Geography Class 01

A basic introduction

What is geography(2:11:00PM)

- Geography= Geo+ Graphy. It is the description of Earth and the phenomenon related to Earth.
- **Parts of Geography**
- **Physical geography:**
- The study of land is called geomorphology.
- The study of the atmosphere is climatology.
- The study of water/oceans is called oceanography.
- The study of soil in relation to life is called biogeography.
- **Economic Geography**
- Water resource
- Mineral resource
- Natural vegetation
- Agriculture
- Industries
- Transport and services
- **Human Geography**
- Population
- Settlement
- Tribes
- **Cosmology**
- Universe
- Big Bang
- Stars/Galaxies/Solar system/Earth
- **Environmental Geography**
- Ecosystem
- Pollution/degradation
- Biodiversity
- Sustainable development

Syllabus discussion(2:26:00PM)

- Explained through slides
- **Prelims:**
- Indian and World Geography- Physical, Social, Economic Geography of India and the World
- Relevance in Environment syllabus
- **Mains:**
- **GS 1**
- Salient features of the World's Physical Geography.
- Distribution of Key Natural Resources across the world (including South Asia and the Indian sub-continent); factors responsible for the location of primary, secondary, and tertiary sector industries in various parts of the world (including India).
- Important Geophysical phenomena such as earthquakes, tsunamis, Volcanic activity, cyclones etc., geographical features and their location changes in critical geographical features (including water bodies and ice-caps) and in flora and fauna and the effects of such changes.
- **GS 3**
- Major Crops - Cropping Patterns in various parts of the country, - Different Types of Irrigation and Irrigation Systems; Storage, Transport and Marketing of Agricultural Produce and Issues and Related Constraints; E-technology in the aid of farmers.
- Infrastructure: Energy, Ports, Roads, Airports, Railways etc.(to be covered in Economics as well)
- Disaster and Disaster Management(Separate classes)

A brief analysis of the Geography portion(2:59:00PM)

- Explained through charts
- Prelims- 14 questions were asked in 2022.
- GS 1 Mains 2021- 95 marks
- Youtube links to previous year's question discussion were shared.
- **Previous year's questions(Prelims) discussion**
- Static and conventional
- Current affairs based,
- Location-based(both static and current affairs based).

- **Previous year's questions(Mains) discussion**
- Static- Basic
- Static- Applied
- Static + Current Affairs based
- Current Affairs based

Sources(3:16:00PM)

- NCERT Class 11- Fundamental of Physical Geography; India: Physical Environment
- NCERT Class 12- Fundamentals of Human Geography; India People and Economy
- Certificate Physical and Human Geography by GC Leong (refer especially for climatology)
- Total Geography(Class 10, ICSE) especially for Human Geography
- Physical Geography- Savindra Singh (only if a student wants to, not mandatory).
- Primary Source: Class notes

Map Reading(3:25:00PM)

- Mark the important locations discussed in the class in your Atlas on the same day
- Wall maps are important to developing pictorial memory(try to visualise on a daily basis)
- Make a list of current based locations on a daily basis.
- Atlas: Preferably Orient Black Swan School Atlas
- Carry some physical blank maps in Geography classes of India and World.

Overall Approach to be followed(3:33:00PM)

- **Explained with a flowchart:**
- Start with basics
- Conceptual clarity
- Practical Application
- Facts and Information
- Diagrams and Maps
- Connect with Current Affairs
- Whatever is covered in class, try to revise it the same day.
- Doubt resolution

Earth's solar system and Universe(3:46:00PM)

- A brief list of topics to be covered(through slide)
- **What is geography?**
- Geo+Graphy means the description of Earth. It is the study of places and relationships between people and their environment.
- The term geography was coined by **Eratosthenes-** a Greek Philosopher who is also called the **father of geography.**
- Geography was developed initially as a science of writing Atlas.

Topics for next class: Shape of Earth, latitudes, longitudes, rotation and revolution.

Geography Class 02

A brief overview of previous class

The shape of the Earth(1:10:00 PM)

- **Evidence to support the spherical shape of the earth**
- Explained with the help of slides
- **a. Circumnavigation of Earth:** It was first done by Magellan in 1519.
- **b. Circular horizon:** Horizon is the place where the sky and the Earth's surface appear to meet. The horizon appears circular when viewed from a tall building or ship. The horizon widens with an increase in altitude.
- **c. Ship's visibility:** A distant ship appears to be rising out of the water which is due to the curvature of Earth's surface. This is also explained by the Bedford level experiment.
- **d. Sunrise and Sunset:** The different timing of sunrise and sunset at different places is possible only if Earth is spherical in shape.
- **e. Lunar eclipse:** The circular shadow of the Earth is visible during the lunar eclipse.
- **f. Shape of other planetary bodies:** The spherical shape of all other planetary bodies implies the spherical shape of the Earth.
- **Actual shape of the Earth**
- Earth is flattened near the poles and bulged at the equator. It is due to the continuous rotation of the Earth. This shape of Earth is called a Geoid or oblate spheroid.
- Pole to pole diameter- 12714km
- Equatorial diameter- 12756 km
- Newton proposed this for the first time and he also said that the same applies to other spinning bodies.

- Doubt resolution

Latitude and Longitude(1:47:00 PM)

- Explained with the help of slides
- **Latitudes**
- It is an angular distance of a place on Earth's surface measured in degrees from the center of Earth towards the North and South of the equator.
- **Parallels** of latitude are the imaginary lines connecting the places with the same latitudes.
- The parallels of latitudes are always parallel to the equator and to one another.
- The length of parallels decreases from equator to pole.
- The parallels of latitude are concentric circles.
- **Longitude**
- The angular distance of a place east or west of the prime meridian is called longitude.
- **Meridians** are semi-circles running from pole to pole connecting places with the same longitude.
- Meridians of longitudes are not parallel to each other and the distance between them decreases from the equator to the poles.
- The distance between two meridians of longitudes separated by 1deg along the equator is equal to 111 km.
- The distance between two parallels of latitudes separated by 1 deg anywhere is equal to 111km.
- Each deg is divided into 60 minutes and each minute into 60 seconds.
- Doubt resolution
- **Great circle**
- It is the circle with the longest possible circumference drawn on Earth and divides it into two equal halves.
- An infinite number of great circles can be drawn.
- A great circle can be used to find the shortest distance between two points on the surface of the earth.
- **Standard latitudes:**
- Tropic of Cancer(23.5 deg N)
- Tropic of Capricorn(23.5 deg S)
- Equator(0 deg)
- Arctic Circle(66.5 deg N)
- Antarctic Circle(66.5 deg S)

Rotation and revolution(3:06:00 PM)

- **Rotation**
- The movement of Earth on its own axis is called rotation.
- **The axis of rotation** is an imaginary line passing through the poles and the Centre of Earth around which Earth rotates.
- **The orbital plane** is the plane in which the earth orbits around the Sun.
- The angle between the axis of rotation and the orbital plane is equal to 66.5 deg.
- The angle of tilt of the axis of rotation from its normal position is 23.5 deg.
- Earth rotates around its axis in a counter-clockwise direction or from west to east.
- The time taken to complete one complete rotation by the earth is known as the **period of rotation** of the earth.
- **Sidereal day vs Solar day**
- Explained through slides and video
- **Solar day**
- It is the time taken for the Earth to rotate on its own axis so that the Sun appears in the same position in the sky.
- Solar day= 24 hrs
- **Sidereal day**
- It is the time taken to rotate on its own axis so that a distant star appears in the same position after completing 360 deg of rotation.
- Sidereal day= 23 hrs 56 mins
- **The linear speed of rotation**
- The linear speed of Earth's rotation is maximum along the equator and is equal to 1650 km/hr and it decreases as we move from equator to pole.
- Satellites and rockets are launched closer to the equator in order to utilize the initial thrust provided by Earth's linear speed of rotation.
- **Kourou in French Guinna** in South America is the best location to launch rockets.

- Also, it is launched from the East coast so that in case of failure the rocket falls into the ocean and not on land.

Revolution(3:54:00 PM)

- The movement of Earth around the Sun is called revolution.
- Earth revolves around the Sun in an elliptical orbit.
- The period of the revolution of Earth is equal to 365 days and 6 hours.
- The direction of revolution is counterclockwise or from west to east.
- **Perihelion** is the position of Earth closest to the Sun in its orbit. (January 3rd)
- **Aphelion** is the position of Earth farthest from the Sun in its orbit(July 4th).

Topics for next class: Seasons, Time zone, and Dateline

Geography Class 03

A brief overview of the previous class and doubt resolution

Seasons(1:19:00PM)

- Explained with the help of slides
- **Circle of Illumination**
- Explained with a diagram
- It refers to the line that divides the regions of day and night on the Earth.
- **Understanding seasons:**
-

	Intensity	Length of the day
Rotation(absent) **Tilt(absent)** **Revolution(absent)**	Intensity is highest at the equator and decreases as we move towards Poles.	24 hrs day on half side, 0 hrs on other side
Rotation(present) **Tilt(absent)** **Revolution(absent)**	Intensity is highest at the equator and decreases as we move towards Poles.	Every latitude will experience 12 hrs of the day and 12 hrs of the night.
Rotation(present) **Tilt(present)** **Revolution(absent)**	Highest at 23.5 deg North, higher intensity in Northern hemisphere and lower intensity in the southern hemisphere(compared to the previous position)	12 hrs at the equator, increases to 24 hrs towards Northern pole and decreases to 0 hrs towards the southern pole
Rotation(present) **Tilt(present)** **Revolution(present)**	The intensity is highest at 23.5 deg South and higher intensity in the southern hemisphere and lower intensity in the northern hemisphere	The length of the day is 12 hrs at the equator and increases to 24 hrs at the south pole and decreases to 0hrs at the north pole

- **Dictation:**
- Seasons are observed on the Earth because Earth revolves around the Sun in a tilted axis of rotation whose angle of inclination with respect to the orbital plane is always constant.
- A season is a period of the year that is distinguished by specific climatic conditions.
- Seasons are mainly due to variation in the length of day and night and the intensity of sunlight received at the surface.
- The regions receiving higher intensity of sunlight for longer duration experience summer and the regions receiving lower intensity of sunlight for shorter duration experience winter.
- As the Earth revolves around the sun, the regions of summer and winter change continuously.
- **Summer solstice(21st June))(All positions with respect to Northern Hemisphere)**
- Sunrays fall vertically at the **Tropic of Cancer.**
- The intensity of sunlight has increased in the northern hemisphere.
- The length of the day increases from the equator to the north pole.
- **Winter solstice(22nd December)**
- The sun rays fall vertically at the **Tropic of Capricorn**
- The intensity of sunlight has decreased in the northern hemisphere.
- The length of the day decreases from the equator to the north pole.
- **Equinox(21st March-Spring, 23rd September-Autumn)**
- Sunrays fall vertically along the equator.
- The intensity of the sunlight is highest at the equator and decreases uniformly towards both the north and south pole.
- The length of the day is 12hrs across all the latitudes.

Position of the overhead Sun(2:39:00PM)

- The position of the overhead sun is always between **23.5 deg North and 23.5 deg South.**

- Every location between the Tropic of Cancer and the Tropic of Capricorn will receive at least 2 days of 90 deg sunlight except those locations lying in the tropics which will receive 90 deg sunlight only once.
- **Polar day and polar night**
- Explained with the help of a diagram and video
- The regions receiving 24 hrs of daylight increase from 90 deg North/South up to a maximum of 66.5 deg North/South. These regions experience **mid-night Sun.**
- **Previous year's prelims questions discussion**

Time zones(3:26:00PM)

- A time zone is a region of the globe that observes a uniform standard time.
- The entire globe is divided into 24 time zones with the Greenwich meridian as the standard reference.
- From the Greenwich meridian, time increases towards the east and decreases towards the west.
- With every change of 15 deg, time changes by 60 minutes. So with every 1 deg, it changes by 4 mins.
- India follows 82.5 deg East longitude as the standard reference for its time zone. It passes through **Mirzapur near Allahabad in UP.**
- **Question:** Toronto follows 77.5 deg West longitude. The time in Mirzapur is 6 pm. Find the local time in Toronto. **(Ans: 7:20 AM of the same day)**
- **Multiple time zones**
- Before independence, India followed 3 time zones based on Calcutta, Madras, and Bombay along with a local Chai Bagan time in Assam.
- In 1906, India adopted 82.5 deg East longitude as the standard time zone India and the local time zones of Calcutta and Bombay were continued till 1955.
- The longitudinal extent of nearly 30 deg between East and West has resulted in a mismatch of the Sun Cycle and human activities which has resulted in a demand for a second-time zone for the Northeast.
- **Issues in adopting multiple time zones**
- Economic integration such as banking, stock exchange, etc
- Issues in synchronization of transportation such as railways
- Administrative convenience
- To reduce the communication gap

Topics for next line: International Date Line, Daylight saving time, Origin of Universe, etc

Geography Class 04

A brief overview of previous class

International Date Line(1:28:00PM)

- It is an imaginary line of demarcation on the Earth running from the North to the South pole and demarcates the change of calendar day.
- It was agreed upon in 1884.
- The IDL roughly follows 180 East or West longitude, however, it is not a straight line and follows a zig-zag path to accommodate the islands in the Pacific ocean.
- If a person crosses IDL from West to East, she or he gains a day and has to subtract a date from the calendar.
- If he/she crosses IDL from East to West a day is lost and has to add a date in the calendar.

Daylight saving time(1:52:00PM)

- Explained with the help of a diagram
- It is the practice of shifting time by 1 hour ahead by forwarding time in the clock just before the beginning of summer.
- It is practised in temperate countries with a longer duration of the day during summer.
- Doubt resolution

Universe(2:03:00PM)

- **What is Universe?**
- The limitless expanse of space surrounding us consisting of the solar system, stars, galaxies, dark matter, dark energy, etc.
- The universe has 100-400 billion galaxies and with each galaxy containing 100-400 billion stars.
- **Origin of Universe:**
- There are **three major theories** regarding the origin of the Universe:
- **a. Steady-state theory**
- **b. Pulsating theory**
- **c. Big Bang Theory**

- **Steady-state theory**
- It was proposed by **Fred Hoyle.**
- The overall size and mass of the Universe remain constant at any point of time.
- The Universe has no beginning and no end but is always expanding, creating new stars and galaxies at the same rate old ones become unobservable.
- **Pulsating theory by Arthur Eddington**
- The Universe expands and contracts alternatively.
- It expands due to explosion and contracts due to gravitational pull.
- The Universe is currently in the phase of expansion.

Big Bang Theory(2:46:00PM)

- Explained with the help of diagrams
- It was proposed by Georges Lemaitre in 1927.
- The Universe was once an extremely compact, dense and hot singularity. There was no other matter, nor space, nor time.
- 13.7 billion years ago, a cosmic explosion happened called as big bang.
- The universe started to expand since then and is still continuing today.
- The expansion subsequently led to the formation of elementary particles, atoms, molecules, gaseous clouds, stars, galaxies, etc.
- In 1929, **Hubble** proposed that all observable stars and galaxies are moving away from the earth. This he discovered through **red shift.** The rate of expansion of the Universe is called as **Hubble's constant.**

Life cycle of star(3:09:00PM)

- Explained through a diagram.
- **Stellar nebula**
- It is a giant load of gas and dust mainly made up of **hydrogen.**
- The gaseous particles collide due to gravity and the entire nebula starts to spin.
- **Proto star**
- It is a spinning gaseous mass with a hot core due to heat released during the collision of gaseous particles.
- When the temperature of a proto star's core crosses **15 million degrees Celsius,** a **nuclear fusion** reaction begins at the core resulting in the birth of a star.
- When the supply of hydrogen runs out, the core starts to contract and simultaneously the outer shell expands, resulting in the formation of a **red giant.**
- When a low-mass star with **less than 10 times the mass of the Sun**, it becomes a **red giant** and its core collapses leading to the formation of a **planetary Nebula** which is a spherical shell of gases.
- A planetary nebula will gradually be left with the core inside which is called a **white dwarf.**
- **A white dwarf** is theorised to become a **black dwarf.**
- If the mass of a star is more than 10 times the mass of the Sun, it results in a **red supergiant.**
- All **red supergiants** lead to **supernova explosion** due to the explosion of its core.
- After a supernova explosion, if the remnant core is between 1.4 to 3 times the mass of the sun, it results in a **Neutron star**. It is a very heavy-density body composed of closely packed neutrons.
- **Black hole**
- If the remnant core, after a supernova explosion is more than 3 times the mass of the sun, its core collapses under gravity resulting in the formation of a **black hole.**
- The black hole is a body with a singularity at the core having infinite gravity and density.
- M87 black hole was the first black hole to be photographed.

Galaxies and Stars(3:54:00PM)

- A galaxy is a sprawling system of gas, dust, dark matter, dark energy and stars held together by gravity.
- All galaxies contain a supermassive black hole at their centre.
- **Types of galaxies**
- **Elliptical galaxy**-Spherical or oval shaped with stars distributed uniformly throughout.
- **Spiral galaxy-** with spiral arms, relatively a flat disc with a central bulge.
- **Irregular galaxy-** It has no definite shape/structure.
- The **Milky Way** is a spiral galaxy. Sun is located on the **Orion arm** of the Milky way galaxy.
- The nearest star to Sun is **Proxima Centauri** located at a distance of **4.3 light-years.**
- **Sirius** is the brightest star in the sky located at **8.6 light-years.**
- **Andromeda** is the nearest galaxy.

Topics for the next class- Stars, solar system
Geography Class 05

A brief overview of the previous class and doubt resolution

Stars continued(1:27:00PM)

- **Light year**
- The distance travelled by light in one year at the speed of **$3 * 10^8$ m/s.**
- The sunlight takes **8.3 minutes** to reach Earth.
- **Twinkling of stars**
- Explained with a diagram
- It is due to turbulence in the atmosphere, light from stars get deflected more as it comes from a point source. However, planets being near to Earth, their light will not twinkle.
- Twinkling is not observed in space.
- **Constellation**
- A group of stars forming a recognisable pattern in the sky is called a constellation.
- Example: **Big Dipper**
- A star which is aligned with the axis of rotation of Earth is called a **Pole star.**
- In the Northern hemisphere, it is **Polaris**. In the southern hemisphere, it is **Sigma Octantis.**
- The pole star is always fixed in the sky, so its position will not change during the night. However, the angle at which the pole star is visible varies with latitude. It is visible at **90 degrees** near to poles and at **0 degrees** near the equator.
- UPSC PYQ discussed

Solar system(2:00:00PM)

- **Origin of the solar system**
- **1. Evolutionary theories**
- It proposes that the material of the solar system condensed into the Sun and planets simultaneously as isolated masses of matter from a single cloud of gas, therefore, all the bodies are of the same age.
- **a. Gaseous hypothesis**
- It was proposed by **Immanuel Kant.**
- There was a gaseous cloud made up of hard and cold particles which are supernaturally created.
- These particles collided with each other due to gravitational force releasing heat and gradually forming a rotating structure.
- Rings of matter were thrown off from this structure which cooled down to form planets.
- **b. Nebular hypothesis**
- It was proposed by **Laplace.**
- A pre-existing nebula was there in a rotating state.
- With gradual cooling, the nebula shrank which led to more spinning.
- This resulted in an increase in temperature at the centre and the entire nebula gradually developed into a flat disc.
- Rings of matter got separated from this disc due to centrifugal force which got condensed to form planets.
- **2. Catastrophic theories**
- Catastrophic theories assume the existence of a binary system of stars.
- A catastrophic event causes the matter of a star to come out of it and form planets. So as per catastrophic theories, Sun is older than the planets.
- **a. Planetesimal hypothesis**
- It was proposed by **Chamberlin and Moulton.**
- There was a protostar accompanied by a companion star.
- As the companion star came near the protostar, gravitational pull led to the ejection of matter from the protostar.
- This matter condensed to form protoplanets called as **planetesimals.**
- Planetesimals resulted in the formation of planets.
- **b. Tidal hypothesis**
- It was proposed by **Jeans and Jeffrey.**
- It proposes a very big intruding star which came near to the sun.
- The gravitational pull led to the ejection of tides of matter forming planets.
- Doubt resolution

Solar system contd(3:05:00PM)

- **Sun**
- There are total 6 layers of the sun
- **a. Core**

- The temperature is above **15 million degrees Celsius** and energy is produced due to **nuclear fusion reaction.**
- **b. Radiative zone**
- It means emitting radiation.
- Energy from the core is carried outward by radiation through this zone.
- **c. Convective zone**
- This is the 3rd layer and convective currents transfer heat to the surface.
- **d. Photosphere**
- It is the lowest layer of the Sun's atmosphere.
- It is the layer from which visible light originates.
- This is the brightest layer.
- The average temperature is **5500 degrees Celsius.**
- **e. Chromosphere**
- It is the intermediate zone of the Sun's atmosphere and appears like a red rim during a total solar eclipse.
- It emits colourful lights.
- **f. Corona**
- It is the uppermost layer of the Sun's atmosphere and is visible only during a total solar eclipse.
- The temperature is nearly **2 million degrees Celsius** here.
- NASA's **Parker Solar Probe** is the first-ever mission to "touch" the Sun.
- **Solar flares**
- It is the sudden outburst of energy with a storm of hot atoms released into space.
- **Sunspots**
- These are the dark spots on Sun's atmosphere, that is, the photosphere.
- The temperature of Sunspots is lower than the surrounding that is around **3800 degrees Celsius**, however, the magnetic activity is higher in these regions.
- The number and position of sunspots vary in a **cyclical manner. i**t is called a **solar maxima** where the number of sunspots are the highest. It is called a **solar minima** where the number of sunspots are lowest.
- The time gap between solar maxima and solar minima is **5.5 years.**
- The sunspot cycle or solar cycle extends over **11 years.**
- The last solar maxima happened in **2014**, the last solar minima happened in **2019-20.**

Planets(3:40:00PM)

Jovian planets	**Terrestrial planets**
Jupiter like	Earth-like
Larger in size	Smaller in size
Made of gases(low density)	Made of rocky material(high density)
Experience weak solar winds	Experience strong solar winds
Thick atmosphere	Thin atmosphere
A large number of satellites	A small number of satellites
They are colder in temperature	They are warmer in temperature
Rotation is faster	Rotation is slower
Rings are present	No rings present

- **Planets:**
- **Mercury**
- The smallest planet.
- It has no atmosphere.
- **Venus**
- It is called as **Earth's twin** as both are similar in size.
- 95% of the atmosphere is made of carbon dioxide.
- **Earth**
- Earth is also called a **blue planet.**
- Earth has the **highest density** of all planets.
- **Mars**

- It is called as **Red planet.**
- * Earth and Mars are located in the **Goldilock zone.**
- It is the **habitable zone** around a star where water can exist in a liquid form.
- UPSC PYQ discussion

The topic for the next class- Solar system continued
Geography Class 06

A brief overview of the previous class and doubt resolution
Planets continued(1:19:00PM)

- **Jupiter**
- It is the largest planet in the solar system.
- It is 11 times bigger than Earth.
- A red giant spot is present which is a giant spinning storm.
- **Saturn**
- The second-largest, however, the lightest planet in the solar system.
- **Uranus**
- It is tilted by 98 Degrees resulting in **retrograde rotation.**
- (Venus is tilted by 178 degrees and thus, it also has a retrograde rotation).
- * All the planets follow prograde revolution and all planets have prograde rotation except Uranus and Venus which have retrograde rotation. Thus, Venus and Uranus rotate clockwise and all other planets rotate in the counterclockwise direction.
- **Neptune**
- It is the farthest planet.
- It is the only planet not visible to the naked eyes.
- It is a bit smaller than Uranus(the smaller twin of Uranus)
- The distance between the Sun and the Earth is called **1AU(Astronomical Unit).**
- The outer range of the solar system is **50,000 AU** where the **Oort cloud** is present.
- **Satellites**
- Mercury and Venus have no satellites.
- Earth has 1 satellite.
- Mars has two satellites - **Phobos and Deimos.**
- Jupiter has 79 satellites. There are 4 satellites of Jupiter that were discovered by Galileo- Io, Europa, Ganymede and Callisto are known as the 4 Galilean satellites of Jupiter. **Ganymede** is the largest satellite in the solar system
- Saturn has 82 satellites. Titan is the largest satellite of Saturn and the second-largest in the solar system.
- Uranus- The names of Uranus's moon are named after the characters of Shakespeare. Important ones are **Miranda, Oberon.**
- Neptune- The largest one is **Triton**(it is not a natural satellite of Neptune and thus has a rotation opposite to that of Neptune)
- Pluto(dwarf planet)-**Charon** is the natural satellite of Pluto and it is as big as Pluto.

Moon(1:47:00PM)

- **Phases of the moon**
- Explained with the help of a diagram.
- **The dark side of the moon**
- Explained with the help of a diagram.
- The period of rotation is equal to the period of revolution, and thus only one side of the moon is visible to us all the time. The far side of the Moon always faces away from Earth, because of **synchronous rotation in the moon's orbit.**
- **Dwarf planet**
- The criteria that must be satisfied for a body to be classified as a planet are given by **International Astronomical Union(2006):**
- a. It should orbit around the Sun.
- b. It should have enough mass to achieve hydrostatic equilibrium.
- c. It should have cleared its neighbourhood.(Pluto was disqualified based on this point).
- There is a total of 5 dwarf planets including Pluto.
- **Kuiper belt**
- It is a belt with remnants of planets with frozen gases, rocks and debris material.
- Comets originate from this zone.
- **Asteroid belt**

- They are small, rocky, metallic objects with nickel and iron core and are located in a belt between **Mars and Jupiter.**
- Jupiter is known as the **protector of Earth** but not always.
- **Meteoroids** are the asteroids which have come out of their belt and are approaching the Earth
- When a meteoroid enters the Earth's atmosphere, it catches fire, producing a flash of light called a **meteor or shooting star.**
- When a meteoroid survives its journey through the atmosphere and falls on the Earth's surface, it is called a **meteorite.**

Comet(2:54:00PM)

- Explained with the help of a diagram.
- A comet is a frozen body with a rocky and metallic core surrounded by gas and dust called a coma.
- They are from the Kuiper belt and develop a very elongated orbit around the sun with tail pointing away from the sun.
- The tail is longest when it is closest to the sun.
- A shooting star appears for a fraction of a second while a comet is still in the sky and can be observed for hours when it is closer to the Earth.
- Example: Haley's comet, Neowise comet(2020), Leonard(2021).
- PYQ question discussion

Eclipse(3:08:00PM)

- Explained with the help of a diagram
- Eclipsed means getting blocked. During a solar eclipse, the sun is blocked, and during a lunar eclipse, the moon is blocked.
- **Eclipse**
- When one heavenly body moves into the shadow of another, it results in an eclipse.
- **Umbra** is the darker shadow produced by the blocking body which causes a total eclipse.
- **Penumbra** is the lighter shadow which causes a partial eclipse.
- **Solar eclipse**
- When the moon blocks light from the Sun, from reaching the Earth, it casts a shadow onto the Earth causing a solar eclipse.
- **Types of solar eclipse**
- **a. Total solar eclipse**
- It is when the Sun is completely blocked by the moon.
- The photosphere is completely blocked while chromosphere and corona is visible.
- It occurs in the regions of the umbra.
- **b. Partial solar eclipse**
- It is when the sun is partially blocked and is visible from the penumbra.
- **c. Annular solar eclipse**
- It is when the moon is at its apogee, that is, farthest from the Earth and it will not be able to block the entire photosphere resulting in a ring called as a **ring of fire.**
- **Lunar eclipse**
- Explained with the help of a diagram and video.
- When Earth comes between Sun and Moon blocking light from the Sun which was supposed to be reflected by the moon causing Earth's shadow to fall on the moon.
- **Types of lunar eclipse**
- **a. Total lunar eclipse**
- It is when the moon is located within the umbra of the earth and is totally shadowed.
- In this position, only the light from Earth's atmosphere reaches the moon which has majorly red light, therefore the moon is called as **blood moon.**
- **b. Penumbral lunar eclipse**
- It is when the moon is completely located in the penumbra and in this position, the moon appears darker in comparison to the full moon.
- **c. Partial lumar eclipse**
- It is when the moon is located between umbra and penumbra and only a partial shadow of the earth covers the moon resulting in a partial lunar eclipse.
- * A full moon at perigee appears very big and it is known as **supermoon.**
- * The second full moon of the month is called a **blue moon.**
- **Difference between a solar and lunar eclipse**
-

Solar eclipse

It happens on a new moon.

It appears for a shorter duration.

It can be viewed from a smaller region.

Day time

Not to be seen directly with naked eyes.(Sunlight falling on dilated eyes is dangerous)

- Doubt resolution

Topics for the next class- Geomorphology
Geography Class 07

A brief overview of the previous class and doubt resolution
Galactic movement(1:13:00PM)

- Explained with the help of a video
- The Sun - including our whole solar system - orbits around the centre of the Milky Way Galaxy, this is known as **Galactic movement.**

Geomorphology(1:21:00PM)

- **Topics to be covered:**
- Origin and evolution of earth
- Geological time svale
- Interior of Earth
- types of rocks
- Different types of earth's movement
- Continental drift theory
- Sea floor spreading
- Plate tectonics theory
- Vulcanism
- Geomagnetism
- Earthquakes
- Tsunamis
- Exogenic movements
- Landforms

Origin and evolution of earth(1:27:00PM)

- Shown with the help of a video
- **What is Geomorphology?**
- It is the study of the physical features of the Earth and the processes in which those features are formed.
- **Origin and evolution of earth**
- Origin of Universe- Big Bang theory
- Origin of the solar system- Nebular hypothesis(both topics covered in previous classes)
- **Evolution**
- The planet Earth was initially barren, rocky and hot, volatile ball of mass. It had a thin atmosphere of hydrogen and helium.
- **Formation of inner layers**
- Due to a gradual increase in density at the centre, the interior temperature increased while the temperature near to the surface decreased.
- Through **density separation,** the heavier elements sank towards the centre and the lighter ones moved towards the surface.
- With time, as the Earth cooled further, it gradually condensed into a smaller size.
- Further, the process of **differentiation** led to different layers in the interior.
- **Formation of atmosphere and hydrosphere**
- The early thin atmosphere with hydrogen and helium was very light and was **stripped off due to solar winds.**
- During the cooling of the earth, gases and water vapour were released from the interior and the process through which they were outpoured onto the atmosphere is called as **degassing.**
- **Volcanic eruptions** released more water vapour and gases. Important gases at this stage are, Carbon dioxide, methane, water vapour and nitrogen and very little oxygen.

- As the Earth cooled, water vapour started to condense. The carbon dioxide in the atmosphere was dissolved in rainwater and the temperature of the atmosphere further decreased. This led to more condensation and more precipitation.
- The rainfall water collected in the depressions on the surface forming oceans which was completed by 4000 million years ago.
- Life began to evolve by 3800 million years ago in ocean waters as non-photosynthetic microorganisms.
- Between 3000 to 2500 million years ago, blue-green algae emerged in ocean waters which released oxygen through photosynthesis.
- By 2000 million years ago, oceans were saturated with oxygen and oxygen started flooding the atmosphere resulting in the evolution of new atmosphere.

Geological time scale(2:23:00PM)

- Explained with the help of a chart
- Overall the Earth's geological time period is divided into 4 Eons.
- Each Eon is divided into multiple eras.
- Each era is subdivided into periods.
- Each period is subdivided into epochs.

Each epoch is further divided into age

Eons	Era	Period	Epoch	Age	Life/major events
Hadean (4800 million years ago(mya) to 4000mya)					Formation of inner layers, oceans and atmosphere
Archean (4000mya to 2500mya)					Evolution of earliest life(unicellular organisms including blue-green algae)
Proterozoic (2500mya to 570mya)					Evolution of multicellular organisms, primitive and soft-bodied
Phanerozoic (570mya to present)	a. Palaeozoic(Old life)(570mya to approx 250mya) b. Mesozoic(middle life)(250mya to 65mya) c. Cainozoic(new life)(65mya to present)	a.1 Cambrian a.2 Ordovician a.3 Silurian a.4 Devonian a.5 Carboniferous (360-280mya) a.6 Permian b.1 Triassic (250-200mya) b.2 Jurassic (200-150mya) b.3 Cretaceous (150-65mya) c.1 Tertiary (65 mya to 2mya) c.2 Quaternary (2 mya to present)	c.2.1 Pleistocene(2mya to 11700 years ago) c.2.2 Holocene(11700 years ago to present)		a.1 Life developed further but it existed only in marine and only invertebrates existed a.2 First vertebrates appeared in oceans(fish) a.3 First trace of life on land- plants a.4 Emergence of amphibians a.5 First reptiles, coal beds a.6 Reptiles started to dominate b.1 Diversification of reptiles b.2 Age of Dinosaurs b.3 Extinction of dinosaurs c.1 Evolution of mammals, flowering plants and trees, apes; formation of youngest fold mountains like the Himalayas c.2 Evolution of homo sapiens and modern man

Holocene(3:42:00PM)

- There are **3 ages** in Holocene:
- **a. Greenlandian age(11700 years ago to 8200 years ago)**
- **b. Northgrippian age(8200 years ago to 4200 years ago)**
- **b. Meghalayan age(4200 years ago to present)- Mawluh Cave** in Meghalaya provided the evidence and thus the name.
- Many people believe we are living in an **Anthropocene** as humans have had such a significant impact on Earth and its inhabitants that we will have a lasting - and potentially irreversible - influence on Earth. However, it has not been accepted and currently, we are living in the Holocene epoch.
- Doubt resolution

Interior of the Earth(3:54:00PM)

- **Sources of study of Earth's interior**
- Explained with a flow chart
- Sources of study can be:
- **a. Direct sources**
- **b. Indirect sources**
- Direct sources include- Deep Ocean Drilling(Max drill till 12km), Volcanic eruptions
- Indirect sources- Density studies, seismic studies, temperature and pressure studies, meteorite

Topics for next class- Earth's interior, Types of rocks, Different types of earth's movements
Geography Class 08

BRIEF DISCUSSION OF THE PREVIOUS CLASS (01:11 PM)
INTERIOR OF THE EARTH (01:19 PM)
Sources of Study

- **Direct Sources:**
- **Deep Oceans Drillings** through which we can extract the material from the Earth's Interior. However, the maximum depth up to which we are able to Drill is 12 km only.
- **Volcanic Eruptions:** Magma erupted from volcanoes comes from Earth's interior which helps us in understanding the Nature of Materials, Density and other characteristics.
- **Indirect Sources:**
- **Density Studies:** By analysing the average density of the Earth (5.5 gm/cm cube) and its comparison to the density at the surface (*2.7* gm/cm ^ 3). We can conclude that the crust is lighter and the core is heavier (13 gm/cm cube)
- **Seismic Studies**: It is through the Analysis of different types of Earthquake waves, their speed and their Direction while passing through Earth's interior.
- **Temperature and Pressure studies:** Temperature increases by 1 degree celsius for every 32 metres near to surface. However, With the increase in Depth higher pressure result in an increase in the melting points of rocks.
- **Meteorites**: By analysing the structure, mineralogy, etc. we can conclude about the Earth's interior as meteorites are the remnants of the planet.

CHEMICAL AND PHYSICAL DIVISIONS (01:47 PM)

- **Chemical Divisions**
- **CRUST:**
- It is the uppermost layer of the Earth.
- Lightest in terms of Density
- It is also the thinnest of all the layers
- The Crust is of two types: **Continental crust and Oceanic Crust**
- **Continental Crust**
- Si+Al (SiAl)
- 2.7 gm/cm cube
- Older
- 40-50 km
- Brighter
- **Oceanic Crust**
- Si+Mg (SiMa)
- 3 gm/cm cube
- Younger
- 8-10 Km
- Darker

- **MANTLE:**
- The portion of the interior beyond the crust is called the mantle. The mantle extends to a depth of 2,888 km.
- It accounts for 83% of Earth's Volume.
- Denser than Crust but lighter than Core.
- The mantle is divided into Upper Mantle and Lower Mantle.
- **CORE**
- It is innermost and densest layer.
- The core is made up of very heavy material mostly constituted of nickel and iron. It is sometimes referred to as the nife layer.
- It is divided into Outer and inner cores.
- **Physical Divisions**
- **Lithosphere:** It is a solid layer made up of Crust and the Upper part of the Upper Mantle. It is divided into different plates. The thickness of the lithosphere is up to 100 km.
- **Asthenosphere:** It is considered to be extending up to 100km to 400 km. It is semi-solid and semi-liquid in nature and undergoes deformation under pressure. And it is called a Low-Velocity Zone. It is a source of Magma to the surface.
- **Mesosphere:** It includes the rest of the Mantle
- **Barysphere:** Includes both Outer and inner core.
- **Composition:**
- The Major elements of the Earth's Crust:
- The most common chemical elements in the crust are oxygen (46.6%), silicon (27.7), aluminium (8.1), iron (5.0), calcium (3.6), potassium (2.8), and sodium (2.6), and magnesium (2.1).

DISCONTINUITY (03:02 PM)

- It is a transition zone between different layers of Earth's interior with differing physical and chemical characteristics
- **Conrad Discontinuity**: Transition zone between upper and lower Crust.
- **Mohorovicic Discontinuity**: Transition zone between the Crust and Mantle.
- **Repitti Discontinuity**: Transition zone between the Lower mantle and Upper mantle.
- **Gutenberg Discontinuity**: Transition zone between Mantle and Core.
- **Lehman Discontinuity**: Transition zone between Outer core and Inner core

ROCKS AND ITS TYPES (03:13 PM)

- **Definition:**
- Naturally occurring agglomeration of minerals is called as Rocks.
- **Difference Between Rocks and Minerals**
- Kindly refer to the Handout
- **Igneous Rocks:**
- They are formed due to cooling, solidification and crystallisation of Molten material of the Earth.
- They are also called as Primary rocks.
- Igneous rocks are of two types: Intrusive and Extrusive.
- **Intrusive Rocks:**
- They are formed from the Cooling of Magma below the surface.
- The slow cooling of Magma results in a crystalline structure with higher strength. Example: Granite and Gabbro.
- They are also known as Plutonic Rocks.
- **Extrusive Rocks**
- They are formed from the cooling of Magma outside or above the Earth's surface
- Faster cooling results in a Glassy texture and lower strength. They are also known as Volcanic rocks.
- Example: Basalt and Andesite
- **Igneous rocks are also Classified into:**
- Acidic and Basic rocks
- Acidic Rocks contain more than 66% of silica. Example: Granite.
- Basic Rocks contain less than 52% of Silica. Example: Basalt and Gabbro
- **Sedimentary Rocks:**
- They are also called as Secondary Rocks.
- They are formed by the Solidification of Sediments of original igneous or metamorphic or other sedimentary rocks.
- **Stages in the Formation of Sedimentary rocks are:**

- Weathering i.e Breakdown of Original rocks.
- Transportation: By agents such as wind, water, etc
- Deposition: In a basin
- Lithification i.e. conversion of loose sediments into hard rocks.
- It involves **Compaction and Cementation.**
- Compaction: Sediments are squeezed by the weight of overlying layers of sediments.
- Cementation i.e. binding together of Compacted sediments by natural cementing material.
- Sedimentary rocks are formed in different layers or strata and they contain fossil evidence.
- Examples of Sedimentary rocks: Sandstone; Limestone; Shale; Chalk; Coal; Gypsum; etc.

TOPIC FOR THE NEXT CLASS: WILL CONTINUE WITH THE METAMORPHIC ROCKS

Geography Class 09

A brief discussion on a question given in class and a brief review of previous class

Metamorphic rocks(1:45:00PM)

- Explained with diagrams
- Metamorphic rocks involve a change in form through physical or chemical processes.
- Changes in pressure conditions result in **dynamic metamorphism.**
- Change in temperature results in **thermal metamorphism.**
- Together, it is called **thermodynamic metamorphism.**
- **Foliation** is a process in which the minerals get arranged in a series of bands along a plane. It results in **banding.**
- **Lineation** is when minerals are arranged in a linear manner.
- **Examples**:
-

Rock	Metamorphic form
Granite	Gneiss
Sandstone	Quartzite
Limestone	Marble
Shale	Schist
Clay	Slate
Coal	Graphite/diamond

Rock cycle(2:12:00PM)

- Explained through a diagram.
- Igneus rocks are formed from magma.
- The raised elevated region is called an **outcrop.**
- Outcrop gets broken down by **weathering, erosion, transportation, and deposition** and thus the formation of **sediments.** Now this will become **sedimentary rock** by **burial, compaction, and cementation.**
- Now sedimentary rocks can again become outcrop by upliftment or can go deeper burial.
- In case of **deeper burial, and heat and pressure,** they will result in **metamorphic rocks.**
- Now metamorphic rocks can again become outcrops or they can get **melted and be converted into magma** and magma will make **igneous rocks.**
- Igneous rocks can become outcrops or undergo burial and be converted into metamorphic rocks.
- This change in rock form from one type to another is known as the **rock cycle.**

Mapping(2:21:00PM)

- **Oceans**
- Around 70% of Earth is water.
- There are 5 oceans in the world. The **Southern Ocean** is the 5th ocean.
- Order in terms of decreasing size- **Pacific, Atlantic, Indian, Southern, Arctic ocean.**
- All the oceans are connected with each other.
- **1. The Pacific Ocean**
- It is the largest(twice as large as the Atlantic) as well as deepest(average depth) of all oceans.
- The deepest point on Earth is located in the Mariana trench known as **Challenger Deep.** (around 11km deep)
- The Pacific Ocean is also called as **Ring of Fire.**
- Connection of Pacific Ocean and Arctic ocean through a strait known as **Bering strait**(This also separates the USA and Russia).
- **Drake passage**(passage as it is wider than a strait)- connects **the Atlantic and Pacific oceans**

- **The Strait of Malacca** -connects the Indian Ocean to the Pacific Ocean.
- **2. The Atlantic Ocean**
- It is between the Americas and Europe in the northern region. In the Southern region, it connects South America with Africa.
- It is one of the busiest routes.
- This is the youngest ocean.
- **Mid Atlantic ridge**-It extends from the southern part of the ocean to the northern part. It is the longest chain of mountains. **Iceland** is part of the mid-Atlantic ridge.
- **3. Indian ocean**
- It is the only ocean to be named after a country.
- It is the only ocean to be surrounded by landmass completely on one side.
- **4. The Arctic Ocean**
- This remains frozen throughout the year. In winters, the frozen area is bigger while in summers it is smaller.
- Due to global warming, it has started melting. As per IPCC, by 2050, the Arctic ocean might lose all its ice in summers if the current level of emissions is there.
- Polar bears are present here.
- **Arctic amplification-** The Arctic has warmed at roughly twice the rate as the entire globe, a phenomenon known as Arctic amplification. Most scientists agree that this rapid warming is a signal of human-caused climate change.
- **5. Southern ocean**
- In 2000, it was agreed by **International Hydrographic Organisation**, but in **2021**, it was officially made the 5th ocean in the world.
- Up to 60 degrees South latitude is considered the limit of the Southern Ocean.
- **Continents**
- **Continents' size in increasing order:** Oceania, Europe, Antarctica, South America, North America, Africa, Asia.

Earth's movements(3:16:00PM)

- Explained with the help of a diagram
- The various forces acting on Earth's interior and exterior cause physical stress and chemical actions on Earth's material bringing about changes in the configuration of the surface of Earth called **geomorphic processes.**
- Geomorphic processes are the result of two types of forces :
- **a. Endogenetic forces**
- These are the forces acting from the **Earth's interior.**
- The sources of energy are **primordial heat and radioactivity.**
- They are responsible for the formation of **major structural units** on the Earth's surface.
- They result in land **upliftment, subsidence, folding, faulting, etc.**
- Endogenetic forces result in the formation of **mountains, plateaus, basins, plains, etc.**
- **b. Exogenetic forces**
- These are the forces impacting the Earth's surface **from the outside.**
- The sources of energy are **sunlight and gravity.**
- They result in **erosion, weathering, deposition, and smoothening of major relief features**.
- The agents of exogenetic movements are- **wind, water, glaciers, etc.**
- They produce **minor topographical features** such as valleys, caves, waterfalls, etc.

Endogenetic(3:45:00PM)

- Explained with a flow chart.
- Endogenetic forces are divided into 2 types- **Diastrophic movements**(slow, unable to observe)and **Sudden/catastrophic movements**(sudden, able to observe)
- Diastrophic is further divided into 3 types-**Tectonic, Isostatic and Eustatic**
- Tectonic is further divided into 2 types- **Epeirogenic(continent building) and Orogenic(mountain building)**
- Orogenic is further divided into **faulting and folding.**
- **Sudden movements**
- They refer to sudden movements that occur for a short period of time. They are observable. They are non-continuous and unpredictable.
- They include Earthquakes and volcanic eruptions.
- Diastrophic movements are slow and continuous movements that change the Earth's surface like the formation of the Himalayas.
- Tectonic movements refer to building movements.

- Isostatic movements try to balance the various movements.
- Eustatic movements deal with the overall changes in the sea level and the resulting effects on land.

Topics for next class- Geomorphic processes contd, Continental drift, and Seafloor spreading

Geography Class 10

GEOMORPHIC PROCESS (01:08 PM)
ENDOGENETIC

- **They are classified into Diastrophic and sudden movements.**
- These are unpredictable movements for a shorter duration. Examples: Earthquakes, Volcanic eruptions, etc.
- These are observable movements.
- **Diastrophic Movements:**
- These are the movement that move, elevate and build up the portion of the Earth's crust.
- These movements operate very slowly and lead to the formation of Primary landforms.
- Diastrophic movements are of 3 types: Tectonic; Isostatic and Eustatic
- **Tectonic Movement:**
- The word "Tekton" means to build. These are continents and mountain-building movements affecting the Earth's surface.
- The tectonic movement results in the creation of a new landform and includes epirogenic and orogenic movements.
- **Epirogenic Movements:**
- These are vertical movements caused by Radial forces.
- They are characterized by large-scale upliftment or emergence and subsidence or submergence of land areas.
- They are very slow and widespread.
- This movement results in the Continental building. Example: Gradual upliftment of Deccan plateau, Slow subsidence of Northern coast of Gulf of Mexico.
- **Orogenic Movement:**
- These are mountain-building movements caused by tangential forces.
- They involve intense folding and faulting of Narrow belts.
- The tangential forces are of two types: One is Compressional causing Folding and the Second is tensional causing Faulting.
- **Folding:** these are the results of forces causing Earth's rocks to push or squeeze against each other resulting in the formation of Folds.
- Folds are the structures in which the layers are bent or distorted without the loss of continuity.
- **Faulting:** These are generally the result of tensional forces which pulls the rocks apart and results in the formation of Faults.
- Faults are the fractures by which the primary surfaces are broken and displaced with loss of continuity.

TYPES OF FOLDS (1:36 PM)

- The sides of the fold are called Limbs. The up fold is known as **Anticline** which is formed when strata are bent upwards. The downfold is known as **Syncline** when Strata are bent downwards. If both limbs of the fold are inclined at the same angle is called a **Symmetrical fold.** If one of the limbs is inclined At an angle more than the other is known as **Asymmetrical.**
- When the Strata in one limb are folded beyond the vertical axis is called an **Over fold.**
- The fold which is literally lying down due to the continuation of pressure on the limbs is called a **Recumbent Folds.**
- When the pressure exerted on the Recumbent fold is sufficiently great to cause it to be torn from its room and thrust forward it results in **Nappes.** Nappes are well developed in Himalayas and Alps.

TYPES OF FAULTS (1:52 PM)

- The upthrust block in a fault is known as **Horst**
- The down-dropped block is known as **Graben**
- When one of block moves downwards relative to another one due to tensional forces it results in the formation of normal faults which is also called a **Dip-slip fault.**
- When one block moves up in relation to another due to compressional force it results in **reverse fault** which is also known as a **thrust fault**
- When both the blocks move across each other without involving vertical movement is called a **strike-slip fault or transform fault.** An example of a strike-slip fault is the San-Andreas fault.

DIFFERENCE BETWEEN FOLD MOUNTAIN AND BLOCK MOUNTAIN (02:06 PM)

- **Fold mountains**

- are formed due to folding
- These are the resultant of Compressional force
- Soft rocks
- Usually Greater in Length
- Example: Himalayas; Rocky Mountains; Als; Andes; Atlas mountain; Kunlun shan Mountain; Arakan Yoma; Hindukhush; etc.
- **Block Mountain**
- these are formed due to Faulting
- These are the result of both compressional and tensional force
- Hard and Rigid Rocks
- These are usually greater in width
- Example: Vindhya; Satpura; Black forest; etc.

ISOSTASY (2:16 PM)

- Isostasy is the state of equilibrium or balance in Earth's crust. Isostasy movement involved vertical movement under the action of floatation displacement between the rock layers of different densities and mobility to achieve balanced crustal columns of uniform mass above a level of compensation in which the topographic elevation is inversely related to underlying rock density.
- Example: Mountains having deep routes; The Scandinavian mountain with the recent melting of ice sheets are seeing a gradual rise of land which is evident in a series of raised beaches.

EUSTATIC (2:36 PM)

- They involve the worldwide movement of sea level resulting from changes in the total volume of liquid seawater or the capacity of ocean basins.
- Convection from the interior can arch up an oceanic ridge and displays water from ocean basins decreasing or increasing the capacity of oceanic basins.
- The formation of glaciers and the melting of ice will also change the water volume of oceans.

CONTINENTAL DRIFT THEORY (3:03 PM)

- **Introduction:**
- The Continental drift theory was proposed by Alfred Wegner a German meteorologist in 1912. He proposed a theory to explain the major variations in climatic conditions along different parts of the Earth.
- **Assumptions:**
- He proposed that the Earth is made up of 3 layers: Outer SiAl; Intermediate SiMa; And Inner Nife.
- **Theory:**
- The continental masses were assumed to be floating on oceanic crust without any resistance.
- During the Carboniferous period, there was a single supercontinent called Pangea with One super Ocean Panthalassa.
- The supercontinent was split into Northern Angara land or Laurasia and Southern Gondwana land by a rift running from East to west.
- The Northern portion consisted of North America; Greenland; Eurasia without Arabia and India.
- The Southern Gondwana land consisted of Africa with Arabia; Madagascar; India; Australia; Antarctica and South America.
- In North-South Rift separated North America from Eurasia and South America from Africa which started to move towards the west.
- India started to move toward the North, Australia started to separate from Antarctica and move towards North-East, Africa move towards the North and finally, Arabia got separated from Africa and merged with Asia.

FORCES RESPONSIBLE FOR CONTINENTAL DRIFT (3:39 PM)

- Wegener proposed the following forces as causes of continental motion.
- The Equatorward Movement was caused by Gravitational differential force and force of Buoyancy to adjust the center of gravity and center of Buoyancy which he called **Pole Fleeing Force.**
- Westward Movement caused by tidal forces of Sun and Moon

EVIDENCE (3:53 PM)

- Jigsaw fit
- Structural evidence
- Stratigraphic
- Fossil: Mesosaurus and Glossopteris
- Glacial Deposits
- Placer Deposits

TOPIC FOR THE NEXT CLASS: WILL CONTINUE WITH THE DICTATION AND SEAFLOOR SPREADING THEORY

Geography Class 11

A brief review of previous class

Dictation of last class(1:20:00 PM)

- **Evidence:**
- **Jigsaw fit/Juxtafix of continents**, that is, similarities in coastline on opposite sides of the ocean. All the continents can be merged together to form one big continent.
- **Structural evidence:** The mountain belts of Brazil terminate on the Eastern coast of South America and the same type of mountain reappears again in Western Africa.
- **Stratigraphic evidence:** The eastern coast of Brazil has the same type of rock formations observed along the western coast of Africa.
- **Fossil evidence: Mesosauraus**-an aquatic reptile whose fossil remains are found in East and South America and South Africa. Had it been able to swim across the entire Atlantic ocean, it should have been widely distributed. Also, the fossils of **Glossopteris** which were grown only in subpolar climates are now found in warm climatic regions separated by wide oceans.
- **Placer deposits:** Rich deposits of gold placer near Ghana coast without any source of gold nearby but are found in Brazil.
- **Glacial deposits:** The **layers of tillites** are found in warm tropical regions like South America, South Africa, Australia, India, etc.
- **Criticism:**
- The forces envisaged for the movement of continents were considered to be inadequate.
- The rocks of the continental crust and oceanic crust were rigid and would not permit easy drifting of continents over oceanic crusts.
- The theory did not describe the conditions of pre-carboniferous times.

Seafloor spreading theory(1:36:00 PM)

- Explained with the help of a diagram and a video.
- **Mapping of the oceanic floor revealed the following information:**
- Presence of mid-oceanic ridges along the sea floor. These ridges are active resulting in continuous volcanic eruptions.
- Rocks on either side of the ridge are of the **same age** with similar composition and similar magnetic properties.
- The age of rocks along the oceanic floor **increases** away from the mid-oceanic ridge.
- The rocks of the oceanic crust are **younger** than the continental crust.
- The oceanic crust is **thinner** than the continental crust.
- Based on these observations, **Harry Hess in 1961**, proposed the theory of seafloor spreading.
- According to this theory, the constant magmatic eruptions along the oceanic ridges cause the rupture of the oceanic crust.
- The new lava wedges onto the oceanic crust.
- This pushes the oceanic crust on either side, therefore, the ocean-floor spreads. The spreading crust sinks down at the oceanic trenches and gets consumed.

Plate Tectonics theory(2:01:00 PM)

- Explained with the help of a diagram
- **Introduction**
- The term plate was coined by **JT Wilson in 1965.**
- The theory of Plate Tectonics was proposed by **Mckenzie, Parker, and Morgan in 1967.**
- **Theory**
- Plates are broad and rigid segments of the lithosphere which include the rigid upper part of the upper mantle and crust.
- The plates are in motion on the underlying **asthenosphere.**
- Plate tectonics is the study of deformation within plates and of the interaction of plates around their margins.
- Plates are nearly 100kms thick and have high rigidity and are unable to deform except in response to a very strong and prolonged force.
- There are **7 major plates** on Earth's surface such as **Pacific, North American, South American, African, Eurasian, Indo-Australian, and Antarctican.**
- There are **many minor plates**, for example, **Nazca, Arabian, Cocos, Philippines, etc.**
- **Differences with respect to continental drift theory**
- The continental drift theory(CDT) assumed the SIAL layer of continental crust above the SIMA layer of oceanic crust. However, as per plate tectonics theory(PTT), a plate may consist of both continental and oceanic crust.
- CDT assumed that the continental crust floats freely over oceanic crust without much resistance, however, PTT proposes that the plates while in motion offer high resistance.

Plate movements(2:55:00 PM)

- Explained with the help of a diagram
- **1. Divergent boundary**
- **a. Ocean-ocean divergence**
- A plate margin with oceanic crust on both sides where the rising magma splits the lithosphere separates it into two different parts and moves them apart in two opposite directions.
- Hot magma comes up through the cracks and solidifies leading to the formation of a new oceanic crust.
- The continuous build-up of solid magma results in the formation of mid-oceanic ridges along the plate margins.
- In this plate margin, shallow earthquakes with a focus up to 70 km are observed.
- **b. Continent-continent divergence**
- The formation of divergent plate boundaries along continents involves **3 stages:**
- **i. Intra continental rifting**
- The upward movement of magma below a continental crust causes the fragmentation of continents through the creation of numerous cracks and faults.
- Such a series of faults are called **rift valleys.**
- Rising magma starts to come out through this rift.
- Example: **East African Rift Valley**
- **ii. Inter-plate thinning**
- It involves partial melting of the lithosphere and gradual thinning of continental crust.
- Rift valley starts to widen and may get filled with ocean water resulting in the formation of a shallow sea.
- Example: **Red Sea**
- **iii. Formation of the mid-oceanic ridge**
- The continuous spreading of the continental plates away from each other and the creation of new oceanic crust along the rift valley by the rising magma pushes the continental mass sufficiently apart.
- At this stage, there will be a new oceanic basin along both sides of the ridge.
- Example: **Mid Atlantic Ridge.**
- **Note: Continent-ocean divergence** is not found anywhere in the world currently. If at some point it is found anywhere on earth, it will be gradually converted to ocean-ocean divergence, thus we do not study it separately.

Topics for the next class: Plate tectonics continued
Geography Class 12

A brief overview of the last class
Convergent Plate Boundary(1:18:00PM)

- **Ocean-Ocean convergence**
- Explained with the help of a diagram.
- When two oceanic plates converge, oceanic plate of **higher density** descends into the asthenosphere. This process is called as subduction. The region of subduction is called as a **subduction zone.**
- The process of subduction leads to the formation of **trenches** which are the deepest regions on the surface of the Earth. For example, the subduction of the Pacific plate below the Eurasian plate has resulted in the **Japan trench, Mariana trench, Aleutian trench, etc.**
- The subducting plate undergoes deformation, intense compression, metamorphism, and partial melting as it reaches the deeper parts.
- Some of the molten material finds its way upward in the form of **volcanic activity.**
- This molten material piles up continuously on the other oceanic crust resulting in the formation of **volcanic mountains on the sea floor.**
- When these volcanic mountains rise above the water level, it leads to the formation of **volcanic islands.**
- The continuous volcanic activity gradually increases the size and elevation of volcanic islands.
- These islands are arranged parallel to the trenches in an arc shape is called an **island arc.** For example, **Japan, Aleutian, Caribbean islands, etc.**
- An **archipelago** is a group of islands scattered in the ocean. It is formed around ocean-ocean convergent plate boundary with intense volcanic activity or due to shifting of plate margins. For example, **Indonesia, the Philippines, etc.**
- Subduction zones are the sites of the most widespread and intense earthquakes.
- In the ocean-ocean convergent plate boundary, all three types of earthquakes, that is, shallow, intermediate, and deep-seated can be formed.

- The majority of the earthquakes appear to be confined to a narrow dipping zone along the subducting slab called as **Benioff zone.**

Ocean-continent convergent plate boundary(2:07:00PM)

- When a plate with an oceanic margin collides with a plate of the continental margin, the oceanic crust being higher in density subducts into the mantle below the continental crust. For example, **the Nazca plate subducting below the South American plate.**
- During the subduction, the sequence of sedimentary layers along the continental margin gets compressed and deformed to form a chain of fold mountains. For example, **the Andes and the Rockies mountains.**
- As the oceanic plate subducts, it creates trenches, and earthquakes are generated along Benioff zones.
- As the oceanic plates plunge deeper, it gets melted and starts to rise.
- This rising magma will be emplaced in the overlying continental crust which may eventually migrate to the surface leading to the formation of volcanoes.
- For example, the subduction of the Nazca plate below the South American plate has resulted in a series of volcanoes in the Andes such as **Ojos del Salado, Cotopaxi, etc.**
- Ocean-continent convergent plate boundary experiences all three types of earthquakes.
- The Pacific Ocean is surrounded by trenches on all sides which are the zones of intense volcanic activities and earthquakes which is called as **Pacific Ring of Fire.**

Continent-continent convergent plate(2:50:00PM)

- Prior to the collision of the continental margin, the landmasses are usually separated by the oceanic crust.
- As two plates converge, the intervening sea encloses and seafloor subducts beneath one of the plates.
- The continued convergence results in complete subduction of oceanic crust and the two continental mass get stitched together at a zone called a **suture zone.**
- When continental margins continue to collide, the low density of continental material doesn't permit its subduction.
- The oceanic crust completely breaks from the continental crust and gets completely assimilated into the mantle.
- At this point in time, volcanic activity stops.
- The continued convergence forces the continental crust partially under the other creating an unusually thick layer of intense folding.
- The sediments deposited in a basin between the continental margins undergo continuous and intense compression resulting in the upliftment of the very high-fold mountains. For example, **The Himalayas.**
- Shallow and intermediate earthquakes are observed along this margin.

Conservative plate margin or parallel plate margin(3:26:00PM)

- Explained with the help of a diagram
- At conservative plate margins, the plates slide past each other without any formation of new crust, nor the destruction of existing crust.
- Along this plate margin, the transform faults roughly move parallel to the direction of plate movement.
- For example, **the San Andreas fault of California**
- Such a series of transform faults are found along the oceanic crust where they offset the oceanic ridges throughout their length.

Summary(3:43:00PM)

-

	O-O Divergence	**C-C Divergence**	**O-O Convergence**
Features	Mid oceanic ridges(MOR), New oceanic crust,	Rift valley, Shallow sea, MOR, New oceanic crust	Trench, Subductio islands, Island Ar mounts(mountain

Earthquakes (shallow /Intermediate/ Deep)	Shallow only	Shallow only	All types
Volcanism	Yes	Yes	Yes
Examples	Mid Atlantic Ridge, Carlsberg Ridge, East Pacific Rise	East African Rift Valley, Red Sea	Japan, Aleutian, I

-

	O-C Convergence	**C-C Convergence**	**Conserv**
Features	Trench, Fold mountains, Subduction Zone, Benioff zone, volcanoes(on the fold mountains)	High fold mountains, Suture zone, Partial subduction, Nappe	Transfo
Earthquakes (shallow /Intermediate/ Deep)	All types	Shallow and intermediate	Only sh
Volcanism	Yes	No	No
Examples	Andes, Rockies	Himalayas	San And

Topics for next class- Causes of plate motion, Volcanism
Geography Class 13

A brief review of the last class
Causes of Plate motion(1:16:00PM)

- Explained with the help of a diagram
- **1. Convection currents**
- The theory of convection currents was proposed by **Arthur Holmes**.
- The convection currents are generated in Earth's interior due to the intense heat from Earth's core released by **radioactivity and primordial heat.**
- These convection currents are of **two types:**
- **a. Involving the whole of mantle**
- **b. Involving only asthenosphere**
- The convection currents as they ascend from below, diverge and spread laterally.
- The convection causes the lithosphere to split resulting in the formation of cracks. As the plates move laterally, the currents carry the slab of lithosphere along with them.
- When these currents encounter a similar current from opposite directions they descend into deeper parts of the mantle and drag the lithosphere down into the mantle along the trenches.
- **2. Mantle plumes**
- A mantle plume is a type of mantle convection and involves jet-like plumes of low-density material from the **core-mantle boundary.**
- As the plume reaches the lithosphere, it spreads laterally doming the surface zones of Earth and moving them in the direction of mantle plumes.
- Mantle plumes by continuously supplying magma keep the lithospheric plates active, particularly along intra-plate regions.
- The mantle plumes may also result in differential plate motion causing intra-plate movements.

- Mantle plumes are the causes of the formation of volcanic hotspots, for example, the Hawaii hotspot, Reunion hotspot, etc.
- **3. Ridge push**
- The magma rising along Mid-Oceanic ridges forms wedges of the new lithosphere on either side of the plate causing plates to be pushed apart.
- **4. Gravity sliding**
- The spreading centers of ridges stand high on the ocean floor. This results in gravitational sliding of the lithosphere away from the oceanic ridge.
- **5. Slab pull**
- They are considered to be along the subduction zones where the subducting plate pulls the rest of the slab along.

Limitations or Criticism of Plate tectonics(2:15:00PM)

- Both Africa and Antarctica are surrounded by ridges and have no subduction zones to accommodate the new lithosphere generated.
- Plate tectonics in the past, that is, the formation of earlier mountains and movement of different plates and how they are different from the present ones.
- Explanation of whole through video
- Discussion on Mains PYQ asked from this topic.

Volcanism(2:36:00PM)

- Volcanism includes all the phenomena associated with the movement of molten material from the interior of the Earth to the surface.
- Volcanism involves **3 main processes:**
- **a. Generation of magma**
- In the Earth's interior, due to increase in temperature or decrease in pressure or an increase in water content causes the melting of rocks generating magma.
- **b. Intrusion of magma**
- It involves the movement from lower layers into lithospheric layers.
- **c. Extrusion of magma**
- When sufficient pressure builds up in lithospheric layers, magma erupts out onto the surface.
- **Difference between magma and lava**
- Magma is hot, mobile, molten, silicate material. Magma is made up of a combination of solid, liquid, and gases.
- When magma reaches the surface, it erupts as lava.
- Lava is more volatile than magma and it cools either on the surface or underwater.

Types of magma(3:23:00PM)

Granitic	**Basaltic**
Silica content is greater than 66%	Silica content is less than 52%
Fluidity is lower	Fluidity is higher
Density is lower	Density is higher
Temperature is lower	Temperature is higher
Formed from the continental crust.	Generated from Asthenosphere and mantle.

Plate tectonics and magma generation(3:30:00PM)

	O-O(D)	**C-C(D)**	**O-O(C)**	**O-C(C)**	**Hotspot**
Along	MOR	Rift valley	Near trenches along volcanic islands	Near to trenches along edges of continents	Intra plate
Nature of magma	Basaltic	Basaltic	Andesitic	Andesitic	Basaltic
Cause	Convection currents	Convection currents	Subduction	Subduction	Mantle plumes
Type of eruption	Fissure (continuous and smooth)	Volcanic (violent, not smooth)	Strato Volcano(very violent explosion)	Strato volcano	Shield volcano

- **Distribution of volcanoes along the world**
- Shown with the help of a map
- **a. Ridge volcanism**
- Along oceanic floor through Mid Oceanic Ridges. for example, Mid Atlantic Ridge
- **b. Arc volcanism**
- Along ocean-ocean convergent boundary associated with island arcs, for example, Japan, Aleutian.
- **c. Volcanic chains**

- Along ocean-continent convergent plate boundary along the continental margin. for example, Andes and Rockies
- **d. Volcanic clusters**
- Along continent-continent divergent plate boundary. For example, the East African rift valley.
- **e. Volcanic lines**
- ALong the hotspots. For example, Hawaii and Reunion.

Topics for the next class: Volcanism contd, Geomagnetism, Earthquakes, and Tsunami
Geography Class 14

[1:15 PM] Brief Recap:
[1:23 PM] Important Volcanoes of the World Mapping:

- Types of Volcanoes- Active, Dormant, and Extinct
- eg. Mauna Kia, Mauna Loa, Ojas del Salado, Chimbarazo, Cotopaxy, St. Helens (USA), Mt. Etna, Mt. Vesuvius (Italy), Krakatoa (Indonesia), Mt. Fuji (Japan), Barren Island, and Narcondam (India), etc.

[1:49 PM] Volcanic Landforms:

- **Extrusive landforms - outside**
- **A. Volcanic cone** (commonly called volcano itself), **types** of volcanic cones-
- **1. Shield Volcano** - formed due to highly fluid magma, that is, **basaltic magma,**
- They are majorly found along hotspots generated due to mantle plumes,
- They are very large in size, but not very steep, ***eg. Mauna Loa***
- **2. Ash Cinder Cone -** these are the smallest of all the types,
- They are formed due to the accumulation of loose particles of ash cinder near to vent. ***eg. Taal volcano (Philippines)***
- **3. Strato Volcano -** aka composite volcano,
- They are formed by the accumulation of viscous magma around the vent,
- They are majorly found in the regions of subduction zones and formed by ***andesitic magma***, which is viscous in nature,
- They are steeper in slope formed by multiple layers of magma accumulation, ***eg. Mt. Fuji, Krakatoa, etc*.**
- **[2:19 AM] B. Crater-** it is a depression at the mouth of a volcanic vent. It may result in the formation of a crater lake, ***eg. White Island volcano***
- **C. Caldera -** a greatly enlarged depression formed due to the violent eruption of a volcano. It may result in the formation of the caldera lake. e. Lake Toba (Indonesia).
- **D. Flood Basalt Province -** it is formed by the eruption of highly fluid basaltic magma covering a large area and forming sheets of magma on the surface. ***eg. Deccan traps.***
- **E. Hotspring, Geyser, Fumarole:**
- **Hotsprings- thermal springs,** When the ground water sinks deep enough and gets heated by a hotspot or magma chamber it rises to the surface and flows in the form of a spring without explosion. It results in a hot spring or thermal spring. It contains dissolved minerals and has medicinal values, ***eg. in the Hot springs of Iceland, Manikaran, Tatapani, Manali, Rajgir, in India, etc.***
- **Geysers** are fountains of hot water and superheated steam ejected intermittently at regular intervals with an explosion, eg. Geysers of New Zealand, USA (old Faithful geyser)
- **A fumarole** is a continuous jet-like emission of steam and other gases without water, eg. Fumaroles of Iceland.
- **F. Mud-Volcano** - It involves the eruption of mud mixed with water and gases and may not contain magma, eg. Baratan Island (Andaman and Nicobar).
- **[2:51 AM] Intrusive landforms - the landforms below the surface of the earth.**
- **1. Batholiths -** these are large irregular ***dome-shaped*** structures formed by the cooling of magma along deeper layers of lithosphere
- **2. Laccolith -** These are ***mushroom-shaped*** features formed due to the intrusion of magma along the bedding plains.
- **3. Lopolith -** when magma solidifies in ***saucer-shaped*** along a shallow basin it results in lopolith.
- **4. Sill -** these are intrusive ingenious features formed parallel to bedding plains as ***horizontal sheets.***
- **5. Dyke** - these are vertical ***wall-like formations*** due to the cooling of magma in the vertical direction

[3:19 PM] Geomagnetism:

- The magnetic field associated with the earth is called as geomagnetism.
- The Earth has an outer rocky mantle below which there is the liquid outer core which surrounds the solid inner core.

- It is considered that the motion of charges that is iron in the liquid part of the earth's core generates a magnetic field.
- ***The motion of charges that is iron in the outer core is caused by -***
- 1. Rotation of Earth
- 2. Heat rising from the earth's inner core results in the generation of convection currents of molten material in the outer core.
- The motion of charges in this molten material produces an electric current through the earth's core, which results in a magnetic field around the earth causing geomagnetism.
- **[3:57 PM] Paleomagnetism:**
- It is the historical study of earth's magnetism through rocks when igneous magma crystallizes, the crystals of ferromagnetic minerals such as iron, etc. acquire stable magnetism which becomes frozen as the magma cools down. This acquired magnetism is called **fossil magnetism**.
- When paleomagnetic evidence for a given region was checked over a long period of time, a gradual change in the direction was detected. This shows that the position of magnetic poles has changed steadily over time. This movement is called ***Polar wandering***.
- During the study of the oceanic surface, it was found that some of the minerals of rocks are pointed toward the north and some towards the south, it is inferred that the minerals of the rocks did not change their polarity but it is the earth's magnetic field that reversed its polarity.
- Such reversal of magnetic field can be brought by reversal of convection currents in the outer core.
- This **reversal happens every 2-3 lakh years**.
- **[4:06 PM] Auroras:**
- Earth's magnetic field blocks the charged particles from solar winds but some of these charged particles get trapped near polar regions where the magnetic lines are straight.
- Due to the interaction of charged particles with gases in the earth's atmosphere near polar regions colorful lights are released called Aurora.
- It is called Aurora Borealis on the North pole and Aurora Australis on the south pole

Next Class Topic -Earthquake, Tsunamis, etc.
Geography Class 15

A brief review of the previous class and doubt resolution
Earthquakes(1:23:00 PM)

- Explained with the help of diagrams
- **What is an Earthquake?**
- Vibration or oscillation of the earth caused by transient disturbance of the elastic or gravitational equilibrium of the rocks at or beneath the surface of Earth is called Earthquakes.
- The scientific study of earthquakes is called seismology.
- The point where energy is released below the surface is called **focus or hypocentre.**
- The point on the surface nearest to the focus is called the **epicentre.**
- **Causes of Earthquakes:**
-

Natural	Anthropogenic
Plate movements	Mining
Volcanic eruptions	Nuclear explosions
Landslides	Reservoir-induced seismicity(RIS)
Meteorite	
Land subsidence	

Earthquake waves(1:43:00 PM)

- Explained with the help of slides.
- An Earthquake generates two types of waves- body and surface waves.
- **Body waves**
- These are generated from the focus and move through the interior of Earth.
- There are two types of body waves:
- **a. P waves(Primary/Longitudinal/Compressional)**
- They oscillate back and forth in the direction of propagation.
- They are the first waves to be detected during an Earthquake.
- They depend on the density and compressibility of the material.
- P waves can pass through solid, liquid and gases
- **b. S waves(Secondary/Transverse waves)**
- The oscillation occurs perpendicular to the direction of propagation.

- They depend on the density and rigidity of the material through which they are passing.
- Therefore, S waves travel only through solid and not through liquid and gases.
- **Surface waves**
- They are generated from the epicentre due to the interaction of body waves with the surface.
- They are confined to the surface of the Earth.
- They are much slower than body waves and can cause more damage.
- **Shadow zone**
- Explained with the help of diagrams.
- The seismic waves undergo reflection, bending or change in speed while passing from one medium to another.
- A Shadow Zone is a zone in Earth's interior where Earthquake waves are not reported.
- P-waves are not detected between 105 to 145 degrees from the focus resulting in a P wave shadow zone.
- It is caused due to bending and slowing down of P waves as it enters the outer core.
- S wave shadow zone is experienced along all the regions beyond 105 degrees as S waves can not pass through the liquid outer core.

Types of Earthquakes and distribution(2:26:00 PM)

- Based on the **depth of focus,** Earthquakes can be divided into:
- **Shallow Earthquake:** 0-70 km
- **Intermediate:** 70-350 km
- **Deep-seated:** Beyond 350 km
- **Distribution of Earthquakes/Regions**
- Explained with the help of Map
- Pacific Ring of Fire: Along the Eastern Side there is O-C convergence, on the Western side it is due to O-O convergence.
- Mediterranean and Trans-Asiatic belt:
- Mid Oceanic Ridges
- East African Rift Valley- Due to C-C Divergence

Measurement of Earthquakes(2:33:00 PM)

- The instrument used for recording Earthquakes is called a **seismograph.** The output of a seismograph is a **seismogram.**
- **Intensity and magnitude**
-

Magnitude	**Intensity**
It measures the amount of energy released at the focus.	It measures the level of visible damage caused.
Objective measurement	Subjective measurement
It is fixed.	It varies from one place to another.
Richter scale- Range(starts from 1 and there is no upper limit), a logarithmic scale(It increases by 10 times). The highest ever recorded is 9.5 recorded in Chile.	Modified Mercalli scale- Range(1 to 12), a linear scale

- **Impacts of Earthquakes**
- Infrastructure damage- buildings, electric poles
- Liquefaction
- Landslides
- Tsunami
- Flash floods/Collapse of reservoirs/changing the course of rivers
- Trigger fire in urban regions- gas leaks, etc.
- Explanation through videos and doubt resolution

Tsunami(3:20:00PM)

- Explained with the help of diagrams.
- Tsunami is the Japanese word for harbour waves. They are also called seismic sea waves.
- There are **4 stages** involved during Tsunami:
- **a. Generation**
- It is due to the vertical displacement of columns of sea water which can be **caused by:**
- Earthquakes along normal and reverse faults along the sea floor
- Volcanic eruptions on the sea floor or near the coast
- Landslides or land subsidence along the sea floor
- Large meteoritic impact in the ocean
- Underwater nuclear explosion.
- **b. Propagation in deep water**

- When the Tsunami waves move in deep water due to higher depth, the waves move at a faster speed with very low amplitude, therefore, Tsunami is not visible in the open ocean nor will they cause any damage.
- **c. Propagation in shallow water**
- As the Tsunami waves approach the coast, the depth of water decreases, resulting in a decrease in speed and increase in amplitude. This sudden decrease of speed causes piling up of water near the coast called the **shoaling effect.**
- **d. Landfall**
- It means the breaking of tsunami waves.
- Videos of the Tsunami were shown.
- Unlike Earthquakes, Tsunami warnings can be issued a few hours before.

Topics for the next class: Exogenetic movements- Refer to Class 11 NCERT
Geography Class 16

BRIEF REVIEW OF THE PREVIOUS CLASS (01:11 PM)
GEOMORPHIC PROCESS (1:22 PM)
EXOGENETIC MOVEMENTS

- These are the geomorphic processes caused due to various forces acting from outside the Earth's Surface.
- The source of Energy for exogenetic movement are Sunlight and Gravity.
- Different agents of Exogenetic movements are Wind, Water, glaciers, etc.
- The exogenetic process involves Aggradation and Degradation.
- Aggradation is the action of various processes that cause deposition on the surface in order to bring uniformity of the grade i.e. slope.
- Degradation or denudation involves the combined action of various processes that cause varying away of Earth's surface and causes a general lowering and leveling out of Earth's Surface.
- It involves Weathering, Erosion, and Mass movement.

WEATHERING (1:38 PM)

- It is a total effect of various processes that cooperate in bringing about the decay and disintegration of rocks involving no large-scale transportation.
- Weathering is In-Situ.
- It does not involve the transportation of Degraded rock material.
- **Factors:**
- **Rock Type and Structure:**
- It includes rock massiveness, porosity, permeability, the presence of fractures, bedding plain, etc.
- For example, Sedimentary Rocks undergo a faster rate of weathering than igneous rocks.
- **Slope and Aspect**
- A steep slope will greatly aid weathering as disintegrated material is removed faster.
- Slopes which are exposed to wind, rain, and sunlight, are more prone to weathering (aspect).
- **Temperature:**
- A considerable range of temperature both Diurnal and Annual subjects the surface layers to the expansion and contraction
- Temperature also increases the rate of chemical reactions
- **Water**
- The presence or absence of water decides the rate of a chemical reaction.
- When water is added or removed it imposes mechanical stress on the rock that causes it to split.
- **Organisms:**
- It includes the action of plant roots; Decomposing vegetation and Burrowing animals.

Types (2:02 PM)

- **Mechanical/ Physical Weathering:**
- **A. Crystal Growth**
- **1. Growth of Ice crystal**
- When water freezes, it expands. When water finds its way, into cracks or pores, it wedges apart. Rock fissures and joins.
- If it is happening in desert regions, it is called frost shattering, in cold and glacial regions, it is called freeze-thaw.
- **2. Salt weathering:**
- It involves the growth of salt crystals, by crystalization, as moisture evaporates, thus creating pressure, in pore spaces and cracks. It is also called **haloclasty.**
- **B. Pressure/Thermal Expansion:**
- **1. Exfoliation**

- The rapid expansion and contraction of surface rocks weaken the shell creating fissures causing the rock shell to peel off.
- **2. Pressure Release:**
- The confining pressure from the weight of overlying rocks is released, when the overlying cover is removed by erosion. This causes the rock to expand leading to the generation of fractures.
- **3. Block Distengration**
- Where the rocks break into blocks**.**
- **4. Granular Disintegration:**
- When the rocks break up into small granules.
- **Chemical Weathering**
- **1. Hydrolysis:** It is the chemical union of water in which new material is produced through the solution.
- **2. Hydration:** It occurs when minerals incorporate water into their molecular structure, it causes swelling.
- **3. Oxidation/reduction:** It involves the addition or removal of oxygen, and usually causes discoloration. They are the first visible signs of chemical weathering.
- **4. Carbonation:** Rainwater absorbs carbon dioxide and gets converted into carbonic acid. Limestones and dolomites are altered, by the dissolving action of carbonic acid.
- **Biological Weathering**
- It involves the breaking of particles by the pressure exerted by plant roots, Burrowing animals, etc.
- The decomposing organic matter due to the presence of microorganisms releases different chemicals which may increase, the rate of weathering.

EROSION (3:14 PM)

- Erosion refers to the wearing away of land surface by the mechanical action of debris derived from weathering as they are transported to different locations by agents like wind, water, glaciers, etc.
- **Types of Erosion:**
- **1. Abrasion:** wearing away of surfaces By mechanical processes like rubbing, scratching, Polishing, Etc.
- **2. Attrition:** It involves the reduction in the size of Fragments by friction and impact during transportation. It breaks down the load into finer sediments.
- **3. Cavitation:** Collapse of bubbles of water in rivers leads to explosion sending a shock wave which tends to disintegrate the adjacent rocks.
- **4. Corrosion:** It involves the wearing away of particles by the solvent and chemical actions of water.
- **5. Deflation:** The lifting or removal of dust or sand by wind. It involves aerial erosion and removing the broken sediments.
- **6. Hydraulic action:** Breaking of rocks by fast-moving water
- **7. Plucking:** As the glacier moves it drags the rocks and disintegrates them into smaller pieces.

MASS MOVEMENT (3:45 PM)

- Mass in movement under the influence of gravity. The weathered material moves down the hill slope under the influence of gravity with or without the assistance of water. It is also called Mass wasting.
- All the mass movements are of two types: Slow movement and Rapid Movement
- **Slow Movements:**
- Soil creep
- Solifluction
- **Rapid Movements**
- Landslide
- Earth Flow
- Mud Flow
- Rock Slide

TOPIC FOR THE NEXT CLASS: WILL CONTINUE WITH MASS MOVEMENTS
Geography Class 17

Revision: (13:11)

- Weathering.
- Types of weathering, reasons, etc.
- Physical and chemical weathering.

Slow movement: (13:26)

- **Creep:**
- It is the slow downhill movement of soil and weathered mantle, occurring along the mountain slope.
- Creep is slow, steady, and downward movement.
- They are continuous but difficult to notice.

- **Solifluction:**
- It involves the slow movement of soil mixed with water as a viscous fluid.
- It is a process where the soil is saturated and starts flowing over a slope.
- It is more active in the glacial region.

Rapid movements: (13:32)

- **Landslide:**
- The movement of a cross-section of a hill under the influence of gravity.
- The material maintains continuous contact with the surface as it moves.
- **Earthflow:**
- Earthflow occurs on terraces and hillsides, where they are capable of flowage when saturated with water that occurs beneath the earth layer.
- Slope material liquefies and forms a depression.
- **Mudflow:**
- It involves the rapid movement of masses of unconsolidated and uncompacted soil which is saturated with water.
- A mudflow is an earthflow consisting of material that is wet enough to flow rapidly.
- **Rockslide or fall:**
- It involves rapid movement of rock material along the mountain slopes and may involve vertical fall of rocks.

Landforms: (13:45)

- River water: riverine.
- Groundwater: karst.
- Coastal water: marine.
- Wind: Desert/arid.
- Glaciers: glacial topography.

Riverine topography: (13:54)

- River water is the agent in riverine topography.

	Processes	**Erosional features**	**Depositional features**
Riverine	Corrosion Attrition Cavitation Hydraulic action	V-shaped valley. Gorge, Canyon, Rapid, Cataract, Waterfall, Plunge pool, potholes, river capture, meander river cliff.	Meander: slip-off slope, Levee, Floodplain, Oxbow lake, Delta, Alluvial fan,
Karst	Moderate to heavy precipitation. The top layer of limestone/dolomite, Jointed rocks	Sinkholes: depression in limestone region. Caves, pools: opening at the top, etc.	Stalactites. Stalagmites, Pillars: a combination of both stalactites and stalagmites
Marine Desert Glacial	Will be covered in the next class.		

Terms related to the landforms:

- **Stalactites**: They hang as icicles of different diameters.
- **Stalagmites:** They rise up from the floor of the caves.
- **Pillars:** Stalagmite and stalactites eventually fuse to give rise to pillars.
- **Delta:** formed by deposits at old age.
- Delta is finer sediments.
- **Alluvial** is coarse sediments.
- **Meandering:** When the river flows in zig-zag form, usually in its mature phase.
- **Oxbow lake:** It is formed when a meandering river is cut off creating a free water body.
- Marine topography:
- By marine action.

The topic for the next class: **Marine, Desert, Glacial landforms, etc.**

Geography Class 18

<u>A brief overview of the previous class</u> (1:13 PM)

<u>Marine topography</u> (1:19 PM)

- Processes involved are hydraulic action, erosion, and attrition.
- Bay has a round shape and a smaller body as compared to Gulf. Example Gulf of Mexico.
- Valley abruptly ending at the cliff is called hanging valley
- Sea caves

- Arch or natural bridge
- **Depositional features near the coastal region**
- Beach
- Sand bar. Example Srihari Kota is a vast offshore sandbar
- Sandspit one side is connected to a landmass and another end is open to the ocean. If it's connected on both ends it's called a tombolo.
- A lagoon- is made of brackish water.

Arid and desert topography (1:50 PM)

- The wind is the agent behind erosional and depositional features in the desert regions
- Processes involved are Abrasion, deflation, and attrition.
- Mushroom-type rocks due to abrasion of bottom rock
- Ventifact rock formed due to abrasion and its finely polished rock
- Zeugen- hard and soft layer aligned in the vertical direction and causes erosion of the soft layer. Differential erosion
- Yardang- here soft and hard rock are aligned in the horizontal direction.
- Inselberg- eroded remnant hill. Central hard rocks remain and surrounding rock got eroded.
- **Depositional features**
- Barchan- limbs in the direction of winds
- Parabolic- limbs are in the opposite direction of winds.
- Transverse dunes—perpendicular to the direction of the wind
- Longitudinal dunes are formed parallel to the direction of the wind.
- Seif dunes- barchans with one limb
- Playa lakes or bolson lake
- Oasis-fertile region around the lake is called as Oasis

Glacial topography (2:34 PM)

- The related process is plucking and abrasion
- **Erosion features**
- Depression along the mountain slopes is known as a cirque.
- Arete formation takes place when two cirques meet.
- When multiple cirques meet its Horn.
- When Horn collapses due to continued erosion it gives rise to COL
- A U-shaped valley is the erosional feature of Glacial topography.
- Hanging valleys are also formed in glacial topography
- Fjords- valley directly entering the ocean.
- **Depositional features**
- Moraine is the unsegregated deposition of glacial erosion.
- types of Moraine->Lateral moraine, ground marine, medial moraine, terminal moraine etc
- Earlier period glacial deposits are called Tillites.
- Drumlines – Basket of egg topography.oval-shaped hills largely composed of glacial till.
- A longitudinal ridge formed due to deposition is called an Esker.

Break at 3:08 PM

Climatology (3:24 PM)

- **Topics to be covered are**
- Weather and climate
- Composition of atmosphere
- Climatic regions etc.
- Heat budgets etc.
- **Weather and climate**
- The atmosphere is the layer of air surrounding the earth held by gravity.
- It is a thick gaseous envelope that surrounds the earth from all sides and is attached to its surface.
- Climate is the average atmospheric conditions of an area over a considerable period calculated for a minimum of 30 years.
- Weather is a day-to-day state of the atmosphere
- **Composition of atmosphere**
- Nitrogen – 78 .08%-> its basic building block of life. Is not active chemically. It can be absorbed directly by the organism.
- Oxygen- 20.95 %- required for respiration.
- Argon-0.93 %
- Co2-0.036 % -> Its greenhouse gas.

- Neon- 0.002% etc.
- **Water vapor**- its gaseous form of water and its concentration is variable in the atmosphere. 99 % of water vapor concentration in the lower atmosphere is up to 16 KM altitude in the Troposphere. It's needed for weather phenomena such as Cloud formation, Precipitation, etc.
- Concentrated more in the Tropical region and lower in the polar region
- **Dust particles** – the majority of dust particles are in the Lower atmosphere. Dust particles from Wind erosion in arid regions, volcanic eruptions, etc. These are also called hygroscopic nuclei

The topic of the Next class- Structure of atmosphere, insolation, and albedo.
NOTE- Before coming to the next class do read these topics in 11th standard NCERT. Topics- Structure of atmosphere, Insolation, heat budget, etc
Geography Class 19

A brief review of the last class through questions and doubt resolution
Structure of atmosphere(1:24:00PM)

- Explained through a diagram
-

Homosphere	**Heterosphere**
Homosphere exists up to 80 km	It is present beyond 80 km till the edge of the atmosphere.
There is uniform mixing of all gases	The gases form separate layers.
Gases are in molecular form(O_2),	Gases are in atomic form(O).
There is a higher concentration of water vapour and dust.	Water vapour and dust are almost absent.

- **The homosphere is divided into 3 layers:**
- a. Troposphere(16 km)
- b. Stratosphere(50 km)
- c. Mesosphere(Upto 80 km)
- **Heterosphere is divided into 2 layers:**
- a. Thermosphere(Upto 700 km)
- b. Exosphere
- **Troposphere**
- It extends from sea level to up to **16 km near the tropics** and **6 km near the poles.**
- It is also called the **zone of turbulence** or the **zone of convection** and **all weather phenomena** are restricted to the troposphere.
- The troposphere contains **99% of water vapour and dust particles** and **75% of all gases in the atmosphere.**
- Temperature decreases at the rate of **6.5 degrees Celsius per km** with an increase in altitude which is called **Normal Lapse Rate.**
- The edge of the troposphere is called the **tropopause.**
- **Stratosphere**
- This layer is called so because **air is stratified** and **non-convective** in nature.
- It extends from the tropopause to up to **50 km.**
- The temperature rises in the stratosphere due to the **absorption of UV radiation** by **ozone** in this layer.
- The conditions are **extremely dry** except few rare clouds called **stratospheric clouds**.
  Example: **Mother of Pearl or Nacreous.**
- The top of the stratosphere is called **stratopause.**
- **Mesosphere**
- It extends from stratopause to **80 km.**
- Temperature decreases with an increase in altitude.
- The temperature reaches the lowest in the atmosphere, that is, near to **(-)100deg Celsius.**
- **Thermosphere**
- It extends from 80 km **up to 700 km.**
- It consists of a **lower nitrogen layer** and **upper oxygen layer.**
- The temperature rises rapidly due to the absorption of high-energy solar radiation and it reaches nearly **1200deg Celcius at 350 km.**
- **Exosphere**
- It extends from 700 km **to the edge of the atmosphere.**
- It contains **atomic oxygen, helium and hydrogen.**
- It contains a **magnetosphere** which is composed of electrons and protons produced from solar winds and other charged particles. They are arranged in 2 bands - one at **3000 km** and another at **16000 km** called as **Van Allen Radiation Belt.**
- **Ionosphere**

- It is a layer of ions formed due to **ionisation by solar radiation.**
- It is made up of different layers such as **D, E, F, G, etc.**
- It extends between **80 to 650 km** within the thermosphere.
- The ionosphere reflects **short wave radio waves** back to earth and helps in **radiocommunication.**
- **Karman line**
- It is the boundary where outer space begins.
- International Law does not define the limit of outer space, however, above 100 km, the air is too thin for aircraft navigation. Therefore, it is considered the boundary of outer space.
- Discussion of PYQ

Insolation(3:08:00PM)

- Explained with the help of a diagram.
- The amount of incoming solar radiation is called insolation.
- The amount of insolation received by the Earth is **2 billionth of solar energy.**
- The amount of insolation received by Earth is equal to **1.92 calories per minute per cm square** which is called a **solar constant.**
- The **incoming solar radiation is shorter in wavelength** and this radiation is absorbed by Earth's surface and is **re-emitted as long wavelength terrestrial radiation.**
- The atmosphere is almost transparent to incoming solar radiation and opaque to outgoing terrestrial radiation.
- The warming of Earth's atmosphere and its surface by the absorption of terrestrial radiation by some of the gases called as **Green House effect**. The gases responsible are called **Green House Gases.**
- Examples, Carbon dioxide, methane, nitrous oxide, HFC, PFC, SF6(sulphur hexafluoride) and water vapour.
- Since the Earth's surface absorbs the incoming solar radiation and emits the outgoing terrestrial radiation, it acts as a source of heat for the atmosphere. Therefore, temperature decreases with altitude at the rate of **6.5 deg Celsius per km** called as **Normal Lapse Rate.**

Methods of heat transfer(3:37:00PM)

- **Radiation**
- It involves the transfer of heat in the form of radiant energy.
- The incoming solar radiation is in the form of electromagnetic radiation.
- **Conduction**
- It is the transfer of heat through molecular activity at the zone of contact.
- Conduction occurs at the zone of contact between the troposphere and Earth's surface.
- **Convection**
- It is the transfer of heat by the vertical movement of mass or air.
- The convection of air is strong near the equator.
- **Advection**
- It is the transfer of heat by the horizontal movement of mass.
- For example, Planetary winds or ocean currents.

Factors affecting insolation(3:51:00PM)

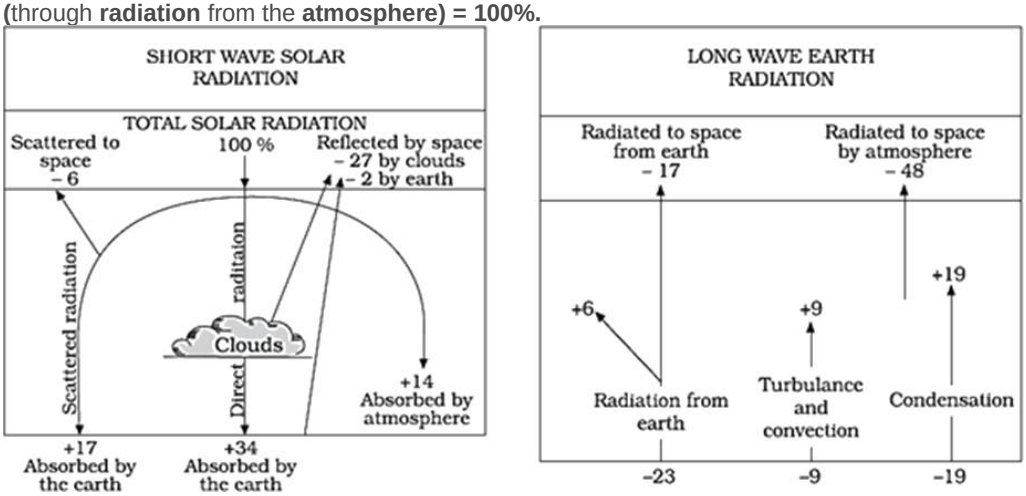
- **Latitude**
- Latitude affects the insolation received per unit area due to changes in the angle of incidence of sun rays.
- At lower latitudes, insolation is concentrated in small areas and at higher latitudes, it is distributed over large areas.
- **Transparency of atmosphere**
- Cloud cover, dust particles, and water vapour reduce the transparency of the atmosphere and affect insolation received at the surface
- **Length of the day**
- The longer the day more the insolation received.
- Doubt resolution

Topics for next class: Heat budget, Albedo, Temperature inversion, etc
Geography Class 20

The class started at 1.10 PM
A brief overview of the previous class:

- Structure of the atmosphere.
- Insolation
- Factors affecting insolation, etc.

PYQs asked in CSE-prelims exam: (at 1.20 PM)
Heat Budget: (at 1.24 PM)

- On a **global scale**, the earth must **re-radiate** as **much heat** as it **receives** from the sun.
- This is **necessary** in order to maintain **the uniform temperature** of the earth.
- The **gains** and **losses** in heat by way of **incoming** solar radiation and **outgoing** terrestrial radiation are called **"Heat Budget**".
- **NOTE: kindly refer to the relevant diagram drawn by Rajesh sir in the live class.**
- **Heat budget mechanism:**
- The earth receives **most** of its energy from the sun through **shortwave solar radiation**.
- The **solar energy** radiated towards the earth's surface is taken as **100 percent** or **100 units**.
- Out of **100 units**, **65 units** are **absorbed** and **35 units** are reflected **back** in the space **without** getting any absorption.
- Out of **35** units of **reflection**, **27** units are reflected by clouds, **2** units by the earth's surface, and **6** units by scattering (due to dust particles, etc) process.
- Out of **65** units of **absorption**, **51** units are **absorbed** by the **earth's surface** and **14 units** are **absorbed** by the **earth's atmosphere**.
- Out of **51** units (that have been absorbed by the earth's surface), **34 units** are **absorbed** into the **earth's atmosphere** and the rest **17** units are **released** by the earth's surface **directly** into **space.**
- Now, **34** units + **14** units = **48** units. These **48 absorbed units** in the atmosphere are **gradually released** into **space** with the passage of time.
- Thus,
- **Outgoing heat** in **total** will be **35** units + **17** units + **48** units = **100 units.**
- In other words**, energy** sent **back** to **space = 35% + 17% (**through **radiation** from the **earth) + 48% (**through **radiation** from the **atmosphere) = 100%.**
- 

Albedo: (at 1.56 PM)

- **Albedo** is the **ratio** between the incoming and reflected the amount of solar radiation.
- It is also called as "**reflection coefficient**".
- The **average albedo** of the earth is equal to **35%**.
-

Surface	Typical albedo
Fresh asphalt	0.04
Open ocean	0.06
Worn asphalt	0.12
Conifer forest (summer)	0.08, 0.09 & 0.15
Deciduous trees	0.15 to 0.18
Bare soil	0.17
Green grass	0.25
Desert sand	0.4
New concrete	0.55
Ocean ice	0.5-0.7
Fresh snow	0.80-0.90

The temperature of the earth: (at 2.15 PM)

- **Temperature** is the **degree** of the **hotness** or **coldness** of a body.
- **Factors affecting the distribution of temperature across the globe**:
- **Insolation**:
- **Insolation** depends upon **latitude, transparency** of the atmosphere, and the **length** of the day.

- **<u>Nature of the surface</u>**:
- The earth behaves **differently** depending on the **specific heat** of the surface.
- The **land surface** with **lower specific heat** heats up **more** rapidly and intensely than the water surface.
- The land cools **more** rapidly.
- **<u>Continentality</u>**:
- That is the **distance** from the sea.
- Locations that are in the **interior** of the continents have a higher range of temperature than the coastal locations.
- For **example, Delhi** experiences hotter summers and colder winters than Mumbai.
- **<u>Albedo</u>**:
- The **surface** with **higher albedo** reflects back **more** insolation resulting in **less absorption** of heat.
- **<u>Distribution of the continents</u>**:
- The **northern hemisphere** with a **larger** extent of the continents than oceans experiences a **higher range** of temperature than the southern hemisphere where the water surface is more.
- **<u>Altitude</u>**:
- With an **increase** in altitude, the temperature decreases at a normal lapse rate.
- **<u>Winds & ocean currents</u>**:
- They **transport** heat from **one** region to another and help in the **global distribution** of temperature.

Distribution of temperature: (at 2.41 PM)

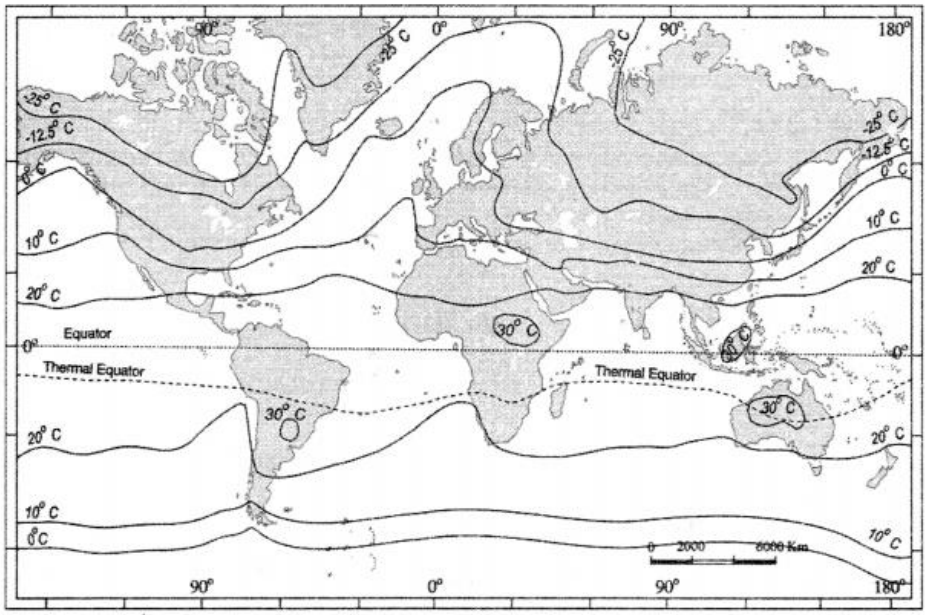
- An **isotherm** is a **line** joining places with **equal** temperatures.
- Using the **distribution** of isotherm, we can understand the **global distribution** of the temperature.
- **a.** By studying the **position** of **isotherm** we can conclude about the prevalent seasons.
- **b.** In **January,** the hotter isotherms are in the southern hemisphere and the colder ones are in another hemisphere.
- **c. Isotherms** move **northward** between **January** to **July** and **southward** between **July** to **January.**
- **d. Istherms** bend **poleward** over the oceans in **January.**
- **e. Istherms** bend **equatorward** over the oceans in **July.**
- **f.** The **seasonal changes** are **less** marked in the southern hemisphere **than** over the northern hemisphere.
- **g.** The **range** of temperature **increases** from the **equator** towards the **poles.**
- 

Fig: The distribution of surface air temperature in the month of January.

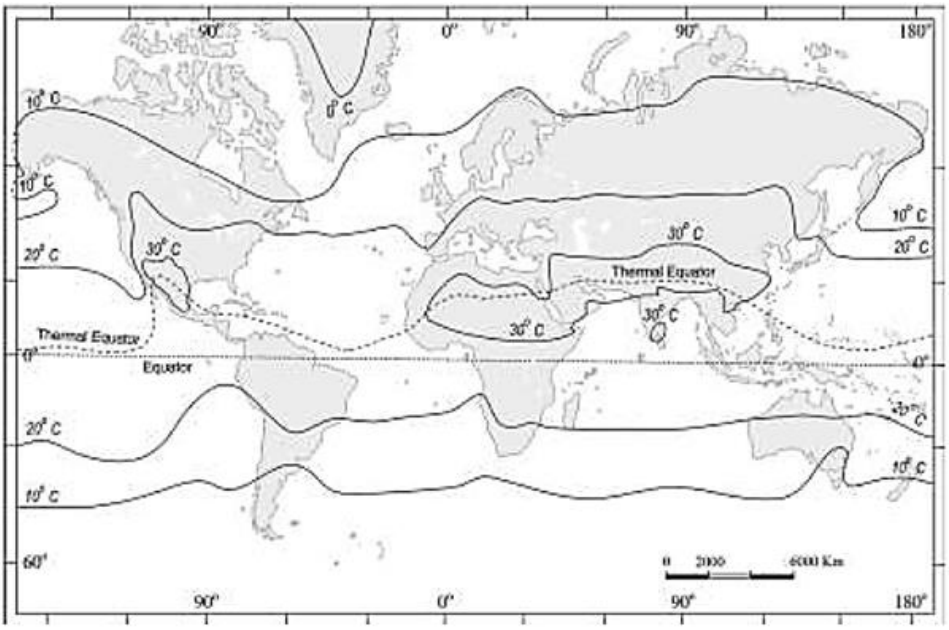


Figure 9.4 (b) : The distribution of surface air temperature in the month of July

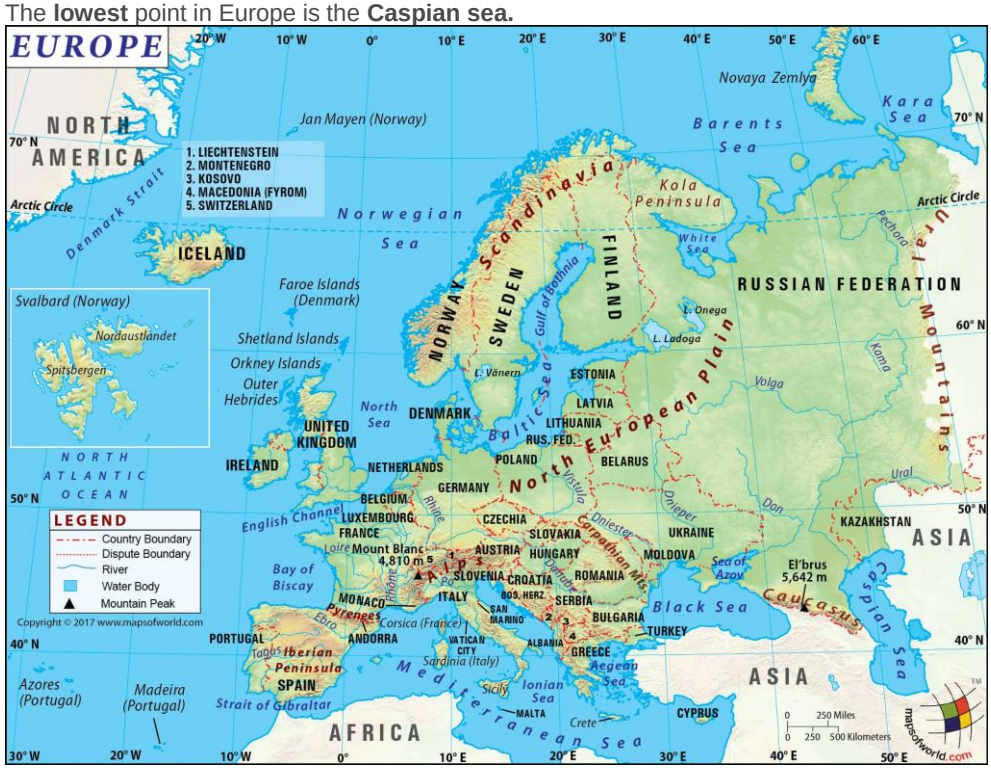
Different terminologies: (at 3.26 PM)

- **Mean daily temperature:**
- It is equal to the sum of 24 hours' temperature divided by 24 hours.
- **Mean monthly temperature:**
- The **Sum** of the **daily temperature** of a particular month is **divided** by **30** days.
- **Diurnal range temperature**:
- The diurnal range of temperature is the **difference** between the **maximum** and the **minimum temperatures** of the **day**.
- **The annual range of temperature**:
- It is the **difference** between the maximum mean monthly temperature and the minimum mean monthly temperature.
- The **annual range of temperature** = **Maximum MMT - Minimum MMT.**
- **Al Azizia** (58 degrees Celcius) in Libya and **Death Valley** (56.7 degrees Celcius) in the USA both **compete** for the record of the highest temperature.
- **Vostock station** in Antarctica recorded the **lowest temperature** which is **-88 degrees Celcius**.

Mapping on continents: (at 3.35 PM)

- There are **seven** continents in the world.
- The continents are, from **largest** to **smallest:**
- **Asia, Africa, North America, South America, Antarctica, Europe,** and **Australia.**
- **Asia:**
- **Water bodies** surrounding **Asia:**
- The Indian Ocean, Mediterranean sea, Black Sea, Caspian sea (lake surrounded by lands), Black sea, Red sea, Arabian sea, Persian Gulf, Bay of Bengal, Andaman sea, South China sea, East China sea, Japan sea (East sea), Bering Sea, and the Arctic Ocean.
- **Demarcation of Asia:**
- The **Ural mountain** is the **demarcation** of **Asia** and **Europe** (Decided by the **National Geographic Society**).
- **West** of **Ural mountain** is called **European Russia.**
- The **Caucasus mountain** (between the **Black** Sea and **Caspian** sea) also **separates** Asia and Europe.
- **Senai Peninsula** is connected with Africa and Africa.
- The **Eastern part** of Papua New Guinea is a **part** of **Oceana** and its **western** part comes under **Indonesia.**

- **<u>Europe</u>**:
- Strait of Gibraltar (between Spain, Morocco, and the UK).
- Mediterranean sea.
- Atlantic ocean
- North sea (having the **best quality** of crude oil: Brent crude oil).
- The **highest** point in Europe is situated in the Caucasus mountain (**Elbrus peak**).
- The **lowest** point in Europe is the **Caspian sea.**



The topics for the next class: (Temperature inversion & its types, atmospheric pressure system, etc).
Geography Class 21

A brief review of the last class and doubt resolution
<u>Temperature inversion(1:17:00PM)</u>

- Explained with the help of a graph
- Normally, temperature decreases with an increase in altitude. The average rate of decrease in temperature with increase in altitude is called as **Normal Lapse Rate.**
- Under certain special conditions in the atmosphere, the reversal of the normal lapse rate occurs so that temperature increases with altitude. This phenomenon is called as **temperature inversion.**
- **Types of temperature inversion**
- **a. Radiation inversion**
- Explained with the help of a diagram
- During **long winter nights, windless calm conditions and a cloudless clear sky**, the land's surface radiates more heat rapidly during the night.
- This loss of radiation by the land surface causes the land to cool down and the air just above the surface also cools.
- This colder air is overlayed by warmer upper air which has absorbed heat from radiation loss. Therefore, temperature increases with an increase in altitude resulting in a temperature inversion.
- It is frequent during winter nights or in snow-covered areas.
- Doubt resolution
- **b. Air Drainage type of inversion**
- Explained with the help of a diagram
- In mountainous regions, hilltops experience rapid fall in temperature during the night.
- The valley sides and the floors remain warmer due to radiation exchange.
- The colder and denser air from the hilltop will start to sink to the valley floor due to gravity. After some time, warmer air rests over cooler air producing temperature inversion along valleys.
- **c. Advection inversion**
- It is produced when a thick layer of warm air passes over a cold water surface or snow-covered surface resulting in a temperature inversion.
- **d. Frontal inversion**
- It is caused due to frontal convergence of air masses.
- Along the fronts, the warmer air is forced upward from the ground by undercutting of cold air which leads to temperature inversion where warm air is lying above cold air.

Significance of temperature inversion(2:20:00PM)

- Temperature inversion prevents convection by creating stability in the atmosphere and it prevents precipitation.
- The conditions of temperature inversion are favourable for the formation of fog and fog causes reduced visibility disrupting transportation.
- Temperature inversion reduces wind activity and prevents the dispersal of pollutants, for example, Delhi in November-December.
- The conditions of temperature inversion along with high pollution result in smog formation.
- In mountainous regions, settlement patterns are influenced by the occurrence of temperature inversion. Therefore, people avoid valley floors for settlements as well as for agriculture. For example, fruit orchards of Himachal Pradesh and Uttarakhand, Coffee plantations of Brazil, etc.

Pressure(2:30:00PM)

- Pressure is the force experienced per unit area.
- Atmospheric pressure is the pressure exerted by the Earth's atmosphere.
- The average atmospheric pressure near sea level is **1013 millibars.**
- Atmospheric pressure decreases with an increase in altitude.
- Pressure is measured using **Barometer.**
- **Isobar** is a line connecting places with uniform pressure.

Factors affecting pressure(3:06:00PM)

- **a. Temperature**
- When air is heated in the atmosphere, it expands and the outward pressure of molecules is spread over a large area, therefore pressure decreases.
- When air cools, it causes contraction resulting in an increase in pressure.
- **b. Altitude**
- The pressure of air at ground level is higher than that of air at higher altitudes.
- When air rises, due to convection, pressure decreases.
- When air sinks, due to subsidence, pressure increases.
- **c. Rotation**
- The rotation of Earth causes air at the poles to be thrown away towards the equator.
- If we consider the effect of only rotation, air piling up along the equator produces a belt of high pressure and at the poles a belt of low pressure.

- **Formation of pressure belts**
- Explained with the help of a diagram.
- Air rising at the equator due to high-temperature causes expansion and therefore the development of a low-pressure belt at the equator.
- Rising air at the equator spreads out as it reaches the top of the troposphere and moves towards the poles.
- This air as they converge towards the polar region experiences an increase in density and begins to sink leading to a high-pressure belt at 30deg North and South due to subsidence.
- Some of the high-pressure air moves towards the equator and some towards the pole.
- The air moving towards the equator replaces the air rising there completing a circulation.
- Low temperature at the poles results in contraction and the development of high pressure.
- Air which is blown away from the poles due to rotation spread out to larger areas and pressure drops leading to a low-pressure belt along 60 deg N and S.
- Some of the air from the subtropical high-pressure belt moving towards the pole reaches 60 deg N and S and converges with air from the poles leading to convection along 60 deg N and S.
- With the apparent movement of the Sun between the tropics, the pressure belts also shift North and South of the equator.
- Distribution of pressure explained with map(Dictation in next class)

Topics for next class: Winds
Geography Class 22

A brief review of the last class and doubt resolution
Distribution of pressure(1:28:00PM)

- Explained with the help of slides. (complete Atmosphere slides and diagrams have been uploaded under Geography class 15)
- **Pressure in January**
- Equatorial low-pressure belt extends well into the southern hemisphere.
- The subtropical high-pressure belt of the southern hemisphere is found only over the oceans.
- The low temperature in the northern hemisphere produces a continuous belt of high-pressure system linking with the Siberian high.
- **Pressure in July**
- Equatorial low-pressure belt extends too much into the northern hemisphere particularly over India and Tibet due to high temperature.
- Subtropical high-pressure belt in the northern hemisphere is not continuous and exists only over the Atlantic and Pacific oceans.
- The subtropical high-pressure belt in the southern hemisphere exists as a single continuous belt.

Winds(1:47:00PM)

- Air in motion is called as wind.
- Winds are driven by differences in pressure across the surface.
- **Factors affecting the motion of winds**
- **a. Pressure gradient force(PGF)**
- The rate of change of pressure with respect to distance is called as pressure gradient.
- Pressure differentials in the atmosphere cause the movement of air from high pressure to low pressure.
- The force causing this movement is called as pressure gradient force.
- Pressure gradient force is always perpendicular to isobars.
- Pressure gradient force is more when isobars are placed closely.
- **b. Frictional force**
- Any moving object near to land surface experiences a frictional force in a direction opposite to that of its movement.
- Winds experience maximum frictional force over the land and near to the surface.
- **c. Coriolis force**
- Explained with the help of a diagram
- It is an **imaginary force** produced due to the rotation of the earth.
- It is the result of the combined effect of various forces and factors such as centrifugal force, angular velocity, variation in speed of rotation at different latitudes, etc on a body in motion on the surface of Earth.
- Coriolis force causes any moving body to deflect towards the **right in the northern hemisphere** and **left in the southern hemisphere.**
- The degree of Coriolis force depends upon the **speed of the moving body, latitude at which the body is moving and speed of rotation of Earth.**

- **Geostrophic winds**
- At some latitudes, when isobars are straight and there is no friction, the pressure gradient force is balanced by the Coriolis force and the resultant wind flows in a **parallel direction to isobars.**
- Such winds are called as **geostrophic winds.**
- When isobars are **circular**, geostrophic winds result in the formation of **cyclonic and anti-cyclonic circulations.**
-

Pressure system	Pressure condition at the centre	Pattern of wind direction in Northern hemisphere	Pattern of wind direction Southern hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anti cyclone	High	Clockwise	Anticlockwise

Planetary winds(3:11:00PM)

- Explained with the help of a diagram.
- These are the winds blowing across the planet throughout the year.
- **a. Trade winds or easterlies**
- They originate from subtropical high and move towards equatorial low.
- In German "trade" means "track", that is, it follows the same direction throughout the year.
- The trade winds are dry and stable in the area of its origin. Moving towards the equator, they pick up moisture and **causes precipitation along the Eastern margins.**
- Reaching western margins, they are totally devoid of moisture and the off-shore trade winds will not result in precipitation causing the formation of deserts. Examples: **Sahara desert, Kalahari desert, Atacama desert, etc.**
- **b. Westerlies**
- They originate from subtropical high and move towards temperate low.
- The vast landmass in the northern hemisphere obstructs the westerlies whereas in the southern hemisphere, they are stronger and consistent due to huge water expanse. Therefore, they are called as **roaring forties, furious fifties and shrieking sixties.**
- **c. Polar Easterlies**
- They originate from the polar high-pressure belt and move towards the temperate low-pressure belt.
- They are extremely cold, dry and stable and blow for long distances affecting the climate.

Inter tropical Convergence Zone(3:56:00PM)

- ITCZ is a **zone of convergence** of trade winds from both the sides of tropics.
- It is centred along the equator, extending up to **5deg north and south.**
- The conditions are- **high temperature, low pressure, calm and windless.** Therefore, they are also called as the zone of **doldrums.**
- **Horse latitude**
- It is the zone of subtropical high-pressure belt.
- Due to vertically descending air, this is the region of **light and calm winds.**
- **Tri cellular meridional circulation**
- The surface winds blow from high-pressure to low-pressure areas.
- In the upper atmosphere, winds move in the direction opposite to surface winds.
- These winds together with convection and subsidence along the low-pressure belt and high-pressure belts result in three cellular circulations along each meridian called as tri cellular meridional circulation.
- The three cells are the **Hadley cell, Ferrel cell and polar cell.**

Topic for next class- Seasonal and local winds, World map practice
Geography Class 23

Overview of the previous class (13:12:55 PM)

- The previous class discussion briefly.
- Diagrammatic representation of the **planetary winds, pressure cells, and ocean currents(cold and warm).**
- Query discussion.

Seasonal Winds:(13:35:27 PM):

- The seasonal difference in temperature and pressure causes the movement of air and subsequent winds blowing in particular seasons called seasonal winds.
- Example-South west monsoons and northeast monsoons.

Local Winds:(13:38:45PM):

- Differences in the heating and cooling of earth's surfaces and the cycles that develop daily or annually can create several common winds called **local or regional winds.**

Land and Sea breeze:

- The diagram is shown and discussed.
- Discussion about mountain breeze, Catabiatic winds.
- **1) Sea breeze:**
- The land gets heated more quickly than the adjacent sea during daytime.
- Low pressure is developed over the land and high pressure is over the adjacent sea. This causes the circulation of relatively cool air from the sea to adjacent land called the sea breeze.
- **2) Land Breeze:**
- The sea breeze results in a cooling effect on the coastal region by late afternoon or evening.
- Rapid loss of heat from the land causes reversal of daytime pressure conditions due to high pressure on land and low pressure over oceans.
- Winds blow from land to sea causing a **land breeze.**
- Fishermen along coastal regions use land and sea breeze for fishing activities.

Mountain and Valley Breeze:(14:02:57 PM):

- During the daytime mountain slopes heat up rapidly compared to valleys.
- This result in the air from the valley moving up along the slopes called **valley breeze or anabatic winds**.
- At night the temperature difference in mountain slopes and valleys is reversed causing winds to blow from mountain to valley called **mountain breeze or catabatic winds.**

World Map diagram:(14:04:47 PM):

- Labeling
- Where to use-
- Distribution of industries, mineral resources, etc.
- Tricks and methods to draw world maps.

Local Winds of different regions of the world:(15:19:32PM):

- **Names of all local winds in short**:
- Berg
- Briekfielder
- Bora
- Buran
- Blizzard
- Chinook
- Etesians
- Fohn
- Harmattan
- Haboob (non-directional)
- Helm
- Icecap blizzards
- Khamsin
- Karaburan
- Levant
- Mistral
- Norte
- Norther
- Pampero
- Sirroco
- Southerly
- **Discussion of each in detail-**
- **Local Winds: Hot**
- **Chinook**-
- North America.
- Along the eastern parts of the Rocky mountains.
- Come during winter.
- Good for Wheat cultivation.
- Also called a Snow eater.
- **Fohn:**
- On the northern slopes of the Alps, the winds descend down

- And moves across Germany in the Rhine river valley.
- Also called Chinook of Europe.
- Direction is from south to north
- **Harmattan:**
- The hot wind of Nigeria.
- Direction from the northeast, land to coast.
- These winds bring dryness.
- Also called Doctor winds.
- **Haboob:**
- They have no specific direction.
- The hot wind of Sudan.
- **Sirocco:**
- Common wind of Sahara.
- Blow from Sahara to Meditteranean.
- South to the north.
- dry but picks up moisture from Meditteranean and causes precipitation.
- Red sand causes blood rain.
- **Different names in different countries:**
- Egypt- Khamsin.
- Libya-Ghibli.
- Tunisia-Chilli.
- When it reaches Adriatic sea-Gharbi
- **Levant:**
- Near the strait of Gibraltar
- Hot wind blowing from east to west.
- **Samoon:**
- In Iraq and Iran.
- It has no specific direction.
- These are hot wind and bring hot temperatures.
- Bring heat strokes.
- Also called Poisoned winds.
- **Loo:**
- In India, comes from west to east in the northern plains.
- **Karaburan:**
- In Mongolia and northern China
- The direction is northeast.
- **Berg:**
- In South Africa.
- Hot wind blowing from east to west
- **Brickfielder:**
- In Australia
- North to south direction.
- The hot wind of Australia.
- **Local winds: Cold**
- **Blizzards**:
- Blows in Canada and Alaska experience cold winds.
- The direction is north to south.
- Flows from the polar region.
- **Norther:**
- Can reach the west coast
- **Norte:**
- Reaches the coast of Canada
- **Guran:**
- Experienced in Siberia.
- From north to south.
- It brings snow.
- **Pampero:**
- In Argentina

- south to north
- **Southerly:**
- In Australia.
- **Mistral:**
- In France.
- Direction from south to north along Rohne river valley.
- **Bora:**
- Another wind of the Adriatic sea.
- Comes from land to the ocean.
- Direction-From north to south direction.

Next class: Climatology will continue
Geography Class 24

A brief review of the last class and doubt resolution
Humidity and condensation(1:23:00PM)

- **Humidity**
- Water in gaseous form is called water vapor.
- The amount of water vapor in the air is called humidity.
- All weather phenomena in the atmosphere are the result of water vapor. The amount of humidity in the atmosphere shows the potential of the atmosphere to cause precipitation.

Measurement of humidity

- **a. Specific humidity**
- It is measured as the ratio of water vapor in grams to the weight of air in kgs expressed as grams per kg of air.
- It indicates the actual amount of moisture present in the air.
- It remains constant with variation in temperature.
- **b. Absolute humidity**
- It is the ratio of the weight of water vapour in grams to the volume of air in metre cube, expressed as grams per metre cube of air.
- It varies with temperature.
- It increases with the contraction of air and decreases with expansion.
- **c. Relative humidity**
- It is the ratio between the amount of moisture present in the air to the maximum amount of moisture it can hold at a given temperature.
- It decreases with an increase in temperature and increases with a decrease in temperature.
- Air is said to be saturated when relative humidity reaches 100%.

Evaporation(2:03:00PM)

- The conversion of liquid water into water vapour is called as evaporation.

Factors affecting evaporation

- **a. Temperature**
- Higher the temperature, higher the rate of evaporation
- **b. Humidity**
- Higher the humidity lower the rate of evaporation due to saturation of the air.
- **c. Wind speed**
- Higher the wind speed, higher the rate of evaporation as air movement provides a constant supply of fresh air with lesser humidity.
- **Distribution of evaporation**
- The rate of evaporation is maximum at subtropical regions than equatorial regions due to higher humidity near to equatorial regions.
- Polar regions experience minimum evaporation.
- Evaporation is maximum along oceans, particularly where warm and cold ocean currents meet.

Condensation(2:21:00PM)

- It is the process of conversion of water vapour into liquid water, so it is the reversal of evaporation.
- The temperature at which condensation takes place is called as **dew point**. If the condensation happens below 0deg Celsius, it is called a **frost point.**
- Doubt resolution

Types of condensation

- **a. Dew**
- It is the moisture deposited in the form of liquid water droplets on land surface.
- The conditions favourable for the formation of dew are- long winter nights, calm air(windless), clear sky(cloudless).

- **b. Frost**
- It is a thin layer of ice on solid surface.
- It is formed when the water droplets fall on cold surfaces below freezing point.
- **c. Rime**
- The deposition of needle-like white opaque icy crystals on surfaces with temperature below 0 deg celsius.
- It is when supercooled water droplets in the air come in contact with very cold surfaces.
- **d. Fog**
- It is produced near the surface where the temperature of the air drops suddenly.
- The visibility will be less than 1km.
- The conditions required for the formation of fog are the same as the conditions of temperature inversion.
- The conditions favoring fog formation are long winter nights, calm air, and a clear sky.
- **Types of fogs**
- **i. Radiation fog**
- **ii. Valley fog due to air drainage type of inversion**
- **iii. Frontal fog**
- **iv. Advection fog**
- **e. Mist**
- It consists of small water droplets suspended in the air.
- It is very similar to fog but with a lower density of moisture.
- The visibility is between 1 to 2 km.
- The mist clears faster than fog.
- **f. Haze**
- It is caused by smoke and dust particles with humidity less than 75% and visibility up to 2kms.

Precipitation

- **a. Instability**
- It is a condition where air does not resist vertical movement and has a tendency to rise upwards.
- Instability leads to convection, cloud formation and precipitation.
- Instability occurs along the regions of high temperature or regions of low pressure with convergence.
- **b. Stability**
- The condition when air resists vertical movement and remains in its original position is called as stability.
- Stability occurs in the regions of low temperature or along the regions of subsidence near high-pressure belts.
- Precipitation is unlikely in this condition.

Types of clouds(3:48:00PM)

- Explained with the help of a diagram
- Cirrus- High altitude feathery appearance
- Alto- Mid altitude
- Stratus- It means layered
- Cumulo- It means cotton wool-like appearance, globular mass
- Nimbus- Rain bearing
- Different clouds are explained using the above nomenclature.

Topics for next class- Rainfall, Tornadoes, Jetstream and air mass, etc

Geography Class 25

A brief review of the last class

Cloud types(1:17:00PM)

- **a. Cirrus**
- High altitude
- Feathery appearance
- White in colour
- Indicates fair weather
- It results in a halo around the Sun.
- **b. Cirrocumulus**
- Cotton wool-like appearance, at high altitude
- It is called **Mackerel sky.**
- **c. Cirrostratus**
- It is layered and high altitude.

- Milky appearance with uniform layers
- **d. Altocumulus**
- Globular masses of clouds with a cotton wool-like appearance at middle altitude.
- **e. Altostratus**
- A layer of clouds in sheets along middle altitude.
- **f. Cumulus**
- A thick cloud of cotton wool appearance with a dome-shaped cauliflower top.
- **g. Stratus**
- A low-lying uniform layer of cloud near ground level.
- It produces light drizzle.
- **h. Stratocumulus**
- Globular masses of cotton wool appear regularly arranged at low altitudes.
- **i. Cumulonimbus**
- They are overgrown cumulus clouds.
- They are very dark, heavy and dense with an anvil top.
- It causes very heavy precipitation with thunderstorms and lightning.

Conditions required for rainfall/precipitation(1:40:00PM)

- a. Mechanism of upliftment for the moist air.
- b. Saturation and cooling of air below the due point.
- c. Presence of hygroscopic nuclei such as dust particles around which water droplets can accumulate.
- Depending on the mechanism of upliftment there are **three types of rainfall:**
- **a. Convectional rainfall**
- It occurs in the regions of intense heating near the ground surface causing air to expand and rise.
- Often it is accompanied by thunder and lightning.
- It is experienced throughout the air in near-equatorial regions and in summers in tropical regions.
- **b. Orographic rainfall**
- When warm and moist air is forced to rise across mountain slopes it cools down causing precipitation on the windward side.
- However, on the leeward side, the descending air will not cause precipitation leading to the formation of a rain shadow area.
- For example, Western ghats, Ladakh.
- **c. Frontal rainfall**
- It occurs in the regions of the temperate zone between 40 to 60 degrees north and south.
- It is due to the convergence of different air masses particularly when the warm air mass rises above the cold air mass causing precipitation.
- **Distribution**
- Equatorial regions experience maximum rainfall of above 200 cm per annum due to conventional rainfall
- Subtropical regions experience minimum rainfall of nearly 25 cm per annum due to subsidence of air and high-pressure belt.
- Temperate regions between 40 to 60 deg N and S experience 100 to 120 cm of rainfall per annum due to frontal rainfall and onshore Westerlies.
- Due to moist maritime air mass oceans experience higher rainfall than continents.
- Coastal regions receive higher precipitation than interior regions.
- **Thunderstorms**
- Due to intense heating and strong vertical convection, cumulonimbus clouds are formed.
- The rain drops in this cloud move up and down due to strong air currents creating electric charges which accumulate on opposite sides of the clouds.
- When both types of charges are attracted, a flash of light is produced called lightning.
- Lightning causes a vacuum in the cloud due to a rapid expansion of the air.
- It is filled by the surrounding cold air producing claps of thunder.
- Doubt resolution

Cloud burst(3:05:00PM)

- IMD defines cloud burst as rainfall over **10 cms per hour** concentrated in a **small area.**
- The following conditions favour the formation of cloud burst:
- a. Rapid convection of highly humid and warm air.
- b. Steep topography causes a huge build-up of clouds without rainfall due to the **funnelling effect.**
- The raindrops become too heavy for the clouds to hold on and drop together in a quick flash.

- Examples: Mumbai cloud burst 2005, Leh 2010, Kedarnath 2013, Dharamshala 2021, Amarnath 2022

Tornadoes(3:28:00PM)

- Explained with the help of a video
- A violently rotating column of air that extends from a thunderstorm to the ground is called a tornado.
- It appears like a **funnel** descending from a cloud. The wind speed goes up to **400 km per hour.**
- It is formed when changes in wind speed and direction create a horizontal spinning effect within a storm cell. This effect is tip vertical by rising air moving up through the thunderclouds.
- A **water spout** is a whirling column of air and water mist formed over water bodies.

Jetstreams(3:41:00PM)

- Explained with a diagram.
- WMO defines jetstreams as strong narrow currents experienced along a quasi-horizontal axis in the upper troposphere or in the lower stratosphere characterised by strong vertical and lateral wind sheer featuring one or more velocity maxima.
- **Characteristics of jetstreams**
- They are thousands of km in length and hundreds of km in width.
- They normally blow from west to east.
- They follow a zig-zag path in the form of Rossby waves.
- The winds are stronger during winter.
- The entire system follows the sun, that is, changes its position with the season.

Topics for the next class: Jet streams, air masses and temperate cyclones.

Geography Class 26

A brief review of the last class and doubt resolution

Jet stream continued(1:27:00PM)

- Explained with the help of a diagram
- **Causes**
- Jetstreams are generated due to the **temperature difference** between two regions. For example, tropical and temperate regions or temperate and polar regions, etc.
- The **difference in pressure gradient with altitude** above warm and cold air masses cause strong movement of winds. Larger the temperature difference stronger the winds.

Types of jetstreams

- **a. Polar jetstream**
- They are formed where the Ferrel and Polar cells meet.
- They are irregular and discontinuous.
- They blow from west to east and they are also called **polar front jetstreams.**
- **b. Subtropical westerly jetstream**
- They are associated with temperature gradients at the poleward limit of the Hadley cell.
- It is more regular and strong.
- They blow from west to east.
- **c. Tropical easterly jetstream**
- It is formed over **India and Africa** in the summers due to the intense heating of the Tibetan plateau and the surrounding regions.
- The direction is East to West.
- **d. Local jetstreams**
- They are formed due to local thermal and dynamic conditions.
- Example: Somali jetstreams
- **e. Polar night jetstreams**
- Over the polar regions, above the troposphere during winters polar night jetstreams are formed.
- The direction is from West to East.

Significance

- The jetstreams are responsible for cyclonic and anticyclonic circulations along the surface.
- Upper divergence in jetstreams causes lower convergence and upper convergence causes lower divergence.
- It changes weather conditions by suppressing or accentuating precipitation.
- It helps in the formation of temperate cyclones.
- The monsoon of South Asia is controlled or affected by subtropical westerly and tropical easterly jetstreams.
- Jetstreams are useful in aircraft navigation.
- They are responsible for ozone depletion in polar regions.
- It helps in the transport of pollutants into the upper troposphere from urban regions.

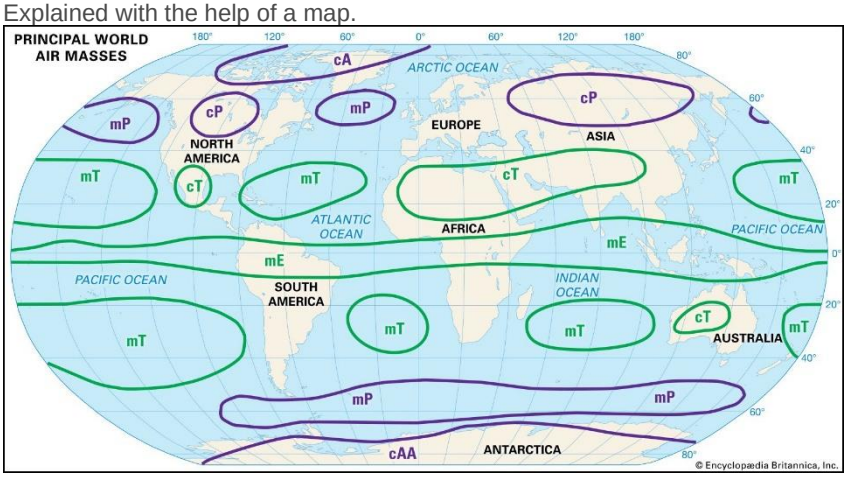
Airmasses(2:18:00PM)

- Air mass is an extensive portion of the atmosphere whose physical properties such as temperature, pressure, and humidity are homogenous horizontally and vertically over a large area.
- The temperature of the source area shall remain uniform horizontally with a very gradual change in the vertical direction.
- The humidity conditions should also be uniform with the least variability.
- The surface area shall remain homogenous for a few hundred km.
- The regions with light divergent winds, high-pressure belts, and anti-cyclonic circulations are more favorable for the formation of air masses due to stable conditions.

Types of airmass

- The various criteria are:
- **a. Source**
- Continental and maritime airmass
- **b. Temperature**
- Warm air mass and cold air mass
- **c. Pressure**
- Unstable and stable
- **d. Latitude**
- Arctic(north pole) - always continental
- Antarctic airmass(south pole)- always continental
- Polar (near 50 deg to around 70 deg)- can be both continental and maritime
- Tropical air mass- can be both continental and maritime
- Equitorial - can only be maritime

Distribution of airmass

- Explained with the help of a map.
- 

Significance of airmass(3:06:00PM)

- Airmasses while moving from one region to another help in the distribution of temperature and changes the temperature conditions of destination regions.
- Maritime air masses bring more moisture content towards continental regions and increase humidity and cause precipitation.
- The dry air masses along subtropical regions formed over the continents help in maintaining the aridity conditions.
- The cold air mass which is formed over Siberia during winter affects the surrounding regions over long distances and causes cold conditions.
- The interaction of warm and cold airmasses leads to the formation of fronts and temperate cyclones.
- The interaction of air masses along the frontal zones results in the formation of frontal inversion and frontal fog.
- The maritime tropical and equatorial air masses in the Indian and Atlantic ocean helps in the development of tropical cyclones.
- Maritime air masses of the Indian ocean play an important role in the Indian monsoon.

Fronts and temperate cyclones(3:22:00PM)

- **Front**
- It is a narrow zone of transition dividing two air masses of differing temperature and humidity characteristics.
- The process of formation of fronts is called **frontogenesis.**
- The process of decay of fronts is called **frontolysis.**

Types of fronts

- **a. Stationary front**
- When the surface position of a front is not changing and the two airmasses are unable to push each other. It is called as stationary front.
- When this front is disturbed, it results in either a warm front or a cold front.
- **b. Warm front**
- The boundary between the warm and cold airmass where the warm air mass is advancing and overriding over cold air mass is called as a warm front.
- The gradient of the warm front is **gradual** leading to the **slow rising** of warm air resulting in **nimbostratus clouds.**
- **Steady rainfall** is experienced over a **larger areas.**
- **c. Cold front**
- It is the boundary between the warm and cold air masses where the cold air mass is advancing and undercutting the warm air mass.
- This results in a **steeper gradient** along the front leading to **rapid upliftment** of warm air and **cumulonimbus clouds.**
- It results in **heavy rainfall** over **smaller regions.**
- **d. Occluded front**
- Dictation to be provided in next class

Topics for next class- Dictation of occluded/temperate fronts; tropical cyclones
Geography Class 27

A brief review of the last class and doubt resolution
Occluded front contd(1:31:00PM)

- It is the later stage of front formation where the air in the warm sector is no longer at the ground surface due to the meeting of cold front and warm front.
- It is a compound zone with both warm and cold front characteristics.
- **Temperate cyclones and different stages of development**
- a. Convergence of two airmasses with different characteristics. Airmasses are stationary or move parallel to each other and a stationary front is formed.
- b. The warm and cold air masses penetrate into territories of each other forming a wave-like front.
- c. With warm and cold fronts starting to move towards each other the warm sector is wedged between the cold sectors.
- d. The warm sector is narrowed in extent due to the advance of the cold front.
- e. The occlusion starts with warm air rising completely above the cold air and cold front completely overtaking the warm front.
- f. The warm sector completely disappears, the occluded front is eliminated and the cyclone dies out.
- Temperate cyclones are also called mid-latitude cyclones or extratropical cyclones or wave cyclones.
- They are more prominent in the regions between 35 to 65 degrees North and South.
- **Role of jetstreams in temperate cyclones**
- Jetstreams being quasi horizontal in nature result in upper divergence in some locations and upper divergence allows surface convergence which helps in bringing different air masses together near to the surface causing the formation of fronts.

Tropical cyclones(2:12:00PM)

- A tropical cyclone is a low-pressure, high-velocity wind system originating within the tropics over the oceans.
- It is called a Cyclone in the Indian Ocean, Hurricane in the Atlantic Ocean, a typhoon in the South China Sea, Taifu near Japan, Bagui near the Philippines and Willy-Willy near Australia.

Stages in the formation of cyclones(On the basis of wind speed)

- 1. Low-Pressure Area
- 2. Depression
- 3. Deep Depression
- 4, Cyclonic Storm
- 5. Severe Cyclonic Storm
- 6. Very Severe Cyclonic Storm
- 7. Super Cyclone

Conditions required for tropical cyclones

- **1. Temperature**
- Above 27 deg Celcius over the water surface to ensure sufficient evaporation.
- **2. Depth of warm water**

- The depth of warm water should extend up to 70-80 metres.
- **3. Humidity**
- Relative humidity of a minimum of 50-60% near the surface.
- * Along the western margins of continents due to cold ocean currents the temperature, the temperature is not high and the air is dry. This suppresses cyclone formation.
- **4. Coriolis force**
- Coriolis force causes wind deflection therefore, tropical cyclones are developed only between 5 degrees to 25 degrees North and South.
- **5. Minimum vertical wind shear**
- Minimum vertical wind shear so that humid and warm air is not swept away. Therefore, the Arabian Sea experiences a lower number of cyclones than the Bay of Bengal.
- **6. Upper-Air Divergence**
- It causes strong convergence and convection near the surface.
- **7. Pre-existing low-pressure conditions**
- Pre-existing low-pressure conditions get intensified to form cyclones.
- Doubt resolution

Formation of tropical cyclones(3:11:00PM)

- Explained with the help of a video
- A strong convection results in a build-up of huge cumulonimbus clouds. The release of latent heat provides more energy to the system supporting further strong convection.
- When the winds start to descend along the sides the entire system is stabilised.
- The lateral winds near to surface start to rotate around the low-pressure centre due to Coriolis force.
- After some time, some of the dense air rising near the centre starts to descend resulting in the formation of an **eye.**

Structure of a tropical cyclone

- Explained with the help of a diagram
- **1. Eye**
- It is the centre of the storm with 5-50 km in diameter with a clear sky, calm conditions, lowest pressure and highest temperature.
- **2. Eyewall**
- A wall of thick cumulonimbus cloud with 10 to 20 km of width.
- It has the strongest winds in the cyclone.
- Thunderstorms occur in this region due to intense convection and rainfall.
- **3. Spiral bands**
- They are also called rain bands or feeder bands.
- They extend for hundreds of km and lead to a galaxy-type appearance.
- **4. Annular zone**
- A zone of suppressed cloudiness, high temperature and low humidity.
- **5. Outer convective bands**
- At the edge of the main cloud mass with instability and convection.

Naming system

- In 2004, 8 countries of the Indian ocean agreed to have a common naming system for cyclones in the Indian Ocean. Each of the countries arranged in alphabetical order submitted a set of 8 names using which a matrix of names was developed.
- The regional specialised meteorological centre of WMO located in New Delhi maintains the list arranged in sequential order and assigns the name alternatively.
- The suggested names shall be neutral politically, religiously, culturally as well as with respect to gender and it should be easy to pronounce.
- All the names in the earlier matrix expired in 2019 and a new matrix suggested by 13 countries was agreed upon.
- The 13 countries are- Bangladesh, India, Iran, Maldives, Myanmar, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Thailand, UAE, and Yemen.

The topic for the next class- Tropical cyclone contd, the difference between tropical and temperate regions, climate regions of the world

Geography Class 28

A brief review of the last class

Recurvature of cyclone(1:24:00PM)

- When the air currents in the local atmosphere push the cold air from the poles towards the equator and interfere with cyclone formation the cyclone which is about to diminish gets more winds and deflects right or eastward under the influence of westerlies.

- This phenomenon is called as recurvature of cyclones.
- Recurvature is very difficult to predict and is usually observed at higher latitudes.
- For example, cyclone Ockhi of 2018.

Cyclones in India(1:35:00PM)

- India experiences cyclones in two seasons-
- a. March to May
- b. October to November
- The Bay of Bengal experiences more cyclones than the Arabian Sea in a ratio of 4:1. It is due to the higher water temperature of the Bay of Bengal caused by the large number of rivers draining into it and higher wind shear experienced in the Arabian Sea.
- **Color-coded warning of IMD for cyclones**
- Green- No severe weather expected
- Yellow- Be Aware
- Orange- Be Prepared
- Red- Take Action
- It is used by IMD to signify the intensity of the situation and the warning associated with it.
- It uses four colors- Green, Yellow, Orange, and Red as per the intensity.
- The objective is to alert people of hazardous weather and be prepared for handling disaster like situations.
- It is universal in nature and is issued during heavy rainfall, floods, and cyclones.
- For cyclones, the warning is represented through a matrix of different colors for the upcoming few days.

Difference between tropical and temperate cyclones (1:58:00PM)

Tropical Cyclone	Temperate Cyclone
1. They are produced mainly over the sea.	They are produced on both land and sea.
2. They generally originate in the tropical region between 5deg and 20 deg N and S.	They originate in the mid-latitudinal region between 35 deg latitude and 65 deg latitude.
3. They are limited to a small area.	They occupy areas measuring thousands of km.
4. They travel from east to west.	They travel from west to east.
5. They are forecasted by high temperature and humidity but still air.	They are forecasted by a fall in temperature and pressure, wind shifts, and a halo around the Sun and the moon.
6. They are associated with violent winds with great speeds, dense clouds, and heavy rains.	The wind speed is low and the rainfall is light, which continues for many days.
7. They are largely a summer phenomenon.	They are most intense in winter.

- PYQ discussion

Polar vortex(2:12:00PM)

- It is a large area of low pressure and cold air surrounding the Earth's poles.
- The term vortex refers to the counterclockwise flow of air which keeps the cold polar air locked inside.
- The polar winter night jetstreams help in keeping this region covered with strong winds.
- Occasionally, when the vortex weakens due to the weakening of jetstreams the vortex expands and sends the cold air southward along with jetstreams.
- This brings down the temperature in southern regions to colder levels of below 0 deg Celcius.

World Climatic Regions(2:25:00PM)

- Explained with the help of diagrams and PPT.

1. Equatorial climate/ Hot and wet equatorial climate

- Temperature- High temperature. Daily max 28 to 30 deg C, Daily minimum 20 to 21 Deg C. Uniform range of temperature throughout the year resulting in no marked change of seasons.
- The diurnal range of temperature is more than the annual range.
- The shortest period of twilight is due to vertical sun rays.
- High rainfall above 250 cm through daily convection and cumulonimbus clouds.
- The relative humidity is high.
- Soil is fragile and devoid of minerals due to high leaching and is more prone to erosion.
- **Vegetation**
- It is evergreen in nature, with tall growing, broad leaves.
- Presence of distinct layers
- Low undergrowth
- A large number of epiphytes and climbers
- The high biodiversity of flora and fauna.

- Region: Amazon basin, parts of Columbia, Ecuador, Congo basin, Indonesia, Malaysia, Singapore, Papua New Guinea, etc

2. Monsoon Type or Hot Zone Eastern Margin

- They are characterized by seasonal reversal of winds.
- The precipitation is concentrated in one of the seasons.
- At least one or more months of the dry season particularly during winter.
- Vegetation is deciduous and sheds leaves during winter.
- Regions: South Asia including India, Pakistan, Bangladesh; Indo-China- Myanmar, Thailand, Laos, Cambodia, Vietnam; Northern Australia
- **Tropical Marine climate**
- In some regions within monsoon type, the winds are onshore during both seasons and cause precipitation throughout the year.
- Examples, are Central America and northeast Australia.

3. Sudan type/Savanna type(Hot zone continental)(3:53:00PM)

- These are the grasslands within tropical regions.
- They experience lesser precipitation that the Eastern margin but more precipitation than the western margin.
- Precipitation is concentrated during summer due to convection.
- There is a definite dry winter season.
- The annual average precipitation = 70cm
- Vegetation type- Dominant tall grass with scattered drought-resistant trees.
- Fire is the limiting factor that checks the spread of vegetation.
- Regions- Savanna of Africa, both north and south of the equator.
- In South America, they are known as Llanos and Campos of South America and Savanna of Northern Australia

Topics for next class- Climatic regions continued, Oceanography

Geography Class 29

A brief review of the last class and doubt resolution

Desert type(1:31:00PM)

- **Conditions required for the formation of hot deserts**
- a. Subtropical high-pressure belt
- b. Offshore trade winds
- c. Cold ocean currents
- Hot deserts are located along the western margins of continents within the hot zone.
- The temperature remains high during the day.
- The diurnal range of temperature is more than the annual range.
- Precipitation is very low and is less than 25 cm per annum.
- Vegetation is xerophyte in nature and the animals are adapted to live in desert conditions.
- Examples: Sahara desert, Mojave desert, Arizona desert, Atacama desert(driest desert of all), Namib desert, Kalahari desert; the deserts of Australia such as Victoria desert.

China Type/Warm temperate Eastern margin(1:48:00PM)

- Summers are hot, winters are cold causing a considerable range of annual temperatures.
- Rainfall throughout the year and more in summer due to tropical cyclones.
- During winter, they are influenced by temperate cyclones.
- Vegetation is the mixture of broad-leaved deciduous and evergreen.
- Regions- Eastern China, Southeast USA, Southeast Brazil, Southeast South Arica and Southeast Australia.
- **Warm temperate continental/Steppe type**
- Precipitation is higher than tropical grasslands due to the influence of temperate cyclones.
- The grass is short and green and very nutritious.
- Rainfall is moderately distributed throughout the year.
- They are known for large-scale wheat cultivation and animal rearing.
- Regions- Steppes of Central Asia, Prairies of North America, Pampas of South America, Velds of South Africa, Downs of Australia.
- **Warm temperate western margin/Mediterranean type of climate**
- In summers, ITCZ shifts northward bringing offshore trade winds with no precipitation.
- During winters, ITCZ shifts southwards bringing onshore westerlies causing good rainfall.
- In winters, they are also under the influence of temperate cyclones.
- It is known for its characteristic dry summer and wet winter.

- The summers are not very hot.
- Vegetation is drought resistant, deep-rooted and short bushes such as olives, grapes, oranges and other citrus fruits.
- Regions- Mediterranean region, California, Central Chile, Southwestern part of South Africa, Southwest and southern Australia.

Cool temperate Eastern Margin/Laurentian type(2:22:00PM)

- Temperature ranges between 20 deg C in Summers and below 0 deg C in winters.
- Rainfall throughout the year and are affected by temperate cyclones in winters.
- Vegetation is a mixed type both deciduous and coniferous.
- Regions: Northeast USA, Eastern Canada, Northern China, Korea, Japan and Southeast Argentina.
- **Siberian type or Cool temperate continental**
- Summers are hot and winters are extremely cold and dry.
- Vegetation is coniferous and is the single largest stretch of vegetation on the surface of Earth.
- This type of vegetation is called as Boreal forest/ Taiga.
- It is low in diversity and high in economic value.
- It is the only type of climate which is exclusively present in the northern hemisphere.
- Regions- Siberia, Scandinavia, Poland, Northern Canada, Alaska.
- **British type/Cool temperate western margin**
- They are under the influence of onshore westerlies throughout the year causing precipitation throughout the year.
- They are under the influence of warm ocean currents which keep their ports ice-free even during winters.
- They are called as mild winter and cool summer climate.
- Vegetation- Mixed type, that is, deciduous and coniferous.
- Regions- UK, parts of western Europe, western Canada, southern Chile, Tasmania and New Zealand.

Polar Type/Arctic type(2:47:00PM)

- It is covered with ice throughout the year.
- It is also called as tundra climate or cryosphere.
- During summers, where the snow melts vegetation grows as short and stunted sedges, mosses and lichens.
- The animals and birds are majorly migratory in nature.
- Regions- Beyond Arctic and Antarctic Circle
- **Koeppen classification**
- Explained with the help of a slide
- PYQ discussion

Oceanography(3:31:00PM)

- How deep is an ocean- explained through a video.
- **Ocean bottom topography**
- **1. Major topographies**
- Continental Shelf
- Continental slope
- Abyssal plains
- Mid Oceanic Ridges
- Trenches
- **2. Minor topographies**
- Continental rise
- Submarine canyons
- Sea mounts
- Guyots
- Island Arc, Archipelago
- **Continental shelf**
- These are the submerged shallow portion of continental crust with depths between 150 to 200 metres.
- It is rich in sunlight, nutrients and oxygen which favours the growth of life.
- They are rich in biodiversity and it is known for rich fishing grounds.
- The width of the continental shelf is dependent on the slope of adjacent land.
- **Continental slope**
- It is the boundary between continents and oceans formed by the outer edge of the continents.

- They are much steeper than the continental shelf.
- **Continental rise**
- It is the base of the continental slope with a lower slope and continues into the abyssal plains.
- **Submarine canyons**
- They are formed along the continental shelf and slope due to turbidity currents of rivers entering the oceans.

Topics for next class- Oceanography continued
Geography Class 30

A brief review of the last class
Ocean bottom topography contd.(1:20:00PM)

- **Abyssal plains or oceanic basins**
- These are large, flat, and tectonically inactive ocean floors with a relatively smooth surface having sedimentary deposition.
- The average depth lies between 3000 m to 6000 m.
- **Sea mounts**
- They are isolated volcanic features formed due to volcanic activity on the oceanic floor.
- **Guyot**
- While sea mounts are sharply pointed, guyots are flat-topped hills with summits below the water level.
- **The following topographies were already covered under Plate Tectonics:**
- **Island and Island Arc**
- **Mid Oceanic Ridges**
- **Trenches**

The temperature of oceans(1:43:00PM)

- **Factors affecting the temperature of the ocean**
- **a. Latitude**
- Lower latitude, higher intensity of sunlight, and higher temperature.
- Higher latitude, lower intensity of sunlight causing lower temperature.
- **b. Winds**
- The planetary wind belts impact the temperature of oceans. For example, in the regions of westerlies, the temperature is slightly higher than the regions of polar easterlies.
- **c. Ocean currents**
- Warm ocean currents cause an increase in temperature.
- Cold ocean currents cause a decrease in temperature.
- Ocean currents help in heat balance between equatorial and polar regions.
- **d. Landmass**
- Seas that are completely surrounded by land will have higher water temperatures due to the continental effect.
- **Vertical distribution of temperature**
- Explained with the help of a graph
- The temperature of ocean water decreases with depth.
- However, the pattern of decrease is not uniform.
- The ocean waters can be differentiated into 3 layers of different temperatures:
- **a. Epilimnion**
- It extends up to 200 m in depth from the surface.
- The average temperature is between 20-25 deg Celcius.
- It is a zone of constant sunlight and mixing due to winds.
- It is a zone of uniform temperature.
- **b. Thermocline or metalimnion**
- The temperature decreases rapidly with depth.
- It is also called the twilight zone.
- **c. Hypolimnion**
- It is a zone of uniform temperature and very cold waters.
- The average temperature is nearly 4 deg Celcius since sea water attains maximum density at this temperature.
- It is also called a dark zone.
- **Horizontal distribution**
- The surface temperature lies between 20-25 deg C in the tropical regions and decreases gradually towards the poles.

- The 3 distinctive layers are visible in tropical regions.
- However, along polar regions, there will be a single uniform layer of cold temperatures.

The salinity of oceans(2:15:00PM)

- Salinity is the number of grams of dissolved salts in 1000 grams of seawater measured as parts per thousand(ppt).
- The average salinity of Earth's oceans is equal to 35 parts per thousand.

Factors affecting salinity

- **1. Sources of addition**
- a. Sediments brought by rivers, wind, glaciers, etc get dissolved in ocean water over a long period of time.
- b. Volcanic eruptions along the sea floor.
- c. Evaporation along the oceanic surface.
- d. Biological agents
- e. Glacier formation
- The salinity of oceans always remains constant. The factors adding up salinity are balanced by the **factors reducing salinity.**
- **2. Factors reducing salinity**
- a. Addition of rainwater
- b. Glacier melting
- c. Rivers
- d. Precipitation of salts along the ocean floor
- **Dissolved salts in seawater(gm of salt per kg of water)**
- Explained with a table
- Chlorine> Sodium> Sulphate> Magnesium> Calcium> Potassium> Bicarbonate> Bromine> Borate> Strontium

Factors influencing salinity(2:36:00PM)

- **a. Temperature**
- Higher temperatures will result in higher salinity.
- **b. Wind Speed**
- Higher the wind speed, the higher evaporation resulting in higher salinity.
- **c. Rainfall**
- Higher rainfall causes lower salinity.
- **d. Rivers**
- River water adds extra fresh water decreasing the salinity.
- **e. Ice formation**
- An increase in ice formation increases the salinity and the melting of ice decreases the salinity.
- **f. Ocean currents**
- It helps in the distribution of salinity from one region to another.
- Doubt resolution

Distribution of salinity(2:46:00PM)

- Explained with the help of a graph
- Along polar regions, low salinity near the surface is experienced due to low temperature and low rate of evaporation, and the addition of freshwater due to the melting of ice.
- Along subtropical regions, high evaporation leads to high salinity along the surface and it decreased rapidly to become uniform after a certain depth.
- In equatorial regions, high precipitation causes low salinity in the upper layer and increases with depth, and then decreases to become uniform.
- **Horizontal distribution:**
- Subtropics> Equator> Temperate> Polar
- The highest salinity body is Lake Van(330 ppt).
- Dead Sea (240 ppt)
- Great Salt Lake(220 ppt)
- **Seas with above-normal salinity:** Mediterranean sea, Red sea, and the Persian Gulf.
- **Seas with below normal salinity:** Arctic Ocean, North Sea, Bering Sea, Baltic Sea, Gulf of St Lawrence

Oceanic deposits(3:24:00PM)

- **Terrigenous**
- It is also called lithogenous(derived from the land)
- Examples: Placer deposits like Gold, gravel, sand, mud, and silt.
- **Biogenous**

- Derived from life.
- Examples: Crude oil, Coral reef, Shells, Pearls, Ooze(shelly skeletal remains of microscopic marine organisms)
- **Hydrogenous**
- It is also known as inorganic deposits.
- Examples: Polymetallic nodules, Polymetallic sulphide, Red clay
- **Cosmogenous**
- It is meteorite debris.

Coral Reefs(3:33:00PM)

- **Corals**
- Corals are masses of limestone and dolomite accumulated by lime-secreting organisms called coral polyps.
- They are developed due to the symbiotic relationship between coral polyps and zooxanthellae algae.
- Coral reefs provide habitat to nearly 31 phyla of animals resulting in rich biodiversity.
- Therefore, they are also called the **Rainforests of oceans.**
- **Conditions**
- Temperature- Above 20 deg Celcius
- Latitude- Between 30 deg N and 30 deg S
- Depth- It can not be more than 200-250 feet below water.
- Sediments- The water should be free from sediments.
- Salinity- It should be average approximately 35 ppt
- Platform- They require a platform provided by a continental shelf.
- **Distribution**
- Explained with a world map

- Coral triangle- that is, Indonesia, Malaysia, Philippines, and Australia and the Coral islands of the Pacific Ocean.
- Atlantic- which includes the Caribbean Sea, Gulf of Mexico, and its surroundings
- Indian Ocean- Red Sea, Persian Gulf, Western and Northern Indian Ocean
- Coral reefs are not found along the western margins of continents due to the presence of cold ocean currents
- They are not formed along deltas due to low salinity and high sediments.

Topics for next class- Coral bleaching, Ocean currents
Geography Class 31

A brief review of the last class and doubt resolution
Types of coral reefs(1:21:00PM)

- **1. Fringing reef**
- A narrow coral platform lying close to the coast.
- Example: the islands of the Caribbean Sea
- **2. Barrier reef**
- A wide coral platform is located far from the coast and is separated by a lagoon.
- Example: Great Barrier Reef
- **3. Atoll**
- A circular coral reef developed around a guyot, sea mount or island.
- Examples: Islands of Pacific Ocean, Lakshadweep, Maldives, etc.

Coral bleaching(1:39:00PM)

- Corals receive their coloration from the algae living in a symbiotic relationship.
- Coral bleaching refers to the loss of color of corals due to stress-induced expulsion of symbiotic algae.
- **The reasons behind coral bleaching are:**
- Increasing water temperature due to global warming.
- Changes in salinity
- Increased sedimentation
- Pollution across coastal regions such as water pollution, thermal pollution, pollution due to plastic, and ocean acidification.
- Increased incidences of cyclones and storms.
- El-Nino
- **Examples of coral bleaching:**
- Between 2014-1017 due to El-Nino, nearly 50% of great barrier reef was bleached.
- 1997-98- The northern Indian Ocean lost a majority of its corals.

Ocean currents and circulations(1:58:00PM)

- It is a general movement of surface water of the ocean in a definite direction over long distances.
- **There are two types of ocean currents:**
- **a. Warm current-** moving from low latitude to high latitude
- **b. Cold current-** moving from high latitude to low latitude.
- **Factors(forces) responsible for the formation/influencing the ocean currents**
- **a. Winds**
- The steady blowing of winds drags the surface water in its direction and brings about the surface flow and steadily sets the water currents in motion.
- **b. Differences in temperature and salinity**
- They cause the water to move and reduce the variation. Such differences guide the movement of ocean currents.
- **c. Shape of coastline and topography** modifies the ocean current's direction
- **d. Coriolis force**
- It causes ocean currents to deflect right in the northern hemisphere and left in the southern hemisphere.

Ocean currents of the world(2:23:00PM)

- **1. Atlantic ocean**
- **North Equatorial and south equatorial currents**
- They are driven by trade winds from east to west.
- **Counter Equatorial current**
- It is caused due to the merging of the North equatorial current and the south equatorial current on the western side which flows from west to east in between them.
- The south equatorial current is bifurcated near Brazil and the northern branch joins the **North equatorial current(NEC).**
- The combined waters flow towards Caribbean islands. Some part of this current flows on the Eastern side of the Caribbean as the **Antilles current.** The rest of the water enters the Caribbean Sea and then the Gulf of Mexico.
- The current coming out of the Gulf merges with Antilles current and flows across the South East Coast of the USA as **Florida current.**
- Along the Eastern coast of the USA, it is called **the Gulf stream.**
- The Gulf stream beyond the Newfoundland island turns right under the combined effect of Westerlies and Coriolis force and flows as **North Atlantic Drift.**
- It crosses the Atlantic Ocean and reaches the west coast of Europe and gets bifurcated into two parts.

- The northern part along the coast of England or Norway flows as **North Atlantic Drift or Irminger current** towards the Arctic Ocean.
- The southern part flows towards the equator as **Cold Canary Current** and joins the North Equatorial Current and that completes the circulation.
- In the North Atlantic Ocean, the continuous circulation of water in a clockwise direction results in the slow movement of water within, which is called a **Gyre.**
- Within this gyre, a type of seaweed grows in a large quantity called **Sargasso.** Therefore, the sea is called as **Sargasso sea.**
- There are two cold ocean currents in North Atlantic Ocean from the Arctic Ocean:
- **a. Labrador Current** flows between Canada and Greenland and merges with the gulf Stream.
- **b. East Greenland Current** between Greenland and Iceland merging with North Atlantic Drift.

Currents of the South Atlantic Ocean

- The southern branch of the South Equatorial Current moves along the coast of Brazil as the **Brazilian current.**
- At higher latitudes, the Brazilian current is deflected towards the left and flows as **South Atlantic Drift.**
- The absence of landmass and strong westerlies causes a continuous flow of water without any obstruction at midlatitudes from west to east in the southern hemisphere surrounding Antarctica as **Cold West Wind Drift.**
- The South Atlantic Drift merges with west wind drift. Near the Cape of Goodhope, a part of it diverts north as **Cold Benguela Current** which joins the South Equatorial Current.
- The **cold Falkland current** flows near the Southeast coast of South America and merges with the Brazilian Current.

Currents of the Pacific Ocean(3:36:00PM)

- **North Pacific**
- **North Equatorial current**, **South equatorial current,** and **Counter equatorial currents**
- **Kuroshio current** along Philippines and Japan
- Kuroshio becomes **North Pacific current or North Pacific Drift.**
- **Warm Alaska Current**
- **Cold Californian current**
- **Cold Oyashio current** and **Cold Okhotsk current**
- **South Pacific**
- South Equatorial Current
- **East Australian Current**
- **Cold Peru Current or Humboldt Current**

Indian Ocean(3:48:00PM)

- **Southern Indian Ocean**
- **North Equatorial, South equatorial,** and **Counter equatorial current**
- **Mozambique current**
- **Agulhas current**
- **West wind drift**
- **Cold West Australian Current**
- **North Indian Ocean**
- In winters the North equatorial current flows westward above the equator. Counterequatorial current flows between NEC and SEC.
- The Northeast monsoon drives the water of the Bay of Bengal and the Arabian Sea to circulate in a counter-clockwise direction called **Northeast Monsoon drift.**
- In summer, the entire water of the North Indian Ocean comes under the influence of the Southwest Monsoon producing a clockwise flow of **Southwest Monsoon drift.**
- During the summers, the North equatorial current and counter equatorial current are nearly absent.

Topics for next class- Ocean currents continued
Geography Class 32

A brief review of the last class
Ocean currents contd(1:30:00PM)

- Revision with the help of videos and globe.

Significance of ocean currents (1:42:00PM)

- The ocean currents help in the global distribution of temperature, salinity and heat balance.
- The cold ocean currents along the western margins of continents in tropical regions contribute to the formation of deserts through the desiccation effect.

- Examples: Sahara effect(Canary Current), Namib desert(Benguela Current), Atacama desert(Peru/Humboldt current).
- Within the tropical regions along the East coast of continents, the warm ocean currents cause high temperature of the water and high evaporation causing more precipitation and the formation of tropical cyclones.
- Examples: Florida coast under the influence of Florida current, the Coast of China and Japan under Kuroshio current.
- Along the western coast of continents, in temperate regions, the British climate experience mild winters and ice-free coast due to the presence of warm ocean currents. Examples: North Atlantic Drift along Britain and Norway coast.
- Within temperate regions, along the Eastern margins of continents warm and cold ocean currents meet creating ideal conditions for the growth of fish.
- Examples: Near Newfoundland island merging of Gulf steam with Labrador current and East Greenland current has resulted in Grand bank, Georges bank.
- The merging of warm and cold ocean currents results in the formation of fog which may obstruct ocean navigation.
- The cold ocean currents are the regions of upwelling which bring deep cold and nutrient-rich water to the surface which helps in the growth of fish supporting large-scale fishing activity. Example: Peru and Chile
- Ocean currents are used in navigation in the ocean.

Upwelling and downwelling (2:08:00PM)

- **Upwelling**
- The offshore winds push surface water away and cause the cold water from the bottom to rise to the surface.
- This brings cold and nutrient-rich water to the surface.
- Upwelling is more active in the regions of cold ocean currents.
- **Downwelling**
- The onshore winds pile up the water near to the coast causing the sinking of water below the surface layer.
- Downwelling is more active in the regions of ice formation and the regions where warm and cold ocean currents meet.

Thermohaline ciculations (2:19:00PM)

- These are deep ocean currents driven by differences in water density which are controlled by temperature and salinity.
- It begins near polar regions where ice formation leaves the water saltier and denser causing sinking or downwelling.
- The deep water upwells in the regions of cold ocean currents.
- This current underwater moves in a single and continuous belt across the different oceans. Therefore, they are called **Great ocean conveyor belts.**
- **Atlantic-Meridional Overturning circulation (AMOC)**
- AMOC is part of the thermohaline circulation in the Atlantic Ocean.
- The recent AR6 of IPCC talks about the weakening of AMOC due to global warming.
- **Factors responsible for weakening**
- The temperature difference between tropical and polar regions is decreasing due to the warming of the Arctic region.
- Weakening of North Atlantic Drift
- Excessive addition of freshwater due to increases melting of ice in polar regions reduced downwelling.
- **Impacts of weakening**
- Western European countries will experience harsh winters and frozen ports.
- The western parts of oceans in tropical regions experience a rise in sea levels.
- Increase the occurrence of cyclones in tropical waters.
- Disturbance of fishing zones.
- Disturbance of marine ecosystem due to disturbed temperature and salinity conditions.

Water mass (3:12:00PM)

- It is a body of water with uniform characteristics of temperature and salinity.
- There are 3 types of water masses:
- **a. Surface water mass**- Subtropical surface water mass.
- **b. Intermediate water mass-** Antarctic intermediate water mass.
- **c. Deepwater**- North Atlantic deep water mass.
- ***Significance -***

- It helps in the generation and movement of the thermohaline circulation and the movement of water mass help in the distribution of temperature, salinity and oxygen.
- It results in the generation of upwelling and downwelling.
- The uniformity of conditions supports plankton and coral growth.
- PYQ discussion

Mapping (3:25:00PM)

- **Americas**
- Americas are called as New World.
- They are named after Amerigo Vespucci.
- Latin America means all the countries in the Americas except USA and Canada as they speak English.
- **North America**
- The Rocky Mountains.
- Appalachian mountains.
- Labrador.
- Great Plains- Prairies of North America.
- Mt. Mckinley/Denali- is the highest peak in North America.
- Death Valley- The lowest point in North America.
- Mojave Desert
- **South America**
- Andes mountains- The most extended mountain range.
- Aconcagua- highest peak in South America.
- Valdes Peninsula(Argentina)- is the lowest point in South America.
- Amazon- Largest river(volume wise) on Earth's surface as well as 2nd longest river on Earth after the Nile river.
- The Guiana Highlands.
- Angel falls(Venezuela)- is the highest waterfall in the world.
- Amazon Basin/Selvas.
- Llanos.
- Campos.
- **Oceania**
- Australia
- Micronesia- Mariana Islands, Kiribati islands, Marshal islands.
- Melanesia- Papua New Guinea, Fiji.
- Polynesia- Hawaii, New Zealand, Easter Island, Tonga, Cook island.
- Mount Wilhelm- the highest point in Oceania.
- Lake Eyre- the lowest point in Oceania.
- **Antarctica**
- Russians were the first to reach Antarctica.
- Antarctica is also known as Terra Australis Incognita/ White continent.
- The size of Antarctica doubles in winter due to the freezing of ice.
- Antarctic treaty system, 1961- Antarctica can only be used for peaceful scientific purposes.

Topics for next class- El Nino and related phenomena

Geography Class 33

A brief review of the last class and doubt resolution

El-Nino and related phenomena(1:26:00PM)

- **Walker circulation(Normal condition)**
- Near the South American coast winds blow offshore and blows the surface water westward away from continents.
- This results in the upwelling of cold water from the bottom and the air above this cold water is stabilized and convection is suppressed.
- The water flows towards the west as southeast trade winds blow towards the western pacific region.
- It is heated and rises causing convection, cloud formation, and precipitation.
- The rising air flows eastward in the upper troposphere and descends down along the Eastern Pacific and completes the cell.
- This result in high pressure and low temperature along the eastern pacific and low pressure and high temperature along the western Pacific.
- The resulting convective cell is called **Walker circulation.**

- In this condition, the eastern pacific coast experiences drought with the western pacific having good rainfall.
- **El-Nino**
- Once in 7-8 years, by October-November, the ITCZ moves too much south of the equator resulting in the weakening of trade winds.
- The weakening of trade winds reduces the upwelling along the coast.
- The warm tropical surface water along the Eastern Pacific is not moving away rather it starts to flow back causing a reduction in upwelling.
- This results in warm surface water off the coast of South and Central America which is called as El-Nino.
- The appearance of El Nino causes air pressure to drop over the Eastern Pacific and rise over the western pacific.
- This sea-saw variation of air pressure is called an **ENSO(El Nino Southern Oscillation).**
- It causes heavy precipitation along the Eastern Pacific and drought-like conditions along the western Pacific.
- After one or two years, the enhanced **Hadley circulation** strengthens the trade winds, ITCZ shifts north, and increases upwelling bringing back normal conditions.

La Nina(Little girl or girl child)(2:22:00PM)

- El-Nino is usually followed by La-Nina.
- It is the intensified high-pressure conditions and cold temperatures along the eastern pacific and lowers low pressure and high temperature along the western Pacific.
- This causes very high precipitation in India and Australia resulting in floods and very dry conditions in Peru and Chile.

Impact of El-Nino(2:56:00PM)

- Pressure-It causes global climatic imbalances through variations in pressure patterns across the world.
- It causes a global rise in ocean water temperatures which reduces the growth of algae and impacts the marine ecosystem across various parts of the ocean.
- The warm temperature of the oceans triggers large-scale coral bleaching.
- It causes very heavy precipitation around the coastal deserts of Peru and Chile.
- The suppression of upwelling is devastating for the fishing sector killing fish in a large scale along Eastern Pacific.
- The decomposition of fish releases hydrogen sulfide causing dark waters and making it toxic.
- The decline of fish causes the migration of birds along the coast of Peru and Chile impacting its fertilizer industry.
- The high pressure along the western pacific disturbs the flow of Monsoon winds causing drought conditions in India and Australia.
- During El Nino, high pressure along the western Pacific suppresses cyclones in India and Australia.
- High pressure along the Caribbean Sea results in a low number of cyclones.
- Australia experiences large-scale wildfires/forest fires.

El Nino Modoki(3:16:00PM)

- While El-Nino is characterized by strong warming in the Eastern Pacific Ocean, El Nino Modoki results in the warming of the Central Pacific Ocean with the cooling of Eastern and Western parts.
- It creates a two-cell Walker circulation over the tropical Pacific region with precipitation in the Central part and dry conditions in the Eastern and Western parts.
- While El-Nino results in diminished Hurricanes in the Caribbean Sea, El-Nino Modoki results in increased Hurricanes.
- During this time, cyclones occur more in the Arabian Sea than in the Bay of Bengal.

Madden Julian Oscillation(MJO)(3:28:00PM)

- Unlike ENSO, which is stationary, MJO is an eastward-moving disturbance of clouds, rainfall, winds, and pressure that traverses the planet in the tropics and returns to its initial starting points in 30-60 days on average.
- MJO has two parts:
- a. Convective side with enhanced precipitation
- b. Subsiding side with suppressed precipitation
- MJO can modulate the timing and strength of Monson as well as tropical cyclones.

Indian Ocean Dipole(3:44:00PM)

- The difference in sea surface temperature between the Western Arabian Sea and the Eastern Indian Ocean of Indonesia is called as **Indian Ocean Dipole**.
- Similar to MJO, it is a coupled ocean and atmospheric phenomenon.
- **Positive IOD**

- Warm sea surface along the western part.
- Less precipitation in Indonesia and Australia.
- Good for Indian Monsoon.
- Reduces the impact of El Nino on India.
- During positive IOD, the Arabian Sea experiences a higher number of cyclones than the Bay of Bengal.
- **Negative IOD**
- Warm sea surface temperature in the Eastern part.
- More rainfall in Indonesia and Australia.
- Bad for Indian monsoon.
- Increases the impact of El Nino on India.
- Indian Monsoon + El Nino + Convective side of MJO + Positive IOD= Normal or above normal monsoon
- PYQ discussion

Topics for the next class- Tides and biogeography
Geography Class 34

Revision of the previous class[MJO, ENSO, La-Nina, walker circulation]
Explanation of Heat dome [will be covered in detail in disaster management]
Tides [13:37:00]

- The regular rise and fall of the water level in the world's oceans resulting from gravitational attraction by the moon and the sun is called tides.
- The combined gravitational pull of the sun and moon pull the ocean water in a bulge.
- The centrifugal force due to the revolution of the earth pulls another bulge in opposite direction. The bulges in one direction create low waters in another.
- As the earth rotates this position of high and low water changes across the surface.

Factors affecting tides [14:01:00]

- The gravitational pull of the sun and moon
- The relative position of the sun and moon
- The centrifugal force of earth's revolution [* For example-Bay of Fundi, Bay of Khambhat/Cambay-water level of tides are too extreme]
- [* For example- Chandipur coast (over the Mahanadi river) the water levels are too extreme]

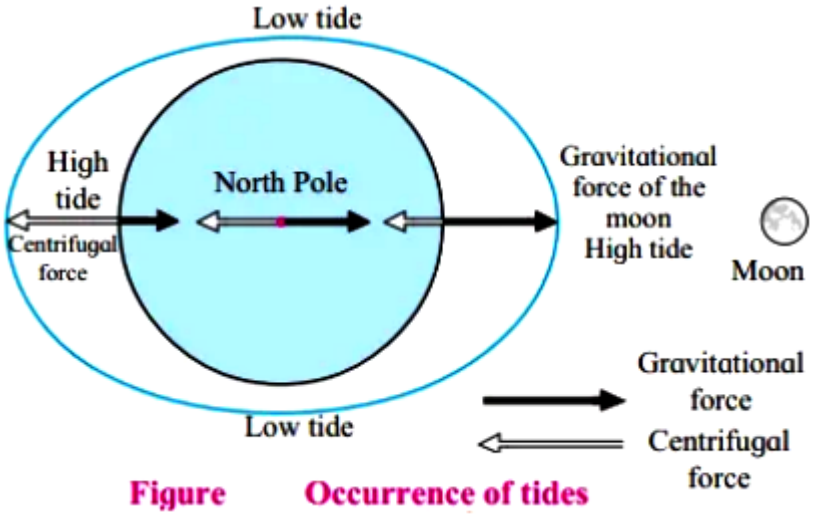
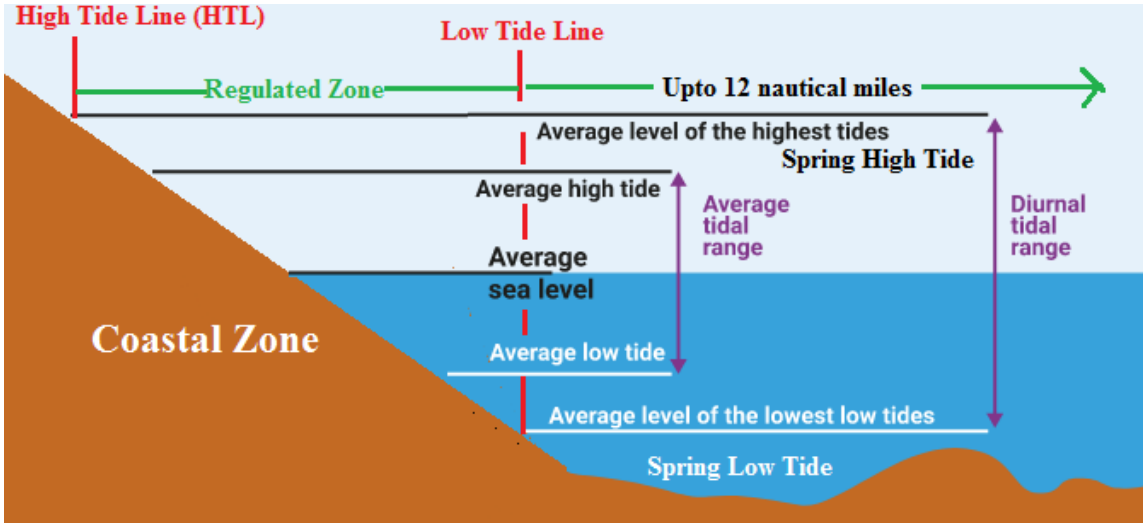


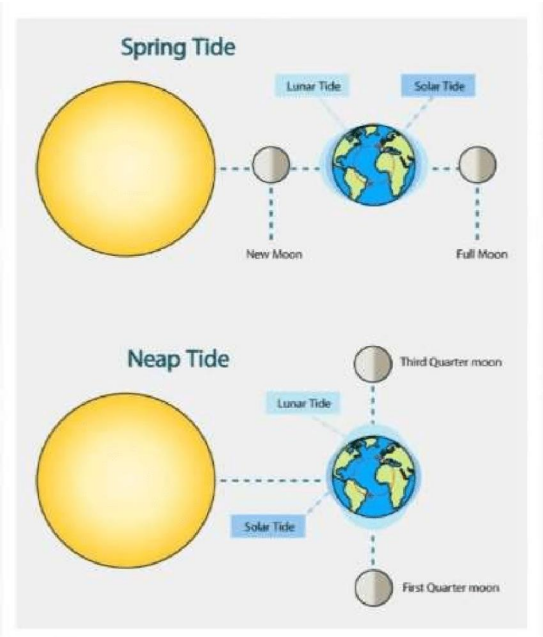
Figure Occurrence of tides



- Topography of land around the coastal region and distribution of water

Types of tides [14:08:00]

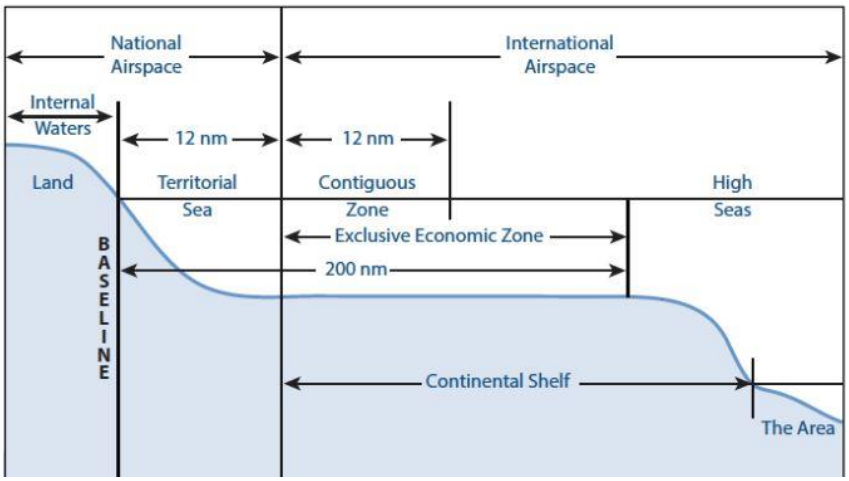
- **Spring Tides**- It is very high, High tide, and very low, Low tide is experienced when the sun, moon & earth are in a straight line [**Syzygy**]
- The conjunction is when the sun and moon are on the same side, Opposition is when there are on opposite sides of the earth
- **Neap tides**- The smaller high tides and the smaller low tides experience when the sun and the moon are perpendicular to each other
- The position is called quadrature
- **Diurnal/semi-diurnal sides**- diurnal tides occurig once in day. Semi-diurnal occurring twice a day.



Significance of the Tides [14:20:00]

- Generation of tidal energy
- Navigation for tidal ports- For example- Kolkata port supports the shipbuilding industry
- Natural cleansing of coasts- helps in maintaining biodiversity along the tidal range
- **Negatives-** It causes coastal erosion and restricts delta formation.

Maritime Zones [15:00:00]



- **Baseline**- It is an average line of low waters
- **Internal waters**- It is the landward side of the baseline. It includes the backwaters, lagoons, and deltas
- **Territorial sea**- 12 Nautical miles from the baseline. A country has sovereign jurisdiction at the bottom, surface, and air within the territorial sea. However, innocent passages are allowed with restriction.
- **Contiguous Zone**- Upto 24 Nautical miles from the baseline. Sovereign jurisdiction over the bottom and surface but not in the air
- **Exclusive Economic Zone**- Upto 200 Nautical miles from the baseline. Resources can be exploited on the floor. In the regions where the continental shelf exceeds 200 NM, resource exploitation is allowed till the edge of the continental shelf.
- **High seas**- International waters and the common heritage of all mankind. It is beyond any national jurisdiction and comes under International seabed authority

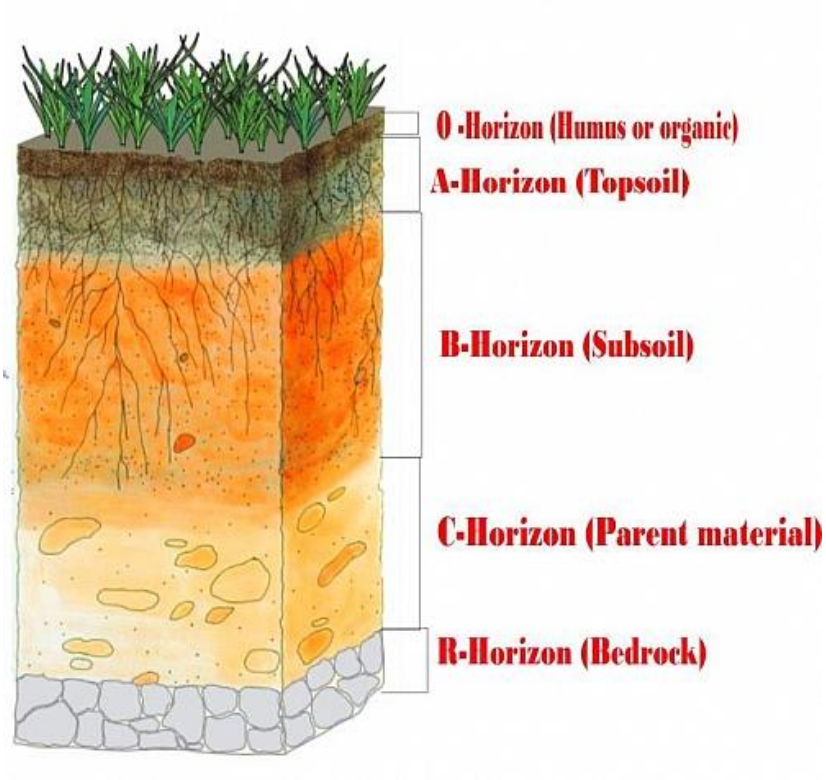
Bio-Geography [15:20:00]

- It is the branch of geography that studies soil and its relation with life [i.e. vegetation]

Terms related to the soil

- **Soil**- The loose surface material consisting of inorganic and organic matter and is the source of water and nutrients for vegetation. **True soil** is characterized by distinct horizons and the capacity to support plants [Horizons= layers] [* Layers means they are rich in nutrients]
- **Regolith**- It is a layer of unconsolidated material derived from weathering of parent rock
- **Horizons**- A distinguishable layer in the soil that has certain chemicals under distinct colors is called the horizon
- **Soil profile**- The vertical arrangement of horizons down to the parent rock material is called the soil profile.

Soil Profile [15:37:00]



-
- O- Horizon - The layer where one finds leaf debris + organic matter + leaf litter
- A horizon- Top soil- It is dark in color [* Why dark?- because of humus content. The matter left after the decomposition. It is rich in nutrients]. The nutrients can be easily assimilated by the organisms. It is highly fertile and productive
- B- horizon- Subsoil- fewer nutrients and lighter in color
- C- Horizon is called Regolith and not the parent material- no nutrients
- The Last one is D-Horizon which is Bedrock.

Factors affecting soil formation [soilgenesis] [15:46:00]

- **Soil**= PCORT [Parent rock + Climate + Organisms + Relief + Time]
- **Role of parent rock material-** It decides the soil texture, color, and composition. The influence of the parent rock diminishes with time. For example- quartzite rock results in sand soil. Black soil [basaltic magma]. It will decide on crystal, color, texture, and overall composition. Its influence will be on the beginning of the time
- **Climate**- Climate affects soil formation directly by controlling weathering, percolation, moisture level, etc. It helps in the development of different horizons For example- in the southern peninsula- Rocks are igneous and metamorphic rocks. The same parent material is there but the climate changes the types of soil. [Climate is the most prominent factor].
- **Organisms-** Plant roots, burrowing animals, and microorganisms help in loosening up the soil and air circulation.
- **Relief/ slope-** It determines the thickness of the soil
- **Time**- It determines the maturity of soil

The Topic for the next class- Processes involved in soil formation, Soil types, and India- physical geography.
Geography Class 35

A general talk on the UPSC exam and a brief review of the last class
<u>Soil formation process(1:22:00PM)</u>

- **a. Transformation**
- The process of change of soil constituents from one form to another through breakdown, weathering, decay, etc is called a transformation process.
- **b. Translocation**
- The movement of soil constituents from one horizon to another within the soil profile is called as translocation.
- The translocation process depends on the rate of precipitation and evaporation.

Different processes of translocation:

- **a. Eluviaiton-** the downward transport process through which the minerals are removed from the top layer.

- **b. Illuviation-** the reversal of eluviation where the matter accumulates in the lower horizons. It involves the deposition of minerals in lower layers.
- **c. Leaching-** The percolating water removes humus and soluble basis from the upper horizons and deposits in lower ones. It is more pronounced in humid areas.
- **d. Laterisation-** In hot and wet equatorial regions, heavy leaching removes silica and other minerals except iron and aluminium which accumulates at the surface leading to the formation of hard iron crust. Lateralisation results in the formation of laterite soil. Laterite soil is slightly acidic and it is good for the cultivation of plantation crops such as spices, cashew nuts, coffee, tea, rubber, etc.
- **e. Podzolization-** In temperate regions, and high altitude conditions the slow decomposition of coniferous litter along with the precipitation creates a soil solution that is strongly acidic. It is due to the formation of organic acids which removes aluminium, iron and other organic matter. However, it leaves a top acidic layer rich in silica. The resultant soil is called pozole soil.
- **f. Calcification-** It involves the accumulation of calcium carbonate in the top layer of soil. It is more active in temperate grasslands where evaporation exceeds precipitation. Calcification increases the fertility of the soil.
- **g. Salinisation-** It involves the accumulation of highly soluble sodium and magnesium salts in the soil. It is active in the regions where there are excessive evaporation, that is, arid and semi-arid regions. It is also found in the regions of faulty irrigation practices.
- **h. Gleyisation-** It is observed in water-logged conditions where the colour of topsoil changes due to reduction reactions. It involves the accumulation of organic matter in the upper layers of the soil.

Distribution of soils(2:22:00PM)

- Overall soil in the world can be classified into **Pedocal and Pedalfers:**
- Ped means soil, cal means calcium, alfe means aluminium and iron.
-

Pedocal	**Pedalfer**
High evaporation	High precipitation
Prairie soil(also called as black earth)	Podzol soil
Chernozem and Chestnut soil	Red and yellow soil
Red desert soil	Laterite

- Laterite soil to Podzoil soil with increasing latitude. (usually found along the eastern margins of continents)
- Red desert soil to Prairie soil as we move along the longitude from the western margins of continents towards interiors.

USDA Classification of soil type(2:55:00PM)

- Explained with the help of a table
- PYQ discussion

Indian Physical Geography(3:04:00PM)

- **Mapping**
- Wakhan corridor
- **Order of Border length:** Bangladesh(4000 km), China(3500 km), Pakistan(3200 km), Nepal(1700km), Myanmar(1650 km), Bhutan(700km), Afghanistan(100 km)
- **Maritime boundary-** Sri Lanka, Maldives, Bangladesh, Pakistan, Myanmar, Thailand, Indonesia
- Presently India has **28 states and 8 Uts**
- **Union Territories-** Delhi(NCT), Andaman and Nicobar, Chandigarh, Dadra and Nagar Haveli and Daman and Diu, Jammu and Kashmir, Ladakh, Lakshadweep, and Puducherry(Yanam- Andhra Pradesh, Mahe-Kerala, Puducherry and Karaikal in Tamil Nadu).
- **Different regions:**
- Western region-4- Gujarat, Rajasthan, Madhya Pradesh, Maharashtra
- Northern-4- Punjab, Haryana, Himachal Pradesh, Uttarakhand
- Southern-6- Goa, Karnataka, Telangana, Andhra Pradesh, Tamil Nadu and Kerala
- Eastern 6- UP, Bihar, Jharkhand, Chhattisgarh, Odisha, West Bengal
- Northeastern(7+1)- Sikkim, Assam, Arunachal, Nagaland, Manipur, Mizoram, Tripura, Meghalaya

Physiography(3:50:00PM)

- **Classification:**
- **Mountains**- Himalayas, Aravalli, Central India, Western and Eastern Ghats
- **Plateau-** Malwa, Deccan, Chhotanagpur, Meghalaya
- **Plains-** River(Indus, Ganga and Brahmaputra); Coastal(Western and Eastern)
- **Islands-** Andaman and Nicobar, Lakshadweep
- We call the Indian part of Asia as **Indian subcontinent.**

Topics for next class- Physiography of India
Geography Class 36

A brief review of the last class and doubt resolution
Subcontinent(1:22:00PM)

- A subcontinent is a large landmass that is part of a continent but considered separate from the rest of the continents.
- Examples: Indian subcontinent, Alaskan subcontinent, etc.
- **Reasons for considering India as a subcontinent:**
- **a. Geographical reasons**
- The Indian subcontinent has well-defined physical boundaries such as Himalayas and Hindukush in the north, Poorvanchal in the east, Indian Ocean in the south.
- **b. Geological reasons**
- The countries of the Indian subcontinent share a common geological history such as the upliftment of the Himalayas, tertiary formations of river plains.
- **c. Political reasons**
- These countries share a common political identity.
- **d. Historical and cultural reasons**
- Historically ruled by large empires such as Mauryan, Mughals, etc.
- They also share a common culture like language, festivals, etc.
- Mapping quiz

Himalayas(1:39:00PM)

- **Evolution**
- Please refer to plate tectonics continent-continent convergence(starting from Pangea)
- **Stages in the formation of the Himalayas**
- The Himalayas were formed in **3 different stages:**
- **1st-** Between 120-70 million years ago which resulted in the formation of **the Great Himalayas**
- **2nd-** Between 30-25 million years ago which resulted in the formation of **the Middle Himalayas.**
- **3rd-** Between 20-2 million years ago which resulted in the formation of **Shiwaliks.**
- **The shape of the Himalayas**
- The overall shape of the Himalayas is **arcuate** with a **deep knee bend** where the strike of ridges suddenly turns at right angles.
- It is also evident by the rivers taking **sharp U-turns** in this region. Example: **Brahmaputra and Indus.**
- This bend of the Himalayas is called **syntaxial bending.**
- It is due to the maximum push offered at both the ends of **Indian Peninsula** during its **northward drift.**
- In the northwest direction, the Aravallis and in the northeast the Assam ranges acted as two extended arms while the central areas sagged giving an arcuate shape.

Evidence to support the continued upliftment of the Himalayas

- Frequent earthquakes are observed in the Himalayas with higher intensity.
- The topography with high slopes and frequent disturbances such as landslides.
- Rivers of the Himalayas are in the youth stage with high energy levels and high erosional capacity.
- The recent drying up of lakes of Tibet.
- Recent adjustment in the height of peaks. For example, the height of Mt Everest has been readjusted from 8848 to 8848.86m
- **Fault zones**
- ITSZ - Indo Tsangpo suture zone- Tibetan plateau and Great Himalayas
- MCT- Main Central Thrust- Great and Lesser Himalayas
- MBT- Main Boundary Thrust Between Lesser Himalayas and Shiwaliks
- MFT- Main frontal thrust between Shiwaliks and the great plains

Ranges and Mapping(3:00:00PM)

- Explained through a diagram
- **From North to South:**
- Trans Himalayas
- The Great Himalayas
- Middle Himalayas
- Shivaliks
- These will be covered in detail in Mapping classes
- **Trans Himalayas**

- Karakoram range, Ladakh range, Zanskar mountains, Kailash mountains.
- They are formed much before the Great Himalayas.
- The fossils found here are primitive in nature.
- Spiti valley(Behind the Great Himalayas)
- **The Great Himalayas**
- They are also called **Himadari.**
- They stretch from **Nanga Parbat(Jammu & Kashmir)** to **Namcha Barva (Arunachal Pradesh).**
- **Middle Himalayas**
- are also called as **Lesser Himalayas or Himachal.**
- They are discontinuous.
- They include- Pir Panjal, Dhauladhar, Mussoorie range, Naga Tiba, Mahabharat range(Nepal), Arunachal Pradesh(Dafla Miri Abor Mishmi)
- **Shivalik**
- Known as Jammu hills in Jammu(Vaishno Devi), Arunachal(There is no Shivalik here, Shivalik are merged with Lesser Himalayas)

Regional division(3:26:00PM)

- Between **River Indus** and **River Satluj**- **Punjab Himalayas**
- Between **Satluj and Kali rivers** -**Kumaon Himalayas**
- Between **Kali and Teesta rivers- Nepal Himalayas**
- Between **Teesta and Brahmaputra- Assam Himalayas**

Difference between Western Himalayas vs Eastern Himalayas

Western Himalayas	**Eastern Himalayas**
Extent: Indus to Kali	Teesta to Brahmaputra
Height: Taller	Shorter
Coniferous type	Evergreen type
Temperature is lower	Temperature is higher
Precipitation is lower	Precipitation is higher
Wider; lesser Himalayas and Shivalik are separate	Narrow; Lesser Himalayas and Shiwaliks have merged
Elevation increases gradually	Elevation increases abruptly
Lower biodiversity	High Biodiversity
Snowline is lower in altitude	Snowline is higher in altitude

Purvanchal(3:39:00PM)

- Patkai range
- Naga hills
- Manipur hills
- Mizo hills or Lushai hills
- Tripura hills
- Meghalaya was part of the peninsular region. It has three hills- Garo, Khasi, and Jaintia.
- Barail range

Peninsular region(3:43:00PM)

- It is a great complex of ancient rocks which has existed as a single rigid block for millions of years.
- It extends from Gujarat in the west to Meghalaya in the East, from the northern plains in the north to the Indian Ocean in the south.
- This region has undergone a few episodes of tectonic activities such as the submergence of western parts of western ghats, and the formation of rift valleys such as Narmada, Tapi, etc.
- The formation of Deccan traps when the Indian plate was passing over Reunion hotspots due to the eruption of highly fluid basaltic magma.
- **Important hills**
- Aravallis- Old fold mountains
- Vindhyas and Satpuras- Block mountains
- Western ghats and Eastern ghats
- **Plateau**
- Malwa
- Bundelkhand
- Chhotanagpur plateau
- Meghalaya plateau
- Deccan plateau- Maharashta plateau, Telangana plateau, Karnataka plateau and Rayalaseema plateau

Topics for next class- Difference between Western and Eastern ghats, physiography continued

Geography Class 37

A brief review of the last class and doubt resolution

Difference between the Western Ghats and Eastern Ghats(1:23:00PM)

Western Ghats	Eastern Ghats
Extends from Tapi to Kanyakumari	Extends from Odisha to Nilgiri
Taller	Slightly shorter
Continuous	Discontinuous and broken
Altitude increases towards the south	Altitude increase towards the North
Closer to the coast	Far from the coast
They are narrow	Wider
Receive more precipitation	Lesser precipitation
Higher biodiversity	Lower biodiversity

Western Ghats

- Called Sahayadri in Maharashtra and Karnataka
- Nilgiris- Blue Mountains
- Anaimalai hills
- Cardamom hills

Eastern ghats

- Nallamala hills
- Palkonda hills
- Shevaroy hills

Plains of India(1:40:00PM)

- **a. River plains**
- Indus plains
- Ganga plains
- Brahmaputra plains
- They are called the northern plains
- **b. Coastal plains**

Northern plains

- **Formation**
- The northern plains are formed due to the deposition of sediments brought by the rivers from the Himalayas. These sediments filled up the leftover basin after the formation of the Himalayas.
- It extends for a total of 3200 km of which India has 2400km.
- It is the largest alluvial plain in the world.
- **Parts**
- **a. Rajasthan plains**
- It is widely accepted that the Rajasthan plains are the result of the mythological river which may be part of the Indus system.
- The drying up of this river due to natural as well as anthropogenic factors has resulted in the formation of arid and semi-arid regions.
- The western part of Rajasthan consists of a desert proper called as **Marusthali**. Between Marusthali and Aravallis, the semi-arid region is called as **Rajasthan Bagar** which is drained by the **Luni river.**
- **b. Punjab Haryana Plains**
- These are the plains of the Indus river and its tributaries in India.
- Doab is a land between two rivers.
- **The 5 doabs are:**
- Beas and Satluj- Bist doab
- Beas and Ravi- Bari doab
- Ravi and Chenab- Rachna doab
- Jhelum and Chenab- Jech doab
- Indus river on one side and all the 5 tributaries on the other side- Sind Sagar doab
- **c. Ganga plains**
- It extends from Delhi to Kolkata.
- Ganga- Yamuna doab
- Rohilkhand plains
- Avadh plains

- Lower Ganga plains
- **d. Brahmaputra plains**
- Plain of the Brahmaputra in India
- It extends from Sadiya in the eastern part to Dhubri in the western part.

Type of northern plains

- **a. Bhabar**
- It is a region of porous gravels and boulders deposited by rivers entering the plains from mountains.
- In this region, the smaller river streams disappear and start to flow underground
- **b. Terai**
- It is a marshy region after Bhabar where river streams start to reappear.
- It is very fertile and is widely used for the agriculture of rice and sugarcane.
- They are waterlogged in nature and are prone to waterborne diseases.
- **c. Khadar**
- It is an alluvial plain just next to the river valley and is made up of fresh alluvium and it gets replenished every year.
- It is more fertile.
- **d. Bhangar**
- It is an alluvial plain away from the river valley and is made up of older alluvium.
- It is less fertile than Khadar.
- **e. Duars**
- These are unconsolidated sediments found along the foothills of the Eastern Himalayas.
- These are the sediments deposited by the rivers entering the plains and are useful for tea cultivation.

Coastal plains(2:34:00PM)

- **Differences between Eastern and Western coastal plains**
-

Eastern Coastal plains	Western coastal plains
Wider(150-200 km)	Narrow(maximum up to 65 km)
From Sundarban to Kanyakumari	From Kutch to Kanyakumari
Delta	Estuaries
Dominated by deposition	Dominated by erosion
Emergent in nature(due to deposition)	Submerged in nature(due to erosion), except Kerala which is emergent.
Smooth and is suitable for artificial or manmade harbors	Broken and indented and thus suitable for natural harbors
Has a narrow continental shelf	Has a wider continental shelf

Drainage system(3:10:00PM)

- **Evolution of the Himalayan drainage system**
- The widely accepted theory regarding the evolution of the Himalayas proposes the existence of a single river all along the Himalayas flowing from east to west called as **Indo-Brahm or Shivalik river**. It occupied the remnant of the Tethys basin and it drained into the Gulf of Sindh.
- This earlier drainage system was disturbed by **three main events:**
- a. More rising of Western Himalayas
- b. Upliftment of Potwar plateau and Delhi Ridge
- c. Downthrusting of Malda gap or Garo Rajmahal gap
- This divided the entire river into **three river systems:**
- a. Indus and its tributaries
- b. Ganga and its tributaries
- c. Brahmaputra and its tributaries
- **Evolution of Peninsular drainage system**
- The peninsular drainage system is influenced by **three major events:**
- a. Submergence of the western side of the western Ghats which disturbed the symmetrical pattern of peninsular drainage.
- b. Upliftment of the Himalayas which caused the northern part of Vindhyas to tilt more towards the north and also the deepening of rift valleys of Narmada and Tapi
- c. Gradual tilting of Peninsular block from Northwest to southeast direction causing slope towards the Bay of Bengal

Difference between Himalayan and Peninsular drainage(3:37:00PM)

Himalayan rivers	Peninsular rivers
They are perennial in nature, fed by glaciers, and flow throughout the year	They are rainfed and are seasonal in nature
The river basin is bigger and the catchment area is bigger	Both are smaller here
Higher meandering	Lower meandering
Huge deltas formation	Smaller deltas and estuaries
Large flood plains	Smaller flood plains
These rivers are dominated by the youth stage.	They are dominated by the mature stage.
They are both antecedent and consequent but you will find antecedent rivers	They are consequent
A dendritic pattern of drainage	Rectangular pattern

- Consequent and antecedent river
- The consequent river follows the slope. Examples: Ganga, Yamuna
- The antecedent river will be able to maintain its course in spite of changes in topography. Examples: Indus, Brahmaputra, etc

Drainage pattern

- The flow characteristics of a river are called drainage patterns.
- There are **5 major patterns:**
- **a. Dendritic pattern**
- A drainage pattern where a river and its tributary form a dense network and appear like branches of a leaf or tree. It is prevalent in those regions of plain sedimentary soil with a lack of structural control.
- **b. Rectangular pattern**
- The river takes sharp right turns.
- It is prevalent in plateau regions with high structural control.
- Example, Mahanadi, Krishna, etc
- **c. Trellis pattern**
- The main river flows in a rift valley and the tributaries join at 90degress.
- **d. Radial pattern**
- A drainage pattern in which different rivers are originating and flowing in different directions from a highland or mountain.
- Example: Amarkantak with Narmada and Son.
- **e. Parallel drainage**
- The rivers are running parallel to each other and enter the ocean.
- Example: West flowing rivers of western ghats.

Topics for next class- Important rivers, Indian climate

Geography Class 38

A Brief Overview of the Previous Class:(01:13:00 PM)

Indian Rivers & Their Tributaries:(01:17:00 PM)

- Things to remebers:
- Origin of important reives.
- The states of origin and states through which they flow.
- The location of the mouth of important rivers.
- Tributaries.
- Important features like National parks, sanctuaries, hydropower projects, etc. related to these rivers.
- ***1. Indus:***
- ***(Explained with Maps)***
- Origin: In the Kailash range, Minsarowar.
- Goes to China.
- Flows through Laddakh (PoK) in India.
- Flows through, mouth is at Karachi port.
- Right Bank Tributaries:
- Shyok, Nubra, Gilgit River, and Kabul river.
- Left bank Tributaries:
- Jhelum, Chenab, Rabi, Bias, and Satluj from North to South.
- *Jhelum*:
- From Verinag in Jammu & Kashmir.

- *Chenab*:
- Two small streams on opposite sides of the pass, namely Chandra(originates in Barachergri) and Bhaga(Originates in Surajtal), the united stream Chandrabhaga flows in the northwest direction.
- Chandrabhaga is Chenab.
- *Ravi:*
- The Ravi has its source in Kullu hills near the Rohtang Pass in Himachal Pradesh.
- It drains the area between the Pir Panjal and the Dhaola Dhar ranges.
- It meets Chenab a little above Rangpur in Pakistani Punjab.
- *Beas River:*
- The Beas originates near the Rohtang Pass, on the southern end of the Pir Panjal Range, close to the source of the Ravi.
- It crosses the Dhaola Dhar range and takes a south-westerly direction and meets the Satluj river at Harike in Punjab.
- It is a comparatively small river that lies entirely within the Indian territory.
- *Sutlej:*
- The Satluj rises from the Manasarovar-Rakas Lakes in western Tibet.
- Like the Indus, it takes a north-westerly course up to the Shipki La on the Tibet-Himachal Pradesh boundary.
- It cuts deep gorges where it pierces the Great Himalayas and the other Himalayan ranges.
- Before entering the Punjab plain, it cuts a gorge in Naina Devi Dhar, where the famous Bhakra dam has been constructed.
- After entering the plain at Rupnagar (Ropar), it turns westwards and is joined by the Beas at Harike.

Ganga River System:(02:00:00 PM)

- ***(Explained with Maps)***
- The Ganga originates as Bhagirathi from the Gangotri glacier in Uttar Kashi District of Uttarakhand.
- Alaknanda River joins Bhagirathi at Devaprayag.
- From Devapryag the river is called Ganga.
- Ganga debouches [emerge from a confined space into a wide, open area] from the hills into the plain area at
- It is joined by the Yamuna at Allahabad.
- Near Rajmahal Hills it turns to the southeast.
- It touches Jharkhand also.
- At Farraka, it bifurcates into Ganga-Hugli(it is a major distributary of Ganga, it is also known as Bhagirathi) in West Bengal and Padma-Meghna in Bangladesh.
- Brahmaputra (or the Jamuna as it is known here) joins Padma-Meghna.
- Major Left bank Tributaries:
- a. Ramganga: Form Uttarakhand.
- b. Gomti: From Uttar Pradesh.
- c. Ghaghra River: Comes from China, enters Nepal, then UP, then Bihar where it joins the Ganga river.
- Ghaghra has two tributaries:
- Left banks: Sarda or kali River(comes from Uttarakhand, Forms boundary between India & Nepal)
- Right Bank: Rapti river(comers from Nepal)
- Ghaghra in Ayodhya is called Saryu.
- d. Gandak River:
- Originates near the Tibet-Nepal border.
- It flows into Ganga at Bihar.
- e. Kosi River:
- The Kosi river consists of seven streams known as Sapta Kosi.
- These streams flow through eastern Nepal which is known as the Sapt Kaushik region.
- The river channel is braided and it shifts its course frequently. This has resulted in frequent devastating floods and has converted large tracts of cultivable land into wastelands in Bihar.
- Thus the river is often termed the ‘Sorrow of Bihar’.

Right Banks Tributaries of Ganga:(02:16:00 PM)

- ***(Explained with Maps)***
- *1. Yamuna:*
- Largest and the most important tributary.
- It originates from the Yamnotri glacier on the Bandarpunch Peak in the Garhwal region in Uttarakhand at an elevation of about 6,000 meters.

- It cuts across the Nag Tibba, the Mussoorie, and the Shiwalik ranges.
- It emerges out of the hilly area and enters the plains near
- Its main affluent in the upper reaches is the Tons which also rises from the Bandarpunch glacier.
- Chambal, Sind, Betwa, and Ken are tributaries of the Yamuna river.
- *2. Chambal:*
- The Chambal rises in the highlands of Janapao Hills in the Vindhyan Range.
- It flows through the Malwa Plateau.
- It joins the Yamuna in the Etawah district of Uttar Pradesh.
- Banas is tributary of Chambal.
- The river flows much below its banks due to severe erosion because of poor rainfall and numerous deep ravines have been formed in the Chambal Valley, giving rise to badland topography.
- *3. Son:*
- The Son River rises in the Amarkantak Plateau.
- Its source is close to the origin of the Narmada.
- It passes along the Kaimur Range.
- It joins the Ganga near Danapur in the Patna district of Bihar.
- *4. Ajay and Damiodar Rivers.*

The Brahmaputra River:(02:28:00 PM)

- ***(Explained with Maps)***
- The Brahmaputra's source is the Angsi and Chemayungdung glaciers in southwestern Tibet.
- It flows as the Yarlung Tsangpo River across southern Tibet to break through the Himalayas in great gorges and into Arunachal Pradesh where it is known as Dihang.
- Just west of the town of Sadiya, the Dihang turns to the southwest and is joined by two mountain streams, the Lohit and the Dibang.
- Below the confluence, the river is known as the Brahmaputra.
- It flows through Bangladesh as the Jamuna where it merges with the Ganga to form a vast delta, the Sunderbans.
- The biggest and the smallest river islands in the world, Majuli, and Umananda respectively, are in the river in the state of Assam.
- Dibrugarh, Pasighat, Neamati, Tezpur, and Guwahati are the important urban centers on the river.
- *Major Tributaries:*
- a. Subansiri River,
- b. Kameng River(called Jia Bhareli in Assam), Pakke Tiger Reserve is located on this river.
- c. Manas River:
- Manas River is a transboundary river in the Himalayan foothills between southern Bhutan and India.
- It has two major reserve forest areas, namely the Royal Manas National Park in Bhutan and the contiguous Manas Wildlife Sanctuary.
- d. Sankosh:
- It rises in northern Bhutan and empties into the Brahmaputra in the state of Assam
- e. Teesta:
- The river originates from North Sikkim in the Himalayas.
- The river then flows past the town of Rangpo where it forms the border between Sikkim and West Bengal up to Teesta Bazaar.
- The river flows through Jalpaiguri and then to the Rangpur District of Bangladesh, before finally merging with the mighty Brahmaputra.
- f. Dibang River:
- g. Lohit
- h. Dhansiri.
- i. Kopili River, Barak(Surma in Bangaldesh), etc.

Peninsular Drainage System:(03:18:00 PM)

- ***(Explained with Maps)***
- *Major rivers:*
- Subhrnrekha
- Baitarni & Brahmani: They form Brahmani-Baitarni delta.
- Gahirmata Beach(which is the largest site for the mass hatching of Olive Ridley turtles) is located on this delta.
- Towards its south we have Mahanadi Delta.
- Vansadhara.
- Mahanadi:

- The Mahanadi originates from the Satpura Range of central India and it is a river in eastern India.
- It flows east to the Bay of Bengal. The river drains the state of Maharashtra, Chhattisgarh, Jharkhand, and Orissa.
- The largest dam, the Hirakud Dam, is built on the river.
- Important Tributaries are: Ong, Ib, Mand, Jonk, Telen.
- Godavari:
- This river originates from Trimbakeshwar, near Nasik in Maharashtra.
- It flows southeast across south-central India through the states of Madhya Pradesh, Telangana, Andhra Pradesh, and Orissa, and drains into the Bay of Bengal.
- It does not enter Karnataka.
- Only major right bank tributary is Manjra.
- Left banks are- Pneganga, Wardha, and Venganga, they three merged to form Pranhita.
- Indravati(Chitrakoot Waterfall called Niagra of India) and Sabri River.
- Krishna:
- Krishna is one of the longest rivers in India, which originates from Mahabaleshwar in Maharashtra.
- The river flows through the states of Maharashtra, Karnataka, Telangana, and Andhra Pradesh and drains in the Bay of Bengal.
- Major Left bank tributary:
- Bhima River, Musi River(Hyderabad)
- Right Bank Tributaries:
- Mallaprabha and Ghataprabha, Tungabhadra.
- Cavery:
- It originates from Talakaveri located in the Brahmagiri hills in the Western Ghats.
- The headwaters of the river are in the Western Ghats range of Karnataka state, and from Karnataka through Tamil Nadu.
- Left banks tributaries: Harang, Hemavati, Arkavathy, Shimsha,
- Right banks tributary: Kabini, Amravati, Suvranvati, etc.
- *Other rivers:*
- Luni, Narmada, Tapti, Peirayar, Pamba, Mahadayi, Mandavi, Periyar, etc.

Climate of India:(03:51:00 PM)

- *Factors affecting India's climate:*
- 1. Monsoon: The most important factor.
- 2. Indian Ocean: Moderating effect of the Indian ocean.
- 3. Himalayas: Stops cold winds coming from central Asia and influences the Indian Monsoon also.
- 4. Overall Lattitudial extent of India(nearly 30 degrees)- It is responsible for the varied climatic conditions from tropical to subtropical types.
- 5. The Topographical variations: Presence of Arawalis, Coromandal Coast, Western Ghats, Thar desert, etc.
- 6. Jet streams(Both Sub tropical westerly, Easterly, and Somali jetstreams and tropical cyclones.
- 7. El-Lino, La-Nina, Indian Ocean Dipole, etc.

Topics for the next class: Continuation of the Indian Climate.

Geography Class 39

A Brief Overview of the Previous Class:(01:10:00 PM)

The Monsoon of India:(01:26:00 PM)

- ***(Explained with maps and diagrams)***
- Monsoon is derived from the Arabic word 'Mausim' which means seasons.
- It is a seasonal reversal of winds.
- The classical theory:
- This explains the mechanism of monsoons as huge land and sea breeze due to the reversal of temperature and pressure conditions in the northern plains from summer to winter.
- During Summer High temperature and low pressure on land causes winds to sea to land
- During Winter low temperature and high pressure on land causes winds to blow from land to Sea.

The Modern Theory:(01:43:00 PM)

- ***(Explained with maps and diagrams)***
- *1. Winter(November to February):*
- Temperature is low and pressure is high, causing anti-cyclonic circulations.
- Winds blow outwards from land over which air is subsiding.
- The winds are dry and cold.

- The subtropical westerly jet stream is strong and well-established, it is bifurcated into two branches over the north and south of the Tibetian plateau.
- The southern branch is stronger and is located along the northern Ganga plains.
- This intensifies surface anti-cyclones leading to clear and dry sky weather.
- The winds blow from the land to the sea in the northeast direction which is called the northeast monsoon winds.
- These winds after crossing the Bay of Bengal takes up moisture and cause precipitation along the Coromandal Coast.
- *2. Spring(February to April):*
- The weather is hot & dry.
- The and has started to heat up causing a pressure drop.
- The subtropical westerly jet stream begins to weaken and the southern branch eventually moves entirely to the north of the Tibetian plateau.
- These conditions cause precipitation known as the Pre Monsson Showers.
- For example:
- Mango Showers, Nor Westers, Blossom showers, Loo, etc.
- *3. Summer(May to August):*
- High temperature over deserts and the northern plains causes the development of low-pressure cells.
- ITCZ shifts completely north and is lying over the Ganga Plains as the Monsoon Trough.
- This attracts the southern trade winds towards the north of the Equator which after crossing the equator turn right under the influence of Coriolis force and starts to blow as South West Monsoon winds.
- The temperature stratification in the air does not allow large-scale convection preventing major storms.
- The tropical easterly jet streams which develop over India in summer help in the formation of disturbance in the air in addition to low-pressure depressions in the Bay of Bengal.
- This causes the Bursting of Monsoon which is the sudden onset of moisture-laden winds associated with violent thunders and lightning.
- The monsoon winds gradually get distributed trough out India causing Monsson rainfall
- In some regions, the local stability conditions and also the winds following parallel to topography causes the break in monsoon.
- *4. Autumn(September-October):*
- ITCZ or monsoon trough starts to move back gradually towards the south.
- This also brings back the maximum extent up to which southwest winds blow.
- The southwest winds slowly get replaced by the North East winds.
- Subtropical westerly jet stream reappears to the south of the Tibetian plateau creating dry conditions.
- The high temperature with dry conditions in October along the northern plains is called the 'October Heat'.

***Characteristics of Monsoon*:(03:06:00 PM)**

- The onset of the Monsoon is gradual and withdrawal is an even more gradual process.
- The rainfall decreases from the sea to the land.
- The duration of Minson decreases from south to north.
- Temporal variation: Variation of rainfall with time.
- Spatial Variation: variation of rainfall from one region to another.
- *1. Bay of Bengal Branch:*
- It moves parallel to the Coromandel coast causing no precipitation.
- From Krishna Godavery Delta rainfall starts to increase towards West Bengal.
- Along the Ganga Delta, the Bay of Bengal branch is divided into Eastern and western by Himalayan foothills.
- The Eastern branch hits Meghalaya Plateau perpendicularly causing very heavy precipitation.
- The western branch moves across the Ganga plains.
- Precipitation decreases from east to west along the Ganga Plains.
- Precipitation increases towards the Himalayas from South to North.
- *2. Arabian Sea Branch:*
- Hits the Western Ghats at a right angle causing heavy precipitation along the western side.
- On the eastern side, the descending winds result in a rain shadow effect creating dry conditions in Karnataka, Maharashtra, Telangana, and parts of Andhra Pradesh.

- The Arabian sea branch advances towards Gujarat and grows parallel to Aravalis resulting in very less precipitation in Rajasthan.
- The Arabian sea branch meets the Bay of Bengal Branch near Agra and causes precipitation over the rest of north India.

The Western Disturbances(WD):(03:34:00 PM)

- WD is experienced between October to April.
- During the winters northern India experiences cold and dry conditions along with strong westerly jet streams.
- The Mediterranean receives rainfall due to the onshore westerlies due to temperate cyclones.
- The subtropical jet streams along the Mediterranean region pick up moisture-laden winds and brought to India.
- When these winds accumulate near the northwest Himalayas it causes precipitation.
- Precipitation due to western disturbances decreases from west to east along the Ganga plains.
- Significance of the WD:
- It causes an abrupt decrease in temperature in the northern plains and snowfall in the Himalayas.
- It is good for the winter crops of wheat and mustard.
- It may result in cloud bursts and flash floods. For example, Leh cloud burst.
- Impacts of El Nino, La Nina, MJO, IOD, etc(Refer to oceanography notes)

Soils of India:(03:56:00 PM)

- A general introduction about various types.
- Climate examples- Saline soil of Rajasthan and laterite soil of western Ghats.
- Organic compounds: Soils of Central India.
- Time: Bhangar(New) & Khader(Older)
- Etc.

Topics for the next class: Continuation of Soils.

Geography Class 40

A Brief Overview of the Previous Class:(01:07:00 PM)

Soil Types of India:(01:19:00 PM)

- ***(Explained with a map)***
- ***1. Red Soil:***
- Climate is moderate to low precipitation.
- Dry conditions.
- Parent rock material is granite and gneiss.
- Rich in Iron, Aluminum, and Magnesium and deficient in Nitrogen, Humus, and Phosphorous.
- Regions: Southern Karnataka, Andhra Pradesh, Eastern Madhya Pradesh, Chattisgarh, Jharkhand, Odisha, and parts of northeast India.
- ***2. Laterite Soil:***
- Veery high precipitation with some dry conditions.
- High leaching causing Laterisation.
- Rich in Iron, Aluminum, and Potash, and poor in Silica, bases, Humus, and phosphate.
- It is suitable for the plantation crops of Coffee, tea, Rubber, Cashew Nuts, Spices, etc due to its acidic nature.
- Regions: Westen side of the Western Ghats, Parts of Odhisha, Meghalaya, Hills of Central India, Southern parts of Aravallis.
- ***3. Black Soil:***
- The color is black due to the presence of titaniferous magnetite.
- Parent rock material is basaltic rocks of the Deccan traps.
- It is rich in Humus content.
- Deficient in Nitrogen, and Phosphorous.
- It is called 'self-ploughing' soil beacuse it is sticky when wet and forms cracks when it is dry.
- Regions: Maharashtra, Northern Karnataka, Southern Gujarat, western MP.
- ***4. Alluvial Soil:***
- It is formed due to the deposition of sediments by the rivers.
- There are no marked differences in layers.
- Regions: Northern plains and coastal plains.
- ***5. Arid or Saline Soil(Desert Soil):***
- It is due to high evaporation and low moisture content.
- Salts get accumulated in the top layer due to high evaporation.
- Deficient in Nitrogen & Humus.

- Regions: Northwest Rajasthan, northern Gujarat.
- ***6. Mountain & Forest Soil:***
- There is a thin layer of soil in the case of mountain soils.
- Rich in organic content and slightly acidic.
- Northeastern India, Vidhya's, Satpura, and western Ghats' regions.
- ***7. Peaty Soil:***
- found in regions submerged in water.
- Along the delta regions.
- It has more organic content.
- Saline in nature.
- Regions: Coastal deltas of West Bengal, Tamil Nadu, Kerala, etc.
- ***Common Characteristics of Soils:***
- a. Nitrogen: All Indian soils are Nitrogen-deficient.
- b. Iron & Aluminum is higher in laterite and red soil.
- c. Humus content is high in black soil and mountain & forest soil, and peaty soil.
- Rest all soil has no or very less hums content.

Economic & Human Geography:(02:02:00 PM)

- ***1. Water Resources:***
- ***a. Oceanic Resources:***
- 1. Minerals:
- a. In Dissolved Form: Salts like Sodium, magnesium salts, etc.
- b. Deposited Minerals: can be deposited on:
- Continental Shelf- Gold placer deposits(Subharnrekha , gulf of Mexico, and Yukon region, pearls, shells, sand, granules, magnetite, and phosphorite.
- Oceanic Basin- Polly metallic Nodules(rich in Maganese, also has, iron, nickel, copper, cobalt, silver, gold ,etc.), and Polymetallic sulphides.
- 2. Energy:
- Petroleum- Bombay High, Persian Gulf, Gulf of Mexico, and North Sea.
- Natural gases and Coal.
- Offshore wind Energy.
- Ocean Thermal Energy Conversion(OTEC).
- Tidal waves Energy
- Waves Energy
- Thorium- Monazite sand(Kerala, Tamil Nadu coastal areas,etc),
- They also contain rare earth metals.
- Hydrogen, Deuterium, etc.
- 3. Food resources:
- Fishes.
- Prawns, Crabs,
- Seaweeds.
- 4. Freshwater:
- By Reverse Osmosis(RO)
- Electrodialysis.

Challenges in Harnessing Oceans Resources:(03:17:00 PM)

- a. Geographical limitations- Oceans are too deep, too dark, and too cold.
- To harsh and risky, difficult to reach.
- b. Distribution- It is not uniform.
- Its implications are:
- It leads to difficulty in energy security.
- Wars were fought and geopolitics.
- Pricing issues.
- Ploymetallic Nodules are found in a few areas- Clarion Clipperton Zone, Central Indian Ocean region, etc.
- Deep Ocean Mission of India is related to this.
- c. Technological Issues:
- In the case of PMN, OTEC, Thorium, Ocean waves, etc.
- d. Economic Issues:
- Extractions of PMNs and Freshwater by RO are very expensive.
- e. Environmental Issues:

- It can cause damage to ecological biodiversity, and destroy ecosystems like Coral reefs, mangrove ecosystems, etc.

Fish Resources:(03:31:00 PM)

- Marine fishing is one of the major economic activities around the world.
- *1. Favorable conditions for the growth of fish are:*
- a. Merging of warm and cold ocean currents.
- For example, the Merging of the Gulf Stream and Labrador current near New found land Island, Oyashio and Kuroshio Currents near Japan.
- b. It is the dominant area where there are more phytoplankton found.
- c. Wider Continental shelf. For example, the northeast and northwest Atlantic ocean.
- d. Upwelling of ocean waters: Near the Peruvian Current, California Cold current.
- e. Coral Reefs- These provide the habitat.
- The entire south East Asia.
- Factors for the Fish industry:
- a. Moderate temperature,
- b. Rugged Interior land which is not suitable for agriculture. Ex. Japan, Sri Lanks.
- c. Ports Facilities- broken Indented coasts supporting natural harbors.
- d. Investements and infrastuture.
- e. High demand.
- *2. The tropical region does not have a well developed Fishing Industry beacuse:*
- a. high temperature-
- It is not suitable for fish preservation.
- not suitable for the plankton growth
- High diversity- reduces profit.
- Less developed countries, lower demand, etc.
- *3. Distribution:*
- (Shown on a map)
- Grand bank, Dogger bank, Georges Bank, etc.

India's potential for India:(03:51:00 PM)

- A very high potential for marine fishing.
- Lower Production because of:
- a. Traditional methods- Lower productivity and lower profit.
- b. Fishing in India is a caste-based profession that comes with a social stigma.
- c. Don't catch fish from the deep sea which is of high value.
- d. Climatic Limitations- Monsoons, cyclones, etc.
- e. Poor infrastructure and storage facilities.
- f. Low investments.
- g. Territorial Siisues like Pakistan, and Sri Lanka, which is in conflict frequently.
- *Government Initiatives:*
- a. Blue revolution-
- It was launched in India during the 7th Five Year Plan (FYP) that went from 1985 to 1990, during which the government-sponsored the Fish Farmers Development Agency (FFDA).
- During the 8th FYP, from 1992-97, the Intensive Marine Fisheries Program was launched in which collaboration with MNCs was encouraged.
- Over some time, fishing harbors in Tuticorin, Porbandar, Visakhapatnam, Kochi, and Port Blair were established.
- Several research centers have also been set up to increase production as well as to do improvement in species.
- b. The National Fisheries Development Board (NFDB) was established in 2006 as an autonomous organization under the administrative control of the Department of Fisheries, Ministry of Agriculture and Farmers Welfare, to enhance fish production and productivity in the country and to coordinate fishery development in an integrated and holistic manner.
- c. National Policy in Marine Fisheries: from 2015 to 2020.
- d. Neel Kranti Mission., etc.

Topics for the next class: Freshwater fisheries and natural vegetation.

Geography Class 41

A Brief Overview of the Previous Class:(01:22:00 PM)

Fresh Water Resources:(01:39:00 PM)

- Ocean water -97%.

- Freshwater- 3%.
- Out of the total freshwater:
- a. Icecaps and Glaciere- 68.7%
- b. Groundwater- 30.1%
- c. Other- 0.9%(out of it only 0.3% water is surface water).
- Freshwater on the Surface:
- a. Lakes- 87%
- b. Swamps- 11%.
- c. Rivers- 2%

Issues related to Freshwater in India: (01:46:00 PM)

- 1. Supply-demand mismatch(Water Stress): Increased demand is the major problem.
- ***Supply Side Problems:***
- a. The nature of monsoon- The precipitation is concentrated over a few months and that too with huge variations in terms of temporal and spatial.
- b. Topography- Rain shadow regions of western Ghats, Coromandel coast, Aravalis, etc.
- c. Indian Drainage System- Excessive water in the Himalayan rivers, and deficient water in peninsular Rivers.
- d. Al-Nino, IOD, MJO, etc.
- ***Demand Side:***
- a. Pollution.
- b. Water-intensive agriculture & interstate water disputes. For example, the Cauvery river.
- c. Over-extraction by wells, pumps, etc. for agriculture, industry, and domestic use.
- d. Unplanned urbanization: Encroachemnets of water bodies, pollution, concretization, no rainwater reach, harvesting, etc.
- e. Large-scale deforestation.
- f. Global warming and climate change- It will reduce or disrupt the supply and increase demand.

Water stress in India:

- It is a situation when demand exceeds availability or poor quality of water is available.
- India is the 13th most water-stressed country in the world.
- Falken Mark- It measures water stress.
- If the water availability for any country is below 1700 meters cube/per person/per year then it is called a water stress country.
- India has 1545 in (2011)
- Below 1000 meters cube/per person/per year then it is called water scares country.
- ***Water Stress Regions of India:***
- 54% of India faces extremely high water stress.
- a. Northern Region: Very high stress.
- Punjab, Haryana, Himachal, etc.
- **Reasons:**
- Low precipitation, water-intensive agriculture, deforestation, high-density population, over-extraction of groundwater, etc.
- b. Western & Central India:
- Lack of forest, rainshadow regions, water-intensive agriculture, etc.
- c. Southern Region:
- Lower groundwater, water-intensive agriculture, rainshadow regions, etc.
- d. Eastern India:
- High population, excessive extraction of groundwater- Fluoride and Arsenic pollution, mining, deforestation, etc.
- e. North East India:
- Not so much water stress in this region.

Management of Water Stress:(02:55:00 PM)

- *1. 3R Approach:*
- Reduce: By avoiding wastage of water.
- Reuse: Use of water for other purposes after treating the Grey water.
- Recycle: It means full treatment of water and then recycling it.
- *2. Reduce Pollution:*
- Proper implementation of pollution control and water treatment regulations.
- Awareness.
- *3. Reforestation and Afforestation.*

- *Watershed:*
- It is an area of land where all the water(under it or drains off it) collects into one water body.
- *Watershed Development/Management-*
- It implies rational utilization of land and water resources for optimum and sustained production with minimum hazard to natural resources.
- It involves the conservation and management of both surface and groundwater using watersheds as a single unit.
- *4. Rain Water Harvesting:*
- It is a technique of collection and storage of rainwater into natural reservoirs or tanks or infiltration of surface water into sub-surface aquifers.
- It dilutes the contaminants and increases the groundwater level.
- It involves the methods such as rooftop collection, recharge pits, surface water collection, and groundwater recharge using ponds and lakes.
- *5. Sustainable agriculture:*
- Growing less water-intensive crops.
- Using local varieties,
- Micro irrigation like drip and sprinkler irrigation
- Soil conservation such as mulching, terrace cultivation, etc.
- *6. River Linking:*
- It is also known as the KL Rao Scheme.
- It involves the transfer of water from water-surplus rivers to water-deficit rivers.
- Himlayan componet has 14 rivers.
- 16 in the Peninsular component.
- ***Benefits:***
- Flood control in the North and draught control in the South.
- Increase in irrigation cover.
- Hydroelectric power through dams.
- Inland navigation & Tourism.
- Fisheries development and industrial growth.
- Drinking water supply to cities.
- ***Various issues with it:***
- a. Environmental Issues:
- Submergence of forests.
- Threat to biodiversity.
- Increased Man-animal conflicts.
- Disturbance of the riverine ecology.
- b. Economical Issues:
- It is too expensive.
- We will lose a lot of income due to submergence.
- c. Administrative issues:
- Defining surplus.
- Rural/Tribal displacement.
- It may lead to an increased number of interstate disputes.
- **Way Forwards:**
- We should go with it on a case-to-case basis, and we must focus on managing the demand side issues.

Natural Vegetation:(03:46:00 PM)

- ***World's Distribution of Natural Vegetation:***

Tropical Rain Forest:

- Feature:
- Remains evergreen.
- High temperature & High precipitation.
- Multilayered vegetation and lack of undergrowth.
- Presence of climbers and epiphytes.
- Very high biodiversity.
- High density.
- Regions:
- Amazon, Congo Basin, Ecuador, Venezuela, Parts of Western Africa, Indonesia, Papua-New Guinea, etc.

***Monsoon Forest*:(04:01:00 PM)**

- Rain is concentrated in a specific season with a distinctive dry season.
- Density is lesser than in the Evergreen forest.
- Regions: South Asia, Indo-China, Eastern Africa, Northern Australia.

Mediterranean Vegetation:

- Dry summers and wet winters.
- Vegetation is short bushes and grass with deep root systems that remain evergreen.
- This vegetation is also called Chaparral Vegetation.
- Citrus fruits and viticulture are prominent in these areas.

Mixed Forests:

- These are the regions that are not too cold or not too hot.
- They are a mixture of broad leave deciduous and coniferous forests.
- Found in regions with moderate and uniform rainfall.
- Regions: Eastern Asia(China Type), Western Europe(British Type), etc.

Coniferous Type or Borreal Forests or Taiga Type:

- The temperature is very cold.
- Conical-shaped needle leaves and evergreen.
- Very low diversity as very few species can survive in such low temperatures.
- Regions: Siberia, Russia, Scandinavia, Poland, Canada, Alaska, etc.
- It is the single largest and most continuous stretch of forest on the Earth.
- No regions in the Southern Hemisphere except for the higher altitudes on mountains.

Topics for the Next class: Lumbering, Indian vegetation types, etc.

Geography Class 42

***A Brief Overview of the Previous Class*:(01:11:00 PM)**

***Indian Vegetation:*(01:16:00 PM)**

- ***(Explained with a Map)***
- According to the Champion Classification. There are 16 types of Indian vegetation.
- 1. Tropical Evergreen Forests:
- 2. Tropical Deciduous Forest.
- 3. Tropical Thorn Forests.
- 4. Montane Forests.
- 5. Littoral and Swamp Forests.
- ***1. Tropical Evergreen Forests:***
- Characteristics: High temperature, High precipitation.
- Types:
- ***a. Tropical Wet Evergreen:***
- Annual rainfall exceeds 250 cm.
- The annual temperature is about 25°-27°C.
- The average annual humidity exceeds 77 percent.
- The dry season is distinctly short.
- Distribution:
- The western side of the Western Ghats.
- Some regions in the Purvanchal hills.
- In the Andaman and Nicobar Islands.
- ***b. Tropical Semi-evergreen:***
- They are transitional forests between tropical wet evergreen forests and tropical deciduous forests.
- They are comparatively drier areas compared to tropical wet evergreen forests.
- Annual rainfall is 200-250 cm.
- The mean annual temperature varies from 24°C to 27°C.
- Distribution: Western coast, North East, Lower slopes of the Eastern Himalayas
- Some parts of Odisha and West Bengal.
- Andamans & Nicobar.
- ***Tree species for both above types:***
- Mahagony, Ebony, Indian Rosewood, Laurel, Jamun tree, Irul tree, Rubber tree,
- ***c. Tropical Dry evergreen:***
- Coromandel Cost of India.
- Rainfall in Winter.
- Rest all features of the evergreen forests.

- Tree Species: Tamarind, Neem, Jamun, Toddy Palm, etc.
- ***2. Deciduous Vegetation:***
- ***a. Moist Deciduous:***
- Annual rainfall 100 to 200 cm.
- It will be found around the evergreen forests.
- Regions: Wetter parts of Madhya Pradesh, Maharashtra, Karnataka, Odisha, Jharkhand, Chattishgarh, etc.
- Trees: Teak, Saal, Almonds, Sheesham(rosewood), Sandalwood,
- ***b. Dry Deciduous:***
- Rainfall 70 to 100 cm.
- Regions: A wide strip running north to the south from the Himalayas to Kanyakumari except the regions of tropical thorn and moist deciduous.
- Trees: Bamboo, Sandalwood, red sanders(only found in Palkonda hills, Sheshachalam Biosphere reserve naturally).
- ***3. Tropical Thorn Forests:***
- Preciptarion is less than 70 cm.
- Southern Punjab, Rajasthan, Gujarat, rainshadow regions of the Deccan plateau, etc.
- Trees: Khair, Axel Wood, Babul, Acacia, Date Palm, Neem, Prosopis juliflora (It is a shrub or small tree, It is native to Mexico, South America, and the Caribbean. It is a very invasive species)
- ***4. Montane Forests:***
- Regions: Entire Himalayas, Parts of Vidhya's, Parts of Western Ghats, Shola Forests(Grasslands of South)
- Trees: Pine or Chir Pine, Devdar, Oaktree, Maple, Juniper, Rhododendron, etc.

Littoral & Swamp Vegetation:(02:17:00 PM)

- ***(Explained with a Map)***
- Mangrove Forests:
- They can survive and grow both in fresh as well as brackish water (The mixture of seawater and fresh water in estuaries is called brackish water and its salinity can range from 0.5 to 35 ppt).
- Occur in and around the deltas, estuaries, and creeks prone to tidal influences (delta or tidal forests).
- Littoral (relating to or on the shore of the sea or a lake) forests occur at several places along the coast.
- They grow Pnuematophores which are the aerial roots to breathe directly from the air.
- Stilt Root System: To support and accommodate varying water levels. TheyImpermeable roots so that they will not easily let salts from water.
- Buyont Seeds that float and spread widely and easily in water.
- Controlled opening of stomata.
- Regions: Sundarbans (West Bengal), Mahanadi delta and Bhitarkanika, the Koringa Mangroves, Krishna Godavari Delta, Cavery Delta (Picchavaram Mangrove in the north, and Muthupet Mangroves in the South), Vembanad Lake, Kundhapur, Goa, Ratnagiri, Gulf of Kutch, Andaman & Nicobar, etc.
- ***Importance/Significance of Mangroves:***
- a. Provide habitats to various species of the coastal regions- Huge biodiversity.
- b. They provide barriers against the waves, impacts of cyclones, and tsunamis.
- c. Prevets coastal erosion.
- d. Source of timber and tourism, fisheries.
- e. Honey collection.
- ***Reasons behind the depletion of the mangrove vegetation:***
- a. Overexploitation for wood and timber.
- b. Urbanization and coastal encroachments.
- c. Changes in water levels of rivers due to damns and irrigation- will impact the salinity, and sedimentation will increase.
- d. Pollution along the coastal regions due to the discharge of plastic wastes, thermal water from power plants, sewage, and oil spills.
- e. Climate change- It is causing ocean acidification, ocean warming, and rising sea levels.
- Trees: Sundari, Brugeuiera, Sonneratia, Agar, etc.

Agriculture:(03:04:00 PM)

- ***World's Agriculture Types:***
-

Tropical Types ***Temperate Types***

High rainfall and high temperature.	Precipitation is variable, with lower temperatures.
The population is high with High density.	Lower population.
Developing countries	Developed- So high investments, mechanization,
Types of Agriculture: a. Nomadic herders b. Shifting cultivation c. Intensive subsistence cultivation d. Plantation	Types of Agriculture: a. Mediterranean type, b. Extensive Commercial c. Extensive Commercial Livestock ranching d. Mixed Farming e. Dairy farming, f. Truck farming.

- Tropical region agriculture:
- ***a. Nomadic Harding:***
- It is a primitive and simplest form of pastoralism.
- Depends on animals rather than crops for milk, meat, skin, wool, etc.
- Animals- Sheep, camels, horses, Yalk & Lamma, etc.
- Transhumance- It is the movement of people along with their animals.
- In India for example, Bakrwalas, Gaddis, the Tharus, Gujjars, etc practice transhumance.
- ***b. Shifting Cultivation:***
- It is also called Slash & Burn or Jhum cultivation.
- A particular patch of forest is cut down and burned and primitive agriculture is done for 2-3 years after which the next patch is selected leaving the previous one uncultivated.
- It requires a large area of forest and the land is owned by the community as a whole.
- Regions: Amazon basin, Parts of Venezuela, Mexico, Congo Basin, Sout east Asia, North East India, Sri Lanka, Etc.

Intensive Subsistence Agriculture:(03:29:00 PM)

- It is practiced in areas where the land is small and fragmented.
- Population density is high.
- Multiple crops per year are grown.
- They are dominated by rice cultivation.
- Per Hectare output is very high but per capita, the output is very low.
- Dominated by manual labor, mostly family members are involved.
- regions: South Aisa, deltas of Ganga -Brahmaputra, Indo-China, and eastern China, Korea, Japan, etc.

Plantation Agriculture:(03:35:00 PM)

- They are dominated by large estates.
- Require high capital and high centralization.
- The crops are export-oriented.
- Require manual labor.
- But they are scientifically managed- which means using advanced input, fertilizer, breeding, etc
- Regions and crops:
- Malaysia- Rubber Plantation,
- Indonesia- Sugarcane.
- Fiji- Sugarcane
- India- Coffee & Tea,
- Sri Lanka -Tea,
- West Africa - Coffee & Cocoa,
- West Indies- Banana & Sugarcane.

Temperate Region Agriculture:(03:42:00 PM)

- ***1. Mediterranean type:***
- Rainfall in winters
- Citrus crops like oranges, grapes(Viticulture), and dry fruits.
- ***2. Extensive Commercial Agriculture:***
- It is the opposite of Intensive Subsistence Agriculture.
- Dominated by wheat monoculture.
- Vast extensive and fertile lands are available- Temperate grasslands.
- Large Size of the farm.
- Very low population density.
- Known for large-scale mechanization and scientifically managed.

- Per hectare output is less but per capita output is very high.
- Regions- Prairies of North America, Pampas in South America(Argentina),
- Steppes of Eastern Europe (Ukraine), Velds of South Africa, and Downs of Australia.
- ***3. Extensive Commercial Livestock Ranching:***
- It is the opposite of nomadic herding.
- It involves the commercial raising of livestock over extensive lands.
- Animals- Sheep, Cattle, goats, horses, etc.
- Follow scientific methods of breeding.
- The ranches are very larges with continuous vegetation cover and are managed on a scientific basis.
- They are generally found on the western side of the Extensive Commercial Agriculture areas.
- ***4. Mixed Farming:***
- It is the combination of agriculture and livestock.
- The crops grown are useful for both humans and livestock like maize and corn.
- It requires high expenditure but gives high returns.
- They are generally found on the eastern side of the Prairies, Western Europe, Northeast Argentina, and south-eat Australia.
- ***5. Commercial Dairy Farming:***
- Commercially raising cows for milk and milk products.
- Western Europe, New Zealand, Australia, Northeast USA, Eastern Argentina, etc.
- It requires high capital, is labor intensive, and has high productivity.
- ***6. Truck Farming:***
- Also called Market gardening or factory farming.
- It is growing fruits and vegetables.
- Near urban areas.
- Perishable foods can be transported overnight in trucks.
- Regions: Northwest Europe, North East USA, and other major urban centers.

Topics for the next class: India's agriculture.

Geography Class 43

A Brief Overview of the Previous Class:(01:11:00 PM)

Indian Agriculture:(01:14:00 PM)

- ***Land Use Categories in India:***
- *1. Forest Area:* The area under the forest coverage.
- *2. Area Under Non-Agricultural Use:* Used for human settlements, infrastructure, etc.
- *3. Barren & Waste Land:* The land which can not be brought under cultivation with presently available technology. For example, Chambal Ravines, deserts, etc.
- *4. The area under Permanent Pastures & Tree Crops:* These are commonly owned.
- *5. Net Sown Area:* The area under cultivation in the present year.
- Gross cropped area is the total area under cultivation with the area which is sown multiple times accounted for multiple times.
- *6. Current Follow Area:* which is not been cultivated for the last year.
- *7. Follow other than Current Follow:* It is not cultivated for more than one year but less than five years.
- *8. Culturable Wasteland:* It is not cultivated for more than five years.
- ***Areawise order:***
- Net sown area (Slightly increased)> Forest(Increased)> Area Under Non-Agricultural Use(Increased)> Barren & Waste Land(Decreased).
- The current follow increased slightly due to *agricultural* distress.
- Follow other than Current Follow -Decreased.

Green Revolution:(01:41:00 PM)

- ***Inputs:***
- a. High Yeilding Variety of Seeds: Fast growing, early maturity, Short bushes, High productivity.
- Issues: Require more water, nutrient-depleting, prone to pests and insects.
- b. Irrigation facilities, electricity.
- c. Fertilizers: Mainly chemical fertilizers to replenish nutrients and pesticides to control pests.
- d. Capital/Credit supports through bank loans.
- e. MSP and other Government support/policies to guarantee procurement of the produce.
- It was implemented in Three Phases:
- ***1. 1961 to 1968- Early Mature Programmes:***

- The government started IADP(Integrated Agriculture Development Programme) started in 8 districts of Punjab and Haryana.
- It was very successful.
- ***2. 1968- 1981- Mature phase:***
- All areas of Punjab, Haryana, and Western UP were included.
- farmers were trained and given support.
- By the end of this phase, we achieved self-sufficiency in food grains.
- In these two stages mainly wheat was the target.
- ***3. 1981-1992- The rice revolution:***
- In this Bihar, Adnhraparasedh, West Bengal, Andhra Pradesh, etc were targeted.
- Rice production increased by more than double.

Implications of Green Revolution:(02:02:00 PM)

- ***Positives:***
- Production increased tremendously.
- Productivity increased.
- Farmer's income increased.
- Commercial agriculture started in India.
- We were able to control large-scale famines and epidemics.
- Increase in rural employment.
- ***Negatives:***
- ***1. Ecological:***
- Increase in pollution of water & Soil, air.
- Overexploitation of groundwater.
- Negligence & extinction of local varieties.
- Land degradation due to salinization & chemical fertilizers.
- Soil Erosion.
- Deforestation.
- ***2. Economical:***
- Increased Agricultural expenditure.
- Increased burden on the government in terms of subsidies, MSP, etc.
- Focused only on a few crops.
- ***3. Social:***
- Increased inequalities among the states and within the states.
- Migration of agricultural laborers from UP Bihar to Punjab Haryana.
- The exploitation of farmers.
- Health impacts due to chemical fertilizers and pesticides, increased cancer cases, drug abuse, etc.

Cropping Seasons In India:(02:14:00 PM)

- ***1. Kharif Crops:***
- Sown in June -July and harvested in September and October.
- Require more temperature and more precipitation.
- Examples, Rice, jute, sugarcane, cotton, pulses, millet, etc.
- ***2. Rabi Crops:***
- Sown in October-November and harvested in March-April.
- They require low temperatures and low precipitation.
- Examples, are wheat, Barley, Gram, Mustard, Potatoes, etc.
- ***3. Zaid Crops:***
- They are produced in between both the above seasons.
- They are mainly fruits and vegetables, oil seeds, etc.

Cropping Conditions:(02:35:00 PM)

- Each crop requires a specific temperature, soil type, precipitation, etc.
-

Temperature	Crops
>25 degrees	Rice, Jute, Coffe, Rubber,
20 - 25 degrees	Sugarcane, pulses, cotton, maize, and all other oil seeds except sunflower.
15-20 degrees	Mustard
< 15 degrees	Wheat

Precipitation*:*

-

Precipitation	Crops
150 to 200 cm	Rice, coffee, Jute, rubber.
100-150 cm	Sugarcane,
75-100 cm	Wheat, Maize
<75 cm	Pulses, oil seeds, cotton

Soil Types:

- Alluvial Soil: Rice, wheat, jute, sugarcane, cotton, etc.
- Black Soil: Cotton, oil seeds, tobacco, sugarcane, Citrus fruits, etc.
- Laterite soil: Cashewnust, rubber, tea, coffee, spices, etc.
- Red Soil: Ground nut, potato, tobacco, millet, etc.

Rice & Wheat Regions:(02:57:00 PM)

- The regions include Punjab Haryana, UP, and Bihar.
- Rice in summer and wheat in winter.
- High demand for both rice and wheat.
- The presence of alluvial soil is good for both.
- Presence of irrigation facilities.
- Government support in the form of MSP gives good profit.
- ***Issues***:
- Both are water-intensive, and nutrient-intensive so deplete nutrients of soil at a faster rate.
- Both are labor-intensive and energy intensive.
- Both cause stubble burnings-pollution.
- ***Millets:***
- Bajra, Jowar, and Ragi.
-

Factors	Bajra(Peal Millet)	Jowar(Sorghum)	Ragi(Finger Millet)
Temperature	30	inbetween	20
Precipitation	50 cm	inbetween	100 cm

Distribution of Tea, Coffee & Rubber:(03:18:00 PM)

- ***Tea***:
- The main tea-growing regions are in the Northeast (including Assam) and north Bengal (Darjeeling district and the Dooars region).
  Tea is also grown on a large scale in the Nilgiris in south India.
- ***Coffee***:
- Arabica & Robusta are major varieties.
- Karnataka (54%), Kerala (19%), and Tamil Nadu (8%) are the largest coffee-producing states.
- India accounts for only 4-5% of the world's coffee output, but exports 70-80% of its produce.
- ***Rubber:***
- Southwest coast, primarily in Tamil Nadu's Kanyakumari District and Kerala.
- Also in Coastal Karnataka, Goa, Maharashtra's Konkan Region, coastal Andhra Pradesh and Orissa, the northeastern provinces, and the Andaman and Nicobar Islands, among other places.

Pulses and Oilseeds:(03:30:00 PM)

- India is the largest producer of pulses.
- Can be grown in any type of soil.
- Require very less water and inputs.
- Madhya Pradesh(largest producer), Rajasthan, Uttar Pradesh, Karnataka.
- Reasons for low pulses production:
- Reduction in cultivation area due to the green revolution.
- Higher MPS support for Rice & Wheat makes them more attractive to farmers.
- Now it is shifted to the southern area where it is rainfed.
- The low market price for the farmers- a large number of middlemen.
- Need for bringing new varieties of short duration that can be grown between Rabi and Kharif.
- Government can include pulses under PDS in all states.
- Market reforms for reducing middlemen.

- Need to promote private players and contract farming.
- ***Names of Pulses:***
- 1. Chickpea(Chana)- it gives Gram or Bengal Gram(chana daal).
- 2. Pigeon Pea- Arahar(Tur) daal.
- 3. Black Gram lentil(Urad)- Urad daal.
- 4. Lentil(Masoor dal)
- 5. Green Gram(Moong) - it gives Yellow lentil(Moong Daal)
- These 5 pulses are under the MSP.
- Kidney Beans- Rajma.
- Lobhia- Balck-eyed peas/ Cowpea.
- Horsegram.
- ***Oilseeds***:
- Any type of soil.
- Temperature 20 to 25 degrees.
- Precipitation is <75 cm.
- *Regions*:
- Rajasthan, MP(Largets), Karnataka, Gujarat, Andhra Pradesh.
- We import a huge amount of these:
- Sunflower from Ukraine & Argentina.
- Soya oil from Barzile.
- Import-export policies are very inconsistent, Sometimes it is cheaper to import than produce.
- *We require:*
- Better quality of seeds.
- Technology to increase yield.
- Awareness among the farmers.
- Micro-irrigation can increase the yield.
- Farmers should also have small-scale oil-producing plants to improve their income and profit.
- Some oilseeds that are untapped like cotton seeds, rice bran, etc should be tapped.
- The government has launched Integrated Scheme for oilseeds, oil palm, pulses, and maize development program(ISOPOM) to promote the production of oilseeds.

Practiced Drawing India's Map:(04:05:00 PM onwards)
Topics for the next class: Resources and their distribution.
Geography Class 44

A Brief Overview of the Previous Class: (01:10:00 PM)
Mineral & Resources:(01:16:00 PM)

- *(Explained with PPTs and Maps)*
- Minerals:
- Two types:
- *1. Metallic:*
- a. Ferrous: Example, Iron, Manganese, Nickle, etc.
- b. Non-Ferrous: Ex. Copper, Aluminium, etc
- *2. Non-Metallic:*
- a. Organic or Energy Minerals:
- Example, Coal & Petroleum.
- b. Inorganic Minerals:
- Examples, Mica, Graphite, Limestone, etc.
- ***1. Iron:***
- Ores of Irons:
- Magnetite(Best quality)- It is igneous.
- It is black.
- Haematite(Red), Limonite(Brown), and Siderite(Grey)- All three are sedimentary in nature.
- Distribution:
- North America(USA- Near great lake region, Appalachian Mountains, Labrador region in Canada, Newfoundland, etc.
- South America: Brazile, Peru, Chile, etc.
- Europe: Kiruna & Gallivare (Sweden), Bilbao (Spain)
- Africa: Bomi Hills(Liberia).
- Asia: Krivoy Rog, Kerch (Ukraine), Kuzbass, Magnitogorsk (Siberia), Manchuria (China)

- Australia: Iron Knob, Mount Goldsworthy.
- ***2. Manganese:***
- Ore is Pyrolusite.
- South America: Macapa, Minas Geraise (Brazil), Western Mato grasso.
- Africa: Zaire, Postmasberg (South Africa).
- Asia: Nikopol and Tokmak (Ukraine), Chiatura (Georgia), Urals

Copper:(01:40:00 PM)

- Ore: Chalcopyrite is major ore.
- Distribution:
- North America: Sudbury, Lynn lake (Canada)
- South America: Casapalco (Peru), Chuquicamata & San Jose (Chile).
- Africa: Katanga.
- Asia: Lake Balkhash (Russia), Ulanbatore (Mongolia)
- ***Bauxite:***
- It is an ore of Aluminum.
- North America: Alabama, Arkansas (USA),
- South America: Jamaica, Guyana, Surinam,
- Europe: France, Hungary,
- Africa: Guinea,
- Asia: Urals, Krasnaya (Russia),
- Australia: Weipa, Cape York, Darling Range.
- ***Gold & Silver:***
- North America: Yellow knife (Canada), California, Alaska (US)
- Africa: Witwatersrand (South Africa)
- Asia: Kolyma river, Lake Baikal,
- Australia: Kalgoorlie and Coolgardie.

Coal, Petroleum & Natural Gases:(01:58:00 PM)

- ***Coal:***
- *Anthracite*- It is the best quality coal.
- It has 85 to 95% carbon content.
- *Bituminous*- Between 45 to 85% Carbon content.
- *Lignite*- 38 to 45% carbon content.
- *Peat*- Less than 38% Carbon content and very high organic content.
- North America: Pennsylvania, Appalachian, Rockies, Mexican gulf (USA), Vancouver, Nova Scotia (Canada),
- South America: Santa Caterina (Brazil), Concepcion (Chile),
- Europe: Great Britain, Ruhr & Saar (Germany), Spain,
- Africa: Zambia, Zimbabwe, Enugu (Nigeria), Transvaal & Natal (South Africa),
- Asia: Donetz, Donbas, Moscow – Tula, Kuzbass, Urals, Lena (Russia), Shanzi, Shantung, Yunnan (China)
- Australia: Ipswich, New Castle.
- ***Petroleum:***
- North America: Gulf coast, Appalachian, California, Alaska (USA), Prairies, Edmonton, Calgary (Canada),
- South America: Maracaibo, Orinoco basin (Venezuela), Magdalena (Columbia), Punta Arenas (Chile), Falkland,
- Europe: North Sea, Norway,
- Africa: Algeria, Libya, Nigeria – Niger delta,
- Asia: Dhahran, Quatif (Saudi Arabia), Mosul, Kirkuk, Zubair (Iraq), Masjid Sulaiman (Iran), Kuwait, Bahrain, Qatar, Abudabhi (UAE); Baku (Azerbaijan), Urals, Caucasus, Caspian sea, NW Siberia, Sakhalin (Russia); Sumatra, Borneo (Indonesia); Brunei; Sarawak, Sabah(Malaysia), China
- ***Shale Gas:***
- China, Argentina, Algeria, USA, Canada, Mexico, Australia, South Africa, Russia, and Brazil.
- ***Uranium:***
- Australia, Canada, Kazakhstan, Russia, etc.

Resources In India:(02:24:00 PM)

- ***Rock formations in India:***
- ***a. Archaen Rocks:***
- These are the oldest rocks.

- It is the base of all the rocks, which is why it is called the fundamental complexity of the country.
- They are mainly made up of igneous and metamorphic rocks.
- They do not have any fossils in these rocks.
- There are no economically important minerals in these rocks.
- These are found on the surface in - Bundelkhand and Nilgiri.
- ***b. Dharwar Rocks:***
- These are the sedimentary deposition of the Archean rocks.
- These are the oldest sedimentary rocks of India.
- They have large quantities of Iron rocks.
- There are no fossils in these rocks.
- Found in Dharwar, Hospet, Kudermukh, and Bellary in Karnataka, Chota Nagpur Plateau, and Aravalis.
- ***c. Cudapah Rock Formation:***
- It is the result of the erosion of Dharwar and Archean rocks along the basins of the surrounding region.
- Limestone, Dolomite, and Glass making sand are found in these rocks.
- ***d. Vindhyan Rock Formation:***
- These are the result of the block mountain formations.
- We find different layers of sandstone and limestones, and Diamonds(Panna and Golconda).
- ***e. Gondwana Rocks:***
- After the formation of Vindhyas.
- They were formed during the carboniferous period.
- Found along the major rift valleys like Damodar, Godavari, etc.
- ***f. Deccan Traps:***
- These were formed due to the spreading of magma from the irruption of the Reunion Hotpot.
- The magma followed a step-like topography.
- It is very rich in black soil.
- Black soil is a very good aquifer.
- No metallic minerals in this region.
- ***g. Tertiary Rocks:***
- They were formed due to the formation of the Himalayas.
- No metallic minerlas.
- There are few sources of limestone present in these regions.
- ***h. The Ganga plains or Quartenery Rocks:***
- Made up of sediments from rivers.
- Has alluvial soil, very fertile.
- No metallic minerals in these rocks.

Iron & Manganese:(02:44:00 PM)

- ***Iron:***
- Odisha: Gurumahisani, Sulepat, and Badam Pahar in Mayurbhanj district; Baramjader group extended in Keonjhar and Sundargarh districts.
- Singhbhum district of Jharkhand,
- Bailadilla of Bastar district in Chhattisgarh;
- Sandor Hills at Bellary - Hospet region and Bababudan Hills at Chikmanglur district in Karnataka;
- ***Manganese:***
- Keonjhar and Koraput region in Orissa,
- Balaghat and Chindwara in Madhya Pradesh,
- Nagpur and Bhandara in Maharashtra,
- Panchamahal in Gujarat,
- Vishakhapattinam and Srikakulam in Andhra Pradesh,
- Singhbhum in Jharkhand,
- Udaipur and Banswara in Rajasthan.

Coal & Petroleum:(02:54:00 PM)

- ***Coal:***
- The main regions of Gondwana rocks are found in West Bengal, Jharkhand, and Orissa from where 76% of the total coal production is found.
- The first effort made to extract coal with modern technology in India was at the Raniganj coal region in West Bengal.

- Raniganj area of West Bengal, located in the upper valley of the Damodar river, is the most important and largest coal area in India.
- Good quality Bituminous coal is found in Jhariya, Bokaro, Giridih, Karanpura, Ramgarh, etc. of Jharkhand.
- Tatapani-Ramkola of Chhattisgarh.
- Talchar- coal area of Orissa (Brahmani river valley)
- Singreni coal areas (Krishna Godavari river valley) of Andhra Pradesh are other major and important areas of coal.
- Tertiary coal is found in Neyveli (Tamil Nadu, famous for Lignite) and Palana (Rajasthan).
- ***Petroleum & Natural Gas:***
- Assam region: Digboi, Naharkatiya, Hagriyan-Moran, and Surma river valley. Natural gas is also found in the Bagrijan-Moran area.
- Gujarat region: Khambakt and Ankleshwar while oil regions are extended up to Navgaon, Kosamba, Olpad, Dholka, Mehsana, Kalal, etc.
- Mumbai High region, 176 km away from the Mumbai coast,
- Region off-shore in Krishna - Godavari river valley.
- ***Shale Gas:***
- Cambay Basin.
- Ganga Basin
- Assam-Arakan Basin
- Damodar or Gondwana Basin
- Krishna-Godavari Basin.
- Cauvery Basin.

***Issues Related to Mining*:(03:22:00 PM)**

- ***1. Environmental Issues:***
- a. Pollutions:
- Air Pollution: Large-scale dust particles are generated due to Open cast mining.
- Water Pollution due to leaching, seepage, and disturbance of groundwater aquifers.
- Soil pollution due to chemicals usage, and soil erosion.
- b. Large-scale Deforestation and Land degradation: Example, Kudremukh hills.
- c. Habitat loss.
- ***2. Social Issues:***
- a. Displacement of tribal communities and people on large scale.
- b. Migration of people.
- c. health issues associated with life and threat to life.
- The exploitation of labor.
- ***3. Technological Issues:***
- a. Old and outdated methods of mining.
- b. High wastage.
- c. Lack of proper treatment of wastages.
- ***4. Administrative Issues:***
- a. Illegal Mining- Economic loss, loss of revenue for the government, damage to infrastructure.
- b. Threat to human life due to illegal mining, ex rat hole mining in Meghalaya.
- c. Lack of clear and transparent government policies.
- ***Coal Mining Issues in India:***
- a. Unevenly distributed.
- b. The cost of coal extraction is higher due to inefficient techniques.
- c. Lack of high-quality coal.
- d. A large quantity is of Bituminous type which has high ash content.
- e. Open caste mining causes air pollution, land degradation, etc.
- ***Shale Gas Extraction Issues:***
- Water-intensive extractions.
- Disposal of water used is a challenge as it is chemical-laden water.
- Require a larger area for extraction.
- Disturbs the rock's layers.
- Water pumping may disturb the groundwater aquifers.
- Health issues for the miners.
- Major Vs Minor Minerals in India.
- (Refer to the handouts)

Manufacturing Industries*:*(03:45:00 PM)

- It is the production of identical goods on large scale using raw materials, machinery, power, and specialized labor in the factory setting.
- It produces standardized commodities.
- ***Factors required to set up an industry or locational Factors:***
- ***a. Raw materials:***
- It should be easily and cheaply available.
- Easy to transport.
- They can be:
- Weight Losing Raw Material: Example, Sugarcane
- Non-Weight Losing: Example, Cotton.
- Reusable & Non-Perishable.
- ***b. Labour:***
- Available.
- Skilled labor.
- Cheaply available.
- ***c. Market:***
- Distance of market from raw materials.
- Size of the market and demand.
- Competition in the market.
- ***d. Infrastructure:***
- Well connected.
- Multimodel transport.
- Cheaper transport facilities.
- ***e. Power:***
- Regularly available.
- Cost of power supply.
- Hydropower is the cheapest source.
- ***f. Capital:***
- Investors.
- ***g. Government Policies:***
- Tax benefits, subsidies, export-import policies, cheap land availability, etc.

***Common framework* (04:03:00 PM):**

- ***Common framework:***
- Significance:
- Locational Factors:
- Distribution with a Map.
- **Problems:**
- Recent Government Initiatives for the industry.
- ***Footloose Industry:*** An industry that is not dependent on specific raw materials or can be obtained anywhere is called a footloose industry.
- government policy is a major factor in the growth of this industry.
- For example, the IT industry.
- ***Cotton Textile Industry:***
- Significance: It is the largest agro-based industry.
- Three types: Hand Looms Power Looms and Mills.
- ***Factors:***
- Raw materials:
- Black soil areas.
- Easy to transport.
- As it is non with losing: It can be set up anywhere.
- Labour is available.
- The market is huge all over India.
- Better transport infrastructure is needed.
- ***Distribution:***
- Bombay Spinning and Wining Company, Bombay, and Madras.
- After Independence: Cotton-producing areas went to Pakistan.
- Bombay is called the Cottonopolice of India.

- Ahemdabad- the Manchester of India.
- Pune, Surat, Vadodara, etc.
- Then later it shifted to:
- Banglore, Coimbatore(Manchester of South India), Chennai regions, Madurai, Salem, etc.
- Second shift happened in North India:
- Huge market, alluvial soil, cheap labor, port facilities in Kolkata, etc.
- Kanpur, Agra, Mathura, Banaras, Bhopal, etc.
- ***Issues:***
- Poor quality of raw material.
- Fluctatuion in supply.
- Technology is very old.
- Competition from Bangladesh, Vietnam, etc.
- Best Cotton is produced in China, the USA, Uzbekistan, and Egypt.
- Power supply: Both regularity and availability are the main issues.

Topics for the next class: Continuation of the Industries.

Geography Class 45

A Brief Overview of the Previous Class:(01:15:00 PM)

Jute Textile Industry:(01:26:00 PM)

- *(Explained with Maps and PPTs)*
- ***Significance:***
- Jute is known as the 'Golden fiber'.
- Jute products are environmentally friendly, and an alternative to plastics.
- It is also used in many soil erosion control measures.
- ***Location Factor:***
- a. Raw material- Jute.
- High temperature & High Precipitation is required.
- A good quantity of water is required.
- Soil- Alluvial soil is best suited.
- Requires high humidity.
- The best-suited region is the delta region- Ganga Brahmaputra delta, Godavari-Krishna Delta, etc.
- b. Labour intensive- Requires cheap labor.
- c. Regular & cheap power.
- ***Distribution:***
- Delta Regions- In west Bengal.
- The first jute mill was set up in Rishra in 1855.
- Major quantity and better quality jute supplies were from the present-day Bangladesh region.
- Right now 90% of Jute mills in India are situated in West Bengal ANd Assam region- Kolkata, Howrah, Serampur, Rishra, etc.
- Gradually it was distributed in three directions: Towards Andhra Pradesh(Rice packaging), Madhya Pradesh(Cement packaging), and UP-Bihar(Sugar Packaging).
- ***Issues Faced:***
- a. Water intensive.
- b. The availability of jute is not regular.
- c. The quality of jute compared to Bangladesh is poorer.
- d. Competition from Bangladesh and cheap synthetic materials like plastics.
- e. Very strong labor unionism- Frequent strikes and lockouts.
- f. Technology is outdated.
- The government enacted Jute Packaging Material Act 1987: Under this Act, the central government decided the percentage of the packaging to be done using jute bags.

Silk Textile Industry:(01:45:00 PM)

- *(Explained with Maps and PPTs)*
- ***Significance:***
- Traditionally India was one of the suppliers of silk and was the part of Silk Route.
- India is the only country with all 5 varieties of silk.
- Sericulture is the method of cultivation and production of Silk.
- India has 2nd largest silk textile industry in the world.
- Highly labor intensive- Employment in rural areas and mainly women.
- An additional source of income for the farmers.

- It can utilize non-arable land also.
- ***Location Factors:***
- The raw material is most important- Sericulture.
- Labour intensive- Cheap and skilled.
- Government Support- for sericulture activities plays an important role.
- ***Distribution:***
- a. Mulberry Silk- In Karnataka(the highest producer), Andhra Pradesh, and Telangana- More than 50% comes from here.
- Types of Silk: Kanchi, Mysore, Thanjavur, Anantapur, Kurnool, Hyderabad, etc.
- b. Erie Silk: Also known as Ahimsa silk.
- West Bengal- 24 Parganas, Kolkata.
- c. Munga Silk of Assam- Also known as the Golden Silk.
- d. Tasar Silk:
- Oak Tasar in UP Bihar.
- Tropical Tasar in Orissa, Jharkhand, and Bihar.
- ***Problems:***
- Raw material**:** Irregular availability.
- Market- Tough competition from China, Japan, and Italy.
- Also competition from artificial silk.
- Lack of government support for the sericulture farmers.

Sugar Industry:(02:03:00 PM)

- *(Explained with Maps and PPTs)*
- ***Significance:***
- 2nd the largest agro-based industry in India.
- **Locational Factor:**
- Raw material:
- Hig precipitation, alluvial soil.
- Weight-losing and Perishable raw material- It has to be crushed within 24 hours(Crushing period).
- Too bulky to transport.
- ***Distribution:***
- ***a. North:***
- Punjab, Haryana, UP, and Bihar.
- Reasons: Alluvial soil, Good irrigation facilities, Favourable climatic conditions.
- Good capital is available for sugar mills.
- UP - Saharanpur, Meerut, Faizabad, Sitapur,
- Bihar- Chnaparamn ,Muzzafarpur,
- Haryana- Karnal, Ambala,
- Punjab- Jalandhar, Patiala, etc.
- ***b. South:***
- The sucrose content in the sugarcane cultivated in the south region is very high because of humidity due to the nearness of the sea.
- Black soil is also very good.
- Development of irrigation facility.
- Prot facilities for the export of sugar.
- It has a longer crushing period than northern sugarcane.
- Sugar mills are run by cooperatives- beneficial and well-managed
- Per hectare production is more in southern regions.
- Maharashtra- Pune, Nashik, Kolhapur, etc
- Karnataka- Belgaum, Mandya,
- Tamil Nadu- Trichi, Salem,
- Andhra Pradesh & Telangana- Krishna-Godavari belt.
- The southern belt produces more than 50% of India's sugar.
- ***Problems:***
- a. Per hectare production is lesser than the world average because we don't have a plantation type of cultivation of sugarcane.
- b. Production functions because of monsoon dependency and poor irrigation.
- c. Prices are not free, they are decided by the government.
- d. local competition from Gur and Khandsari in which wastages are higher.

- e. Fair & Remunerative prices(FRP) are less.

***Iron & Steel Industry*:(02:24:00 PM)**

- *(Explained with Maps and PPTs)*
- ***Significance:***
- It is the basis for all other industries.
- ***Locational Factors:***
- a. Raw materials availability-
- Iron ore and coal in equal quantities.
- Limestone and Manganese are also required.
- Water is required in large quantities for cooling purposes.
- These are weight-losing materials- 2/3rd of the weight of all the raw materials is lost when steel is produced.
- b. Labor- Should be abundant, skilled, and cheap.
- c. Power supply- Continous supply at affordable prices is a must.
- d. Infrastructure- Good transportation of raw materials and finished goods.
- Transportation is required Bidirectional relationship between iron & coal.
- ***Distribution***:
- a. Eastern Belt:
- Because Iron, coal, and Maganese are available.
- b. Karnataka region.
- *Integrated Steel Plants:*
- Bhilai (with erstwhile USSR technical and financial support),
- Rourkela (with German assistance) and
- Durgapur (with U.K assistance)
- The Burnpur Steel Plant
- Bokaro steel plant was started
- Salem Iron and Steel Plant in Tamil Nadu
- Vizag Iron and Steel Plant in Andhra Pradesh
- Vijayanagar Iron and Steel Plant
- Visweswaraya Iron and Steel, etc.
- ***At World Level:***
- Great Lake Area of the USA- Pittsburg area.
- Russia & Ukraine area.
- Germany- Ruhr valley.
- The Uk, and France & Belgium.
- Asia:
- China is the largest producer in Asia.
- They import iron ore from India.
- Japan- Very high-quality steel.
- They have neither iron ore nor coal.
- ***Mini Steel Plants:***
- These are small-scale steel pants established near urban areas.
- They are based on scrap iron and don't require iron ore.
- They have a short gestation period.
- They require small capital investment and fulfill the local demand.
- ***Problems of Mini Steel Plants:***
- a. Shortage of scrap iron is a major issue.
- b. Waste segregation is minimum and collection is mostly unorganized.
- c. they are dependent on the government's power supply- face a shortage of power.
- ***Problems associated with the overall Iron & Still Industry:***
- a. Old and outdated technology- Poor efficiency
- b. Requires huge investments.
- c. Power availability.
- d. Competition from foreign suppliers.
- e. Environment pollution issues.

***Cement Industry & Fertiliser Industry*(02:55:00 PM)**

- *(Explained with Maps and PPTs)*
- ***Raw Materials for cement:***

- a. Limestone- Cudappah region Andhra Pradesh, Vindhayn rock formation, Dun Valley, and Pir Panjal.
- b. Coal- Tertiary and quarternary rocks.
- c. Gypsum- Rajasthan.
- It can also be produced from sea shells- in Gujarat & Maharashtra.
- Slag from Iron & Steel and Sludge from fertilizer plants are also good sources of Gypsum.
- ***Raw Materials for Fertiliser Industry:***
- a. Nitrogenous Fertilisers are produced from Naptha and Ammonium Sulfate
- Naptha:
- It is a mixture of hydrocarbons and is the byproduct of the petroleum refinery industry and is also imported.
- Ammonium Sulfate- Gujarat, Rajasthan, etc.
- b. Phosphatic Fertilisers Uses - Rock phosphate- Rajasthan, Gujarat, + imported.
- c. Sulfurous fertilizer is produced from Sulfuric acid.
- We are not self-sufficient in fertilizers and are majorly imported.

Transportation:(03:23:00 PM)

	Roadways	***Railways***	***Inland***	***Airways***
Advantages	a. Last mile connectivity including the difficult terrains. b. It supports all other transport means. c. Gives more choice and freedom for individuals.	a. Cheaper and comfortable for long journeys. b. It supports tourism. c. Supports industries for the transport of heavy and bulk materials. d. Employment. e. Relatively eco-friendly and comparatively safer.	a. Cheapest as naturally available. b. Eco-friendly. c. Best suited for bulky & non-perishable goods. d. industrial growth.	a. Fastest b. It supports tourism and is required in emergencies, distastes, defense, security, etc. c. Good for the transport of perishable goods.
Negatives:	a. Requires regular maintenance. b. Higher chances of accidents. c. Higher pollution.	a. High investments. b. High cost of maintenance. c. Not for difficult terrains & requires the support of roadways.	a. Not for perishable goods as it is slower. b. Many of the rivers have seasonal flow, c. water diversion for dams, and irrigation projects reduce water flow. d. Not all channels are navigable. e. Requires regular de-siltation. e. Neglected by the governments.	a. Costly. b. requires other modes as support.

Population Geography:(03:42:00 PM)

- ***Population:***
- it is the total number of individuals of a species living defined area at a given point in time.
- ***Population Density:*** It is also called Crude Density.
- PD= Population/Area.
- Agricultural Density(AD):
- AD= Agricultural Population/ Total agricultural area.
- ***Population Growth:***
- Natural Growth Rate(NGR): [(Total Birth- Total Deaths)/Total Population]*1000.
- ***Birth Rate(BR):***
- BR= *(*Number of live births/Total Population)*1000.
- ***Fertility Rate(FR):***
- FR= [Number of live children between 0-4 years if age/ Female population in fertility period(15-49 years)]*1000.
- ***Replacement Level Fertility:***
- It is the fertility rate required for a generation to replace itself.
- It is the average number of children a would need to have to reproduce herself by bearing a daughter who survives to childbearing age so that each generation exactly replaces itself without considering migration.
- It is generally taken as 2.1
- ***Death Rate:***

- BR= *(*Number of deaths/Total Population)*1000.
- ***Infant Mortality Rate(IMR):***
- *IMR= (*Number of deaths between 0 to 1 year/Total Live Births)*1000.
- ***Maternal Mortality Rate(MMR):***
- MMR=(Number of Deaths of women giving births/ Total live births)* 100000.
- ***Migration:***
- Change of residence for a substantial duration of time is called Migration.
- ***Causes:***
- a. Pull Factor: Better education and a better lifestyle, economic opportunity in the destination.
- b. Push Factor: War, epidemics, conflicts, and the low opportunity at the original residence.
- ***Types:***
- *1. Internal:*
- a. Rural to Urban.
- b. Urban to urban.
- c. Urban to rural.
- d. Rural to rural- This is the highest and has women migration due to marriage as the largest component.
- *2. Internation Migration.*

Population Pyramids:(04:11:00 PM)

- *(Explained with PPTs)*
- ***1. Progressive Pyramid:***
- Where there is a higher youth population.
- Poor and developing countries including India, China, etc.
- ***2. Stationary Pyramid:***
- The number of youth is almost stagnant.
- NGR is almost 2.1.
- Developed countries.
- ***3. Regressive of Contracting Pyramid:***
- Where the number of youth is lower.
- NGR is less than 2.1.
- For example, Japan.
- Declining population.
- Demographic transition theory explains the relationship between economic development and population change in countries.

The Syllabus of Geography is Over.