.7 billion years ago

Big Bang Theory

- Universally accepted theory
- 13.7 billion years ago.

Related Geographers

Georges Lemaître (Proponent)
(1927 A.D)



Robert Hegeron
(Theory explanation) (Gave the term Big Bang)



Fred Hoyle



Other Major Theories and Proponents

- Inflationary theory : Alan Guth
- Equilibrium or Continuous Creation Theory or the Steady State Theory : Thomas Gold and Hermann Bondi.
- Pulsating Universe Theory : Dr. Allen Sandes

- Phenomenon of redshift in space.
- Explosion of supernova in space
- Contribution of Edwin Hubble → *Concept of Expanding Universe*
- Increase in the distance of celestial bodies.

NOTE: → Systematic study of the universe started by *Claudius Ptolemy*.

- After the Big Bang, origin of the solar system - 4.5 billion years ago
- Successful mega experiment of Large Hadron Collider (LHC) by European Center for Nuclear Research (CERN) (Year 2010).
- Concept of God Particle based on Indian scientist Satyendra Nath Bose's Boson Theory, - presented by Higgs (1964 A.D)
- Nicolaus Copernicus - Heliocentric Model

Galaxy

- Group of Stars
- Each galaxy contains 100 billion stars
- Formed by the convergence of massive clouds of hydrogen gas (Nebula)

Types of Galaxies

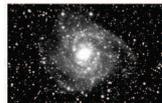
Spiral galaxy

- Milky Way (Mandakini)
- NGC 6872



Elliptical galaxy

(Maffei -1)



Irregular galaxy

(Sextans -A)



Milky-Way or Milk Belt

- Our Solar system (Sun, Earth, planets, satellites etc.) is part of the Milky Way Galaxy.
- Our Galaxy is also known as : **Mandakini or Akash Ganga.**
- **Shape** - Spiral (80% part), Disc-shaped • **Extent** - 80 thousand light years
- Mandakini was first observed by Galileo.
- Nearest galaxy : **Andromeda (Devayani)**
- Least known galaxy : **Dwarf Galaxy**
- One revolution of Mandakini's centre by Sun completes in 250 million years.

Constellation - Total number - 88

- Beautiful organized pattern of stars.
- Largest constellation - **Hydra**
- **Cassiopeia** : W-shape constellation
(**Shera** - **Brightest**)
- **Cygnus** : Cross-shaped constellation
- **Orion** : Hour Glass shaped
↳ (Hunter constellations are Kalpurush) (**Brightest** - **Rigel**)

Saptarishi constellation - Ursa Major

(Great Bear)

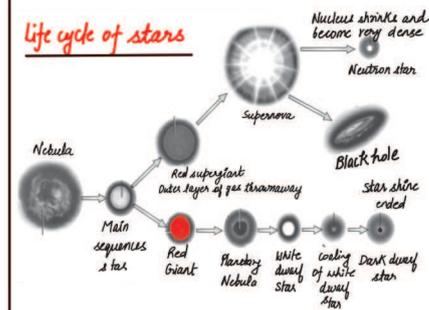
- Group of seven bright stars
- Visible in the first quarter of the night in summer season.
- Third largest constellation in the sky
- **Pole stars** - Member of Little Bear constellation.
- Located in the north direction and helps in navigation at night.
- Big Bear also formed by Ursa Major



Stars

- Colour - defined by its temperature
- Nearest star to Earth - Sun
- Brightest star - **Sirius / Dog star**
- Nearest star after solar system - **Proxima Centauri.**
- **Supernova** - Explosion of stars
- **Chandrasekhar limit** - 1.44 solar mass, the upper mass limit of a white dwarf star.

Life cycle of stars



Some Important - Cosmic / Celestial Bodies / Astronomical Bodies

Bodies	Description
• Astronomical Bodies	• Celestial bodies that shine in the night sky.
• Nebula (Nebulae)	• Clouds of dust and gases (Hydrogen Helium & Other), Cosmic Nursery (birthplace of stars)
• Orion Nebula	• The region of the coolest and brightest stars in the Milky way.
• Quasar	• Bright celestial body, located 4-10 billion light years away.
• Super Cluster	• Large group of small galaxy clusters.
• Constellation	• Group of stars arranged in a certain pattern.
• Supernova or Nova star	• A star formed after the explosion of a giant star (formation of a neutron star)
• Black hole	• A dense gravitational region from which even light cannot pass through.
• Higgs Boson	• " Godd Particle ", the fundamental particle of physics.
• Red Giant	• Giant star formed when hydrogen in the core of a star is exhausted.
• White Dwarf	• Fossil star
• Cygnus	• A bright constellation located in the galaxies.

03 Solar System

Introduction

Group of celestial bodies like sun, eight planets, satellites, asteroids, comets etc.

• **Discoverer:** Nicolaus Copernicus

• **Origin:** 4.5 billion years ago

→ **Nebular Theory:** Immanuel Kant, 1755 AD → Modification

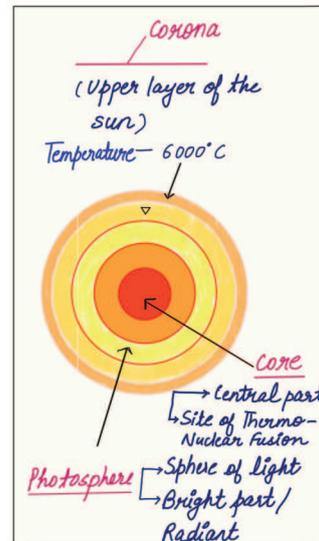
• $H_2 + He \rightarrow$ Nuclear Fusion
 • $H + H \rightarrow He \rightarrow$ sun $\rightarrow H_2 \rightarrow 70\%$

1796
 Laplace

Sun → A star (nearest to Earth)

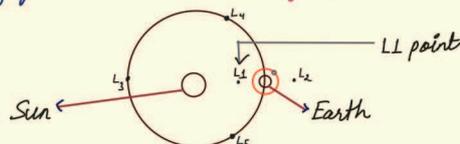
- Located in the centre of solar system
- Age - 4.6 billion years
- Diameter - 13,92,000 Km. (approximately 110 times of Earth.)
- Volume - 13 lakh times of Earth
- Mass - 3,32,000 times of Earth
- Distance from Earth - 14.96 crore Km
- Chemical composition - Hydrogen (71%), Helium (26.5%), Other Elements (2.5%)
- Temperature of the core (central part) - 15 million °C (1.5×10^7 °C)
- Period of rotation - 25 days 9 hrs

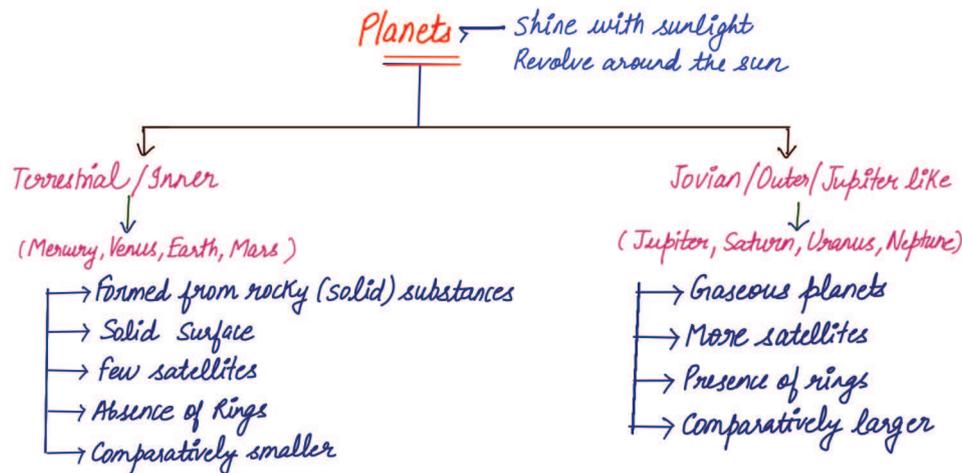
Structure of the Sun



Important

- Nearest star to solar system - Proxima Centauri
- **Speed of Sunlight** - 3×10^8 m/s (3 lakh Km/second)
 → Time to reach Earth - 8 minutes 16 seconds
- **Aditya-L1 Mission** - Study of the sun (located at Lagrange point-L1)
 → India's first solar mission
- **Midnight sun** (Arctic region), country of Midnight sun - Norway
- Source of Energy from sun - Nuclear fusion





Note: - Planets move in the direction of west to East whereas Venus and Uranus move in the direction of East to West.

Planets of Solar System

- Total Number — 8 [Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune]



1. Mercury

- Nearest to the sun, Very hot planet
- No satellite, absence of water
- Smallest planet, highest orbital speed (fastest planet)
- Highest temperature difference (600°C)

2. Venus [Lucifer Planet]

- Nearest to the Earth
- Brightest and hottest planet of solar system (surface temperature - 478°C)
- Composition — sulphuric acid gas
- Evening star or Morning star (seen in west in evening and east in morning)
- Earth's twin or Earth's sister planet
↳ (similar to Earth in density, size and diameter)
- Orbits in opposite direction from other planets
↳ Clockwise (from East to West)
- No satellite

3. Earth → Shape - Goid

- Fifth largest planet of the solar system
- Densest planet of the solar system.
- Blue Planet (due to presence of water)
↳ Only planet where life is possible
- Only natural satellite — Moon
- Second closest star — Proxima Centauri

4. Mars

- Red planet (due to iron oxide, red soil)
- Axis tilt and day-night duration similar to Earth.
- Second smallest planet after mercury
- Two major satellites — Phobos and Deimos
- Largest volcano — Olympus Mons
- Highest mountain of solar system — Nix Olympia (3 times of Everest)
- Mission — Mangalyaan

5. Jupiter

- Largest planet of the solar system
- **Yellow Colour** - due to SO_2
- Least rotation period (on its axis)
- Rings made of silicate around
- Third brightest object after Moon and Venus.
- A massive storm **Great Red spot** present
- Atmosphere full of Hydrogen, Helium and other gases.
- Satellites discovered by Galileo - (4 satellite)
Io, Europa, Callisto, Ganymede (largest)

6. Saturn

- Second largest planet of the solar system, A gas giant and massive body (Hydrogen + Helium)
- Rings made of rocks and ice chunks → **Galileo Galilei**
- Maximum number of satellites (146) - (as of February, 2025)
- Density - less than water (can float on water)
- **Yellow colour** (Ammonia + Methane)
- Satellites - **Titan (largest)**, Mimas, Tethys, Rhea, Phoebe, Enceladus etc
↳ similar to size of mercury.

7. Uranus

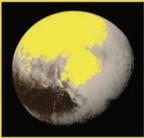
- Discoverer - **William Herschel (1781 AD)**
- Third largest planet (by radius)
- Fourth largest planet (by mass)
- **Colour - Greenish** (due to methane)
- Tilted planet, known as Ice giant
- Coldest planet
- Atmosphere made of Hydrogen, Helium
- Clockwise rotation like Venus (East to West)
- Satellites - **Titania (largest)**, Ariel, Miranda etc.
- Has the largest number of moons (274 moons)

8. Neptune

- Farthest from the sun, Ice giant
- **Colour - Blue/Green** (due to Methane)
- Fourth largest and third heaviest planet of the solar system
- Atmosphere made of Hydrogen and Helium
- Discoverers: **Johann Galle and Urbain Le Verrier (1846 A.D)**
- Satellites: **Triton, Nereid**

Pluto - dwarf planet

Natural Satellite - 'Charon', Nix, Styx, Kerberos, Hydra.



(first to be termed as planet)

(Year - 2006)

- Removed from the planet list by **International Astronomical Union (IAU)**
- Member of Kuiper Belt
- Kuiper Boundary Belt lies beyond Neptune (spherical orbit of asteroids and comets)

↳ Pluto, Eris, Ceres, Haumea - Dwarf planets.

Makemake

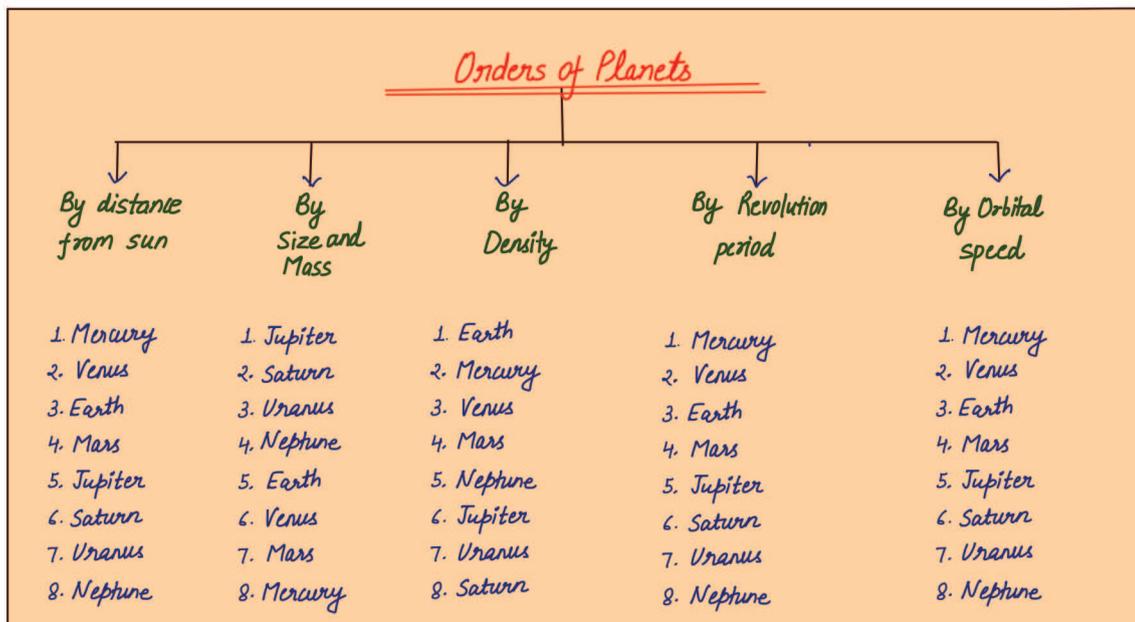
↓

Third largest and second brightest dwarf planet.

NOTE :- The number of satellites keep changing. For updates visit the website :
- Theplanets.today.com

Scan QR Code for
The Solar System :
At a Glance





The Moon

- Natural satellite, non-luminous
- Fossil planet
- *Sea of Tranquility* → First step of Neil Armstrong
- Distance from the Earth → 384,400 Km
- Radius → 1737.5 Km • Diameter → 3475 Km
- Rotation + Revolution → 27.3 days (59% part of Moon is visible)
- Moon's gravity is 1/6th of Earth
- Highest Mountain → *Leibnitz* (10,668 meters)
- Time taken by moonlight to reach Earth - 1.3 minutes
- *Selenology* - Scientific study of the moon.
- Mission - *Chandrayaan I, Chandrayaan III*



Comet / Tail star

- Bodies made of stone, dust, ice and gas.
- While approaching sun, burning of dust and ice forms bright tail.
- Tail always away from the sun.
- Hailey Comet
↳ 1986 → 76 years later → will be visible in 2061 ←

Asteroids

↳ Big-Big rocks

- Small bodies orbiting the sun in the orbit of Mars and Jupiter.
- First asteroid discovered - *Ceres*
- Visible with naked eye - 4 *Vesta*
- Asteroid named after *Pl. Jarraj* (2019)

Meteorites

- Remains of comets and asteroids.
- Revolve around the sun
- Burn in mesosphere of atmosphere
- Meteor → shooting star
- Meteorite (Those which fall on Earth without burning)
- Meteor showers / sighting month - December/January
- Lyrid Meteor shower - April Month

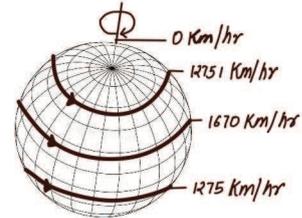
04

Rotation & Revolution

Rotation

- Earth's rotation on its axis.
- Daily Motion

- Rotation Period — 23 hours 56 minutes 6 seconds (sidereal Day)
- Direction — West to East
- Rotation Speed — Maximum at Equator and minimum at poles.
 - Tilt of Earth's Axis — $23\frac{1}{2}^\circ$
 - Inclination of Earth's axis relative to orbital plane — $66\frac{1}{2}^\circ$
- Effects → Occurrence of Day and Night
 - Change in direction of winds and ocean currents
 - Tides in oceans.



Speed of Earth's Rotation

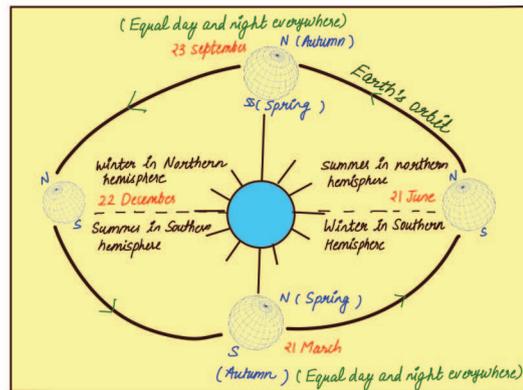
Revolution

- Along with rotation, Earth's movement around the sun
- Annual motion.

- Revolution period — 365 days 6 hours 9 minutes 9 seconds
- Path of Revolution — Anticlockwise, Elliptical path
- Effects
 - Change in seasons
 - 6-month day and 6-month night at poles
 - Determination of year duration

Leap Year

- At an interval of 4 years.
 - Number of days in a year — 366 days
 - February month — 29 days
- Note: Due to the tilt of Earth's axis, days and nights become longer or shorter.



Earth's revolution and seasons

Distance between Sun and Earth

- Minimum — Perihelion — 3 January → 147 million Km.
 - Maximum — Aphelion — 4 July → 152 million Km.
- NOTE: Apse line: line joining Perihelion and Aphelion.

Solstice (Sankranti or Ayanaent)

Limits of sun's uttaranayan (northward) and Dakshinayan (southward) movement. → Maximum difference in day-night duration

Summer Solstice

- Also known as summer solstice or cancer Sankranti.
- Sun's rays fall vertically on Tropic of Cancer.
- Longest day in Northern Hemisphere (21 June)
- Higher temperature at North Pole
- 6-month long day begins at North Pole

Winter Solstice

- Also known as winter solstice or Capricorn Sankranti.
- Sun's rays fall vertically on Tropic of Capricorn (22 December)
- Longest day in Southern Hemisphere
- 6-month long day begins at South Pole
- Maximum temperature at South Pole.

Equinox

- Sun's vertical rays fall on Equator
- Equal day and night everywhere
- No pole tilting towards sun

Important

- Midnight sun in Norway - 21 June
- Shortest day in North Hemisphere
- Summer Solstice in Southern Hemisphere } 22 December
- 21 March and 23 September - Equal day and night globally.

Vernal Equinox - 21 March

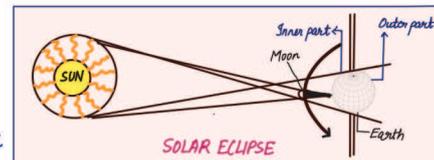
- Northern Hemisphere - Spring
- Southern Hemisphere - Autumn

Autumnal Equinox - 23 September

- Northern Hemisphere - Autumn
- Southern Hemisphere - Spring

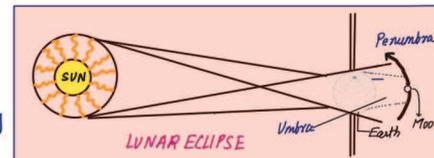
Solar Eclipse (Surya Grahan)

- Condition : Moon comes between Sun and Earth (Conjunction position)
- Time : New Moon (Amavasya)
- Types : 1. Total Solar Eclipse (Full Sun covered)
2. Partial Solar Eclipse (Partial Sun covered)
3. Annular Solar Eclipse
- Important Events : • Corona of the sun (Ultraviolet rays) visible
 - Diamond ring phenomenon
 - Dark Shadow - Umbra
 - Light shadow - Penumbra



Lunar Eclipse (Chandra Grahan)

- Condition : Earth comes between sun and moon (Opposition position)
- Time : Full Moon (Not on every Full Moon)
- Types : 1) Partial → Difference in Axis of Moon and Earth - 5°
2) Complete



Main Moon Phases

- **Super Moon** - Moon closest to Earth
- **Blue Moon** - Two full moons in one month
- **Blood Moon** - Tetrad

Tides

↳ Rise of sea water (Tide) and fall of sea water (ebb)

- Cause of occurrence: 1) Gravitational pull of the sun.
2) Gravitational pull of the moon.
3) Centrifugal force of Earth.

↓
Theory
↓
(Progressive Wave Theory)
↓
(William Whewell)

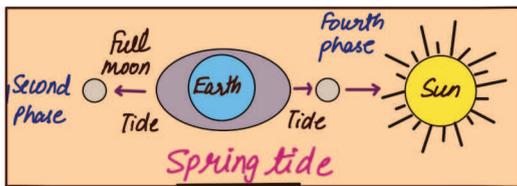
Important

- Sun, Moon, and Earth in one line - **Syzygy**
- Moon's nearest distance from Earth - **Perigee**
- Moon's farthest distance from Earth - **Apogee**
- ★ Maximum 7 lunar and solar Eclipses possible in a year.

Types of Tides

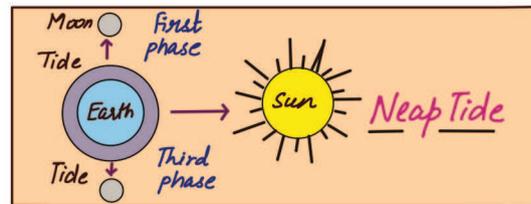
Spring tide (High Tide)

- Sun, Earth, and Moon in a straight line.
- Time - Full Moon and New Moon



Neap tide (Low Tide)

- Sun, Earth and Moon at right angles.
- Time - 7th and 8th day of Krishna and Shukla Paksha.



Important

- Time gap between two tides - 12 hours 26 minutes
- World's highest tide - Bay of Fundy, _____ → Nova Scotia (Canada)
- Generally 7-day gap between spring and Neap tides.
- Tidal Energy (in coastal areas), helpful in fisheries.