S1 Origin of earth

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Geography

Geography began in Egypt (gift of Nile), first term coined was delta made by river and having triangular shape

1) Physical Geo :	Geomorphology, Climatology, Oceanography
2) Indian Geo :	Physiography, River System, Biogeography, Economic and Human geography.

Geomorphology:

1) Formation of earth
2) Earth interiors and rocks
3) Origin of continent and ocean
4) Continent drift theory
5) Sea Shore Theory
6) Convection Current Theory
7) Endogenic vs Exogenic

Geocentric Model :

- Earth at center of universe. Heliocentric Model : Sun at centre of universe

Universe :

- Comprise of all things from Planet, Satellite,Sun, Solar System, Milky Way (galaxy), etc.
- Observable (8cm disk) Whole (97 km disk, or much more)

Gaseous hypothesis of Immanuel Kant : 1755

- Primordial dust (there from beginning) Solar Nebula -> Fission of Hydrogen atom, Gravity pull -> converted to disk like structure with sun at centre.(Flattening occurred due to sun gravitational pull) -> Spin induced with inc in speed because of conservation of momentum. - > rings separated from disc (bc of centrifugal force) - > Dust rock accumulate and formed planets
- Limitation of Gaseous Hypothesis : Only solar system not universe, No explanation of formation of primordial matter, Couldn't elaborate spin induced.

Theory of Expanding Universe : Edwin Hubble : 1929

- Objects in the universe are Moving away from each other.

Big Bang Theory : Georges Lemaitre : 1931

- : Extrapolation of expanding theory : Implies that objects were much closer an external force is pushing them away. -> Lead to Big Bang theory
- (13.7 Billion years ago)
- Flow -> Singularity (initial entire mass in very small size) High temp, density and Pressure ->Explosion -> Material moved outwards with very high speed -> Energy converted into subatomic particles -> formation of Hydrogen -> Fusion and formation of mass

Earth Rotation :

- 23H, 56M, 4.09S, West to east, Counter clockwise, 1038 miles/hour at equator and 0 at poles.
- Sun to earth : 93 Million miles +- 3 million miles, complete in one year, in counter clockwise direction in elliptical orbit.
Aphelion :	farthest to sun (152 mil Km).
Perihelion :	closest to sun (147 mil Km).

Goldilocks Zone : Ideal distance from star to support life and water can exist in liquid state. earth lies in Goldilocks zone.

S2 Earth

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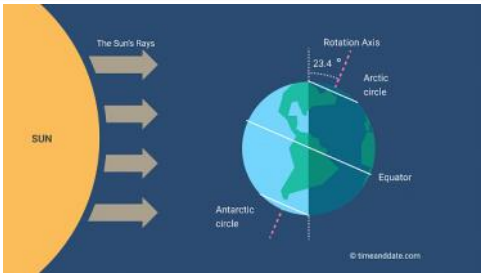
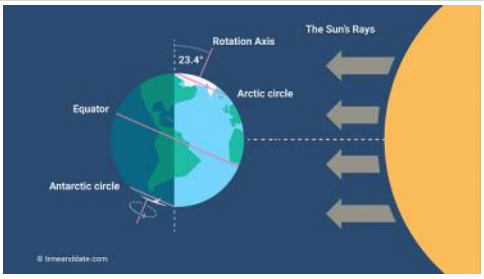
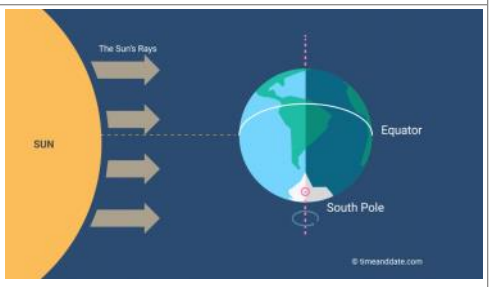
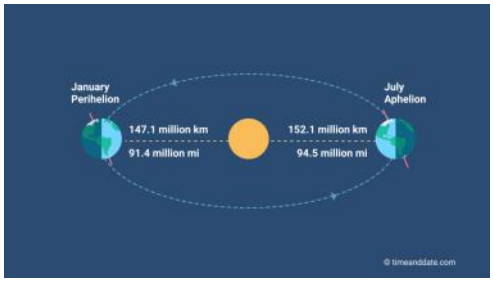
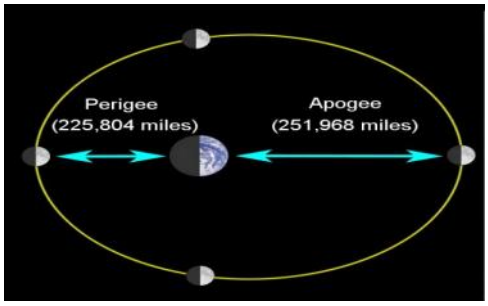
Earth :

1) titled at angle of 23.5* from vertical : various region experience diff season
2) Orbit is elliptical
3) Plane revolve and rotate in anti-clockwise direction
4) Shape of earth is Geoidal : budge at equator

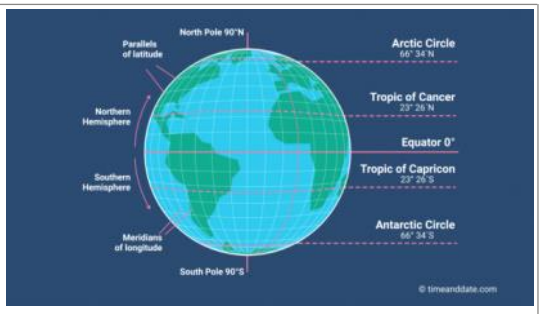
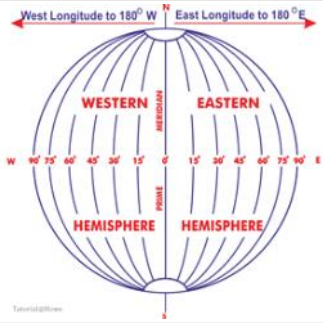
Oct - Feb (Solstice) :	• North Hemisphere away from sun, NH short days long night, Winter. • Arctic under permanent darkness, Antarctica continuous day. • Max in 22nd December. • NH -> Winter solstice, Longest Night. • SH -> Summer solstice, Longest Day	
April - Aug (Solstice) :	• NH toward sun, Longer days shorter night, Summer in the NH, • Arctic circle continuous day. • Max on 22nd June • NH -> Summer Solstice. • SH -> Winter Solstice	
Equinox	• Equal duration of Daytime and night time • March Equinox : 21st march • September equinox : 23rd Sep	

Climate :	Avg weather over 20 years.
Season :	Climatic condition over 2 month.
Weather :	Day to day atmospheric condition.

Aphelion : Perihelion :	• Farthest from sun (152 Million Km) • 4th July • Closet from sun (147 Million Km) • 3rd January	

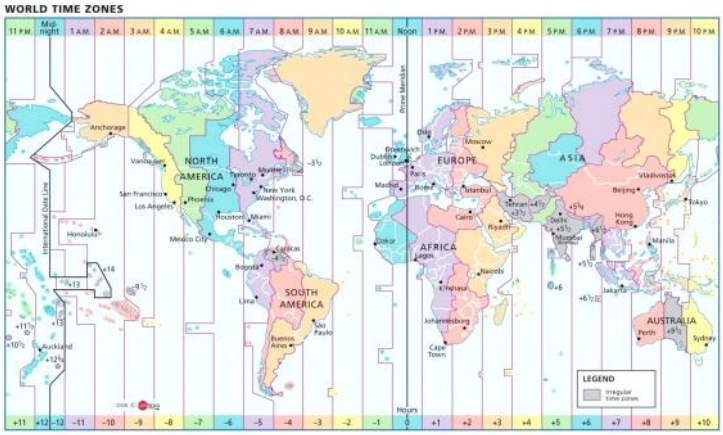
Apogee Perigee		

Most of the Satellite launch from equator -> speed of rotation is max at equator, adds up to rocker and help attain escape velocity.

Latitude :	• Started by sailors. • Horizontal, parallel. equator, • Latitude angle from equator, 0* at equator, Ex- 40*N. • **Tropic of Cancer :** vertical position of sun on 21st jun. • **Equator :** vertical at equinox. • **Tropic of Capricorn :** 22nd Dec solstice	
Longitude :	• For reference time, Vertical, crosses each other. • Divides in Western and eastern hemisphere. • Ex : 40*W. Places east to prime means time is ahead, sun rises early • 1) **Prime Meridian 0***: Longitude passing through Royal observatory in London Greenwich • 2) **Anti Meridian 180*** : Opposite of prime meridian	

GMT :

- Greenwich Meridian time : reference time
- IDL : International Date Line : Imaginary line separating / demarcates one date to the nest. lies toward Anti Meridian. Not straight line.
- Cross IDL west to east, we subtract a day



Tidal locking :

- same face of moon is seen because of high earth gravity.
- 1 rotation = 1 revolution.

Milankovitch cycle : Milutin Milankovitch :

- Ice Ages Cycle over millions of years
- Reason

Eccentricity -	Orbit changes b/c of pull by Jupiter, from circular to elliptical Every 100,000 years, distance from sun changes heat and cooling.
Obliquity :	Axial tilt changes to 21.5 to 24.5, happens every 26,000 years. affect cooling of polar region
Precession :	Wobbling of the planet, Axial tilt changing 14,000 years

S3 Evolution of earth

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Mains Syllabus :	Structure of earth , basic feature of earth, Rock cycle

Formation of earth :

- Dust particle revolve around sun -> under influence of gravity -> Majority in similar direction. -> Particle Merge after (Collision + Gravity pull) and also produced heat -> Force of gravity increase -> more collision and heat -> formed PLANETESIMALS (Building block of planets)
- Plantesimals underwent collision -> generate heat and added rotation -> Proto-Earth (Molten mass rotating continuously forming circular shape) -> Liquid of different structure created layer
- Heaviest material iron and nickel formed core in middle, Lighter element formed crust

Giant Impact Hypothesis :

- Theia (large celestial object) -> hit molten earth -> Molten material splashes held by gravity merged to form moon.
- Moon is formed of lighter earth material.
- Evidence : Presence of external material in mantle (Sink part of Theia Rocks)

Evolution of earth :

- Large amount of gas was trapped along with very high heat. (Ex- Fe2O3 - > Molten Fe +O2)
- Phase of degasification : Volcanic Eruption : release heat and gases from interior atmosphere (CO2,NH3,CO,SO2, H2O Vapor)
- Phase of Torrential rains -> Formation of dust clouds -> Block sunlight -> aided cooling - > Condensation and Rain for 1000 years -> surface cool down.

Residual Heat :	Trapped heat in earth, in the interior of earth.
Geothermal Gradient :	Change in temp as we move inside earth.

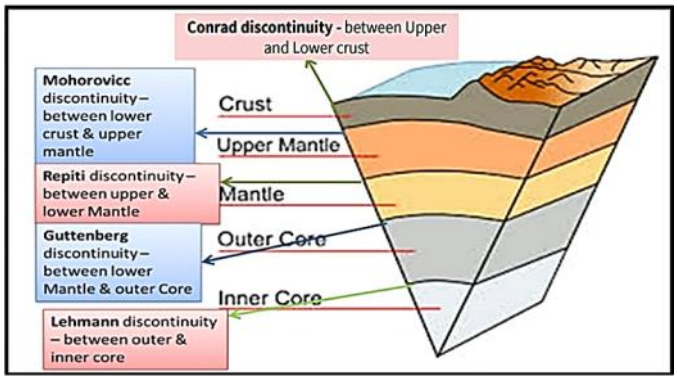
Life began in stable ocean :	Chemothesys (no photosynthesis)
Carbon Fertilization :	Accelerated growth of plants I excess CO2.

Highest	Himalayan peak : 8.8 km
Deepest	Mariana Trench : 11 km
Radius of earth :	6400 km
Earth is smooth in large perspective.	

Interior of Earth Source:

1) Direct sources :	• Volcanic eruption • mining • digging.
2) Indirect Sources :	• Study of earthquake (Seismic energy waves), • Asteroids and meteors (Astro-materials), • Gravitational and magnetic anomalies.

Crust :	**Brittle layer, Topmost layer.**
Moho layer :	Between crust and mantle
Mantle :	**Deformable layer, 68% of earth mass, 3.4g/cm3 higher than crust, Contains Asthenosphere**
Guttenberg layer :.	Between mantle and core
Core :	**• 2900km depth, 31% of earth, FeNi layer** **• Outer Core (Fe Ni) : Less pressure, Molten state** **• Inner core (Fe Ni): Pressure exerted is very high, Despite high temperature material remain in solid structure.**



Geomagnetism :

- Outer core Fe Ni at high temp, electron escape and start revolving with outer core and create magnetism.
- Magnetic field lines changes with time, recently in 2020. movement of chunks inside core.
Impact of geomagnetism :	• Protection from Charge particles from sun, • Auroras is formed by free radical creation in atmosphere. • NH -> northern lights (Aurora borealis) • SH -> southern lights (Aurora Australis).

Asthenosphere :

- Semi solid semi molten plastic state , between Upper mantle (solid) and Lower mantle.
- Presence of radioactive material Ur and K.
- Under high temp they undergo thermonuclear reaction -> under heat material melt partitional.

Discontinuity :

- with inc in depth, materials changes, pressure and temperature changes, density changes
- Earth : Fe>O>Mg>S>Ni>Ca>Al Earth Crust : O>Si>Al>Fe>Ca>Mg>Na>K

Continent Crust :	• 30 km (70 in Himalayan), • Granite Silica aluminium • light material density: 2.7gm/cm3
Ocean Crust :	• 10 km thin but high dense and heavy. • Mafic in nature • high material density 3 gm/cm3

S4 Geology

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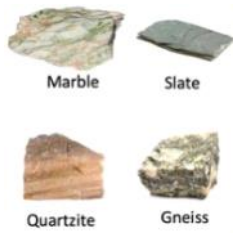
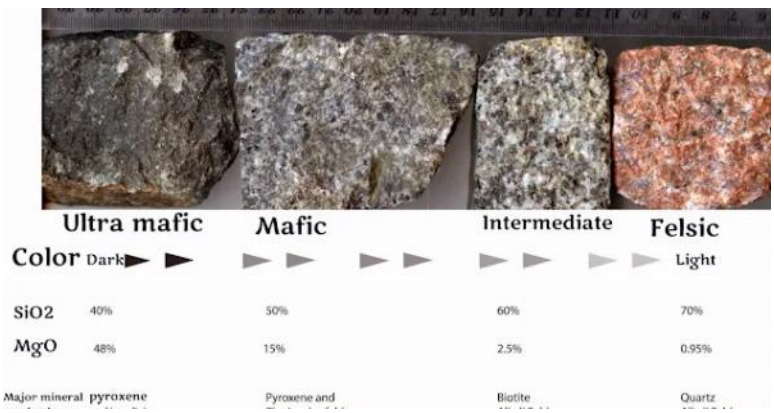
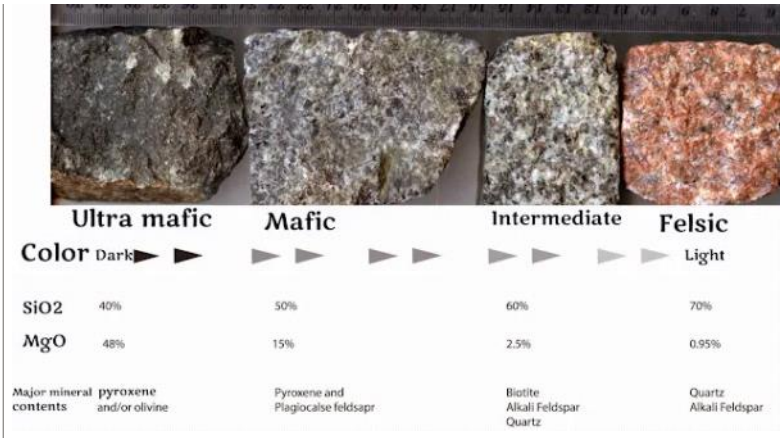
Rocks:

- Minerals aggregates with combination of mineral traces properties.
- Type - Igneous/ Sedimentary/ Metamorphic.

Igneous :	• Cooling down of lava/magma, • No fossil/organic matter (source are interior of earth). • Black soil do not have organic content.	
Sedimentary Rocks :	• Solidification of deposit, Compaction bc of pressure from above layer, • deposition by river, glacier etc. • **Cementation** : Calcium carbonate hardens and binds soil	
Metamorphic Rocks :	• Name derived from changing states, • When Igneous or sedimentary are exposed to high temp or high pressure -> they breaks and metamorphic rocks are created.	

Igneous rocks

Physical classification:	1) Extrusive Igneous (Volcanic) 2) Intrusive Igneous (Inside earth) Cools slowly and particle can bind more easily hence larger grains. 
Chemical classification of igneous :	1) Felsic : Dominate by silica and iron (less qty), less dense, light colour. 2) Mafic : Dominate by Mg and Fe, High density, Dark colour, 3) Ultramafic : Rick in Fe and Mg (>60%) , Density highest, Greenish in appearance. 



Sedimentary rocks :

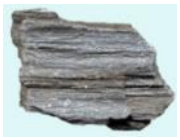
- Softer rocks, break easily bc of presence for hetero mixture. Used in art structure (Sand Stone).
- Have remains of fossil and organic matter.
- Steps of LITHIFICATION : Deposition -> Compaction -> Cementation.

-
- Classification :

1) Clastic Sedimentary :	• Large rock breaks down (bc of heat/cold/expansion -> particles caries by winds, rivers -> deposition. • Ex - Sandstone, Siltstone
2) Chemical Sedimentary :	• Deposit carried out by chemical reaction. • Diffused iron in water with plan generated O2 forms Fe2O3 and get Iron ore deposited. • Same with limestone, Coals (Carbon from plants/animal).

Metamorphic Rocks :

- Deep beneath earth surface, with high temperature and great pressure.
- Like Limestone-> Marble. No organic matter present.
- Composition

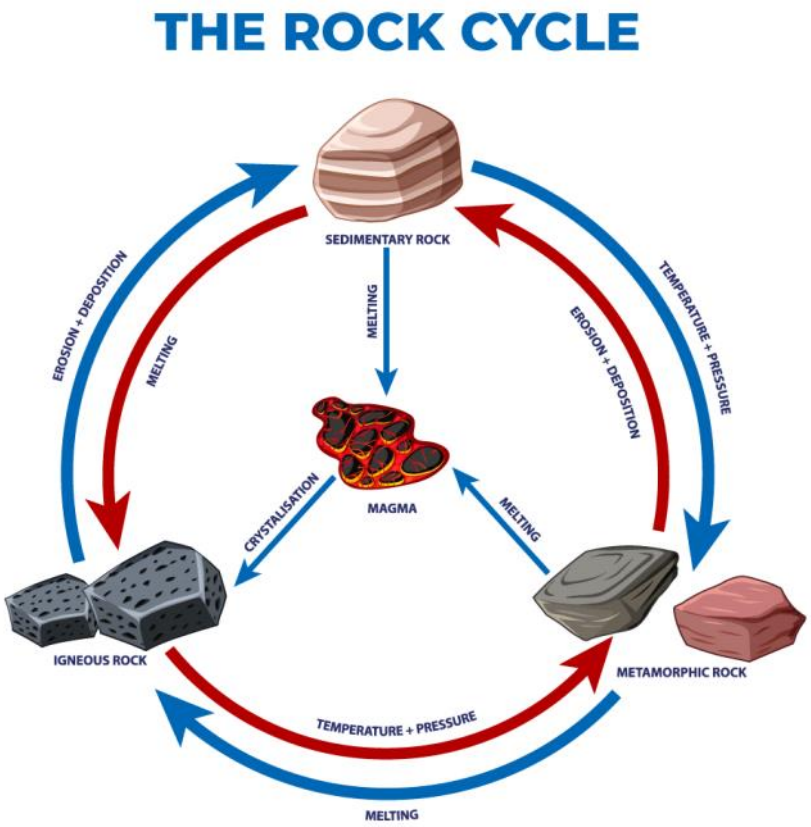
1) Foliated Rocks :	Different materials layers arranged in bands. ex- Phyllite etc.	
2) Non Foliated :	Bc of heat diff material mixed and fused, ex -Marble, Quartzite.	

- Type of metamorphism :

1) Dynamic :	pressure, induced by movement of surface
2) Thermal :	temp

Rock Cycle :

- Conversion of rock type into another type, under weathering, erosion. cooling , heating, compacting, melting.



S5 Distribution of continent and ocean

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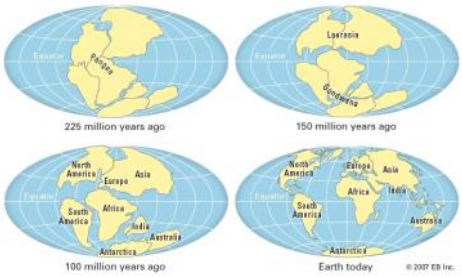
Origin of Continents :	Continental Drift theory, Sea floor spreading, Conventional current, Plate tectonics.

Contraction Theory : 1900s	• By James Dwight Dana • Feature of earth result of cooling down and forming cones and corners. Absurd
Continental Drift Theory of Taylor : 1910	• By F B Tylor • Lands are drifting, horizontal displacement of the continents Could not explain reason
Continental drift hypothesis of Alfred Wegener : 1912	• By Alfred Wegener • Shapes of land masses in map arrange in patterns, • then started studying rock structure • postulate all world was one super continent named PANGEA surrounded by PANTHALASSA. • Pangea cracked -> Formed Laurussia Land and Gondwana Land separated by sea Thethys. • Reason of drifting was not given because Alfred was not a geologist. Alfred was mocked for this. Proved century later by Tectonic theory.



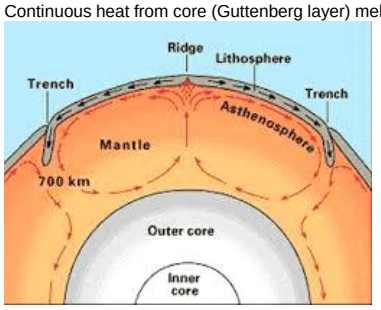
Continental Drift theory CDT Evidence : (Wegner's Theory)

1) Jig saw fit of continents :	• Ancient supercontinent Pangea, Westward movement (based on America S and N movement), • movement away from south polar (based on breaking of Gondwanan land).
2) Presence similar :	• mountain range in North America and Europe
3) Placer Deposits :	• When material in the source rocks are insoluble in water they eroded by rivers and get carried over to far distance place. • Gold placer deposit in Western Africa has source rock in Western Brazil (South America).
4) Glaciers :	• Continental glacier (high latitude), Alpine (high altitude) , • Slow moving block of ice (glacier) creates Glacial Striations (straight line scratch in surface rocks) and Tillite deposits. • India, Africa, Australia, South America being part of Antarctic shows evidence of Glacier strata.
5) Fossils of species :	Dinosaurs and plants (ferns) species fossils found bw two continents.

Wegner's Assumption :	1) Borrowed idea from Edward Suess 2) Continent represent SiAl and Ocean as SiMa, SiAl floats on SiMa like boat.
Reasons Cited :	1) Westward drift : bc of gravity of sun and moon. 2) Movement away from pole : Polefluckt : bc of buoyancy and centrifugal force. move toward equator and away from poles.
But reason and assumption were incorrect hence rejected at that time.	

Convection Current Theory :

- Arthur Holmes (physicists) Propagation of heat in interior of planets. (residual heat)
- Convection current : Heat water propagates from lower to outside. in same manner Residual heat is moving. Has vertical and ho rizontal component.
- Continuous heat from core (Guttenberg layer) melts mantle and move up and mantle from surrounding fills the gap.



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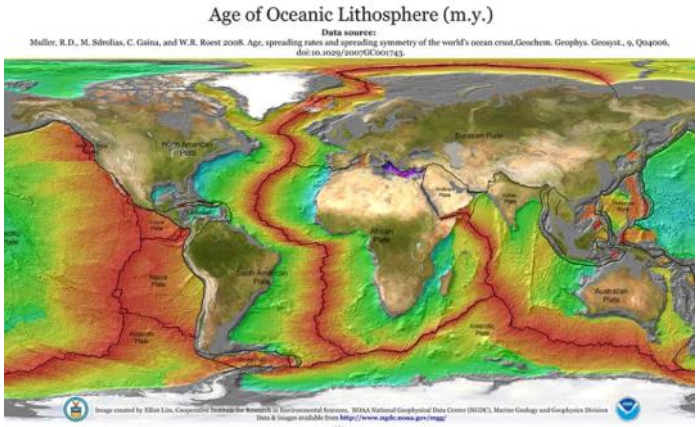
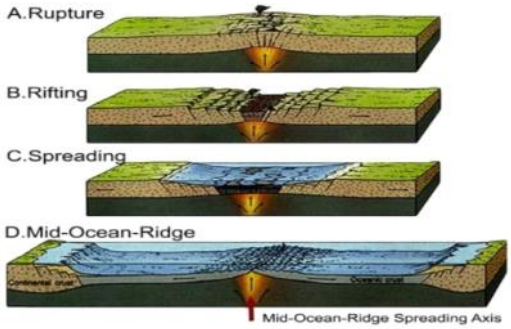
1) Vertical current :	Volcano or swell up land (upliftment of land) with cracks in surface. + subsidence of land.
2) Horizontal component :	Pulling away land and creates cracks, volcanoes.

Sea Floor Spreading theory :

- Harry Hess explores sea beds and found ridges under the ocean (Mid Oceanic ridge MOR) , Zones of active volcanism.
- Ocean deposits , rock, sediment are younger than 200 million years, younger than continental rocks. Rocks closes to ridge are young,
- Magnetic field lines getting changed, due to changing Geomagnetism alignment . also helped in calculating age of the rocks by comparing alignment. We can see pattern of Magnetic

field line alignment in symmetric both side (Mirror reflection).

- 

- 

- **Sea Floor Spreading Observation :**
    1) Ocean not featureless plains
    2) New rocks 200 million year
    3) Near ridge rock younger
    4) crest volcanoes present
    5) Age of rock mirror image around ridge
- **Limitation** : Small feature not explained, no movement of continent, no speak of lithospheric.

S6 Plate Tectonics

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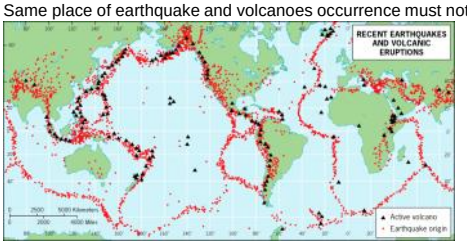
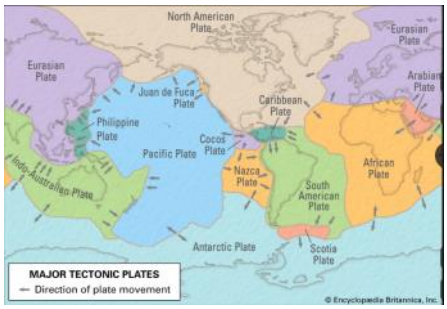
Plate tectonic :

- Same place of earthquake and volcanoes occurrence must not be coincidence. And led to Plate Tectonics By Tuzo Wilson, Morgan and Parker



- Lithosphere (100Km) Solid is not uniform and broken in smaller parts (Plates) overlay on aesthenosphere (Semi solid semi liquid bc of nuclear reaction of Ur and K) , move wrt to each other due to convection current, moving at around 5-10 cm/year.
- Movement causes Folding, Faulting, Earthquake.

Major Plate :	NA, SA, Pacific, Eurasian, Indo-Aus, Antarctic, African
Minor Plate :	Arabian. Cocos, Caroline, Philippine, Nazca etc.



Why do plates moves :

- Due to Horizontal component of Convection current,
- Source of heat from

Gutenberg Discontinuity	(Residual heat in interior)
Asthenosphere	(Radioactive material thermonuclear reaction).

- Plate Boundary / Plate Margins :

1) Active -	Movement still happening
2) Passive -	Moving happened but not anymore

- Both type of movement Convergent, Divergent occur depending on position and direction of Horizontal Convection current.
- If vertical component of Convectional current hits mid tectonic plates -> leads to thinning of plates occur and hole is created. If thinning led to crack -> Volcanoes appear. Creation of ocean takes place.
- Red sea was created by diversion.

Wilson Cycle :

- Supercontinents keep on getting created and are broken into smaller sub parts, movement of smaller parts can again from supercontinent.
- Rodinia -> Pannotia -> Pangea

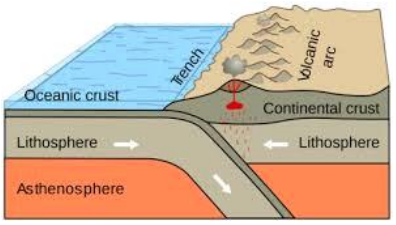
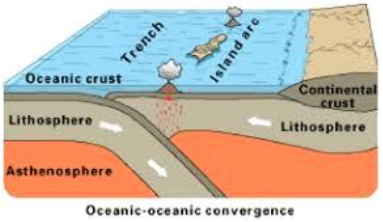
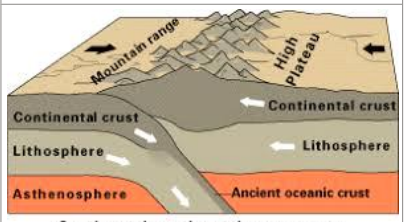
Types of plate Movement (across the same plane) :

1) Toward each other :	Convergent Plates (Destructive plates)	
2) Away from each other :	Divergent plates (Constructive plates)	
3) Parallel to each other :	Transform plates. (Conservative plates margins)	

Convergent plates Boundary :

- Subduction zone, existing plate is destroyed while moving down of other layer, Give rise to earthquake when sudden movement is there overcoming blockages.

- Landforms Convergence :

Oceanic Continental Convergence :	• Oceanic trenches, Fold mountain, Volcanoes • SA and Nazca, heavier oceanic while go subduction. • Slab pull : Overhanging portion of subducting plate will exert pull to remaining portion. fold created on Continent and formation of mountain occur (Mt Andes). Active seismic Zone (Earthquake prone zone). Water forms vapour -> rise up -> Volcanic eruption (Mt Cotopaxi, Mt Aconcagua)	
Oceanic Oceanic Convergence :	• Islands, Seamounts • Older plate is heavier and undergo subduction, -> Trench is formed (Mariana trench) , • Seismic active, Formation of volcanic (Mt Pinatubo) -> formation of islands arc. • If submerged in water called as Seamounts/ Sea Mountains.	 Oceanic-oceanic convergence
Continental Continental Convergence :	• Fold Mountains • Formation of Mountain with heavier plate one plate going for subduction • Active Seismic zone but no Volcanic activity found.	 Continental-continental convergence

S7 Convergence and Divergent landform

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(Q) Discuss geophysical characteristics of Pacific Ring of fire. (Q) What is Circum Pacific Zone of Fire ? Explain the geographical events in the region. (Q) Why do Indonesian and Philippine archipelago have thousands of islands ?	(Ans) Explains plate movement in plate tectonics theory. Pacific plate move west (OO Convergence) , North American plate move west (fast CO Convergence), creating volcanoes and earthquake across the Pacific region. Leading to formation of island and trenches. ..... 1) Pacific Plate - Amur Plate OC : Fuji 2) Pacific plate - Philippine Caroline sea plate OO : Pinatubo 3) pacific - Australian OO - Hunga Tunga Mt 4) Pacific - North American OC - Shasta Reiner 5) Nazca - South American OC : Certoparin

Formation of Himalayas :

- 200 million years ago, Eurasian landmass and India was situated at antarctica , Indian plate detached and moved upward throug h Tethys sea,
- Due to CC Convergence Himalayn formed.
- Stages of formation
    1) Northward movement of Indian Plate (15-20 cm year).
    2) Subduction of Tethan seafloor (formation of bulge 500sq km OO Convergence) Volcanic Erruption, Igneous rocks formation in eurasian plate
    3) Upliftment of Tethean sea floor : rate of subduction of sea floor slower compare to Indian plate movement.
    4) CC Convergence : Fold started to appear, including sea bed land, evidence of marine life fossils found on mountain.
    5) Creation of faults and cracks : Now no more fold could occur, rocks deformed beyond elastic limits, Rough movement bc of rocks rubbing on rocks.
    6) Formation of susiquent ranges : upliftment in side of mountain, increasing size of upliftment. formation of Shivaliks.
- Time gap of 20 million years, Great himalaya > Himachal (Middle Himalaya) > Shivaliks. Indian plate still moving 1-2 cm/year.

Divergent plate boundaries :

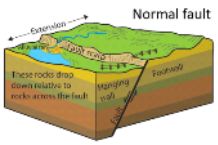
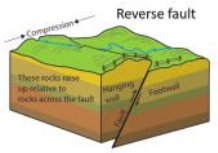
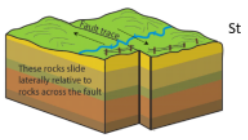
- Creation of newer crust, Constructive plate margins.
- Convection current -> Development of cracks -> rift Valley formation -> Shallow sea -> Mid Ocean ridge & Seafloor spreading.
- Volcanic eruption in MOR can forms islands example : Icelands.
- Landforms created by : rift valleys, MOR, Islands
- Geological events : Non explosive eruption , earthquake.

Transform Plate Boundaries :

- plates moving parallel to each other, conservative plate margins,
- development of large cracks, side by side parallel movement,
- San-Andreas fault in California., earthquake in Gujarat region.

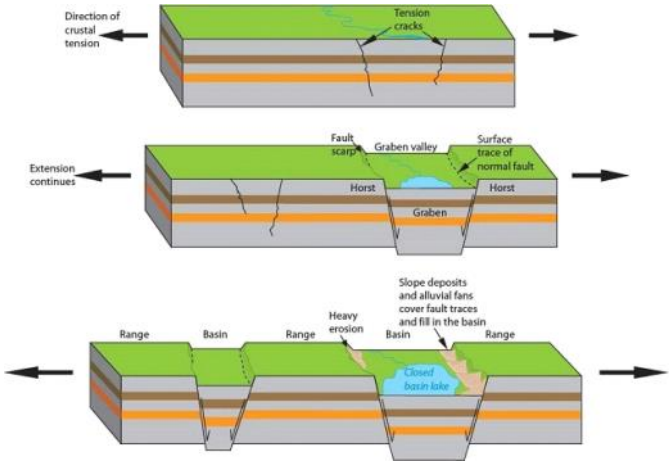
Folding and Faulting: Compression and Tensional forces lead to formation of folds and development of cracks. ..... Folding : Bend in rock response of compression force, Anticline (up) and Syncline (down). ..... 1) Symmetrical fold : same limb each side, in andean Cordillera. 2) Asymmetric Folds : variation in stress Himlayan, Alpine Cordilleras. 3) Recumbent Fold : sleeping fold and may lead to breakage in down fold. 4) Nappe fold : Broken fold due to elastic deformation capabilities breaks, Great Hima laya

Faulting : cracking due to brittle surface.

1) Normal fault :	• Tensional forces, stepp inclined fault zone with downward motion called as ESCARPMENTS • Ex - western ghats.	
2) Reverse Faults :	• Compressional forces , block slides up the other. • Reverse of gravity	
3) Strike Slip Fault :	• Tarnsverse Forces	

Combination of faults : Multiple faults

1) Graben fault :	• Tensional stress, two normal faults, Middle block of U shape sink down, formation of rift valley, • Ex- Narmada and Damodar valley.
2) Horst Fault :	• In case of compression, folds middle part moves up forming A shape plateau, two reverse faults
3) Subsequent Horst and Graben :	ex - Vindhya (up) - Narmada Rift Valley (down) - Satpura (plain).


Direction of crustal tension
Tension cracks
Extension continues
Fault scarp
Graben valley
Surface trace of normal fault
Horst
Horst
Graben
Range
Basin
Range
Heavy erosion
Slope deposits and alluvial fans cover fault traces and fill in the basin
Basin
Range
Closed basin lake

S8 Earthquake

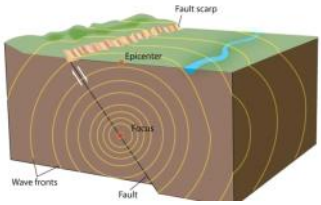
30 June 2024 03:44 PM

Mains :	Shadow zone, Mantle plume, Volcanic hotspot, Global Distribution of earthquake and volcanoes.

Earthquake :

- Shaking of the earth surface,
Natural factors :	Plate movement and friction forces, movement of land across the faults planes, Volcanic eruption,
Anthropogenic factors :	Man made

Focus :	Point of release : origin of the earthquake.
Epicentre :	Directly perpendicular above the focus, origin of earthquake on surface.



Categorisation based on depth

1) Shallow focus	: 0-100 km (max energy released - max destruction)
2) Intermediate	: 100-300 km
3) Deep Focus	: 300-700 km

Earthquake doesn't happen beyond 700km. At that depth, deformation can happen, due to resistance offer and high temp/pressure .

Categorisation on amount of destruction :

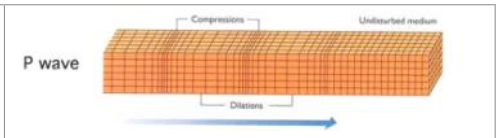
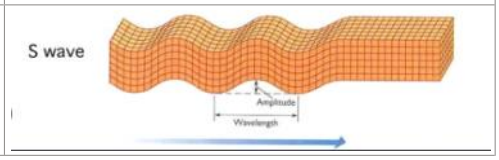
- Determined by factors (Depth of focus, nature of rocks, quality of construction,
- Damage in soft soil and soil rocks > damage in solid rocks, due to formation of waves in liquid movement of soil.
- Greater damage in close packed cilites
- Intensity of earthquake on damage caused : Mercalli Scale (1-10)

Seismograph : Measure energy released in earthquake

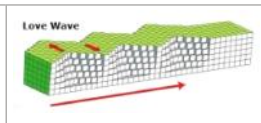
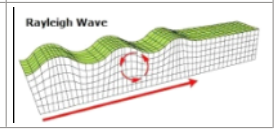
Magnitude : Amplitude of energy released measured in richter scale (logarithmic 1-10 in nature, magnitude of 6 = 10 times of 5).

- Deformation in rocks is measured, if high deformity higher chance of earthquake to happen.
- **Seismic Gap :** if earthquake not happened for long time, very prone to earthquake.
- **Foreshocks :** Energy release prior to the earthquake. Aftershocks : energy released after earthquake.
- Seismic waves : reach epicentre first, transmission of energy from interior to surface (body waves) -> surface waves from epicentre outwards.

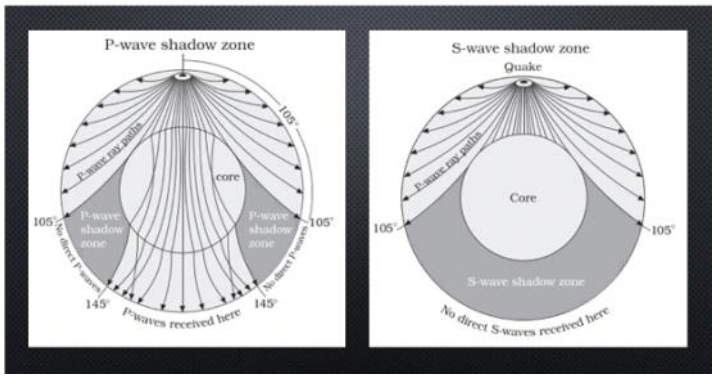
Body waves : Focus to epicentre

1) P Primary waves :	• Direction of particle movement same as direction of wave movement (linear). • very fast/swift wave movement. move in liquid and gas as well. • 4.5m/s-15m/s • Early warning system is based on P wave. gives time of 30 sec to 1 min.	
2) S Secondary waves :	• Particle movement is perpendicular to wave propagation (transversal) , Sinusoidal movement. • 1.7 times slow moving, Not propagated through liquid and gases.	

Surface Waves : Origin Epicentre move outwards.

1) L Love waves :	Horizontal disturbance, Snake like movement, faster.	
2) R Rayleigh waves :	Horizontal waves, slowest wave.	

Shadow Zones :

- Bending of earthquake waves because of different density (different speed).
- Some nearby places do not face earthquake, no energy received.
- 

- S wave shadow zone more larger as S wave cannot travel through liquid core.

Tsunamis (Giant Wave) :

- Earthquake surface wave of Rayleigh type created tidal wave in sea.
- Tsunami travel faster in deeper waters.

Q) Global Distribution of earthquake :

Ans)	1) Intro : why occur 2) Area : Reason of earthquake in each region, Ring of fire and Mediterranean Himalaya, MOR (Mid Atlantic Ridge, east pacific, Indonesian Australian). 3) Draw Map	

Reason of Earthquake :

1) Plate Movement :	Convergent and transform (Violent Earthquake), Divergent (Lower Earthquake).
2) Volcanic eruption	

Earthquake zone of India :

• Zone 2 to 5 (Zone 1 not possible bc there is chance of earthquake everywhere due to fault present) • Himalaya : Very prone due to Convergent, large scale construction not advised. • Intersection zone in Gujarat and Rajasthan region. Faultline present in Maharashtra.	

Induced Seismicity (Anthropogenic Earthquake) : Human Induced like

1) Hydrocarbon Extraction :	fossil fuel and Natural gas, When excess material come out of narrow zone, shaking of the surface is observed.
2) Reservoir induced seismicity :	reservoir and dam induced immensely high pressure and rock beneath develops cracks . Sometime water from reservoir seeps crack and provide lubrication for inducing sliding in rocks. ex : river Koyna
3) Mining operation :	Controlled use of explosives done to loosen the rocks to extract minerals and ore.

Earthquake Swarms :

- Series of low magnitude earthquake concentrated in one particular region.
- Can occur for a few hours to a few weeks in continuation.
- Reason :
    1) Foreshocks of big plate movement
    2) Prior to volcanic eruption
    3) Instability in upper rock structure induced by water seepage.
- Palghar in Maharashtra.

S9 Volcanoes

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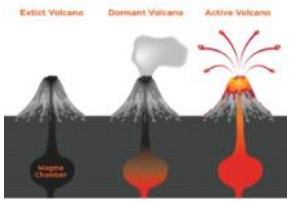
VOLCANOES :

- Volcano is vent in earth crust, through which heated material (gas, water, lava, rocks) are ejected from interior of the eart h.
- **Pyroclastic debris** : smaller solid rocks pushed out during eruption, due to presence of gas pressure.
- Gases are released : Water vapour (dominant), NOx, SO2, CO etc.
- Where is the magma chamber : Upper position of mantle, region near asthenosphere.

- Classified :

1) Active :	Active magma chamber, experienced eruption in past and except eruption in future. Ex : Barren Islands, Mt Pinatubo, Etna.
2) Dormant :	eruption in past but not active anymore, but can become active, Magma chamber is still there but solid plug created in volcan ic vent. Ex : Mt Vesuvius, Mt Kilimanjaro,
3) Extinct Volcano :	Magma chamber solidified, Mt Aconcagua.
	

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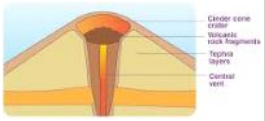
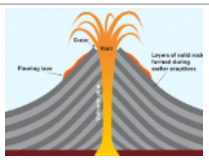
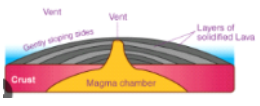
Reason for eruption :

1) Plate movement :	Convergence (oceanic convergence OO, OC), bc of water and sediment are subducted.
2) Divergence :	MOR.
3) Volcanic Hotspot.	Moving tectonic plate over magma chamber
4) Development of deeper cracks/faults	Convection current from aesthenosphere or Guttenberg.

Magma types and Physicochemical Control on eruption style :

Felsic :	• Sl rich and viscous, does not flow easily , forms clumps. • Presence of gases, • Viscous -> Low Fluidity -> Explosive flow -> Low density light color rocks.	
Mafic :	• Rich in Fe and Mg, flows easily, Non Viscous. • Magma forms flood way soils. • High fluidity -> effusive -> less explosion. - > High density dark rocks.	

Types of Volcanic Landforms :

Cinder cones :	Normal volcanic mountain, small in size, volcanic vent. top is blown, igneous rock from cone fly out from explosion. not more than 1000 ft , Ex: Mt Taal (Philippines)	
Composite Volcanoes (Stratovolcanoes) :	Oceanic convergence or volcanic hotspot. layers form due to different material like ash from air settling down, felsic magma, basaltic lava, etc. ex : Mt Fuji, Mt Pinatubo.	
Shield Volcanoes :	Low wide cones, in case very fluid lava flow material will flow wider area and will noty form cones, ex- Canadian shields, Hawaiian	
Lava Domes :	Domes from when viscous lava accumulate and grows inside out around vent. It does not erupt. Very little size	
Fissure Volcanoes :	Ex -Laki eruption in Iceland, Wide fissure cracks, Occurs in zones of divergence, magma from guttenberg zone, Mafic in nature and flows wide.	

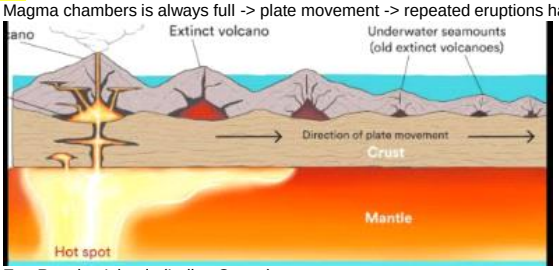
Calderas :	Landform created due to explosive eruption leading to crack in mountain, At point magma chamber is empty and hollow, above cone is collapsed forming a bowl structure. Ex- Hunga Tonga Caldera, Crete Greece, Mt Oregon.	

Mantle Plumes :

- Refers to rising warm column, Also develops head on top. Due to heat mantle melts and undergoes a Vertical rise.
- Heat can generated from :
    1) Plumes of heat from Guttenberg layer, residual heat
    2) Radioactive material heat in asthenosphere.

- Implication :
    1) Generate convection currents
    2) Lead to volcanic eruption (Volcanic Hotspot)

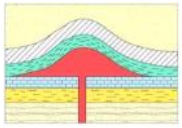
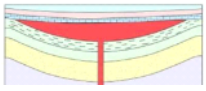
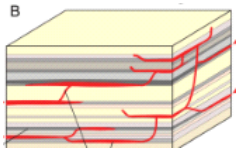
Hotspots :

- Magma chambers is always full -> plate movement -> repeated eruptions happening at same magma but different position of plate -> trail of volcanic landforms is created.
- 

- Ex - Reunion Islands (Indian Ocean).

Intrusive Volcanic Landforms :

- Formed by cooling down of magma. Rich in minerals.
- Denudation : able to see if able layer is eroded.
- Classified based upon the shape if the solidified mass.

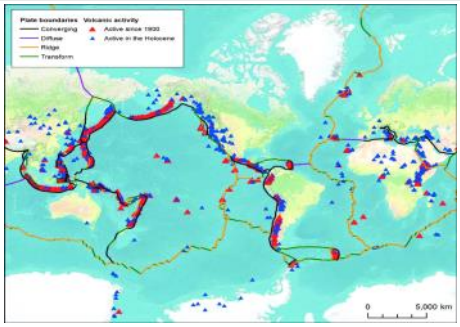
1) Batholiths :	Cooling of whole magma chamber. forms large domes, Ex: Ranchi.	
2) Laccolith :	Dome shaped intrusive body with level base as pipe like neck, formed in case magma does not break crust. Ex- UK, Europe.	
3) Lopolith :	Upside down dome, with flat on top and pipe neck at bottom, occur in case of hard crust.	
4) Phacolith :	Wavy mass of intrusive rocks, Synclines (Base) and Anticline (Top)	
5) Sills and sheets :	if magma enter layer of rocks and solidify in thin layer(Sheets) or thick layers (Sills)	
6) Dykes :	Vertical Layers, forming wall formation of solid magma. Ex : South Africa rich in Kimberlite (Diamond)	

Regions of Volcanic Eruptions :

1) Plate Boundaries	Oceanic Convergence
2) Divergence	MOR
3) Mantle Plumes	Volcanic Hotspots.
4) Development of deeper faults.	

Distribution of Volcanoes :

1) Pacific Ring of fire
2) Mediterranean (OC)
3) MOR (Mid Atlantic-Iceland, East pacific)
4) Volcanic Hotspots.



S10 Geomorphic Process

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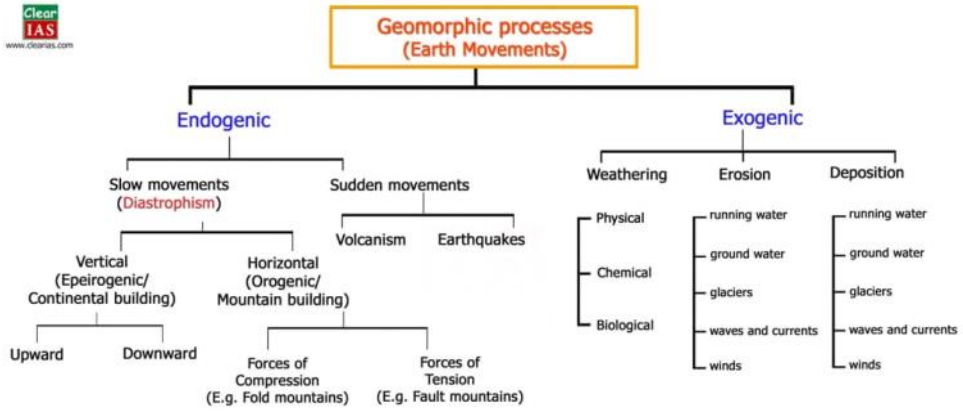
Earth Forces : Endogenic and Exogenic



Endogenic Forces: Forces from interior of earth

1) Sudden Forces :	Earthquake and Volcanoes
2) Diastrophic Forces :	• Compression tension and shearing. • Two types a) **Epeirogeny Forces** : Continent building forces. vertical upliftment and subduction. b) **Orogenic** : Mountain forming like Folding and Faulting.

Exogenic Forces : Forces acting for outside.

1) Weathering : breakage of rocks into smaller fragments, in their original position.

a) Physical :	Mechanical forces like temp, rain, winds etc leading to flaking/exfoliation (Outer layer becoming loose due to expansion and contraction) and outer layer peels off. or rain water seeps cracks and expand when frozen ,crack will deepen further.
b) Chemical :	Reaction -> new compound -> different strength - breakage. like Calcium can be dissolved in water, oxidation (rusting), Carbonation, Hydration.
c) Biological :	Plants root deep in crack, biological action of insects or microorganism leads to cracks widens up.

S11 Weathering and Erosional

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Mass Wasting : (Mass movement) :

- Gravity induce movement of large mass down the slope.
- Factors affecting mass slope :
    1) Volume of water
    2) Steepness of slope
    3) Amount of materials ready to slide.
- Mass Movement based on speed : Fall > Flow > Slides > Creep > Solifluction.
- Types of mass movement

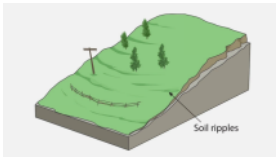
1) Fall :	Only Gravity works, Ex - Rock fall, Debris fall.
2) Flow :	Oversaturation with water, fluidic flow is generated, Ex : Mud flow, Earth flow, Debris flow.
3) Slide :	Movement of layer, Ex - landslide (Avalanches), Mud slide.

Landslides :

- defined as movement of mass of rock, debris, earth down the slope. Initiated by rainfall, snow, water level earthquake, volcano, human activities.
- Submarine landslides by earthquake.
- Avalanche : Movement of large amount of snow/ice move down the slope.

Creep :

- Area of very gentle slope, no presence of rain, very slow movement of topsoil.
- We can see slide tilt/ inclined in structure like tree and poles.



Solifluction :

- In region of higher latitudes and higher altitudes. (permafrost are region permanently frozen
- During summers, top soil of ice melts while subsoil still remain frozen, Disconnect develops bw top and subsoil.
- Topsoil disjoin from subsoil. Movement of topsoil over frozen subsoil is Solifluction.

Levelling cycle of earth :

1) Erosion	Removal	• Removal of material from original places by agents of nature (river, glacier, winds etc) • Speed is high then erosion is more, speed reduce deposition occur
2) Transportation	Movement	• By Agent of gradation : 1) Running water : Fluvial landform 2) Underground water (Karst Topography) 3) Glacier 4) Wind and sea
3) Deposition	Addition	.

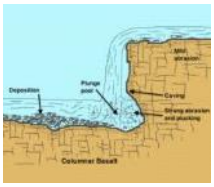
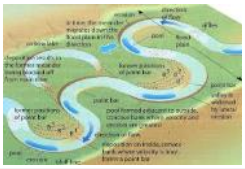
Wind Erosional Ladnform :

Stages of River movement :

1) Upper Course (Youth) :	High slope, high speed, erosion is high, vertical erosion dominant, deep valley is created.
2) Mature state :	Speed Reduce (Haridwar), Erosion+Deposition, when entres the plain, rivers are wide and shallow bc of lateral erosion is domi nant.
3) Old Stage :	No erosion only deposition in river channel and side as well

River Erosional landform :

1) Valley :	Vertical erosion, forming depressed land scoured, form of U or V.	

2) Gorges :	Deep and vertical depressed land. may forms valley with further erosion	
3) Potholes :	Circular depression, very small in size,in youthful and high speed river carry big boulders create slight depression and depression again increase with turbulence of water trapping other rocks.	
4) Plunge pools :	If water hits vertically downward creating pool	
5) Meanders. :	Curvy flow of river, bendy path like snake. River tries to move through path of least resistance. perform erosion (Side of river in flow) and deposition (Opposite side of river) increasing curve path. Once start become more and more exaggerated.	
6) Incised / Entrenched meander :	incase there is upliftment of sea beds but river bed remain at same depth due to erosion and side rock undergoes upliftment.	

S12 Depositional Landform

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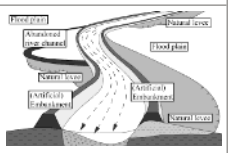
Depositional landforms :

1) Alluvial fans :	Deposit at foot of mountain where river hits plain deposit in shape of fan. Rocks, Boulder, Debris. Only present in youthful stage, in shape of hand fan, at point of Foothills of mountain (slope plain intersection). deposit and rocks	
2) Deltas :	Final stage of movement of river, In shape on Greek alphabet Delta, Very fine deposits	
3) Natural levees :	Deposition across the banks of the river as the river carries silt (Fine particle).	
4) Flood plains :		
5) Meanders		
6) Oxbow lakes :	Curved lake with horseshoe bend feature that has been cut from Meander.	
7) Braided channels :	Sometime at very old stage, Deposition is all across and have many stream of river. Many deposit within river channel.	

Karst Topography :

- Landform develop by underground water. Chemical weathering and erosion of rocks by water.
- if dominated by rock like limestone. Large cave like structure.

1) Erosional :	Sinkholes, caves, uvalas.
2) Deposition :	Stalactites, stalagmites.

- **Erosional karst topography :**

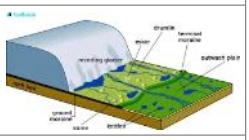
1) Sinkhole :	Sinking of circular land due to weakening of rock base dissolved slowly by water.	
2) Uvalas :	When sinkhole intermix each other leaving trail of upholding land.	
3) Cave :	Big caves for flow of water underground.	

- **Karst Depositional Features:**

1) Stalagmites: Structure formed on evaporation of water and leaving salts behind. on the ground of cave. **2) Stalactites** : on the ceiling on cave. **3) Column pillar** : when both mix together to form pillar.	

Glacier :

Massive body of snow moving down the slope, due to influence of gravity. forms several cracks between moving ice.

1) Till / Tillite :	• Screeching sound from base of glacier b/w layer of massive glacier and surface rocks form till or tillite are fine particles carried by glaciers.	
2) Moraines :	• Glacial deposits formed during the flow of glaciers. Named as per region of deposits. Ex - • a) lateral moraines : bank of glacier • b) Medial moraines : middle of glacier • c) Terminal/End moraine : end point of glacier where liquid water starts.	
3) Outwash Plain :	When glacial ice melts, melt water carries till and deposit them along sides in plain	
4) Cirques :	Creation of eroded amphitheatre like shape, formed when erosion is done at large scale and long-time forming glacier lake.	
5) GLOF :	Glacial lake outburst flood : when rock from mountain hits glacial lake and leasing to flooding.	
6) Aretes :	Erosion from both side of mountain forming ridge like shape in mountain.	
7) Horns :	When erosion happen from all direction leaving sharp point mountain.	

Erosion of continental glacier :

Fjords :	Erosional glacial landforms, long deep narrow channel body of water created due to past glacial erosion during ice age. now these region have presence of water from sea.	

Depositional feature of continental glacier :

1) Drumlins :	Streamlined like formation of rocks created by glacier flow on glacial till in direction of formal flow.	
2) Eskers :	Longitudinal deposits created by glacier moving across. in between tunnels in bottom of glacier	

S13 Climatology

Climatology :

Climate impact many things, Like Soil, Crops, Weather etc

Atmosphere :

layer of gas Density changes : because of gravity Evolution

1) Primordial	(H2, He) Stripped off, b/c of sun and missing magnetism
2) Evolution of new gases	Phase of degasification (NH3,CO2,CO,SO2,H2O)
3) Modification of Atmosphere	Evolution of species (Like plants) Carbon Fertilization , Once Volcanic eruption increases, C2 concentration increase , lead to increase in Photosynthesis lead to O2 increase

Greenhouse effect :

High energy Shortwave radiation (Small wavelength) Small energy : Long wave Only high energy (Short wave) is passed through glass.

Atmosphere passes short wave from sun, but traps long wave from heated earth (long wave terrestrial radiation)

Beneficial : Liquid Water, Night time temp very low -150*C Harmful if in access : High sea level, high Temperature

Composition : N2 (78), O2 (21), Ar (0.93), C02 (0.04)

1) Gases	enabler of life, maintain temp
2) water Vapor	inch thickness, influence climate, behave like greenhouse gas.
3) Dust particle	Scatter Light and Allow us to see by emitting diffuse light, hygroscopic Nuclei Provide surface for condensation of water Vapour.

Modes of heating :

1) Conduction	hot Surface to Air
2) Convection	Movement of cool or warm air
3) Radiation	Short High energy wave

Advection :	Horizontal movement of air Cold Advection : polar winds, Cold air to warmer region, lower temp of mid to higher latitudes Warm Advection : Loo

Wind travel between pressure , and temp is not the only way to control temp

Lapse rate :

Rate of change in temp if we move to high altitude, Density of air max closest to surface(bc of Gravity). 6.5*C/km Prime heat

Close to surface means more heat, move up less particle in atmosphere, less ability to heat trapping.

+ve :	temp reduce with altitude (generally).
0ve :	temo constant.
-ve :	temp increases

Moist lapse rate : Goa Lapse rate < Jaisalmer , Moisture retain heat, Lapse rate will be less. Implication - In Jaisalmer, Land will lose heat more rapid due to no moisture present, Night will be cooler. Whereas coastal area's Night are warmer.

Adiabatic Process :

Changing temp because of changing volume (without any external changes : No net heat transfer). Adiabatic Cooling : Expansion of heated Higher density of air when it move up and because of less gravity it expand and cool down. Adiabatic Heating : Moving of low density air to lower altitude and under more gravity it contract and gets heat up. Implication : Wind Moving up hill cools down + cloud is formed by moisture and moving down ang heats up. East western ghats :Wet and cool West : Dry region and warmer air.

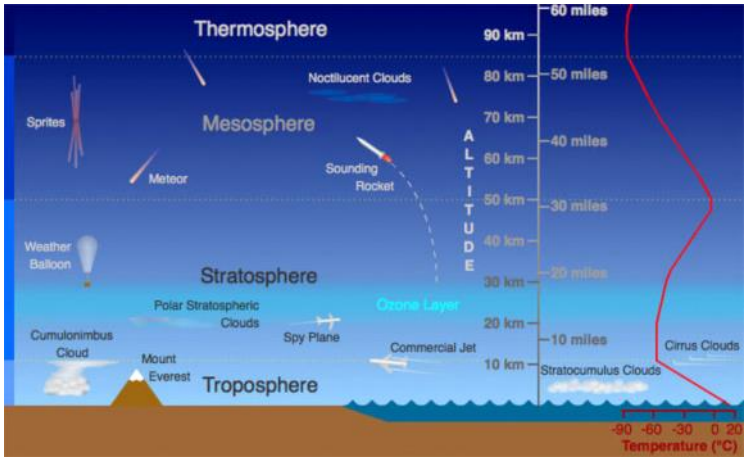
S14 Atmosphere

30 June 2024 03:46 PM

Atmospheric Structure :

Layers of different composition. presence of gas, temp

1) Homosphere :	Homogeneous distribution of gases, upto 100 km
2) Heterosphere :	random concentration , beyond 100 km



Troposphere / Tropopause:	Closest to surface, 80%of mass, avg 13 km, pole 8km, equator 18km, Variation in height : 1) Expansion of atmosphere in equator bc of heat, and compression of air in polar region bc of cold 2) Convective movement of air : rising air column at equator and sinking air column at poles 3) Centrifugal force Fe>Fp Positive Lapse rate: temp reduce with height, All climatic events and weather phenomenon are associated with troposphere
Tropopause :	• Separate Troposphere and Stratosphere. • 0 lapse rate : colder condition from below and warm from top
Stratosphere :	• Above troposphere, weak vertical motion (cool air at bottom) • Calm and stable conditions : Used by large jets plane • Contains ozonosphere O3, (O2+O*->O3) bc of ultraviolet rays, traps UV increase in temp - > -ve lapse rate
Mesosphere :	• 50-80 km in height, • +ve lase rate and gets upto -100*C at 80 km, • Vertical mixing of air, • meteor burn down in this region
Thermosphere and Exosphere :	• Non uniform distribution of gases . • Ionosphere (80-400 km) : Unfiltered solar rays with high energy -> energize molecule and high temp.-> electron jump - > +-ve and -ve ion. Ionosphere helps in radio wave, reflecting wave between antenna. • Aurora -> when electron goes back, atoms release energy back in form of light.

Insolation : amount of solar radiation on a given surface in a given time period, contribute to temperature.

Factors affecting insolation :

1) Angle of Inclination of earth :	North pole in winter and south pole in Summer receive more heat from sun.
2) Revolution if earth :	Temperature is not affected , duration of day affect temperature
3) Configuration of land (slopes of land) :	Southern slope of mountain in north hemisphere observe more insolation. Alps and Himalaya northern slope receive lesser insolation, makes southern slope more habitable
4) Altitude :	Insolation increase with height. Still mountain have less temp bc of less particle and lapse rate.

Albedo : Indicates reflective coefficient of surface for solar energy back to the space, has influence on temp. varies

(No reflection complete absorption 0-1), Ice : 0.8 ~ 80% reflected, Grass : 0.15 ~ 15% reflected : High rise in temp

Polar melting : twice rate : arctic sea ice melting -> more heat absorb bc of water and thin ice -> rise in temp -> more melting and more thinning

Heating of Land and Water :

Land heats only at the surface : temperature rise faster and losses heat faster. Water heats up uniformly.

Day : land is warmer, Night : water is warmer

Seasons - 1) Summer : Land is warmer 2) Winter : Ocean is warmer

Urban Heat Island Effect (UHI) : part of urban and metropolitan area with high temperature compared to rural counterpart. reason :

1) Concrete/ Asphalt structure :	Lower albedo
2) Packed building,	no wind to move heat
3) Lack of green cover:	less evapotranspiration
4) More Greenhouse Gas emission :	High trapping heat.
5) Heat due to Electrical and cooling device .	

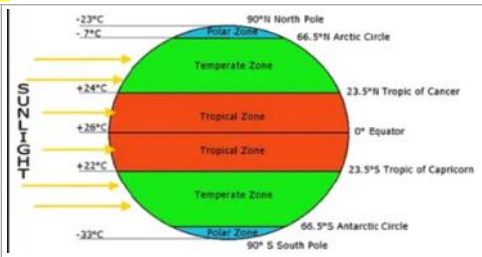
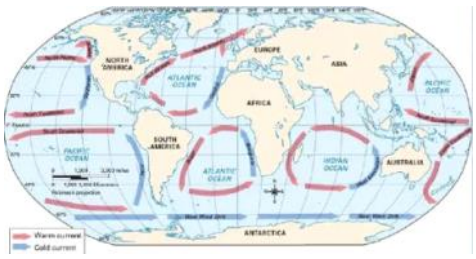
Solution - Green Building : Eco sustainable structure (light and winds)

S15 Temperature Distribution

30 June 2024 04:10 PM

Arctic	Surrounded by land - > land induces phenomenon
Antarctic	Surrounded by Ocean -> Stable air circulation.

Temperature Distribution :

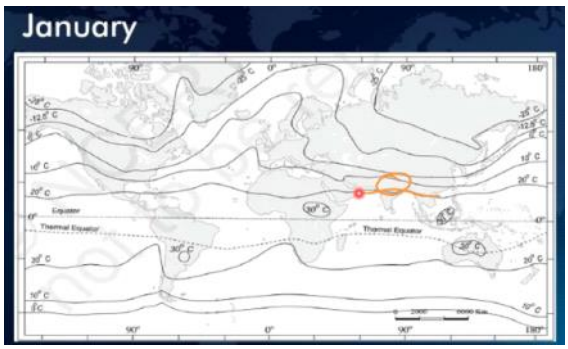
Latitude :	 Direct rays of sun induce greater heating. Lower latitudes receive direct rays of sun -> High temp Higher latitude experience slant rays -> Low temp
Altitude of the place	Normal lapse rate, temp dec 6.5* C per 1000Km.
Distance from sea	Coastal area experience moderate temperature, whereas interior (continental) area extremity of temp. No difference in temp b/w winer and summer temp are same in coastal areas. Presence of moisture which retain heat. And costal area experience land and sea breeze which moderate temp.
Prevailing winds	Existing winds in the region, Warm advection -> Increase temp Cold advection -> Decrease temp
Ocean Current	Warm and cold ocean currents. Like river flow. Cold current : movement of water from higher to lower latitude. Warm current : movement of water from lower to higher latitude. Moving bc of heating by sun, winds, etc. 

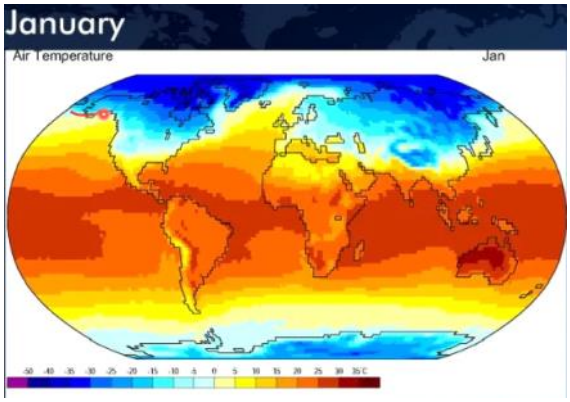
Tropic	B/w Tropic of Cancer and Tropic of Capricorn
Sub-Tropical	Immediately beyond tropics upto 30*/40* latitude
Extra tropical	Beyond the tropic

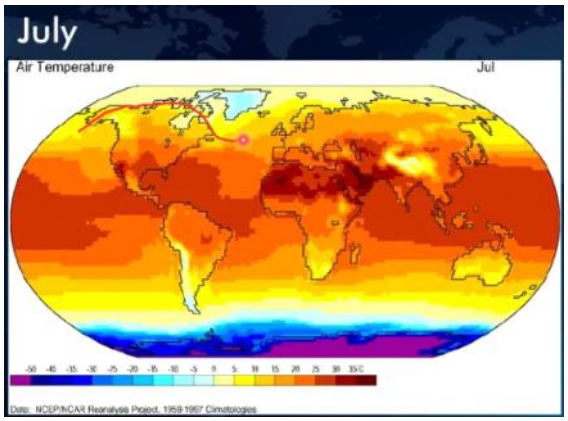
Isotherms :

Imaginary lines joining places having equal temp, reduced to sea level (takes care temp variation due to altitude). Horizonta l or latitude distribution of temp is shown with help of isotherm.
Do not show real temp variation due to altitude.

Isotherms are parallel to the latitudes bc the temp changes very gradually.
Isotherms when move land to water bends toward pole because water at same latitude is warm.

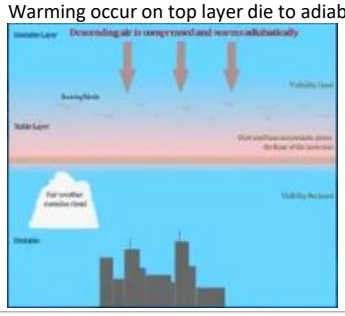
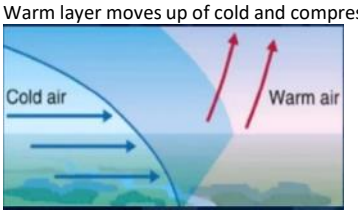






Temperature inversion :
Reversal of normal behaviours of temp in troposphere. Short duration, still air.
Stable air : if cooler air is in bottom and warm air on top -> no movement of air -> harmful as pollutant stays. -> Temp inversion.

Types:

Surface Inversion	• Cooling down of surface., by ground cooling rapidly and only lower air getting cooled down due to convection. • Above layer still remaining warm. Northern India experience this condition. • Ex : Amritsar in winter. a) 5pm : 14*C land, 7*C air b) 2am : land cools 1*C but air at 4*C
Upper air inversion	a) Thermal : Moving up from troposphere to stratosphere, -ve lapse rate is observed. b) Mechanical : Winter month mid to high altitude Inversion occur only on top layer as lower air is very cool bc of cool land. Warming occur on top layer die to adiabatic compression. London smog happened due to this. 
Frontal Inversion	• Fronts : warm air from tropic to pole and cool air from pole to toward tropic. • Zone of transition : bw different aur masses (temp and pressure) • Warm layer moves up of cold and compressed layer and lead to temp inversion. 
Valley Inversion	Region of valleys : temperature gets very low at night by moving of cold air from top to bottom.

S16 Atmospheric Circulation

30 June 2024 04:16 PM

Atmospheric Pressure : pressure induced on the ground surface due to atmospheric column of air particles above.

- Rising air reduce the amount of pressure exerted by ground
- Rising and sinking can be induced by :

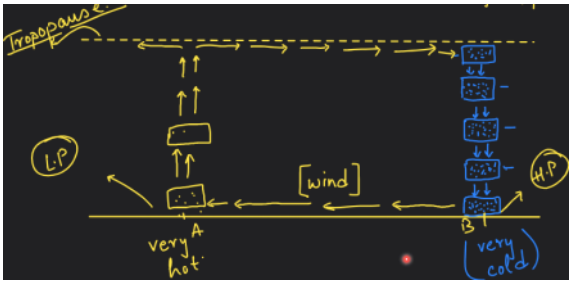
Temperature

Heated air is lighter ->	tend to rise up -> atm pressure decrease
Cooled air is denser ->	tend to sink down -> atm pressure increase

Flow of air

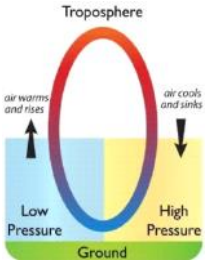
Circulation due to temp :

- In general no movement of air occurs between troposphere to stratosphere (-ve lapse)
- Warmer air rises up from hot land and cold air sinks at cold ground, air flow as winds between this two places.



Circulation due to Pressure (Main factor) :

- Wind movement happens from High pressure to Low Pressure.
- **Pressure Gradient** : Change in pressure over a particular horizontal distance. Difference of pressure induces movement of wind, greater the pressure gradient-> stronger is the wind.



1) **Thermal Pressure Zone**

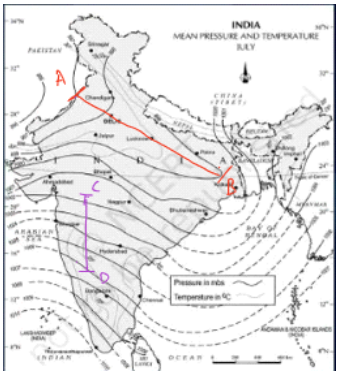
Warming ->	Rising air -> Low Pressure
Cooling ->	Sinking air -> High Pressure

2) **Dynamic Pressure Zone**

Rising air ->	Created due to convergence of air (due to air coming from all direction) -> Low pressure
Sinking air ->	causes divergence -> Creation of high pressure.

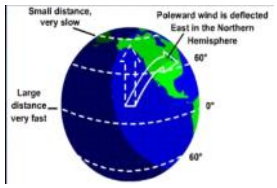
Isobars :

- Imaginary lines joining places of same atmospheric pressure
- Closeness of isobars indicate pressure gradient -> determines strength of the wind.
  If isobar are close- > Strong wind movement.



Factors affecting velocity and direction of wind

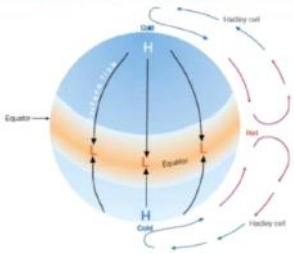
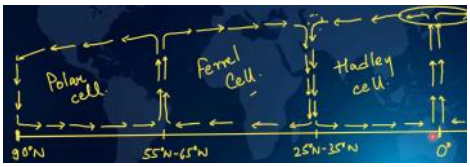
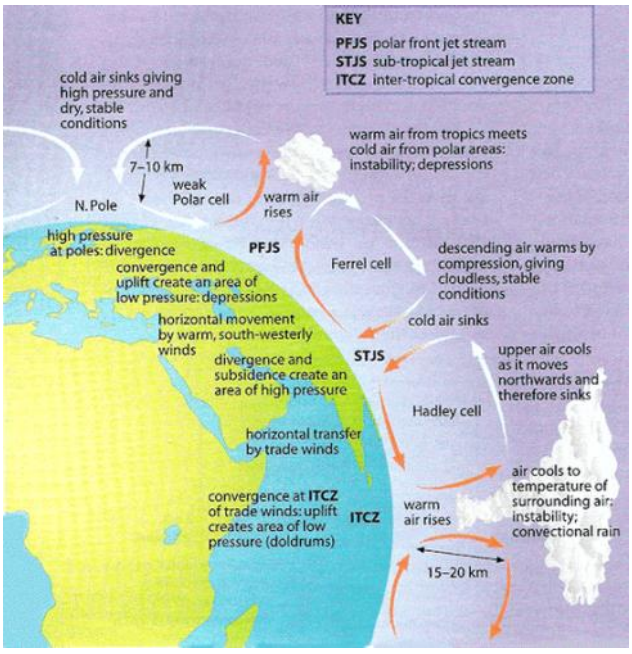
Pressure gradient Force (PDF)	• Shallow gradient (Isobars apart) : weak winds • Weaker gradient (Isobars closer) : strong winds

Coriolis Force	• Force induced due to rotation of planet. Speed of rotation is different for different latitudes. Earth rotate faster at equator. • When moving object from fast to slow , object always fall ahead.  • When air moves from Equator to Pole -> It goes from high speed to low speed -> wind falls ahead -> wind tilt toward rotation of earth • Deflects wind to the right direction in NH and left in SH. • Coriolis force is 0 at equator Coriolis force is max at pole (Speed of rotation is 0) • Coriolis force act perpendicular to PGF • If wind speed is faster, deflection due to Polaris force is also very high.
Frictional force	• Frictional force affect speed, Friction given by surface of land -> Upto elevation of 1-3 km. • Surface of ocean, friction in minimal -> high speed winds • Southern hemisphere wind speed > NH wind
Gravity forces	Wind affected by high to low land influenced by gravity.

Onshore	• Winds from sea to lands • Brings rainfall
Offshore	• Winds from land to sea • Dry in nature, Dry wind

Air circulation Reason:

Difference in temp :
due to different region getting different amount of sunlight bc of earth round shape.

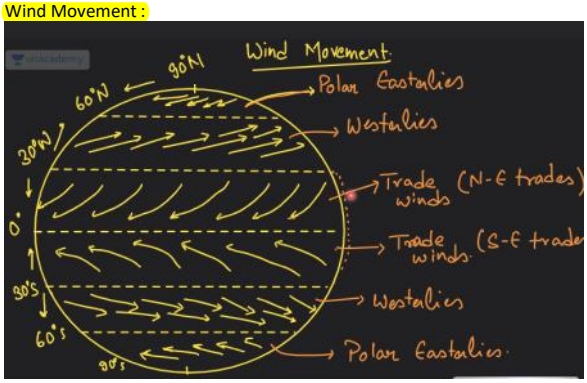
Unicellular model	Also known as Hardy cell. One cell of circulation in each hemisphere. But no winds from pole reaches equator 
Tri Cellular model	  • **Equator Low (Equatorial Trough)** : Inter Tropical Convergence Zone (ITCZ) 0*N • **Subtropical HP zone :** 26*N -35*N :(Horse latitudes : lack of winds at wind coming down : no sail so sailors brings horse)

	• **Sub polar Low Pressure zone:** 55*N-65*N (Doldrums :lack of wind movement at centre point) • **Polar high :** 90*N

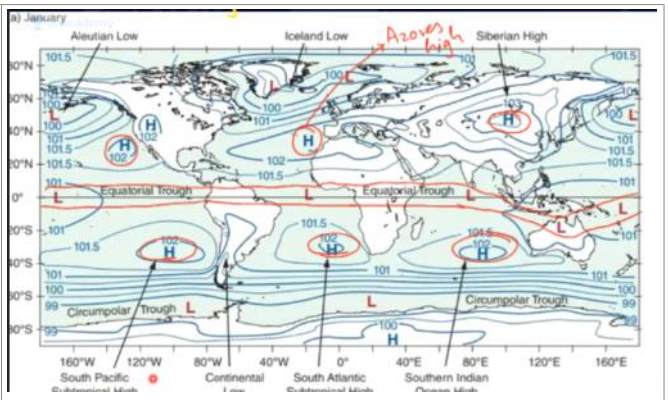
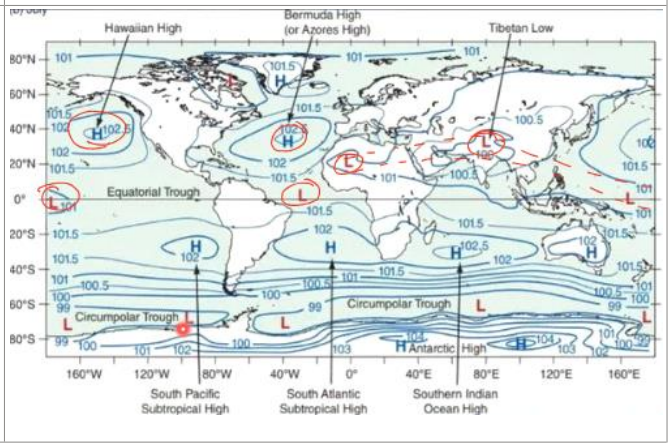
Shifting of Pressure belts/ Zones :

During Northern Summer	• Sun is in NH, Hottest area will not be equator -> absolute thermal LP will be experiences northward of equator -> ITCZ shifts north • Other than polar high, rest of Pressure zone shift with change of season
During Southern Summer	Pressure zone shift south.

Wind Movement :



Pressure distribution

Jan	
July	

Isotherms and Isobars :

- Never criss-cross each other
- If very close to each other indicate drastic pressure/temperature change.

S17 Winds, Humidity ad Condesnsation

30 June 2024 11:59 PM

Geostrophic Winds :

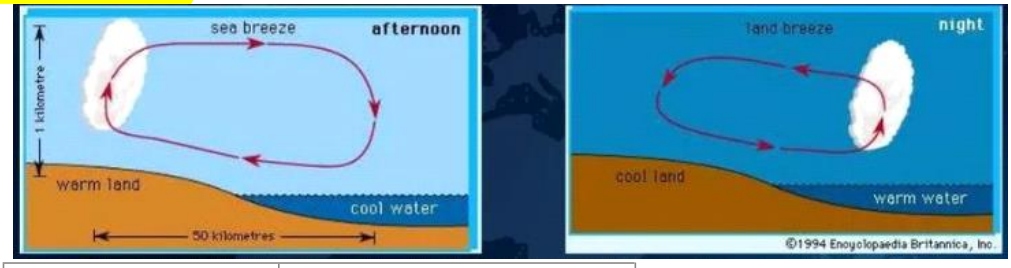
- Those winds with very high velocity
- Bend substantially and start moving parallel to latitude
- Floes at very high altitude, ex : Jet Stream

Local winds :

- Move over small region and only for temporary duration
-

Daily winds	• Land and Sea breeze • Mountain and Valley breeze
Seasonal winds	• Loo • Chinook • Mistral

Land and Sea breeze

- 

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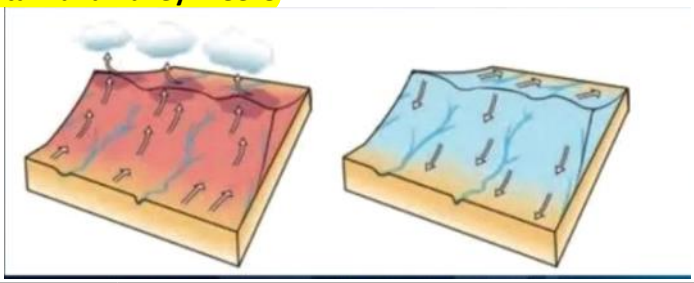
Daytime : Sea breeze	Wind move from sea to land
Nights : Land Breeze	From land to sea

Mountain and Valley Breeze

- 
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Daytime	• Valley Breeze • Valley to mountain, Valley HP • Top mountain -> greater insolation -> warmer -> Low pressure
Night	• Mountain Breeze • Mountain to Valley, Mountain HP • Top mountain very cold -> High Pressure

Loo

- Loo is hot and dry winds, which blows very strongly over the northern plains of India a7JTa.kistan in the months of May and June.
- Their direction is from west to eqst and they are usually experienced in the afternoons. Their temperature varies between 450 C to 500C.

Maximum and Minimum Temperature

Max temp	Is measured around 2 pm
Min temp	Around 5 am
Diurnal range	• Variation bw max and min temp • High range in case of Dry region

Chinooks

- These are warm and dry winds blowing on the eastern slopes (leeward side) of the Rocky Mountain.
- They are called Snow Eaters as they melts the underlying snow cover/ice.

Foehn

- A warm and dry wind like chinook is called 'foehn' along the northern slopes of the Alps mountains., Similar to Chinook
- These are more common during the months of spring and autumn in Switzerland.
- The weather becomes quite pleasant in the valleys due to melting of snow.
- Therefore, valleys of Switzerland are called 'climatic oasis' during winter season.
- These winds help in early sowing of wheat, ripening of grapes and check autumn frost.

Mistral

- Mistral is a cold local win which blows in Spain and France from north-west to south- east direction.
- These winds are more common and effective during winter season because of development of high pressure over Europe and low pressure over Mediterranean Sea.
- The arrival of Mistral causes sudden drop in air temperature to below freezing point.

Blizzard

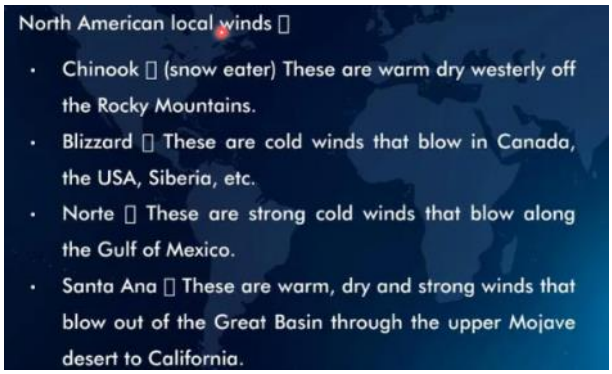
- Blizzard is a violent, stormy, cold and powdery polar wind laden with dry snow and is prevalent in North and South Polar regions, Siberia, Canada and the USA.
- The visibility becomes remarkably low because of snow and ice crystals. The velocity ranges between 80-96 km an hour. The arrival Of these winds causes sudden drop in air temperature to subfreezing level, thick cover Of snow on the ground surface and onset Of cold waves.

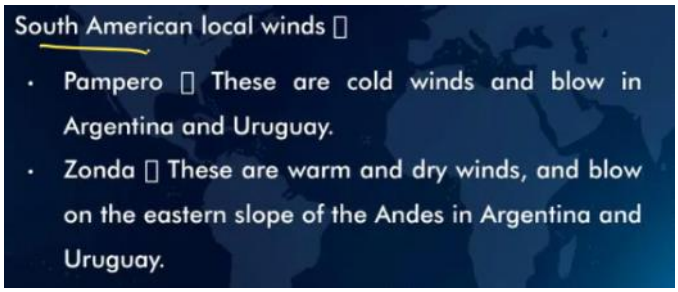
- 

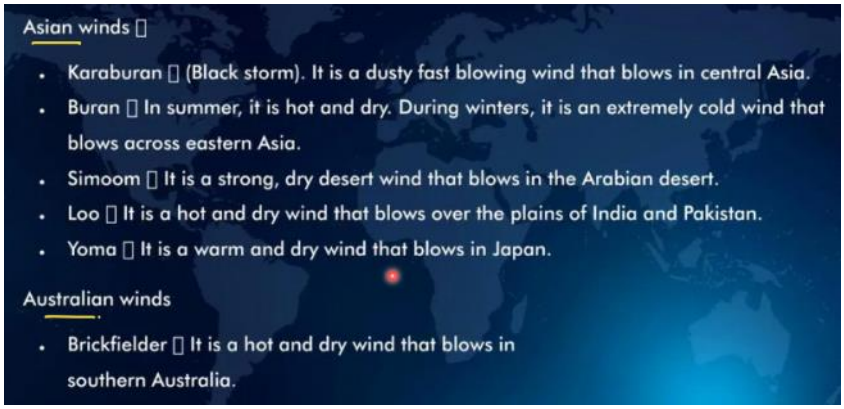
Sirocco

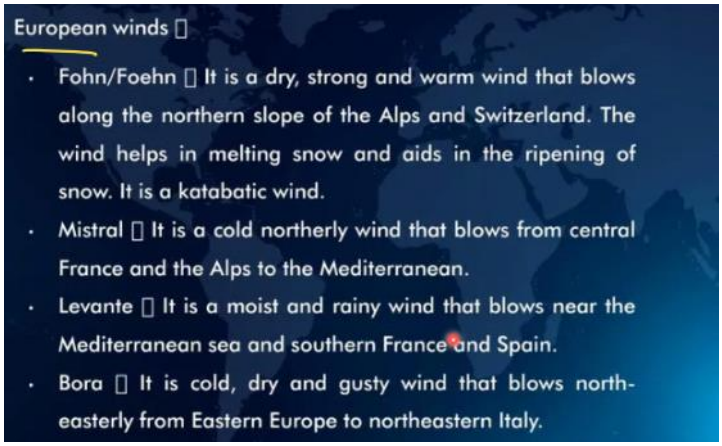
- **Sirocco** is a warm, dry and dusty (full of sands) local Wind which blows in northerly direction from Sahara Desert and after crossing over the Mediterranean Sea reaches Italy, Spain etc.
- Sirocco, while passing over the Mediterranean Sea picks up moisture and yields rainfall in the southern part of Italy where the arrival of rain associated with sirocco is called 'blood rain' because of fallout of red sands with falling rains.

Local Winds









Humidity

- **Humidity :** amount of water vapor present in the parcel of air having a definite volume and temp.
- Carrying capacity of air : Total amount of vapor that a n air parcel can accommodate within itself at that temperature.

Heated air	Particle far away, more water can be accommodated. Warming up of air parcel increases the temp and carrying capacity of air.
Cooled air	Particle close to each other, less space Cooling reduce carrying capacity.

Measure of humidity :

Absolute Humidity :	In 1 m3 of air, measure the weight of vapour. Gm/m3, decreases from equator to pole. Changes with temperature and pressure.
Specific Humidity :	In 1 Kg of air measure the weight of vapor. Volume not fixed. Percentage. Doesn't change with temp.
Relative Humidity :	At any temp compare of moisture which can be carried, ratio with carrying capacity. Changes with temp. As temp increases RH decreases. 

Saturation of air :	If RH = 100%, air cannot hold any more moisture.
Condensation :	• More cooling decreases Carrying capacity below vapor present -> extra moisture will condensed as water droplets. • Condensation happen on surface. -> Dew formation • In case of Goa, dew occur at 27.5*C, which has high moisture content in air But in case of Delhi, dew occur at < 10*C
Clouds:	• Rising air column -> Expands -> Cooling of air -> Condensations -> clouds.

	• Clouds are defined as aggregates of innumerable tiny water droplets, ice particles or a mixture of both in the air generally much above the ground surface. • High pressure are do not experience rainfall.
Frost	Formation of ice after condensation and at very low temperature.

Latent Heat of Condensation :

The energy released during the condensation of water vapour into water droplets and ice crystals and vice versa is known as latent heat of condensation.

S18 Clouds & Fog

06 July 2024 02:13 PM

Thunder and Lightning

- Lightning is flow of large amount of charge in a short time period, -ve -> +ve / zero
- Ice particle falling down, rub with each other and gaining electron and falling particle develop -ve charge. Only happen in dense and thick cloud. Ground surface is zero charged
- Due to high amount of heat flowing, sudden explosive expansion of air occurs -> thunder

Types of Cloud

- All in all, there are ten fundamental types of clouds

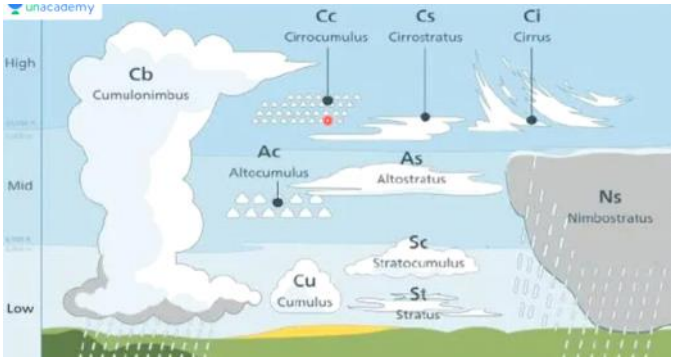
Name indicating altitude of forming

Cirro : (high)
Alto : (mid)

High-level clouds (6-13 km):	Cirrocumulus, Cirrus, and Cirrostratus.
Mid-level clouds (3-6 km):	altocumulus, altostratus.
Low-level clouds (0-3 km):	Stratus, Cumulus, and Stratocumulus.
Multi-layered clouds:	Nimbostratus and Cumulonimbus

Name indicating type of cloud

Cirrus	High altitude cloud, No rain. Feathery, wispy formation, minute ice crystals Yellow and red coloured during sunrise/ sunset. Cloud develops halo 
Stratus	Layered structure of cloud, thin layer large area Can cause mist or drizzle
Cumulus	Accumulation of clouds, puffy and vertical development, heaped up cotton structure. not available in polar region, because we have no evaporation and sinking air. 
Nimbus	Rain bearing clouds, low cloud, long continuous rainfall, lightening Multilayered clouds, vertical extent goes toll middle cloud region. 
Cumulonimbus	Heavy rain, strong winds, tornadoes. Tallest cloud with span extent above 2 km. 



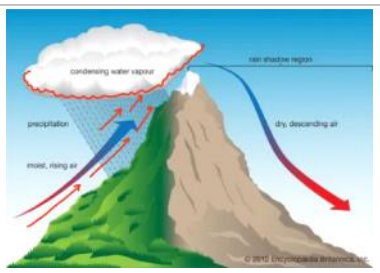
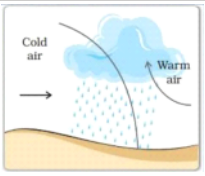
Cloudburst :

- A cloudburst is a localized but intense rainfall activity. Rainfall of 10 cm or more in an hour over a roughly 10 km x 10-km area is classified as a cloudburst event.
- Mostly in hilly region : Himalaya, Western ghats, Creates flash floods
- In Plain region : at point of very Low Pressure

Hailstorm :

- 2 prerequisite condition
  - Presence of cumulonimbus clouds
  - Strong continuous updraft, very low pressure land surface
- When rain melt -> Strong updraft moves up and solidify it -> it freeze and accumulate more material -> fall and melt Again updraft move above -> continuous process create big chunk of ice known as hailstorm.

Type of Rainfall :

Convectional rainfall	• Due to convectional current (heating of land) • Around equator -> high temp of land -> rise of air due to warming formation of cloud : cumulus-> cumulonimbus • Heavy afternoon rainfall.
Orographic or Relief rainfall	 Around equator, tropical islands due to physical barrier
Cyclonic or Frontal rainfall	 Observed in mid latitudes.

Fog :

- Condensation near to ground
- Fog is a cloud with its base at or very near to the ground a cloud that touches the ground
- Fog shows up when water vapor, or water in its

Types of Fog

Radiation Fog	Terrestrial radiation cools the surface suddenly -> air above cools down Condensation happens, which on morning dissipates group upward need clear sky, winter, calm condition
Advection Fog	Formation of fog due to horizontal wind, wind moving from heat to cold area.
Upslope Fog	Winds blow air up a slope (orographic uplift)
Steam Fog	Fog formed when cold and dry air blows over warm water body.
Valley Fog	Cold air from mountain top flows down to warmer air in valley

S19 Air Masses, Fronts & Cyclones

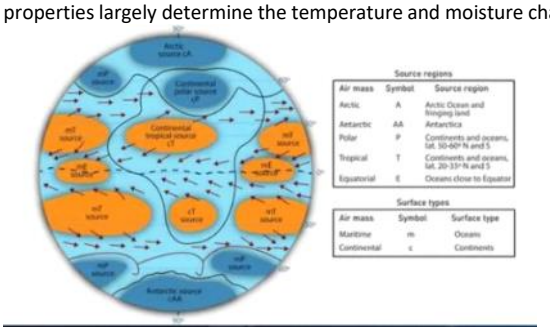
06 July 2024 05:10 PM

AIR MASSES :

- The air with distinctive characteristics in terms of temperature and humidity is called an air mass.
- When the air remains over a homogenous area for a sufficiently longer time, it acquires the characteristics of the area.
- Naming of air mass is done on basis of source region.
- Source Region :

Over Desert	Dry and warm
Over Ocean	Warm and moist air

Source regions :

- The areas over which air masses originate or form are called source regions whose nature and properties largely determine the temperature and moisture characteristics of air masses.
- 

M	Maritime	Very high moisture
C	Continental	Dry air

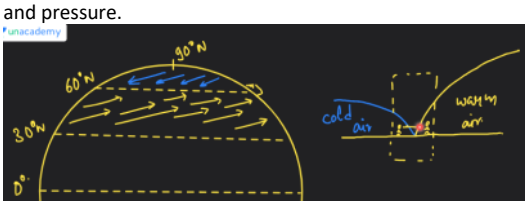
No **cE** airmass present :	• Bc around equator, amount of moisture is very high, due to extreme precipitation, which cannot be name as continental. • Less land mass area present in equator to propose properties of continental.

Properties if air

Cold Air	• Sticks to ground, Heavier, More Dense • Created due to thermal pressure at poles • Always be present, Cold air supply is always maintained.
Hot Air	• Very expansive, greater volume, very light • Generated due to dynamic pressure • Variation can be bit more as compare to thermal pressure

FRONTS:

Zone of transition :	Fronts
Formation :	Frontogenesis Greater temo diff -> fronts have greater frequency and are long lasting

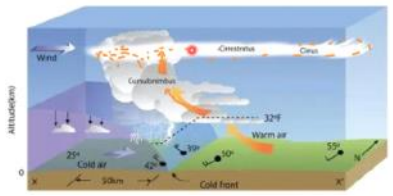
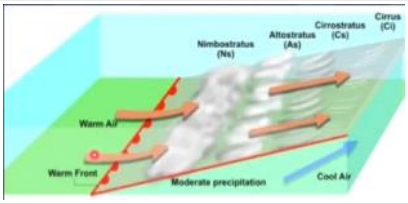
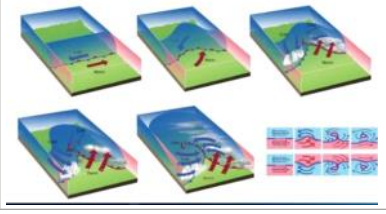
- When two different air masses meet, the boundary zone between them is called a front.
- The fronts occur in middle latitudes and are characterized by steep gradient in temperature and pressure.
- 

How	When diff airmasses come in front of each other creating zone of transition
Where	Mid Latitude
Why	Air Circulation Polar air moves toward lower lat. And westerlies move toward high lat.
When	Throughout the year More frequency in winter season, more temp diff bw poles and tropic

Frontolyzes (Death of Fronts)	• If none of the air masses move into each other, bc of lack of enough energy • Cold and Heat air intermix with each other bc of dilution and there is no sudden transition.

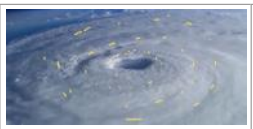
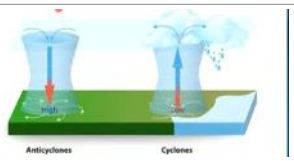
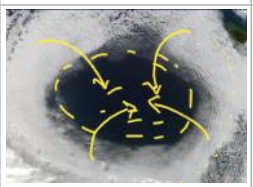
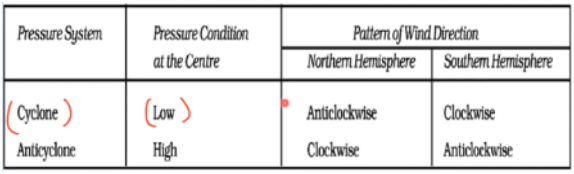
Types of front :

Stationary Front	• When cold and hot air does not move, and both don't have energy to move each other
	• May convert to
	  • Rejuvenation or development of front
	  • Frontolysis (Mixing of air)	

Cold Front	• Cold air moves into region of warm air. • Warm air thrown up violently -> undergo condensation -> Cumulonimbus cloud is created • Heavy storms, lightning & rainfall	
Warm Front	• Warm air moves into region of cold air • Warm air rise gradually above cold air region. -> condensation happen in horizontal manner -> stratus and nimbostratus cloud formation • Moderate but continuous rainfall	
Occluded Front	• As front develops, starts deforming and eventually closes • Closing phase -> Occluded front • After this Frontolysis occurs	

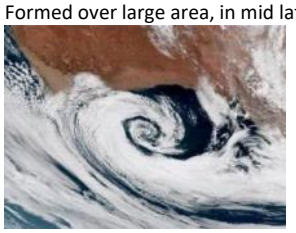
CYCLONES :

- Intense Low pressure system, attracts winds from all sides - > generate circular motion (bc of Coriolis force).
- Wind circulation around

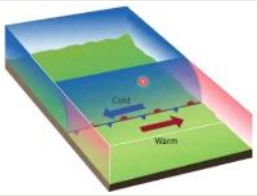
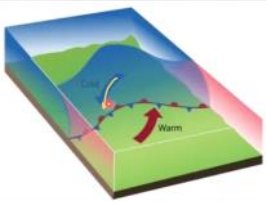
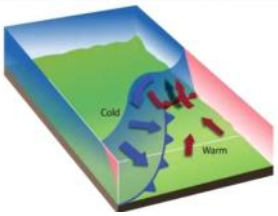
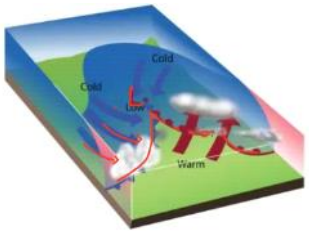
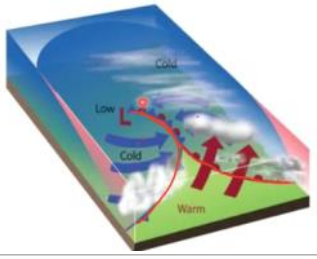
Cyclonic Circulation	• Low pressure • Cloud formation, stormy weather, strong winds, heavy rains. • NH : Anti-clockwise direction (bc of Coriolis force in right direction) SH : Clockwise (bc of Coriolis force in left direction.		
Anti-Cyclonic Circulation	• High Pressure • No cloud, NO rains, calm condition • NH : clockwise SH : anticlockwise		

Pressure System	Pressure Condition at the Centre	Pattern of Wind Direction	
		Northern Hemisphere	Southern Hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise

TEMPERATE CYCLONES :

Where	Formed over large area, in mid latitude areas (35*-65* N/S) 
Why	Formed due to frontal development, prominent in winter.
Move	movement occur in westerlies, move west side to east.

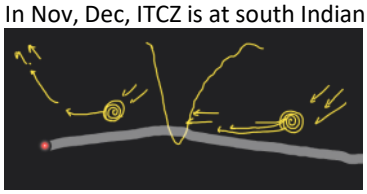
Phase of formation of temperate cyclones :

Stage 1 : Stationary/ Beginning phase		
Stage 2 : Beginning of young adult	• Formation of front • Can intensify into simultaneously development of cold and warm front	
Stage 3 : mature	• Simultaneously development of warm and cold front • More generation of rising air • Intense LP is created • Will attract more winds • More convergence • More generate of rising air • Cold front : Stormy, Strong winds, heavy rains, thunder and lighting. • Warm front: Moderate conditions, med rainfall for prolonged period.	
Stage 4 : Beginning of occlusion	• The front begin to close • As Cold air continuous to uplift the warm air, leaving cold air only on the surface.	
Stage 5: Late Occlusion or Dissipation	• As the ground is enveloped with cold air, front dissipates • Leads to the dissipation of cyclone	

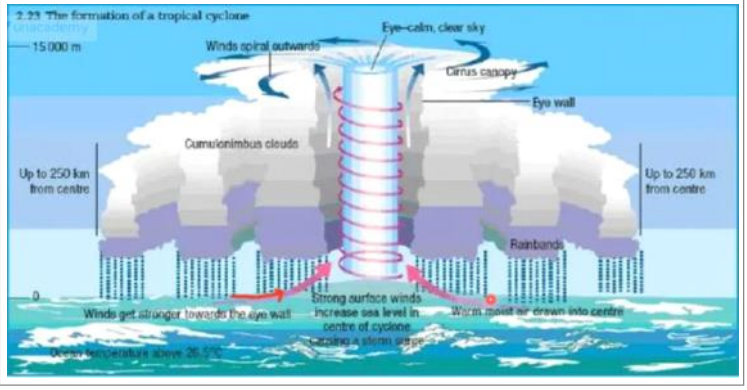
S20 Tropical Cyclones

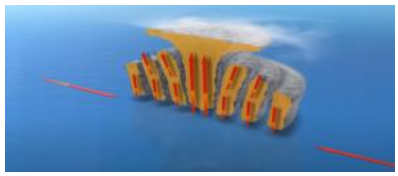
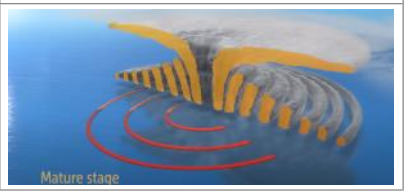
06 July 2024 10:56 PM

TROPICAL CYCLONES :

What	• Very small in size, for 1 week, Wind velocity is very high -> High Destructive capability • Also known as Heat engine, LP attracts winds -> rise up - > condensed -> latent heat released -> increase temp -> intensify low pressure -> attracts more wind • Gets strong over water bodies : gain moist winds over ocean. • Cannot develop over land bodies : lack of moist area.
Where	Above region of water bodies
Names	• Cyclones in the Indian Ocean, • Hurricanes in the Atlantic, • Typhoons in the Western Pacific and South China Sea, and • Willy willies in the Western Australia. 
Conditions	• Large sea surface with temperature higher than 27* C (To seed water vapour) • Presence of the Coriolis force (No Cyclone over equator) • Small variations in the vertical wind speed (Otherwise newly formed cloud will move) • A pre-existing weak low-pressure area (to intensify and jump start cyclone)
Movement	• Move toward ITCZ in April, May, June : hits Odissa and Bengal, Gujarat  • In Nov, Dec, ITCZ is at south Indian position : hits Andhra Pradesh, Tamil Nadu, Gulf 

Formation of tropical cyclone



Stage 1 : Start of warming air rising ,creating LP area, winds comes from around to fill gap and gets warm up too	
Stage 2 : Condensation and formation cloud	
Stage 3 : Mature state, rotation due to Coriolis force and formation of eye of cyclone	

Wind Shear :

- Is the difference in wind velocity at various altitude.
- Difference in Speed bw surface winds and high altitude winds.
- Should be minimum to allow formation of cyclones

Coastal Flooding :

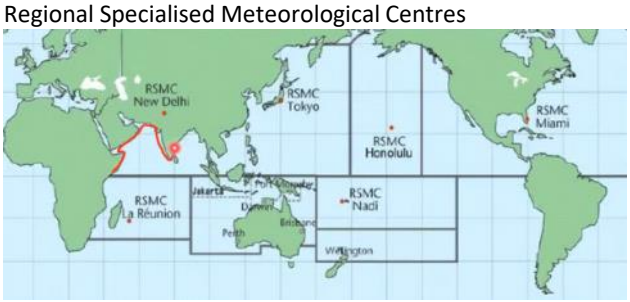
Strom Surges :	• Abnormal rise of water generated by a storm, over and above the predicted tides. • Storm dargs surface water due to friction force, brings large wave and flood coastline
Intense LP :	• Upliftment due to intense low pressure -> bulge in water • When cyclone moves to land, bulge transfer to the land -> coastal flooding
River floods :	• Temp rise of sea level, river water will not be able to evacuate to sea • River water will pile up and spill near the coastline

BOMB CYCLONES :

- Sudden exponentially Destructive and strong accelerated cyclone
- Whenever Cyclone develop, but sometime LP intensifies more than predicted (Bombogenesis / Explosive Cyclogenesis)
- Due to heating or wind movement/rise -> LP dropping more than 24mb within 24hrs
- More prominent in temperate cyclone

Naming of Cyclone :

- To make people aware of cyclonic treats

RSMC	Regional Specialised Meteorological Centres  Name the cyclone in their region Name selected iteratively given by 15 countries one by one.
TCWC	Tropical Cyclone Warning Centres Keeps monitoring temp and pressure of oceans

Difference between Tropic and Temperate Cyclone

Tropic	Temperate
Smaller in size (500km)	Larger (750-100 km)
Strong destructive winds	Moderate winds
Formed only over oceans	Can be formed any where
Moves EW under Trade	Moves WE under westerlies
Always have eye	Can have an eye
Lower latitude	Mid Latitude
Summer Season	Mostly in winters

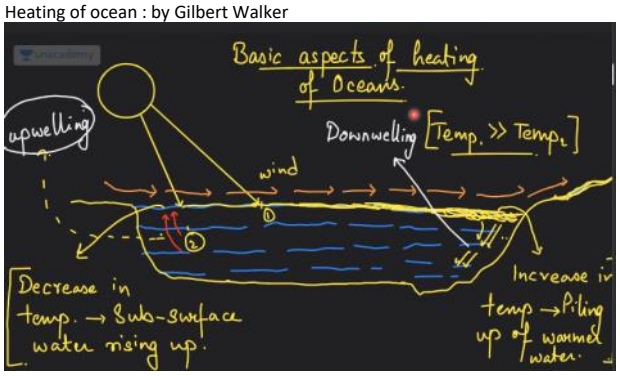
Effects of Air Masses on Climate

Influence	temperature by advection
Precipitation	caused by maritime airmasses (When moved to landmass cause rainfall)
Frontals	Causes Frontogenesis
Cyclones	Temperate Cyclone can be created

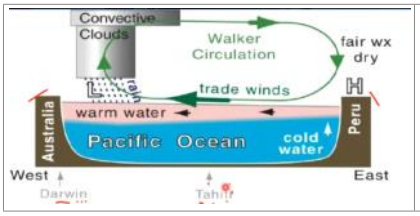
S21 Atmospheric Phenomena

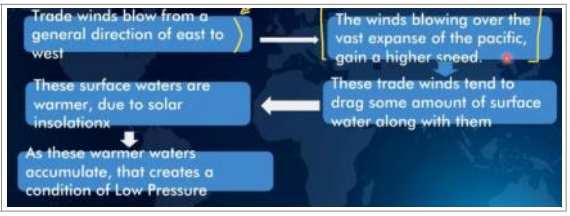
07 July 2024 12:35 AM

Walker cell :

- Heating of ocean : by Gilbert Walker
- 

WALKER CIRCULATION :

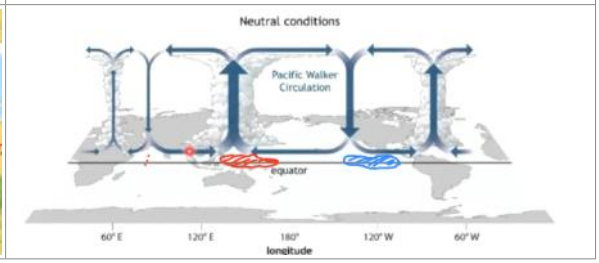
- 

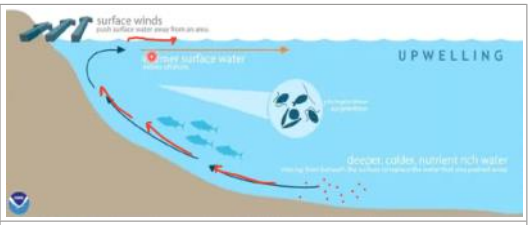


- The longitudinal (east-west) circulation across the equatorial Pacific is known as the Walker Cell or Walker circulation.

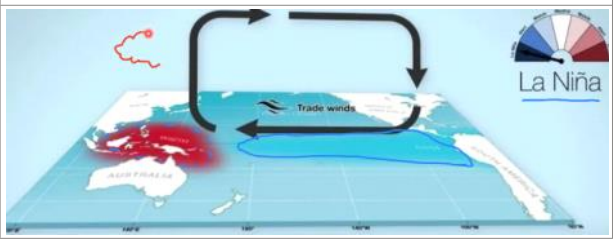
Downwelling near Australia	• Temperature increases, Low pressure Wind reach, warm up, rise up forming clouds, Australia receive rainfall.
Upwelling near south America	• Temperature decreases, HP

- 



Upwelling	• Winds blowing across the ocean surface push water away. Water then rises up from beneath the surface to replace the water that was pushed away. This process is known as "upwelling". Upwelling occurs in the open ocean and along coastlines. • Offshore winds • Beneficial for fishes : brings nutrients from beds -> promote planktons grow -> marine food chain	
Downwelling	• The reverse process, called "downwelling," also occurs when wind causes surface water to build up along a coastline and the surface water eventually sinks toward the bottom. • Onshore winds	

El Niño (ENSO)	• ENSO refers to the El Niño / Southern Oscillation, the interaction between the atmosphere and ocean in the tropical Pacific. • When the wind (Responsible for poling up of water) stops, water push back • Due to excessive heating -> Hp weakens -> Trade winds weaken (as HP is source of Trade winds) -> Flowback of water from W to E (Warm surface water) • Low pressure in eastern area -> Winds move toward east pacific -> Upwelling in W Pacific	
Normal Condition	• Representation of Walker cell • Trade winds help accumulate warm waters in the western equatorial pacific ocean while cold waters emerge in the eastern equatorial pacific ocean. • These cause rainfall in the region of Northern Australia while due to High pressure, there is a lack of rainfall across the western coast of South America.	

La Niña	• These are the conditions where a significant Low Pressure develops across the Western Equatorial Pacific Ocean, while an intensified High Pressure develops over Eastern Equatorial Pacific Ocean. • In a way, it is an intensified walker circulation. It leads to flood like conditions across Northern Australia while leading to drought like conditions across western part of South America. • Phase of cooling of Pacific, opposite of El Niño (Girl Child)	

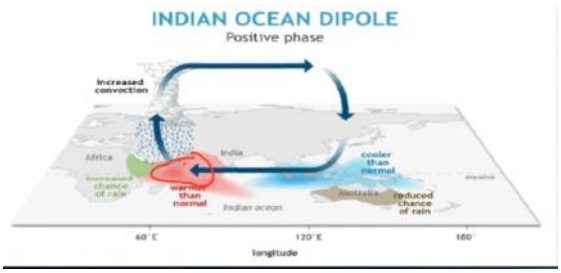
El Niño and the Monsoon

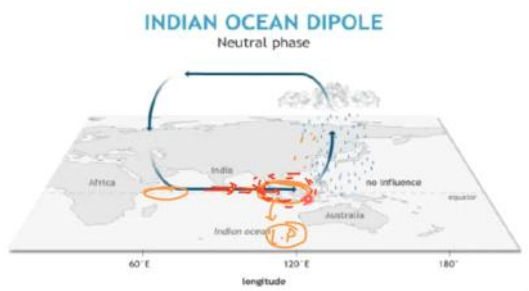
Year	Occurrence	Impact	Monsoon*
2004	El Nino	Drought	88%
2005	Neutral	Normal	101%
2006	Neutral	Normal	103%
2007	La Nina	Excess	110%
2008	La Nina	Above normal	105%
2009	El Nino	Severe Drought	79%
2010	La Nina	Normal	100%
2011	La Nina	Normal	104%
2012	Mild El Nino	Below Normal	92%
2013	Neutral	Above Normal	106%

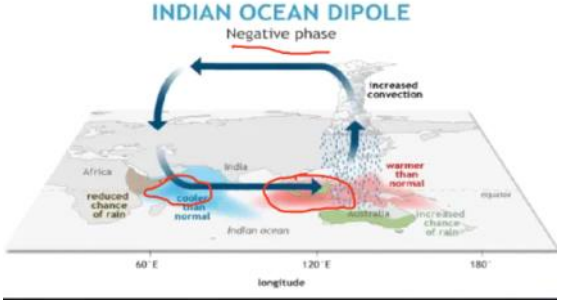
1999 : Strongest El Nino

Indian Ocean Dipole :

- Called the 'El Nino of the Indian Ocean',
- The Indian Ocean Dipole (IOD) is defined by the difference in temperatures between two areas (or poles, hence a dipole) of the Indian Ocean — a western pole near the Somalia coast (western Indian Ocean) and an eastern pole in the eastern Indian & Ocean south of Indonesia.
- IOD is a sea surface warming phenomenon with different regions of the Indian Ocean heating up at a different rate due to: The properties of the nearby landmass, prevailing wind patterns, oceanic circulations etc.
- This induces a thermal pressure difference across the eastern and western end of the Indian Ocean. Which in turn initiates atmospheric circulations and also influences the impact of 'impact of ENSO cycles across Indian ocean'.







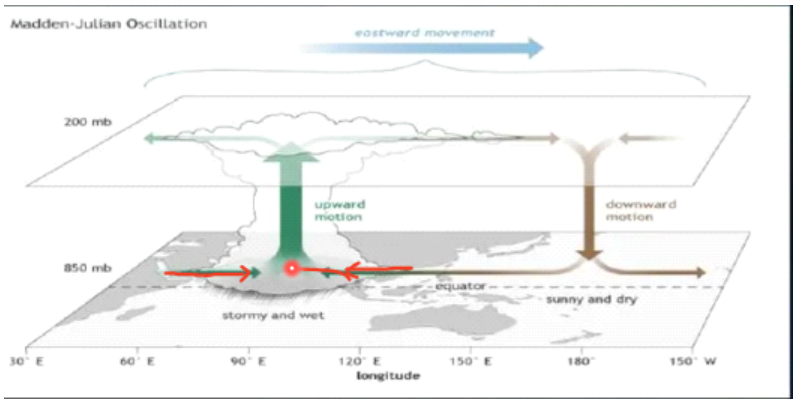
EL Nino	IOD	India
Neutral	+ve	High
El nino	+ve	Less than normal
La nina	+ve	Excess
Neutral	-ve	Less than normal
El nino	-ve	Drought
La nina	-ve	Slightly more than avg

S22 MJO, Jetstream

10 July 2024 04:14 PM

Maddedn julian Oscillation (MJO)

- The MJO is an eastward moving disturbance of clouds, rainfall winds, and pressure that traverses the planet in the tropics an returns to its initial starting point in 30 to 60 days, average. Each cycle lasts approximately 30—60 days.
- 30 to 50 days cycle
- 

- 

- The MJO consists of two parts, or phases:

a. the enhanced rainfall (or convective) phase and	Rain
b. the suppressed rainfall phase.	Calm

JET STREAMS

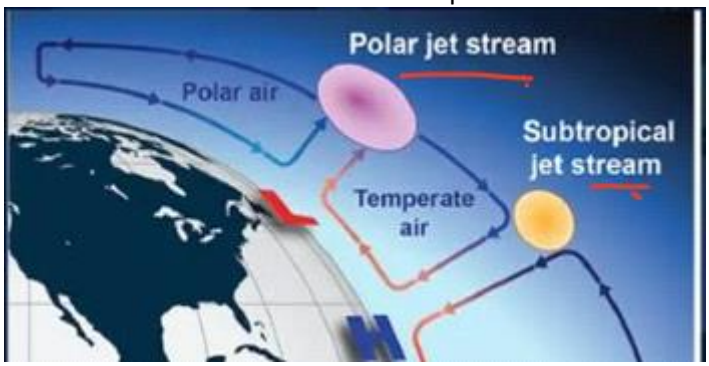
- High altitude ,high velocity winds blowing parallel to latitudes. (rivers of air and wavy in x y direction)
- Found by Weather balloon experiment.
- More studied in WWII, Speed to jet reduce when moving USA-> Japan, and speed increase when move to Japan->USA , Something in Troposhpere which affect speed.

- Jet streams are relatively narrow bands of strong wind in the upper levels of the atmosphere.
- The winds blow from west to east in jet streams but the flow often shifts to the north and south.
- Jet streams travel in the tropopause—the area between the troposphere and the stratosphere—at heights of about 8 to 15 Kilometres (5 to 9 miles).

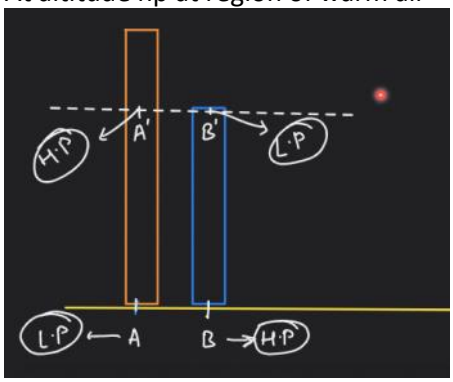
Shape	The strong air currents, which tend to look like wavy, striated rivers when seen on a jet stream map, form when cold air and hot air meet.

Formation

- Thermal Difference at higher altitude
- Formation of Jet where different temp current meet
-

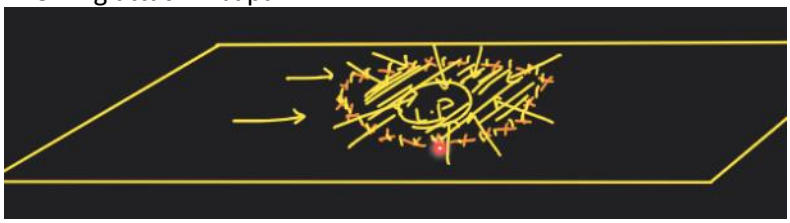


- Pressure Gradient forces :
- At altitude hp at region of warm air-> creating wind from region of the warm points



- Jet streams are stronger in winter in the northern and southern hemispheres, because that's when air temperature differences that drive them tend to be most pronounced.
- The actual appearance of jet streams result from the complex interaction between many variables - such as the location of high and low pressure systems, warm and cold air, and seasonal changes.
- They meander around the globe, dipping and rising in altitude/latitude, splitting at times and forming eddies, and even disappearing altogether to appear somewhere else.

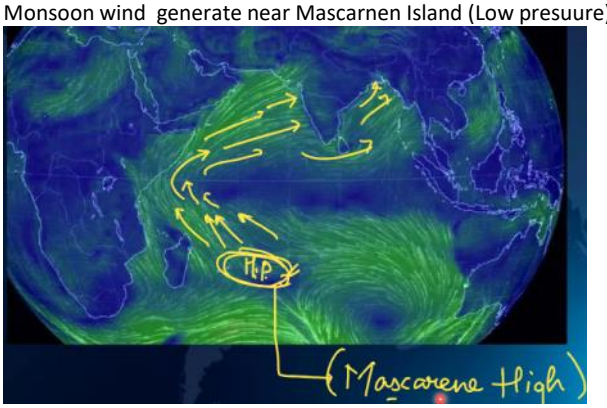
Fire Ring attack in Japan



S23 Indian Monsoon

23 July 2024 08:58 AM

Monsoon wind generate near Mascarnen Island (Low presuure)



JETSREAM EFFECT ON MONSOON

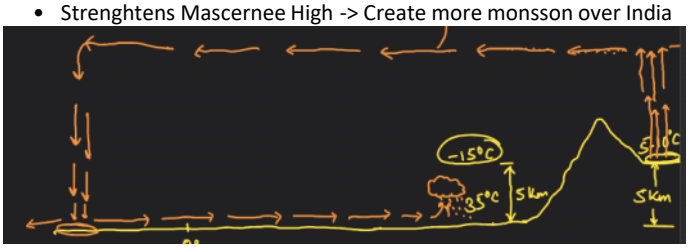
- Subtropical Westerly Jet (NH) -> Divides to -> two distcinct branches
  Act as an air barrier -> does not allow the air from 1 region to other

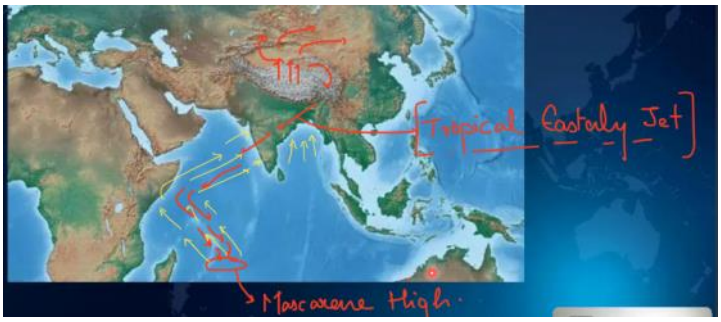
- With change in season Strengthening of one branch is seen
- These are the Jet streams which tend to develop over the region of subtropical high pressure belt.
- During the winter months, these iets lie over the northern part of the Indian subcontinent, having a distinct northern and a southern branch.
- With the onset of summer season, as the ITCZ shifts north, the southern branch of the Jet Stream starts weakening.

- Once the southern branch disappears, the N Branch gets strong, once disappear finally allow movement of monsoon movement
- As long as southern branch is present -> we have moist wind parked at the coastline near the shore but no further movement

FORMATION OF TROPICAL EASTERLY JETS

- Heating of Tibetan Plateau
- The Tibetan highlands are the highest plateau across the world and comprise of rocky structures.
- As a result of this, heat is gained and lost very quickly by these rocks.
- Upper winds (80-90 Km) Jet Stream
- Strenghtens Mascernee High -> Create more monsson over India



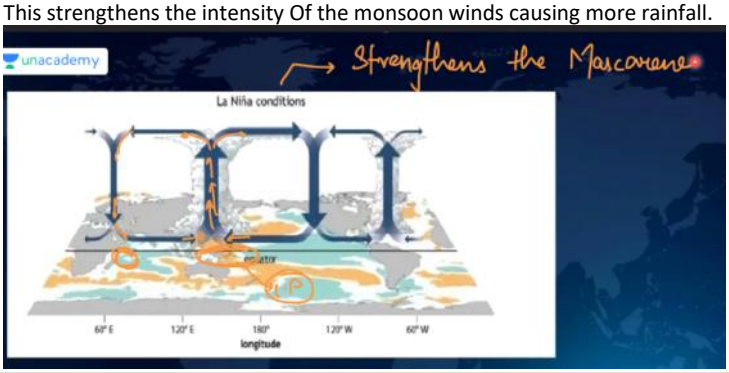


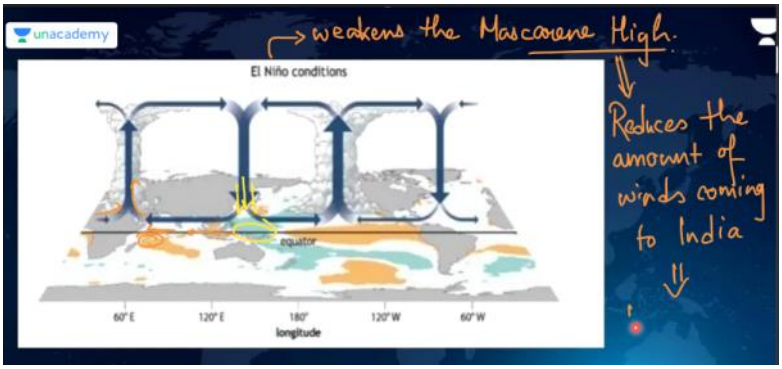
MASCARENE HIGH

- Is a subtropical HP -> Driver of trade winds moving to India
- This is a zone of high pressure which exists around the Mascarene Islands in Southern Hemisphere and hence, the region is ref erred to as Mascarene High.
- During the monsoon months, when it is winter in the southern hemisphere, this region of high pressure is the source of winds which travel across the Indian
- Ocean to reach the ITCZ which lies over India. Stronger the high pressure, more is the rainfall received during the monsoon s eason.

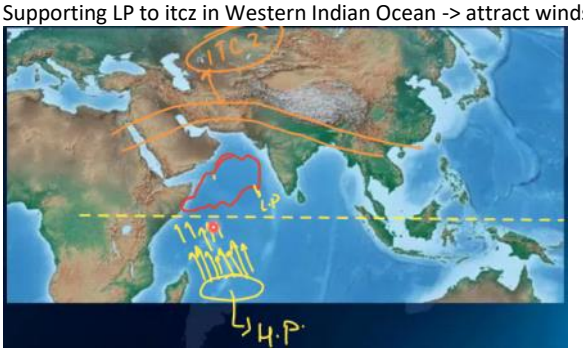
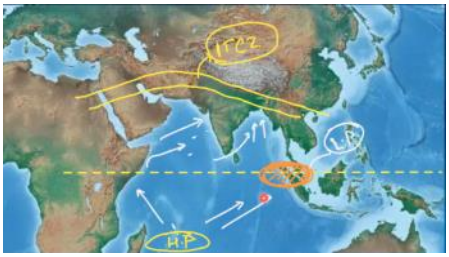
EFFECT OF EL NINO and LA NINA

- Heating of oceanic waters in the Pacific; which ends up creating ENSO conditions in the Pacific Ocean, also end up having a d istinct influence over the Indian Monsoon.
- Conditions of El Nino, decreases the overall rains received by India during the monsoon months.
- Conditions of La Nina on the other hand leads to a surplus amount of rain during the monsoons in India.

Impact of La Nina	• Due to heating of the western pacific, there is creation of low pressure over the region. • The air rises up, forms clouds, and after that diverges from the region of tropopause in the eastern and the western directions. • The part which moves to the west, eventually subsides in the region of mascarene high, thereby strengthening the mascarene high pressure. • This strengthens the intensity Of the monsoon winds causing more rainfall. 
Impact of El Niño	• Due to heating of the eastern pacific, there is creation of low pressure over the region. • The air rises up, forms clouds, and after that diverges from the region of tropopause in the eastern and the western directions. • The part which moves to the west, induces a circulationwhich eventually weakens the high pressure system in existence in the region Of mascarene high. • This weakens the intensity Of the monsoon winds causing a shortage of rainfall.



EFFECTS OF INDIAN OCEAN DIPOLE

Positive	Warmer waters present in western part of Indian Ocean Supporting LP to itcz in Western Indian Ocean -> attract winds toward India -> Heavy Monsoon 
Neutral	LP in eastern Indian Ocean -> Diverts winds -> Weaker monsoon 
Negative	LP in eastern Indian Ocean -> Diverts winds -> Weaker Monsoon

MECHANISM OF SOUTH WEAT MONSOONS

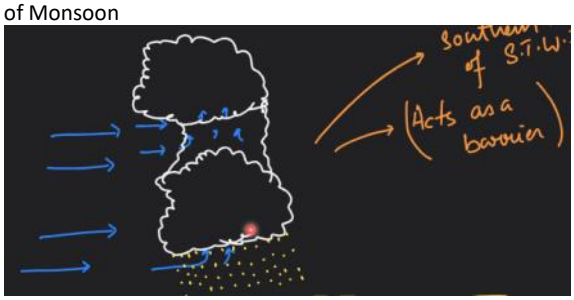
- Heating of lands -> intense LP is created -> ITCZ shifts over India -> Will attract winds form SH -> winds cover large oceanic expanse -> winds carry large amount of moisture
- Onset Of Monsoon -> with Disappearance of Southern Branch of Jetstream
- Tropical Easterly Jets -> Further Strengthens the Monsoons.

DISTRIBUTION OF MONSOON

- Onset of Monsson (beginning) -> rainfall in Kerela coastlines
- Release Rainfall -> Winds moves to Bay of Bengal -> NE India -> Heavy rainfall
- Western India -> Western ghats -> forced rise of air -> High amount of rain
- Move north -> Confronts Aravalli hills -> hits southern part of parallel Aravalli hill ->Southern Rajasthan -> rainfall
- Bay of Bengal -> East to west -> rain in UP Bihar
- All converge to north India -> Intense rise up in Himalaya -> Cloudburst
- 

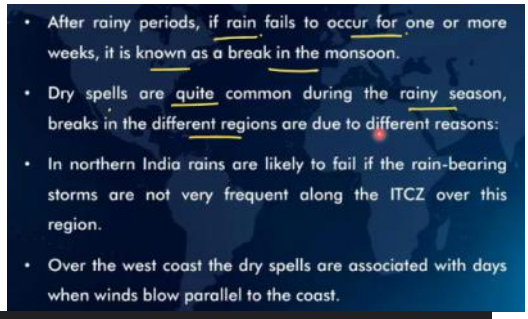
BURST IN MONSOON

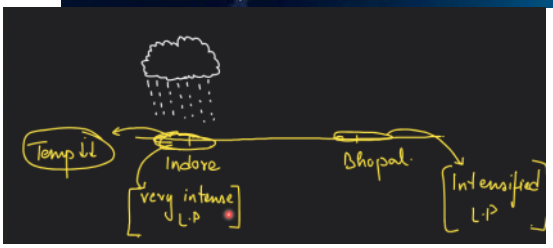
- Disappearance of Southern branch STWJ -> A significant rush in air movement -> Moisture heavy winds rise up due to intense low pressure on the ground -> Lower air and upper air convection happens -> forms dense clouds (km thick) -> Continue rains for a duration of 4-7 days -> Burst of Monsoon

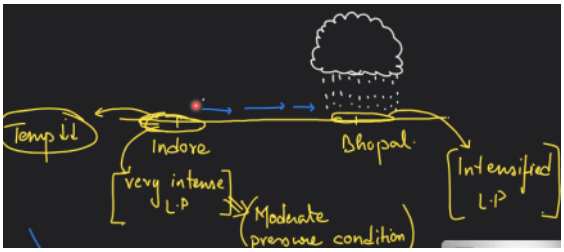


BREAK IN MONSOON

- Change in pressure condition and local levels
- Winds direction often time changes -> Induces 5-7 days of dry condition







RETREAT OF MONSOON

- Withdrawal of monsoonal winds from India
- Retreat is initiated around 17th Sep, is a slow process can take 1-2 month
- Withdrawal is imitated from NW part of the contry
- Direction of wind is NE to SW
- Area which receives rainfall is Coromandel Coast (moist winds from Bay of Bengal)
- Tropical Cyclone in region of northern indian ocean in oct-nov months

NORTH EAST MONSOON

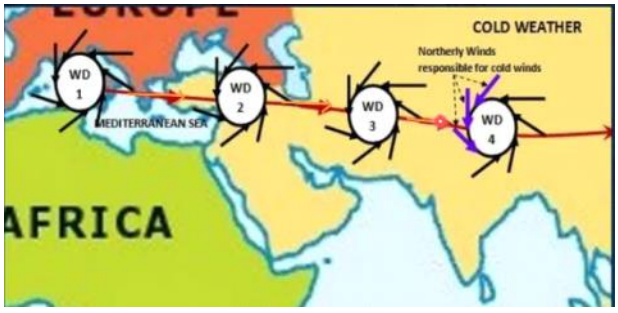
- Potwar plateau -> Sep onwards -> Cold Region -> Localised HP-> Winds movement toward south -> trade winds -> Wind direction NE to SW
- Gets establish after Complete removal of ITCZ from India (retreast of monsoon)
- Rainfall in some area of NE and Coromandal costline
- Duration -> Dec and Jan

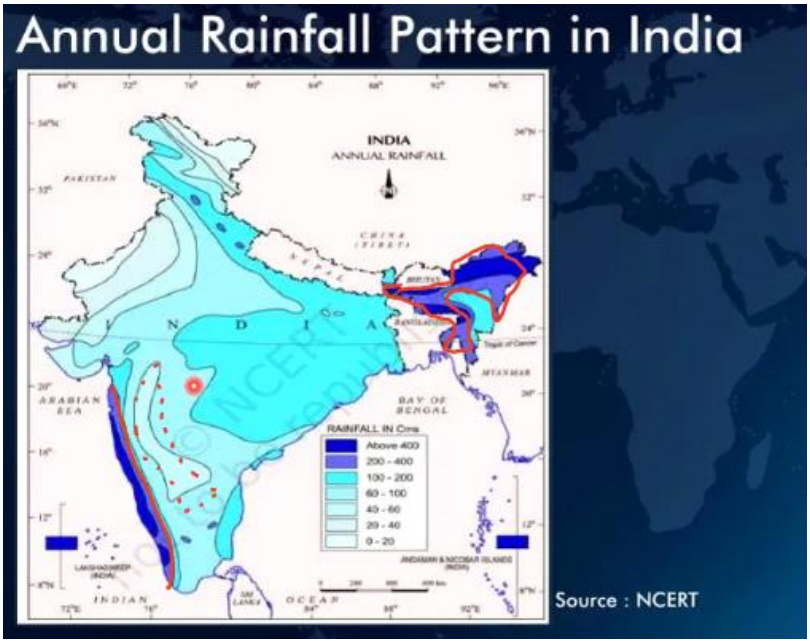
PRE MONSOON SHOWER

Mango Shower :	• Towards the end of summer, there are pre-monsoon showers • Kerala and coasta areas of Karnataka. • They are called mango showers as theyhelp in the ripening of mangoes.
Nor Westres	• Dreaded evening thunderstorms. • Their notorious nature can be understood from the local nomenclature Of Kal Baisakhi', a cal&nity Of the month Of Baisakhi in Bengal and Assam. • These showers are useful for tea, iute and rice cultivation. • In Assam, these storms are known as "Bardoli Chheerha".

WINTER SEASONS

- Western Disturbance : These low-pressure systems, originate over the Mediterranean Sea and western Asia and move into India, along with the westerly flow and are hence known as western disturbances.
- They cause the much-needed winter rains over the plains and snowfall in the mountains. Although the total amount of winter rainfall locally known as 'mahawat' is small, they are Of immense importance for the cultivation Of 'rabi' crops.

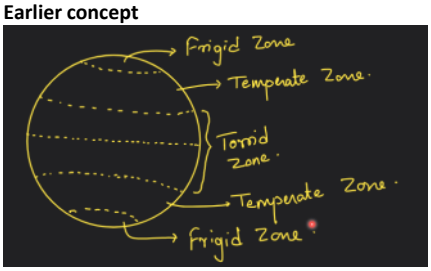



Annual Rainfall Pattern in India
INDIA
ANNUAL RAINFALL
PAKISTAN
CHINA (TIBET)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
SRI LANKA
RAINFALL IN Cms
Above 400
200 - 400
100 - 200
60 - 100
40 - 60
20 - 40
0 - 20
Source : NCERT

S24 World Climate

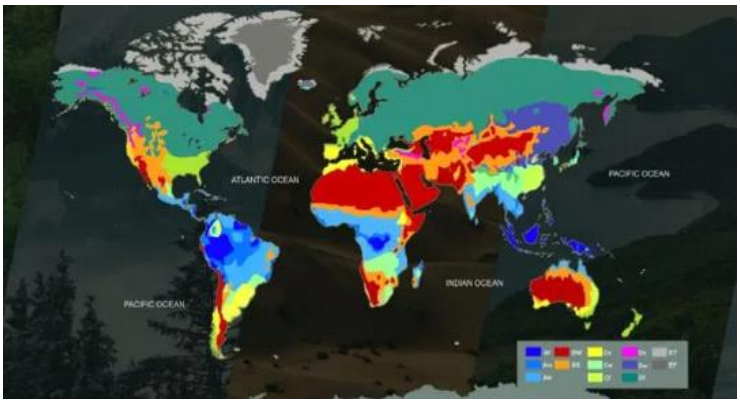
23 July 2024 05:41 PM

Earlier concept



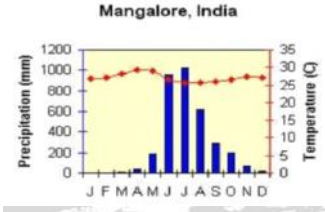
Koeppen's Classification

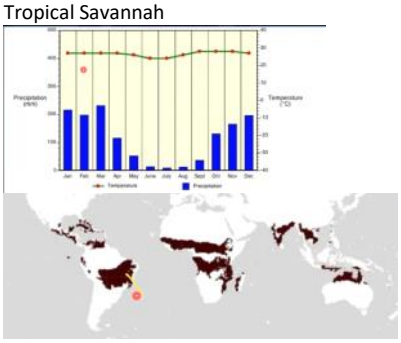
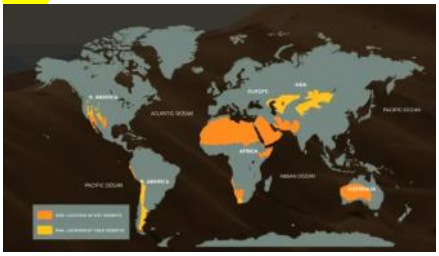
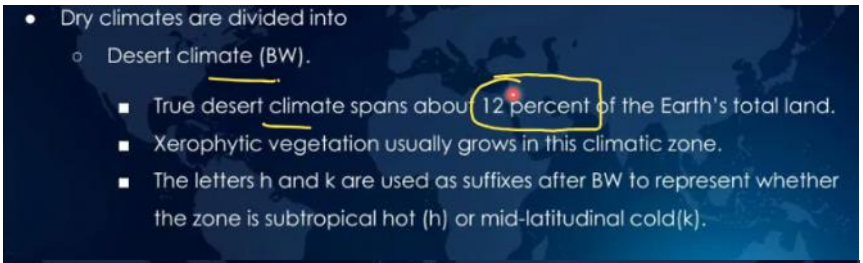
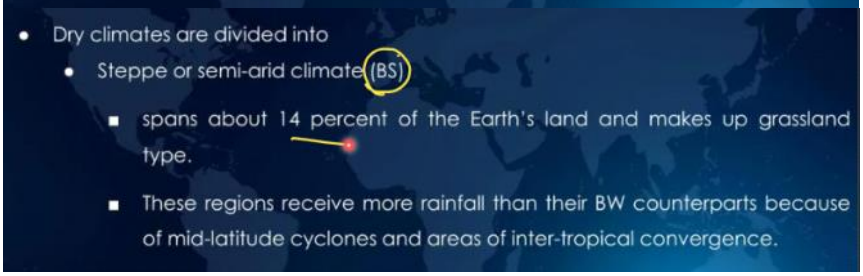
- On basis of Candolle document on distribution of natural vegetation over planet
- Vegetation depend upon rainfall and temperature -> will get idea about climate

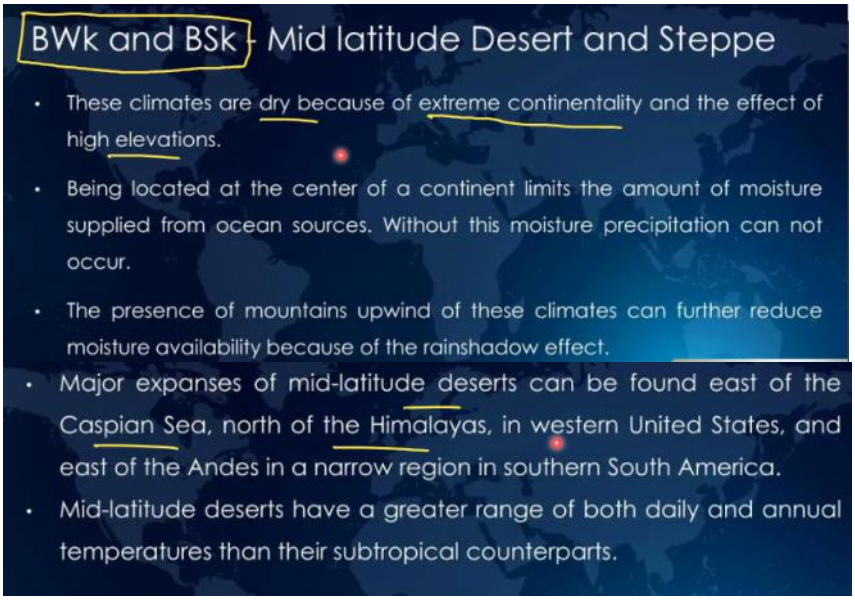
- 

- Climate Indication

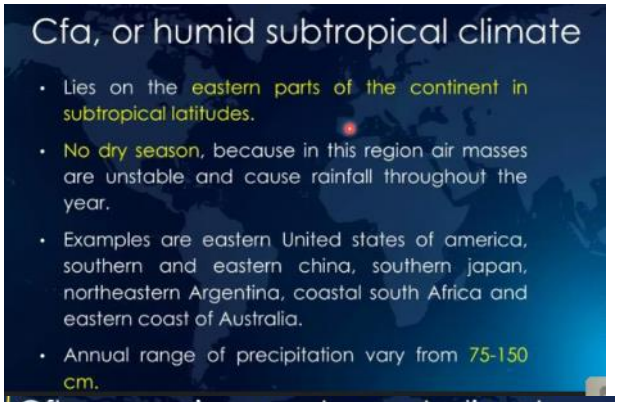
A	Tropical Humid Climate	Avg Annual temp > 18*C Humid tropical climates ; warm and moist conditions throughout the year and mean temperature always above 18*C • Tropical humid climates exist between Tropic of Cancer and Tropic of Capricorn. • The sun being overhead throughout the year and the presence of the Inter Tropical Convergence Zone (ITCZ) make the climate hot and humid. • Annual range of temperature is very low and annual rainfall is high.

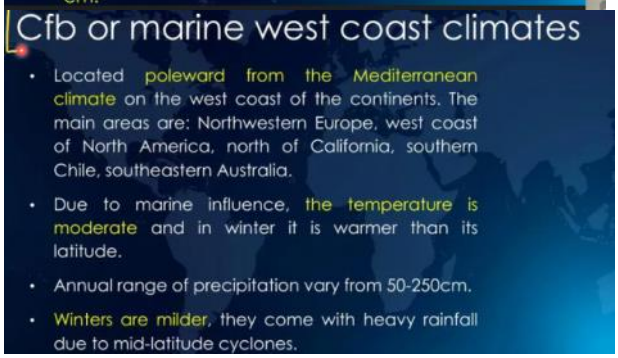
Af Tropical wet climate	• Equatorial Climate , High rainfall throughout year • Rainfall thorughout year, 300cm-400 cm every year • Low annual range of temp (3*C), High Average annual temp • Humidity is extremely high and the surface temperature results in the formation of cumulus and cumulonimbus clouds in the early afternoon time, daily. This results in high rainfall. • Tropical evergreen forests with dense canopy cover and large biodiversity. • "Equal" day length • Dense Evergreen forest of tall trees for sunlight • Forest floor -> minimal sunlight -> Lack of vegetation -> Herbivores population less -> Trees dependent animal high like Monkeys, bird, Insects (Frog, snakes, amphibians, reptilian)	EX : Peru, Amazon Basin, Congo rover Basin, Philippines etc. 
Am Tropical monsoon climate	• Annual rainfall is similardo that of Af, but precipitation usually occurs within the 7-9 of the warmest months of the year. • During the rest of the year. there is less precipitation. Winter is dry • Found over the Indian sub-continent, North Eastern part of South America and northern Australia. • Heavy rainfall occurs mostly in summer. • Tropical Broadleaf evergreen forests deciduous trees and Trees shed theorf leaved during dry season	Wetstern Ghats 

			• High population of Herbivores	
		Aw Tropical wet and dry climate	• Distinct wet and dry season • Wild fires common due to dry and dense grass presence • The wet season is shorter and the dry season is longer with the drought being more severe. • Temperature is high throughout the year and diurnal ranges of temperature are the greatest in the dry season. • Tall to short continuous grasslands with scattered trees. Deciduous forests. • Northern and eastern India, Interior Burma, Llanos of Venezuela, campos of Brazil, western central Africa etc.	Tropical Savannah 
B	Deserts	• Dry Climate, • Precipitation < Evaporation • Dry climates are characterised by very low rainfall hat is not adequate for the growth of plants. • Large diurnal temperature range, highest daytime temperature. • Evaporation and transpiration play a greater role in shaping the vegetative state than temperature. • Plants : Xerophytes (no leaves no water loss by transpiration) like cactus • Bwk : Cold Desert BWh : Hot Desert  • Deserts : Ocean current, Continentality, Region of subtropical HP zone (Sinking air, no rains)   	

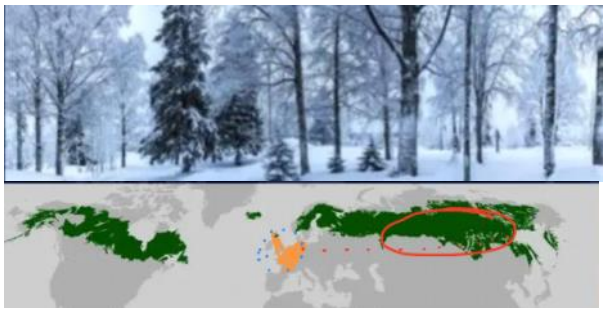


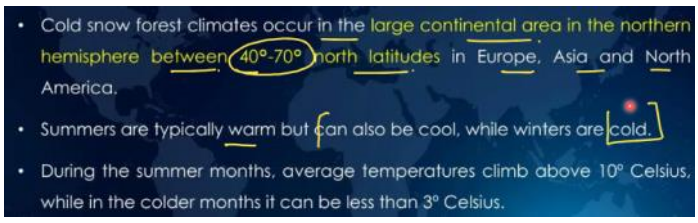
C	Moderate	Winters not cold, summer not hot Mild winters, average temperatures of the coldest and warmest months beings between 8* to 18*, and 22*C respectively

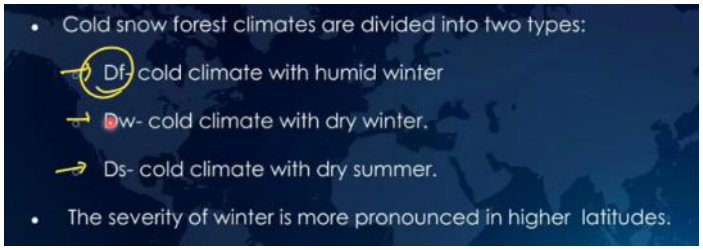
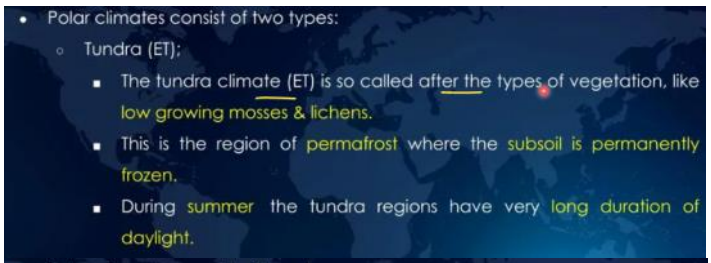
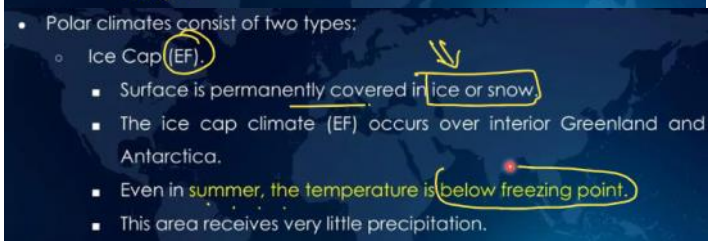




D	Cold Snow Forest	Frozen Winters Average temperatures of coldest and warmest months being below -3*C and above 10*C respectively





		 •  • 
E	Polar Climate	Polar climates characterrized by summerless season  •  • 
H	Highland	Places at elevation

Temperate Grasslands	Mid Latitude
NA	Prairies
SA	Pampas

Central Asia	Steppes
Hungary	Puszta
South Africa	Veld
Australia	Downs
New Zealand	Canter burry

- Indication of rainfall

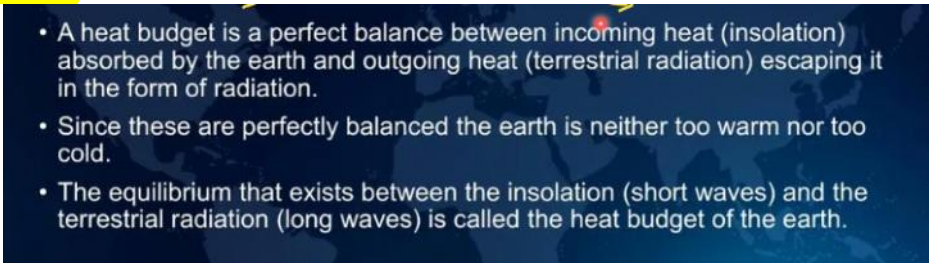
f	Rainfall throughout the year, no dry season
m	Monsoonal Rainfall,
s	Summer dry season, winter rains
w	Summer rains, winter dry season

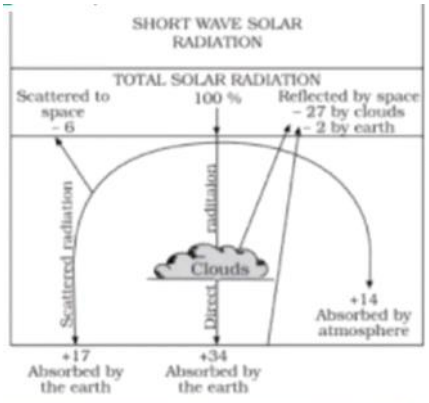
- Classification of deserts

h	Hot Desert
k	Cold Desert , avg annual temp <18*C
W	True Deserts
S	Semi Arid Climate

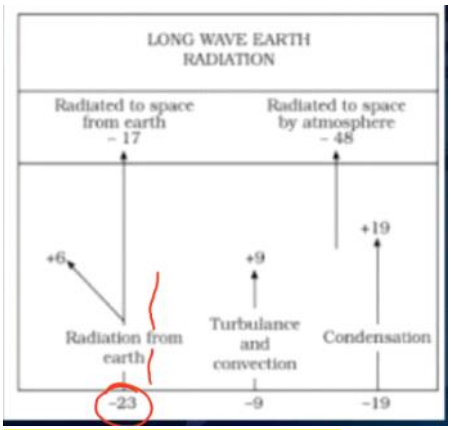
- For temperature a, b, c, d used

HEAT BUDGET

- 

- 

Heat absorbed by surface : 17+34 = 51%

- 

Heat radiacted back : 23 +9+ 19 = 51%

- If the total insolation received at the top of the atmosphere is considered to be 100%, a certain amount of energy is reflected, scattered and absorbed while passing through Earth's atmosphere and only the remaining amount of radiation reaches the earth's surface.
- Approximately 35 units are reflected to space even before reaching the earth's surface.
- Of these, 27 units are reflected from the top of the clouds and 2 units from the snow and ice-covered areas of the earth. The reflected amount of radiation is called the albedo of the earth.
- The remaining 65 units are absorbed, 14 units within the atmosphere and 51 units by the earth's surface. The earth radiates back 51 units in the form of terrestrial radiation.

S25 Oceanography

24 July 2024 11:48 AM

OCEANIC RELIEF

• Land under the waters of the oceans exhibits and complex varied features, these are formed by the factors of

Tectonic	mid Oceanic ridge, Oceanic trenches
Volcanic	Seamounts
Depositional / Erosional process	Guyots, Submarine canyon, deep sea plains, continental shelf, Continental rise, Continental slope.

Seamounts & Guyots

- 

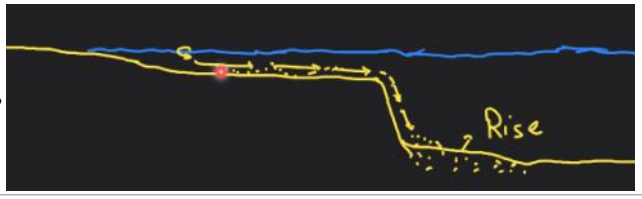
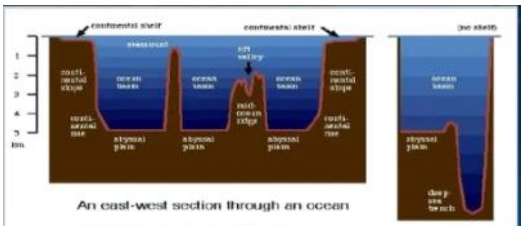
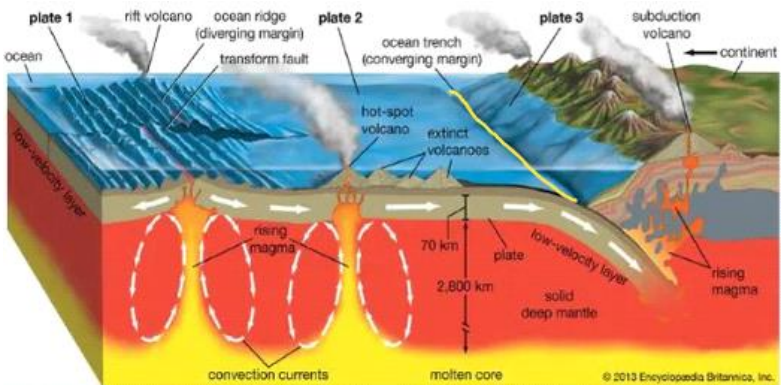
- Seamount : Under Water volcanic eruption create mountain under the sea surface
- Guyots : Seamounts oftentimes gets eroded by the action of the sea -> creates a flatten top

Division of Ocean Floor

- Besides, these divisions there are also major and minor relief features in the ocean floors like ridges, hills, sea mounts, guyots, trenches, canyons, etc

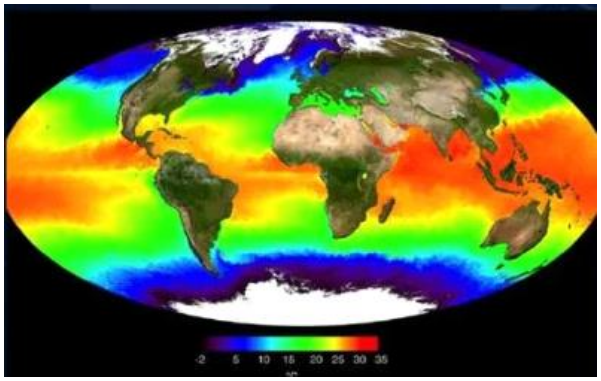
- 

Continental Shelf	• The continental shelf is the extended margin of each continent occupied by relatively shallow seas and gulfs. • It is the shallowest part of the ocean where depth varies from 30m to 300/600m • Average width is 80km, in some cases not existent or marginal like coasts of Chile, west coast of Sumatra are the largest is around 1500 km, eg Siberian shelf in the Arctic ocean. (Subduction caused due to convergence hence the ocean relief is very steep) • The shelf typically ends at a very steep slope, called the shelf break. • Source of fossil fuels • Have access to sunlight and allow plants and biodiversity to grow • 7-10 % of oceanic area, Represent 90% of oceanic biodiversity • Shelf area is depends on topographical feature of coastlines In case of Hilly coastline, shelf is not present •  • We have Western coastline -> which is submergent coastline Wetsren coastline is wider than eastern coastline despite steepness of Western ghats (Escarpments)
Continental Slope	• Indicates the end of Continents • Connects continental shelf and ocean basins • The depth of the slope region varies between 200 and 3,000 m. • Canyons and trenches are observed here.
Continental rise	• Deposits or continental rise is not always a feature of every costliness as deposits are not uniform in nature

	• 
Submarine Canyons	• Erosional Process created by rivers -> found at mouth of the major of rivers • Line visible in Ganga in Bay of Bengal and near Pakinstan as well • Some place show canyon without presence of river • Turbidity Current : Particle such as sediment, sand, rocks, gravel, stones slides down the slope in certain area (45-50km/hr) - > Create scratch -> more particle scratches the surface
Deep Sea Plain	• Flattest and smoothest regions • Depth varies from varies between 3 km to 6km, no sunlight • Fine graded sediments like clay and silt - Deposits if polymetallic nodules • Benthos/ Benthic species like Anglerfish 
Oceanic Deeps / Trenches	• Created by Oceanic Oceanic Convergence (E.g. Mariana Trench), Oceanic continental Convergence (Kuril Trench, Japan Trench) • Deepest region in ocean, Narrow sidewalls and V- Shaped structure Found at margins of Continent / Island chains 

OCEANIC TEMPERATURE

- Prime source of heating is the solar energy
- The process of heating and cooling of the oceanic water is slower than land.



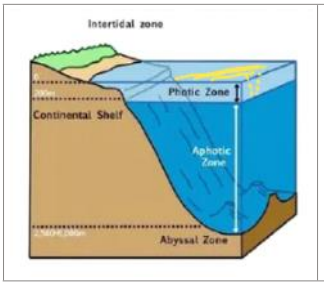
- Factors affecting Temperature distribution

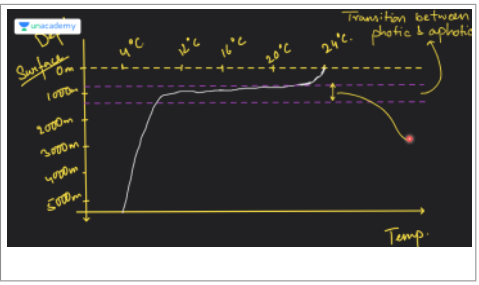
Latitude	Surface water temperature decreases from equator to polewards because of INSOLATION.

Unequal distribution of land and water	Oceans in northern hemisphere has more contact with land compared to southern hemisphere, so more heat is received.
Prevailing winds	• Offshore winds results in upwelling of cold water from below, driving away warm surface water, resulting in longitudinal variations in temperature. (Decreases the temperature) • Similarly Onshore winds do the opposite. • Offshore -> generate upwelling -> dec temp Onshore winds -> pilling warm water -> downwelling-> inc in temp
Ocean Currents	Warm ocean currents raise the temperature in cold areas while the cold currents decrease the temperature in warm ocean areas. Warm current -> inc temp (N Atlantic Drift) Cold current -> dec temp
Open Seas v/s Enclosed Seas	• At low latitudes, enclosed seas have higher temperatures. (land hot) • At High latitudes, open seas have higher temperatures. (land cold)

Vertical Distribution of temperature

- Temperature and depth are inversely related
- With depth -> solar insolation reduce-> temp decreases
- At the lower portion in aphotic zones, temp is almost consistent @4*C
    - water is at its highest density and cannot ve compressed any further
    - At the depth compressional force is very high, Produces heat which doesn't allow water at depth to freeze

- Thermocline:
    - Sharp decline in temp while moving from photic to aphotic zones
    - Extend - 100-400m below sea level
    - varies one region to other
- 




unacademy
Maps Pointing → S. America
→ Mt. Aconcagua ;
→ Andes
→ Altiplano
→ Lake Titicaca.
→ Gran Chaco.
→ Patagonian Plateau
→ Pampas.
→ Drake's Passage (Ocean);
→ Megallen's Strait.
→ R. Orinoco ; R. Paraña
→ Llanos
→ Campos
→ Falkland Islands.
→ Galapagos Islands.
→ Isthmus of Panama.

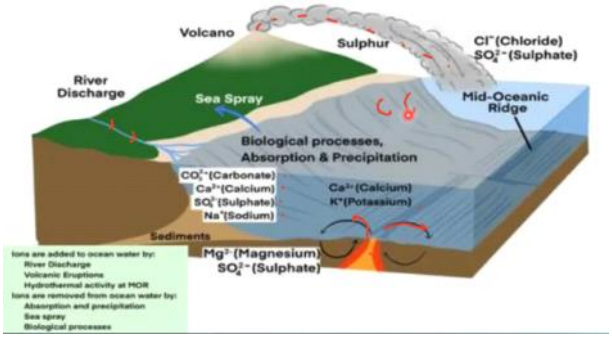
S26 Oceanic Salinity and Currents

24 July 2024 10:39 PM

OCEANIC SALINITY

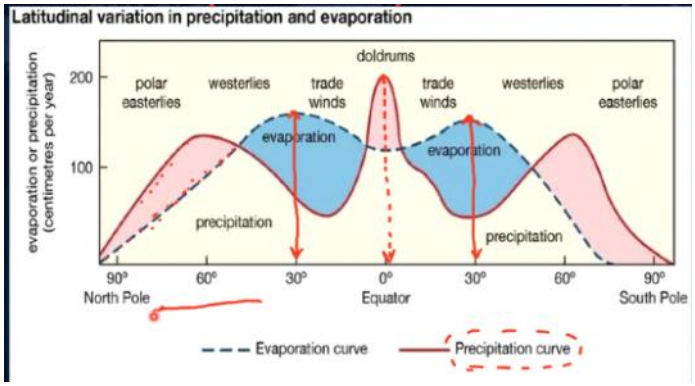
- Measure of salt content present in ocean, present in 1kg of water like : 35gm/kg or 35 parts per thousand
- The total content of dissolved salts in seawater IS called salinity.
- Calculated as the amount of salt (in grams) dissolved % seawater of 1000g.
- Expressed as parts per thousand or ppt.(o/oo)
- Sea water is primarily made up of many ions with Chlorine, Sodium and Sulphate predominating.

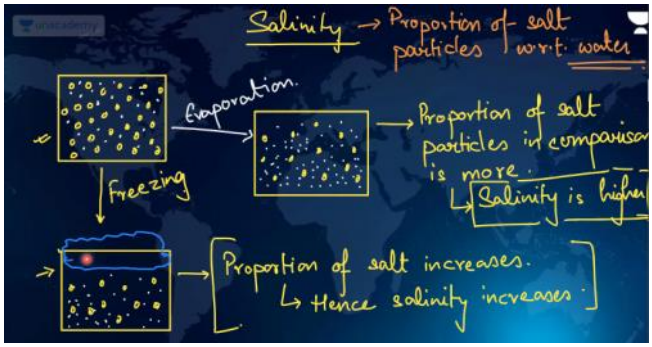
Sources of Salt

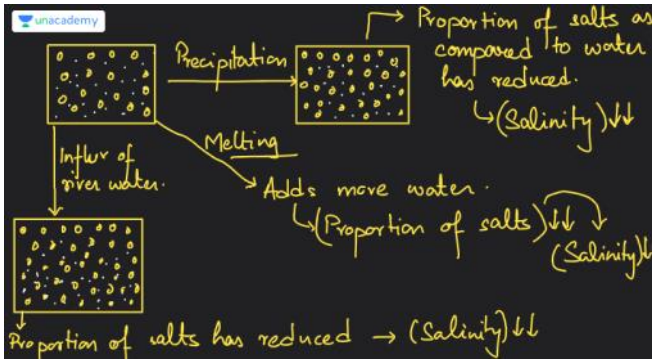


Salts	Amount (‰)	Percentage
Sodium Chloride (Nacl)	27.213	77.8
Magnesium Chloride ($Mgcl_2$)	3.807	10.9
Magnesium Sulphate ($MgSO_4$)	1.658	4.7
Calcium Sulphate ($CaSO_4$)	1.260	3.6
Potassium Sulphate (K_2SO_4)	0.863	2.5
Calcium Carbonate ($CaCO_3$)	0.123	0.3
Magnesium Bromide ($MgBr_2$)	0.076	0.2
Total:	35.00	100.0

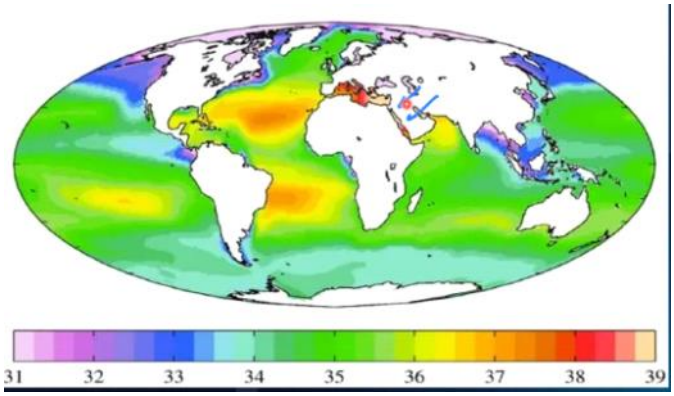
- Surface water salinity depends on the
  - Evaporation, more means more salinity
  - Precipitation, less means more salinity
  - Fresh flow of river water (More flow leads to less salinity)
  - Freezing and thawing of glaciers
- Dissipation rate of salts
  - Salt getting consumed by biloiical process or disspation
  - Keeps Salinity balanced





- 

Distribution of Salininy



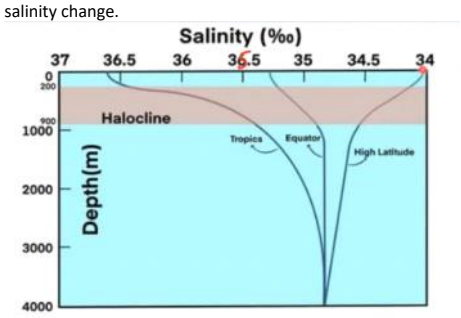
Latitudinal variation in salinity :

- Salinity levels in general reduces from equator polewards
- However salinity is max at tropics -> bc precipitation is very low and high evaporation
- It is more in NH due to presence of land (heating of water due to land heat).

Horizontal distribution of salinity

- The salinity for normal open ocean ranges between 33 o/oo and 37 o/oo.
- In the land locked Red Sea, it is as high as 41 o/oo, while in the estuaries and the Arctic, the salinity fluctuates from O - 35 o/oo , seasonally. This is due to the influx of freshwater.
- In hot and dry regions, where evaporation is high, the salinity sometimes reaches to 70 0/00.
- Maximum salinity (370/00) is observed between 200 N and 300 N.
- The North Sea being in higher latitudes, records higher salinity due to more saline water brought by the North Atlantic Drift. Due to the influence of ocean currents.

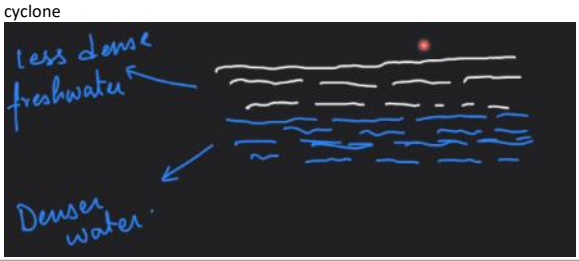
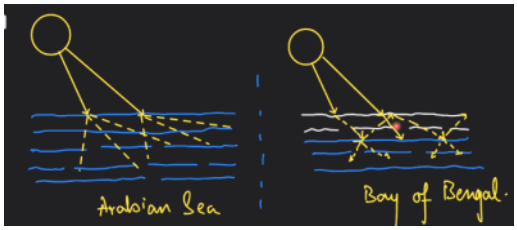
Vertical distribution in salinity

- Evaporation, Precipitation, influx of river, freeszing, melting is restricted to upper 200m of water
- In lower portion of ocean, salinity remain almst consistent (35% o/oo)
- **Halocline** : Similar to thermocline. but it measures change in salinity zone, distinct zone of salinity change.
- 

- Halocline variation is highest at tropical as sirface salinity is highest

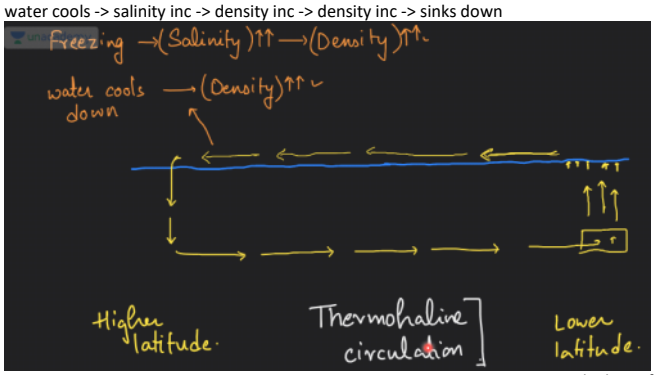
OCEANIC DENSITY

- Density : Mass / Volume
Temperature	-> Density inverse proportional to temp Cold water high density
Salinity	-> Density is proportional to salinity High salinity -> higher density
Both	If both Temp and Salinity are involved -> Temp us determining factor for density Hence at tropic -> High temp -> Less dense

In Bay of Bengal	• Huge river influx of lower salinity and less density • Forms oceanic strata, Significantly marked ocean stratification Greater heat trapping in surface bc of internal refraction-> temp increases -> more cyclone 
Arabian sea	• Less river flux -> Uniform distribution of water • 

- Higher salinity is much more denser stays below the water having Lower salinity(lower density). Higher the density, deeper it is. This property leads to ocean stratification.
- Highest salinity in water bodies
  - Lake Van in Turkey (3300/00),
  - Dead Sea (2380/00),
  - Great Salt Lake (2200/00)

THERMOHALINE CIRCULATION

- Important for Temp distribution and nutritional circulation
- Water contract at higher latitude due to less temp, Water expand at lower latitude due to warm temp
- Water move from lower latitude to higher latitude,
  water cools -> salinity inc -> density inc -> density inc -> sinks down
- 

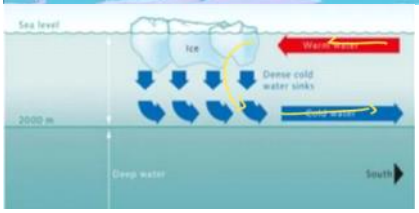
- REGULR HEST EXCHANGE ENCOURAGES CLOUD FORMATIONAND encourages high rainfall in mid and high latitude
- Impact of global warming -> Temp in arctic is increasing -> overturning of water is not achieved as water cannot cool down, circulation inhibited -> Circulation slows down significantly -> regular heat exchange with atmosphere is inhibited -> less than avg rains in North Atlantic -> Creation of dry spell and high temp and heat waves in europe.

Global conveyor belt

The global conveyor belt is a system of ocean currents that transport water around the world. While wind primarily propels surface currents, deep currents are driven by ifferences in water densities in a process called thermohaline circulation. Density depends on both the temperature (thermo) and salinity (haline) of the water. Along this conveyor belt, heat and nutrients are moved around the world in a
leisurely 1000-year cycle.

- The ocean conveyor belt describes the interaction of surface currents like the Gulf Stream and deep, slow-moving underwater currents across all ocean basins.
- These interaction mix ocean waters, salts, and even organisms on a global scale. As ocean temperature and density contribute to temperature change in the atmosphere, the ocean conveyor belt also contributes enormously to climate on our planet.

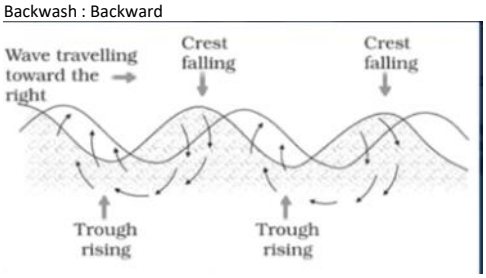
•



TIDES AND WAVES

Waves

- They are defined as undulations (smooth movement of water in upward and downward directions) of surface water, characterized by well developed crests and troughs.
- Movement of particle are oscillatory and rotational
- Swash : Forward movement of water acroos shores
  Backwash : Backward

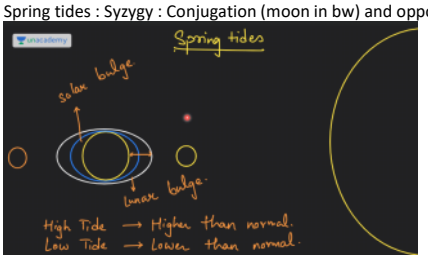


Tides

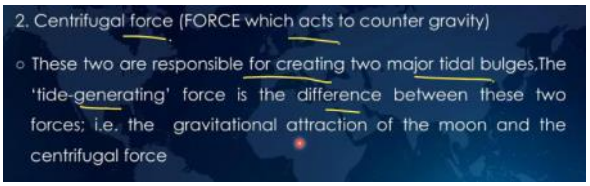
- The vertical motion refers to the rise and fall of water in the ocean and seas.
- Due to attraction of the sun and the moon, the oceanic water is raised up and falls down twice a day and it is periodically.
- Creation if bulge on one side -> leads to development of counter budge in opp side.

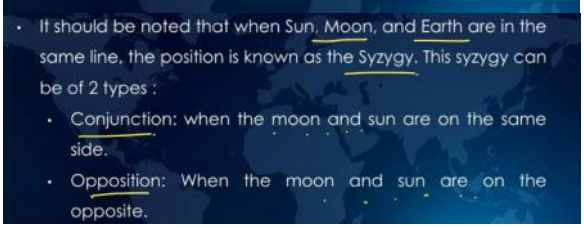
- Factors
  - Sun and moon (large effect due to proximity)
  - Centrifugal force

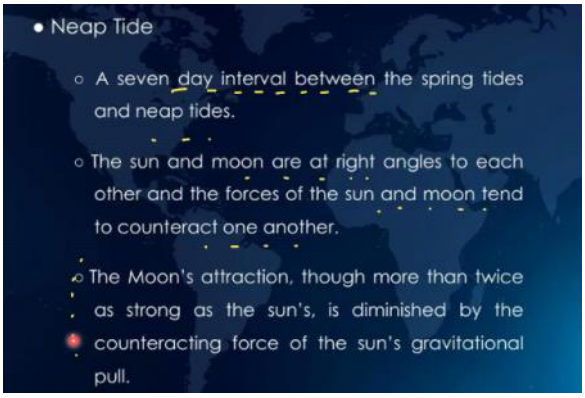
- Spring tides : Syzygy : Conjugation (moon in bw) and opposition (moon opp)



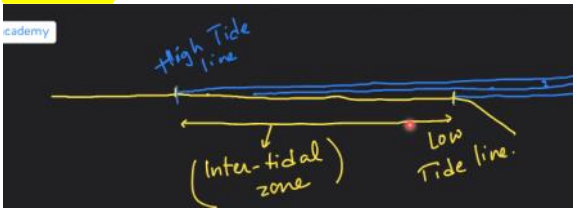
- Neap tides (every 7 days (28/4)) Quadrature

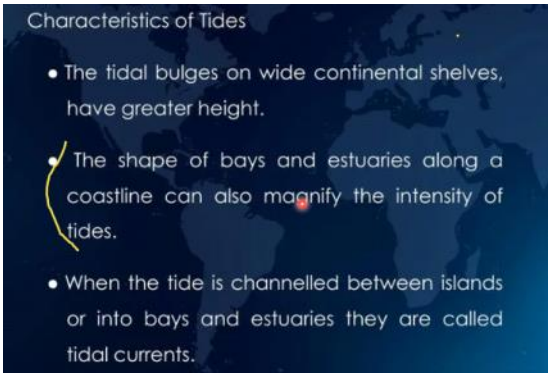






Intertidal zone





OCEAN CURRENTS

- They are like river flow in oceans.
- Regular volume of water in a definite path and direction.
- Ocean curgts are influenced by two types of forces namely :
  - primary forces that initiate the movement of water;
  - secondary forces that influence the currents to flow.

• The primary forces that influence the currents are:	Heating by solar energy; • It causes the water to expand, it results in about 8 cm higherlevel equator compared to the middle latitudes. This small gradient causes the water to flow. Wind; • It causes the surface water to move. • Wind provide directionality Coriolis force • It moves water to the right in northern hemisphere and to the left in southern hemisphere. Ocean Bottom relief (Shape of the coasts) • Obstruction by MOR • Eg Wyrille thompson rodge

Characteristics of Currents

- The currents are strongest near the surface and may attain speeds over five knots. At depths, currents are generally slow with speeds less than 0.5 knots.
- 1 knot = 1.8 km/hr

Types of Ocean Currents

- Based on the depth

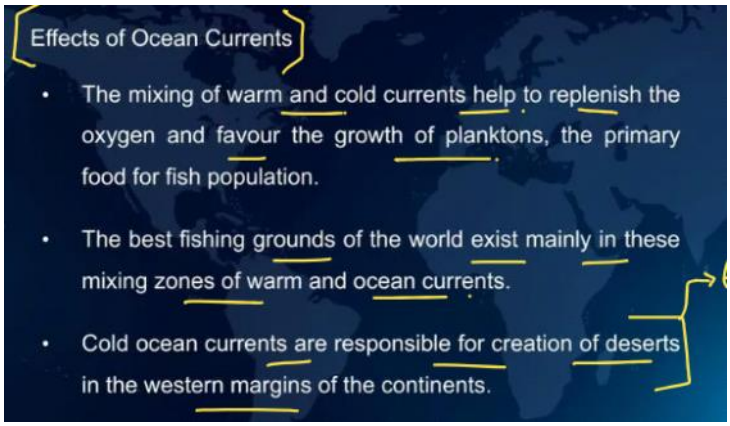
Surface currents	10% of all the water, above 400 m
Deep water currents	Move around ocean basins, due

	to variations in density and gravity.

- Based on temp

Warm current	• Carry comparity warner water in colder are • Bring water from lower to higher latitudes • Region with onshore winds -> warmer temp -> Downwelling • Warm water into cold water areas are usually observed on the east coast of continent in the low and middle latitudes (true in both hemispheres).
Cold current	• Carry colder water in warmer region • Higher latitude to lower latitude • Offshorws wind -> colder temp • Bring cold water into warm water areas They are usually found on the west coast of the continents in the low and middle latitudes (true in both hemispheres) • Trade winds are offshore

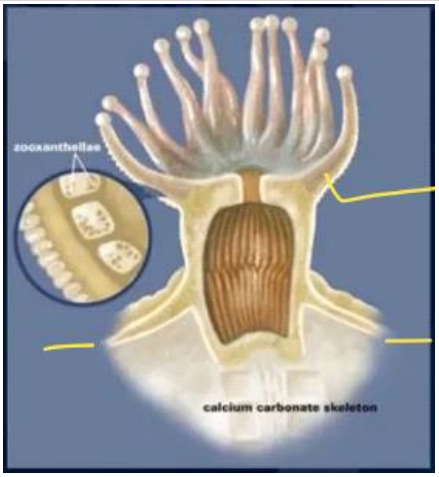
Ideal fishing zone -> where warm water mix with cold water -> inc oxygen conetnet -> plankton growth inc -> fish population high



S27 Coral

29 July 2024 12:17 AM

CORAL REEFS



- Coral polyp - Single unit

- Can Synthesis Ca and Carbonate ion present in ocean water and are able to construct a hard stony exoskeleton around themselves.
- Tentacles + Zooxanthellae (algae photosynthesis) forms mutually beneficial symbiotic relationship

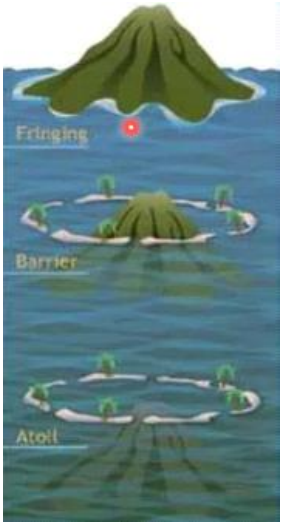
- Rainforest of marine ecosystem :
    - Provide source of food
    - Generate oxygen (by Zooxanthellae) in marine waters
    - Provide shelters to wide variety of organism

- A coral reef is an underwater ecosystem characterized by reef-building corals.
- Reefs are formed of colonies of coral polyps held together by calcium carbonate. Most coral reefs are built from stony corals, whose polyps cluster in groups.
- The largest coral reef is the Great Barrier Reef, which spans 1,600 miles (2,600 km) off the east coast of Australia. It is so large that it can be seen from space.

- Marine species (not found in fresh water)

Warm water corals	• Closer to sea surface (Bc Zooxanthellae require sunlight)
	• Mostly in tropics regions
	• Condition
	  • Clear marine water (no mud, sediment, as sunlight is disrupt)
	  • Avg temp bw 24*C-26*C
	  • Shallow water

Cold waters corals	• Found on thesea floor at greater depth or in higher latitudes • Ex: Rost Reef(off the coast of Norway) • Less presence of Zooxanthellae .
Growth	• Grow on last generation of coral reefs left over exoskeleton after death, as it provide base to grow. Leads to coming closer to surface -> moment come above sea level -> leaves white stoney structre -> create coral islands • Creates white sands. (disintegration of white exoskeleton)



- Ex : Lakshadweep, Maldives, some islands in Andaman and Nicobar.

Fringing	• Coral growing in side • They are formed along the coasts of continents or islands. Their surface is connected with the coast and rises up to low water level as a rugged and uneven platform.
Barrier	• These are situated away from the coast, and in between the coast and the reef there is a relatively wide and deep lagoon, the reef is called a barrier reef.
Atoll	• These are the most common type of coral reefs and are roughly circular or horse-shoe shaped reefs with a steep outer slope leading to deep water and a lagoon in the centre.

Importance

- An estimated 500 million people earn their livelihoods from the fishing stocks and tourism opportunities reefs provide.
- Algae found in the reefs, also replenish the amount of dissolved oxygen in oceanic waters.
- Reefs are even offering hope for new drugs to treat cancer and other diseases.
- Natural Barriers : They buffer shorelines from the effects of cyclones and hurricanes.

S27 Physiography of India, Himalayas

29 July 2024 12:47 AM

Location of India

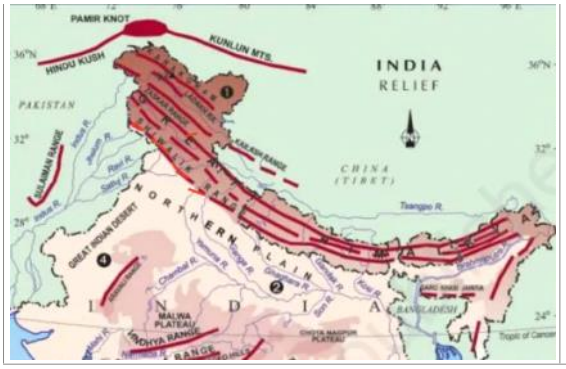
- India is lying entirely in the Northern Hemisphere.
- Between 80*4' N d 37*6' N latitudes; and 68*7' E and 97*25' E longitudes.
- However, the southernmost point lies at 6*45' N in the Nicobar islands.
- India is divided by the Tropic of Cancer(23*30' N) in almost two equal parts.

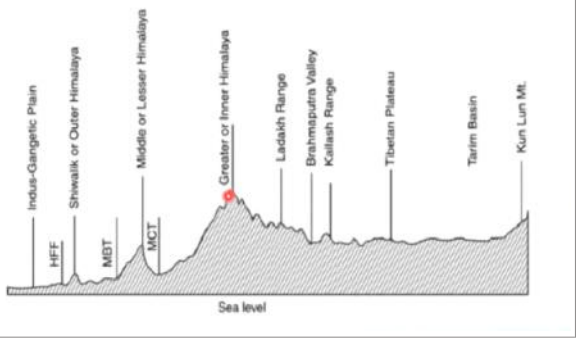
India is a Subcontinent	• Wide variety of topography • Numerous type of climatical aspect • Custom, food, language, belief, changes • All these diversity -> make India Subcontinent
India is Peninsula	• Sea at three side

Tropic Cancer	Gujarat, Rajasthan, MP, Chhattisgarh
The Standard Meridian.	• 82.30* E passes through 5 states • Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Odisha, Andhra Pradesh
Neighbour	• India shares its land boundary with Bhutan, Nepal, Myanmar, China, Afghanistan, Pakistan and Bangladesh • Bangladesh with longest border being with Bangladesh • Shortest with Afghanistan • Sri Lanka and Maldives are the two island countries located in the Indian Ocean, which are our neighbours.

Physiography	• 'Physiography' of an area is the outcome of structure, process and the stage of development • India can be divided into the following physiographic divisions:
	The Northern and Northeastern Mountains The Northern Plain The Peninsular Plateau The Indian Desert The Coastal Plains The Islands

Himalayas	• Himadri + Himachal + Siwalik • Trans Himalaya (beyond Himalaya) , Karakoram, Zaskar, Kailash, Ladakh • Change in direction : Syntaxial bend Actual alignment of mountain bend • Two bends • West : Nanga Parbat • East : Namcha Barwa



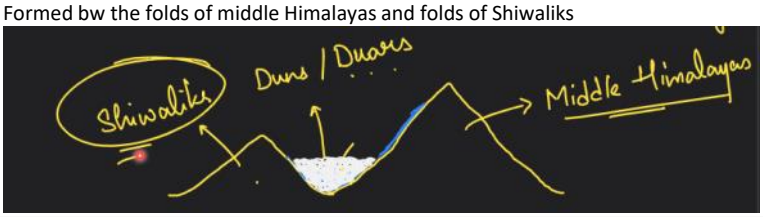
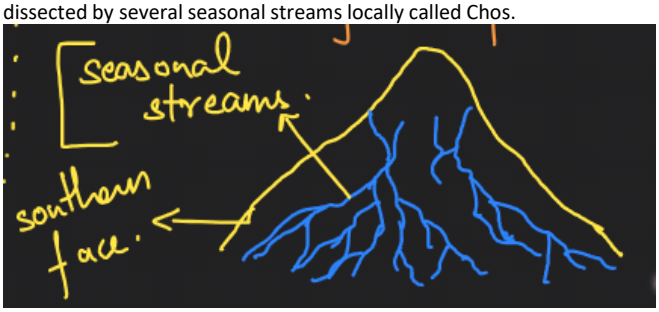
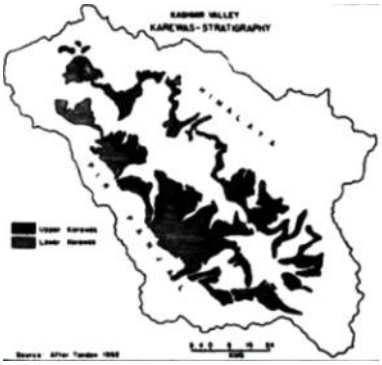


- Consist of the Himalayas and the Northeastern hills.
- Himalayas consist of a series of parallel mountain ranges.
- General orientation Northwest to the southeast Length of The Great Himalayan range (approximate) is 2,500 km from east to west and its width varies between 160-400 km from north to south.
- Width max in west and min in east

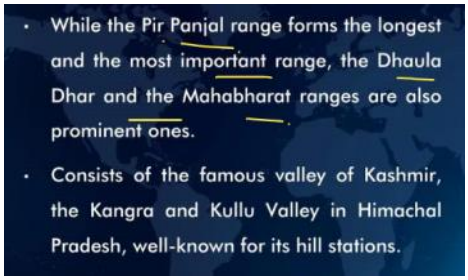
Thrust defaults	• Created due to compression leading to structural breakage of rocks • Rather than compression, sliding occurs, leading go seismic events
Himadri	• The innermost range is known as the Great or Inner Himalayas or the Himadri. • It is the most continuous range consisting of the loftiest peaks with an average height of 6,000 metres and width of 25 km. • The folds of the Great Himalayas are asymmetrical in nature.
Himachal	Himachal or lesser Himalaya • The range lying to the south of the Himadri forms the most rugged mountain system. • The ranges are mainly composed of highly compressed and altered rocks. • The altitude varies between 3,700 and 4,500 metres and the average width is of 50 Km. • While the Pir Panial range forms the longest and the most important range, the Dhaula Dhar and the Mahabharat ranges are also prominent ones. • Consists of the famous valley of Kashmir, the Kangra and Kullu Valley in Himachal Pradesh, well-known for its hill stations.
Shiwaliks	The Shiwaliks • The outermost ran e of the Himalayas. • Extend over a width of 10-50 Km and have an altitude varying between 900 and 1100 metres. • Composed of unconsolidated sediments brought down by rivers from the main Himalayan ranges located farther north. ' • Known by different names from West to the East. ○ Jammu Hills in Jammu ○ Dhang Range and Dhundwa range in Uttarakhand ○ Churia Ghat hills of Nepal ○ Dafla, Miri, Abor and Mishmi Hills in Arunachal Pradesh • Eastern part : Densely forested • Western part : Punjab and Himachal, lower rains, steep southern slope

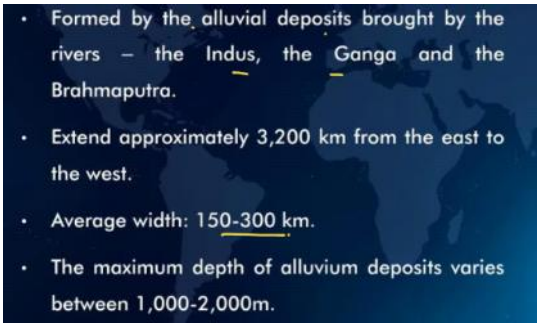
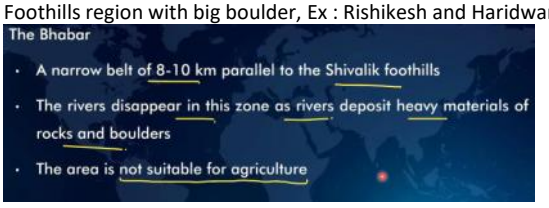
S28 Indian Physiography

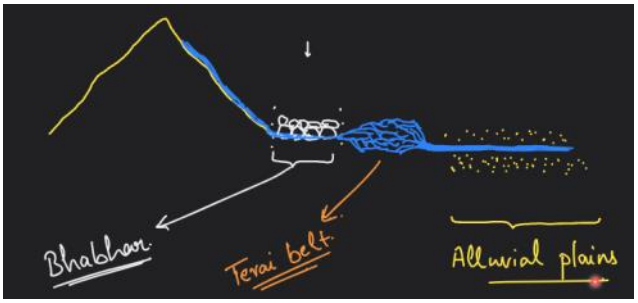
01 September 2024 02:44 PM

Duns	• Named as duns in western Himalayas • Depositional Landform
Duars	Named as duars in eastern Himalayas
	• The longitudinal valley lying between lesser Himalaya and the Shiwaliks are known as Duns. • Dehradun, Kotli Dun and Patli Dun are some of the well-known Duns. • Formed bw the folds of middle Himalayas and folds of Shiwaliks 
Chos	• The eastern part of the Shiwalik range upto Nepal is covered with thick forests but the forest cover becomes thin in the west . • Eastern Himalaya -> Shivalik's -> Densely Forested • Western Himalaya -> Lower rains + Steep Southern Slope -> Punjab + Himachal -> Low Forest • The southern slopes of this range are almost completely devoid of forest cover in Punjab and Himachal Pradesh and are highly dissected by several seasonal streams locally called Chos. 
Karewas	• Depositional Landform very big in size • Lacustrine deposit : deposit created when water exited the large lakes -> leaving behind fertile land • Ideal for Orchard farms (apple) and Saffron. 

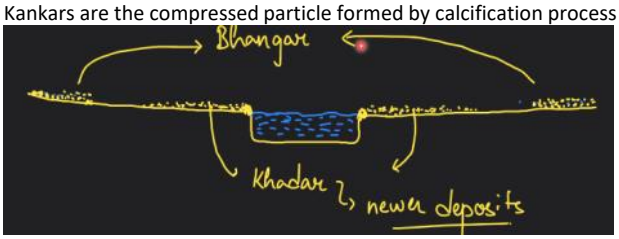
Bugyals	• The valleys are mostly inhabited by the Bhotias, nomadic groups who migrate to 'Bugyals' (the summer grasslands in the higher reaches) during summer months and return to the valleys during winters.
	• Summer grasslands, at hight of 2000m-3000m
	  • Summer : Grass, people migrate up the slope for grazing animals
	  • Winter : Snow, People move down the slope
	• Transhumance : Nomadic Pastoralism, like Bakkarwals, Gujjars, Bhotias (Uttarakhand)
	 

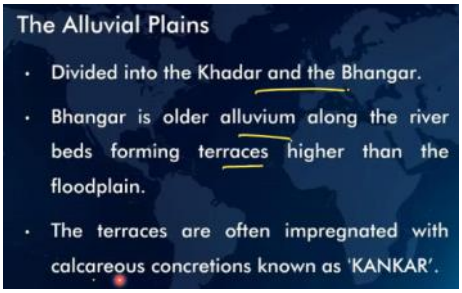
Eastern Himalayas	 • All three ranges of Himalaya are very close to each other • We can see peak of great Himalaya from plains
Middle Himalayas	

NORTHERN PLAINS	• Punjab and Haryana, Widest Plains • Punjab Created by the Indus river Basin • Haryana Created by the ganga river Basin • Have deposit of 3 km but are at the level of sea level • Concept of Foredeep : E Suess • Sedimentary deposits brought by the rivers deposited in area of depression formed during formation of Himalayas 
Bhabhar Terai Belt Alluvial Plains	• Foothills region with big boulder, Ex : Rishikesh and Haridwar  • After Bhabhar, river forms multiple streamlines, very shallow deep rivers • Marshy muddy condition -> Terai Belt -> Rich in vegetation  • After Terai belt river merges and creates Alluvial plains • Plains created by fine particle bring by flood.

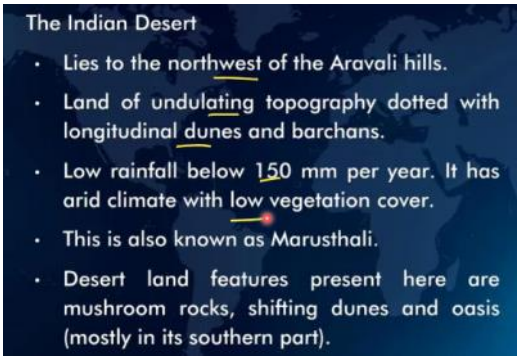


Alluvial Plain	• Khadar are the new fine particles, new deposit around river-> Fertile • Fertile -> We can grow rice, wheat, sugarcane, jute • Bhangar are the old particle and are less fertile • Less Fertile -> We can grow millets, Pulses, Maize • Kankars are the compressed particle formed by calcification process (Cancerous Concretions)

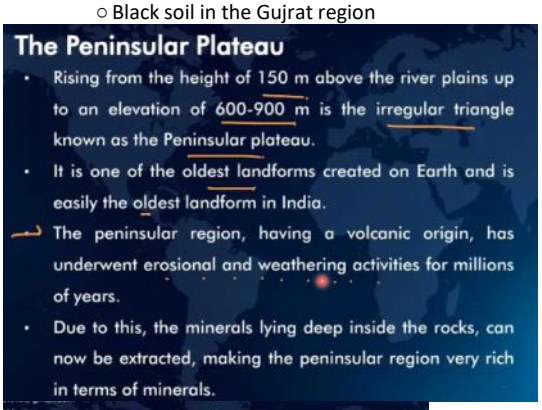
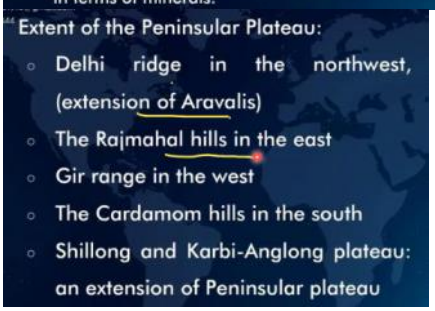
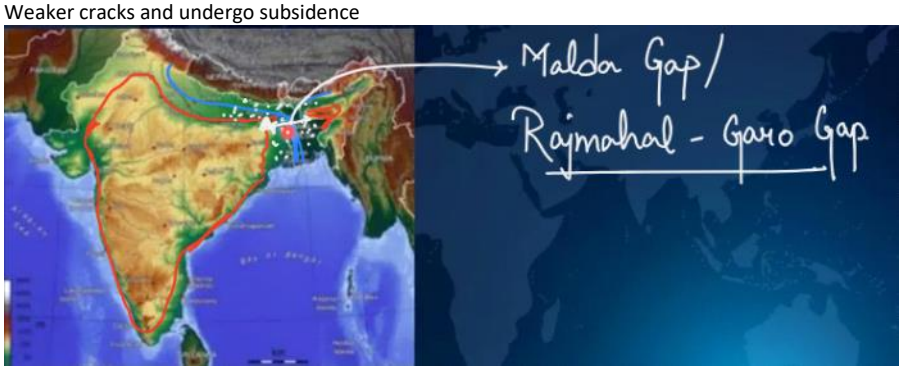


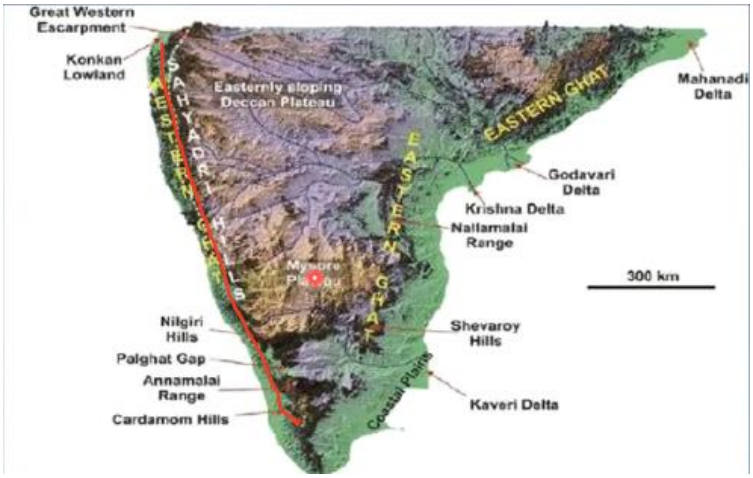


The Indian Deserts	• Iron, crude oil, limestone -> gives idea of presence of shallow lake in history • Reason of Thar Desert -> Alignment of Aravalli • Arabian sea branch of monsoon moves parallel to Aravalli's -> No rainfall • Western Rajasthan lies of the leeward side of Aravalli's

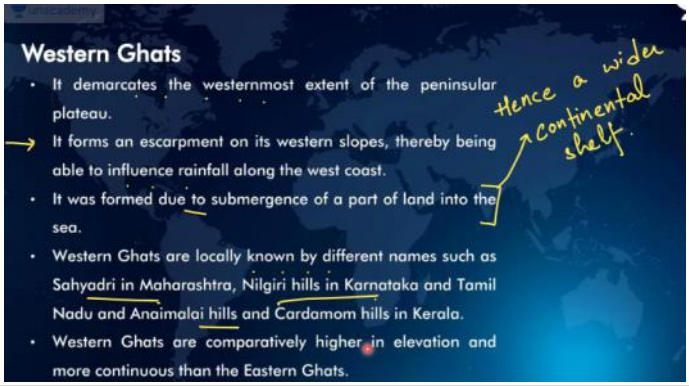


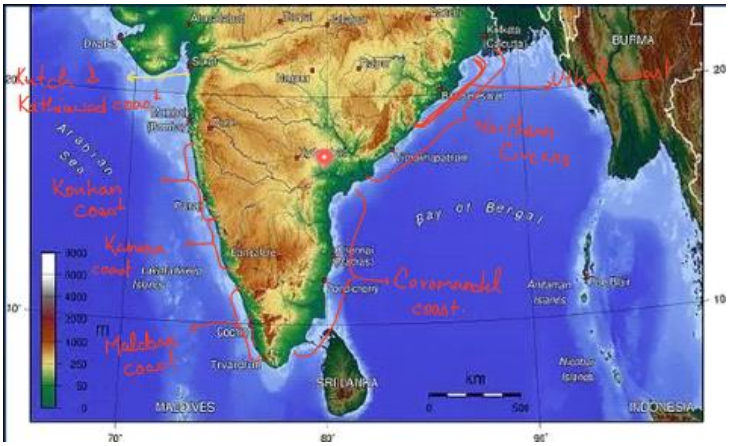
The Peninsular Plateau	• Plateau are Flat table land like structure • Formation of Indian peninsular plateau • Cratons: small building clocks o larger landmasses

	○ Created billions of year of ago •  • Addition of Volcanic eruption -> Lava deposit (Flood basalt) -> Treppen (layer like structure) -> Deccan traps ○ Black soil in the Gujrat region    
Maldar Gap	Weaker cracks and undergo subsidence 
Ghats	• Eastern Ghats crated much earlier • Western ghats created more recently due to subsidence



- Formation
  - Western Ghats : Subsidence
  - Eastern Ghats : slow erosions
  -

Western Ghats	
Eastern Ghats	
Coastal Plains	• Coastal Plains good for Trades and Cultivation • West : Kutch and Khatiwada coast, Konkan coast (Narrow) , Kanara coast, Malabar caost • East : Northern Civcars (Utkal Coast) , Coromandel Coast



Western Coast	• Kandla, Mazagaon, JLN port Nhava Sheva, Marmagao, Mangalore, Cochin, etc. are some of the important natural ports on the west coast. • The western coast may be divided into following divisions – The Kachchh and Kathiawar coast in Gujarat, The Konkan coast in Maharashtra and Goa Malabar coast in Karnataka and Kerala • The western coastal plains are narrow in the middle and get broader towards north and south. • No delta formation takes place. • The Malabar coast has got certain distinguishing features in the form of 'Kayals' (backwaters), which are used for fishing, inland navigation and also due to its special attraction for tourists. • Western Coastline has no delta but presence of only estuaries • Not many rivers drain from west to east -> Hence no deposit • Narmada and Tapi drain through rift valley -> Hence not much erosional Materials
Eastern Coast	○ Emergent coast and broader. ○ Well developed deltas are formed by the east flowing rivers to the Bay of Bengal. Eg:Deltas of the Mahanadi, the Godavari, the Krishna and the Kaveri. ○ Known as Coromandel coast in Tamil Nadu

Islands Group	• Lakshadweep : Coral Islands • Andaman And Nicobar Islands : Oceanic oceanic convergence • Oceanic Crust : Indian Plate + Burmese plate • Importance • Strategic Imp : ○ Geo Political : Indian Boundary ○ Extension of defence might in Arabian and Bay of Bengal ○ Unsinkable Aircraft carriers ○ Control of choke points • Economic Imp : ○ Transhipment hubs ○ Tourism ○ Fisheries • Cultural Imp : ○ Particularly vital tribal groups • Ecological Imp : ○ Critical habitats

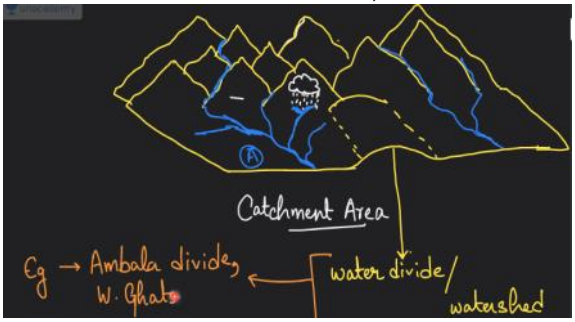
Question	Why does Himalayas experience more landslides as compared to western Ghats
Answer	• Young and Unstable slopes (Sedimentary formation) • Tectonically active -> earthquake are common • Less vegetation cover and deforestation • Construction and mining -> weakening of slope • Multiple rivers and glacier melt • More frequent clouds bursts • Hogback topography : Steep Southern Slopes

S29 30 Drainage Systems

02 September 2024 03:32 PM

<table>
<tr><td>DRAINAGE SYSTEM</td><td>

The flow of water through well-defined channels is known as ‘drainage’ and the network of such channels is called a ‘drainage system’.
They are governed by the topography of the land,the gradient of the land, geological time period, nature and structure of rocks, amount of water flowing and the periodicity of the flow
A river drains the water collected from a specific area, which is called its ‘catchment area’.

</td></tr>
<tr><td>Catchment area</td><td>
• Area from where river accumulate the water
• Could be combination of Glacier stream, rain stream etc
•


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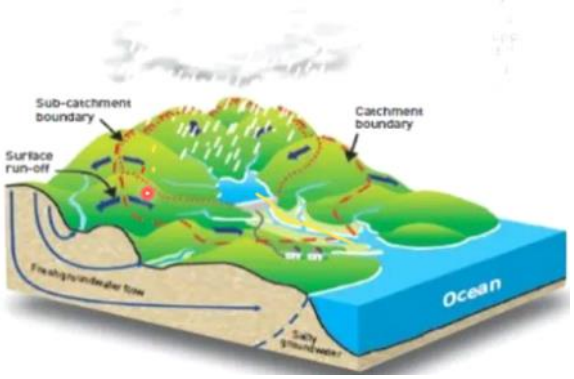
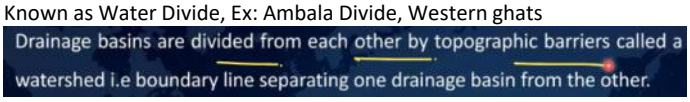
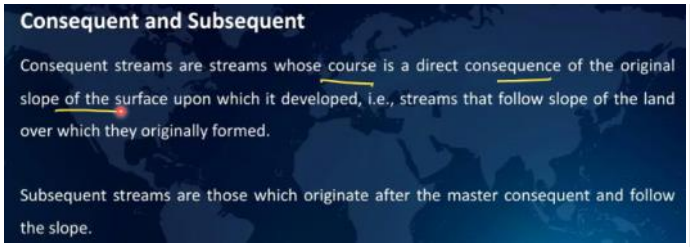
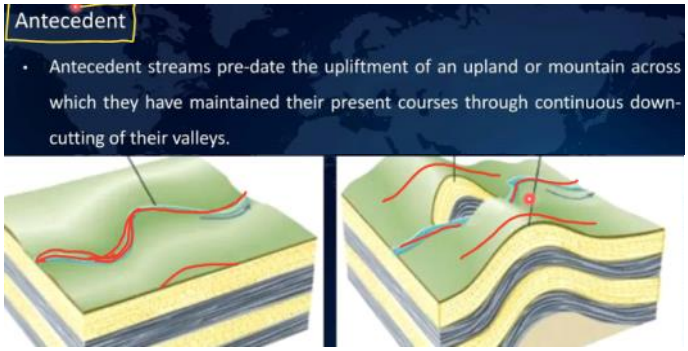
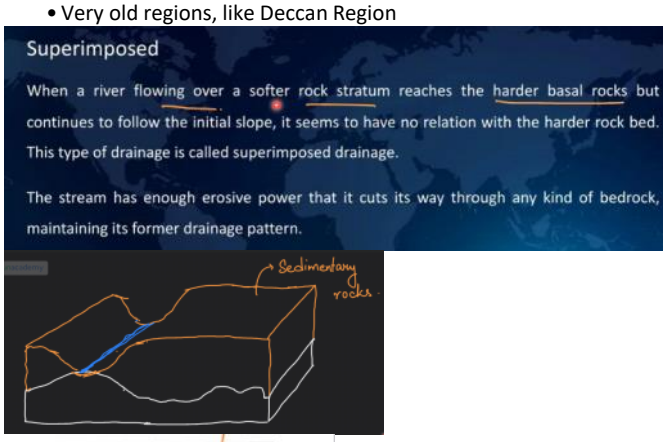
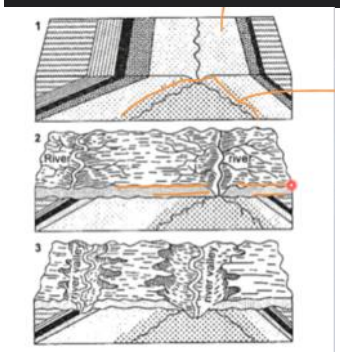
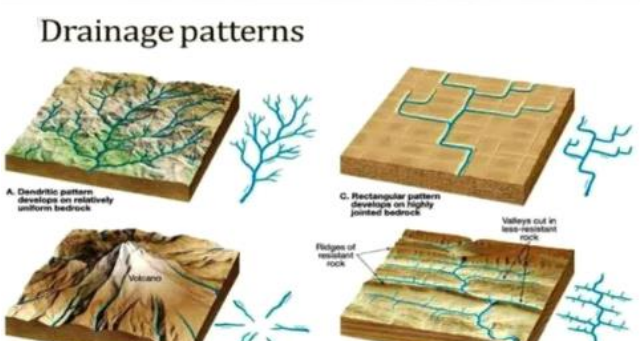


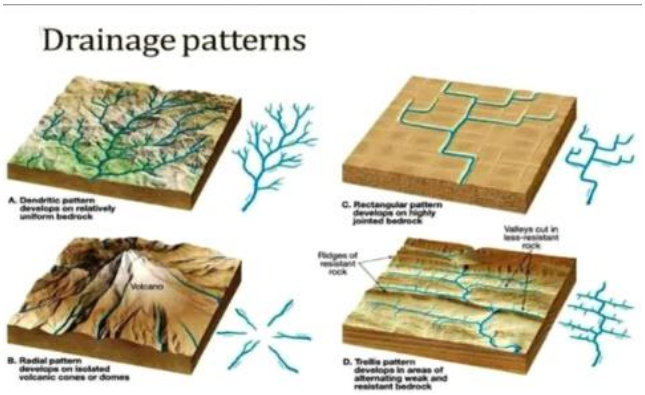
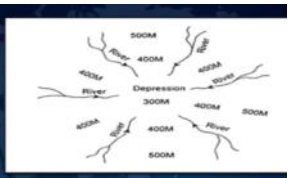
• Water Shed : Physical area distributing two stream, Could be because of land Upliftment.
• Known as Water Divide, Ex: Ambala Divide, Western ghats
•


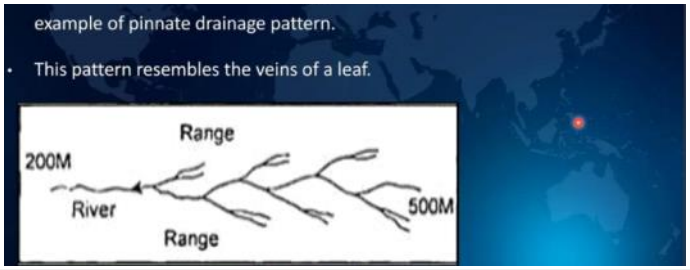
</td></tr>
<tr><td>Streams</td><td>
• On the basis of apparent flow of river

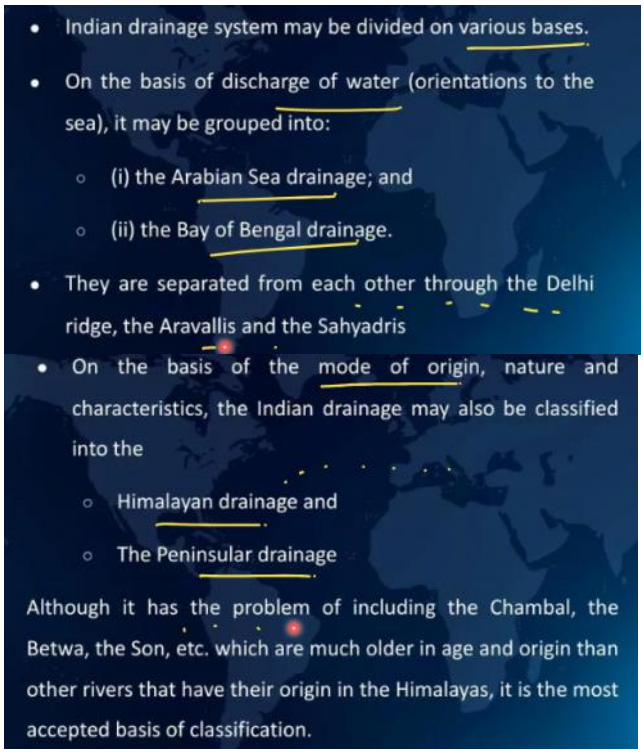
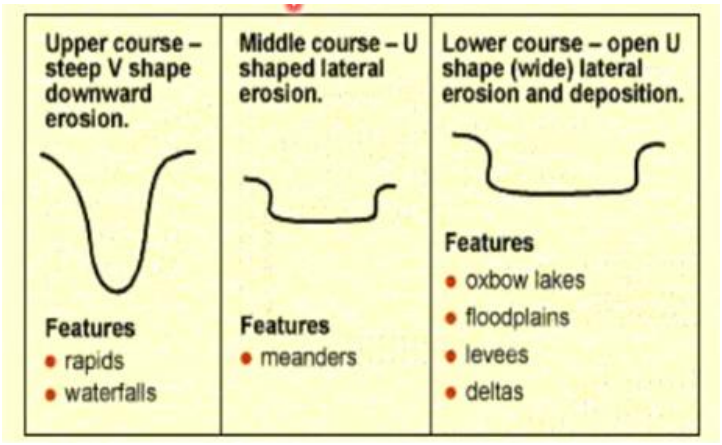

<table>
<tr><td>Sequent</td><td>• Steam which appear to follow the slope of land</td></tr>
</table>
</td></tr>
</table>

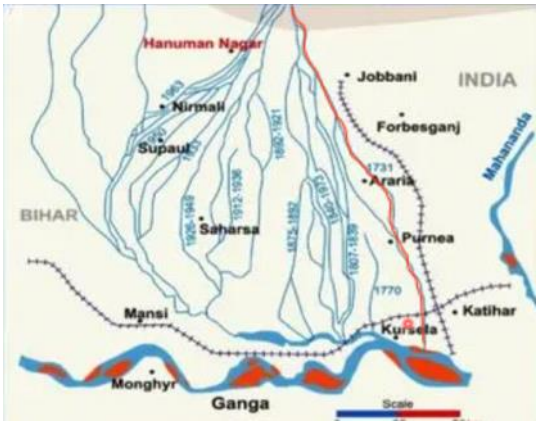
streams	•  • Consequent : River Ganga (Master Stream) • Subsequent : River Yamuna (End up joining Master Stream)
Insequent streams	• Stream which appear to defy the slope of land •  Ex : River Indus, Sutlej, Kosi • Superimposed Drainage: • Very old regions, like Deccan Region  

DRAINAGE PATTERN	• General pattern of arrangement of flow of streams 

	
Dendritic Drainage	• Examples Indus, Godavari, Mahanadi, Cauvery, Krishna etc.  • Observed in uniform rock beds structure having equal erosional impact • No such particular flow structure, it will according to slope of land
Trellis Drainage	 • Alternate arrangement of hard and soft rocks • Primary tributaries appear to be parallel to each other • Secondary tributaries join at right angle • Develops where sedimentary rocks have been folded or tilted and then eroded to varying degrees depending on their strength. • The primary tributaries of rivers flow parallel to each other and secondary tributaries join them at right angles • Examples : Old folded mountains of the Singhbhum (Chotanagpur Plateau)
Radial Drainage	• The streams radiate outwards from a central high point. • Volcanoes usually display excellent radial drainage also commonly developed across domes and laccoliths. • A good example of a radial drainage pattern is provided by the rivers originating from the Amarkantak Mountain. 
Centripetal Drainage	Loktak Lake Centripetal drainage system • Similar to the radial drainage system, with the only exception that radial drainage flows out versus centripetal drainage flows in from all directions in a lake or depression, • Examples: Streams of Ladakh, Tibet, and the Bagmati and its tributaries in Nepal. 
Pinnate	• The drainage network of the upper Son and Narmada rivers denotes the

Drainage	

RIVER SYSTEMS OF INDIA	• In India we worship rivers • River are the credals of civilizations 
HIMALAYAN DRAINAGE	 • Shifting of rivers : River changing its path (around more than 50km range) ○ Reason : Escessive depoit blocks the older channel and river shifts it course



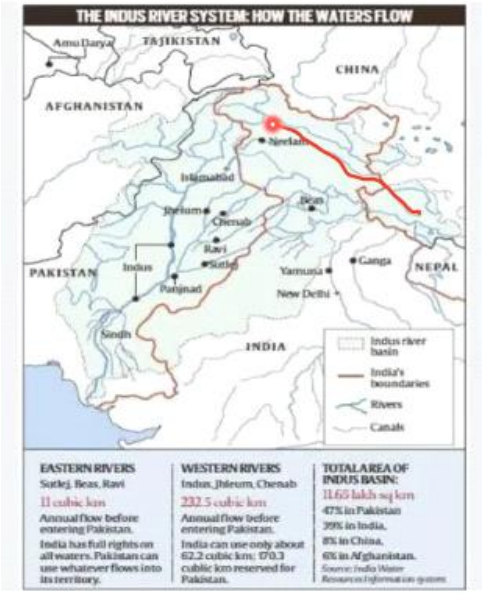
- Prevention of floods : control flow of river in rainy season
  - Regular desiltation and maintenance of river channel
  - Construction of dams
  - Construction of embankment
  - Creating of emergence divergence
  - Maintenance of green cover across river banks

PENINSULAR DRAINAGE	• The Peninsular drainage system is older than the Himalayan one. • Evidence : The broad, largely-graded shallow valleys, and the maturity of the rivers. • The Western Ghats running close to the western coast act as the water divide between the major Peninsular rivers, discharging their water in the Bay of Bengal and as small rivulets joining the Arabian Sea. • Peninsular rivers are characterised by fixed course, absence of meanders and non perennial flow of water. • The Narmada and the Tapi are exceptions which flow through the rift valley and east to west. They make estuaries.
Difference	

Sl. No.	Aspects	Himalayan River	Peninsular River
1.	Place of origin	Himalayan mountain covered with glaciers	Peninsular plateau and central highland
2.	Nature of flow	Perennial; receive water from glacier and rainfall	Seasonal; dependent on monsoon rainfall
3.	Type of drainage	Antecedent and consequent leading to dendritic pattern in plains	Super imposed, rejuvenated resulting in trellis, radial and rectangular patterns
4.	Nature of river	Long course, flowing through the rugged mountains experiencing headward erosion and river capturing; In plains meandering and shifting of course	Smaller, fixed course with well-adjusted valleys
5.	Catchment area	Very large basins	Relatively smaller basin
6.	Age of the river	Young and youthful, active and deepening in the valleys	Old rivers with graded profile, and have almost reached their base levels

HIMALAYAN DRAINAGE

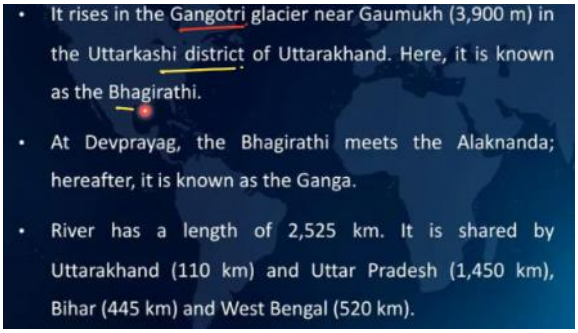
Indus System	• It is one of the largest river basins of the world, covering an area of 11,65,000 sq. km and a total length of 2,880 km. • In India it is 3,21,289 sq. km and a length of 1,114 km. • The Indus also known as the Sindhu, is the westernmost of the Himalayan rivers in India.



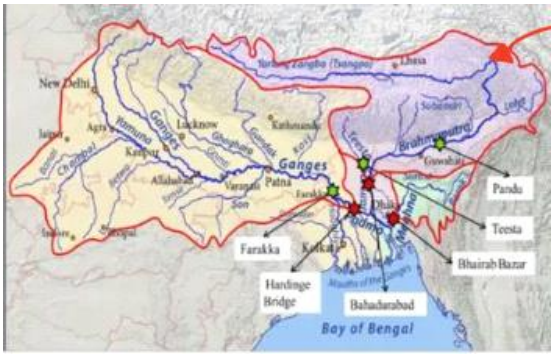
- Punjab : Land of five rivers
  - Jhelum : Verinag Glacier
  - Chenab : Chandra (Chandrataal) + Bhaga River
  - Ravi : Rohtang)
  - Sutlej : Near Mansarovar
  - Beas : Bead Kund (Rohtang) - Only drains through India : meet Sutlej in India
- Chenab + Ravi + Sutlej : Forms natural frontier between India & Pakistan

Ganga System

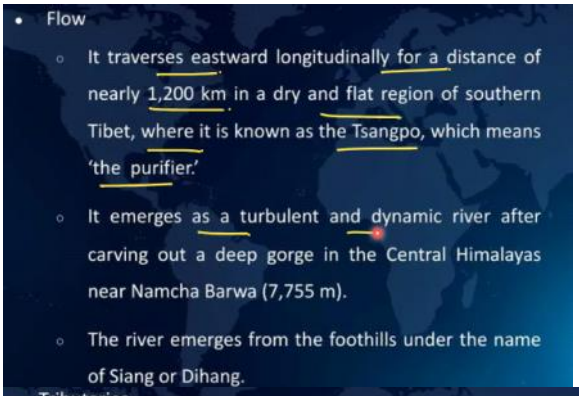
Left Tributaries : Ramganga, Gomti, Gaghagra, Gandak, Kosi (Sapatakosi) , Mahandna (Boundary of Bihar and Bengal)
Right Tributaries : Yamuna, Chambal, Betwa



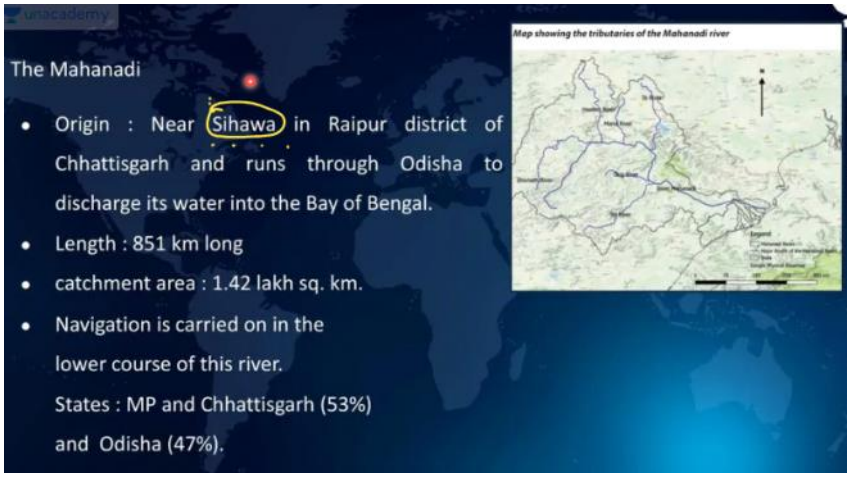
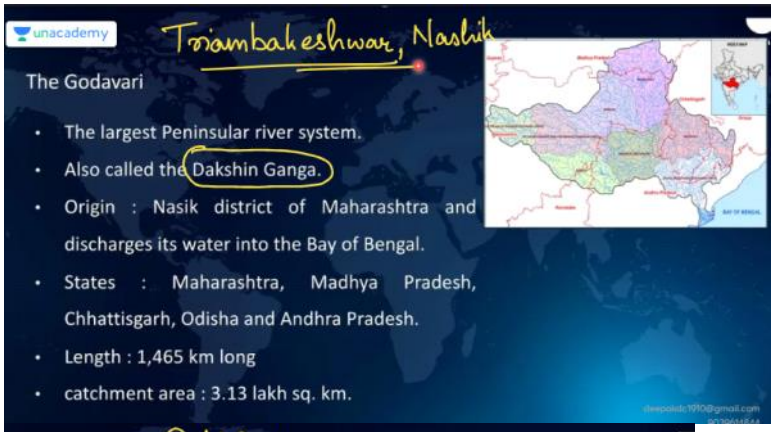
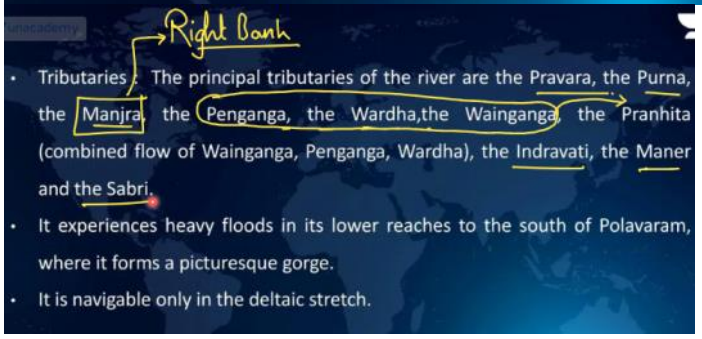
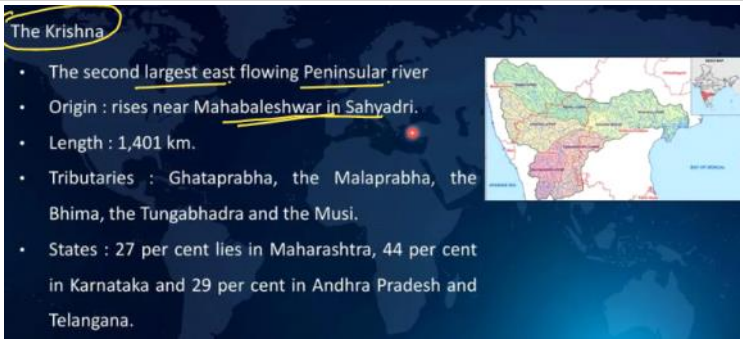
Brahmaputra System



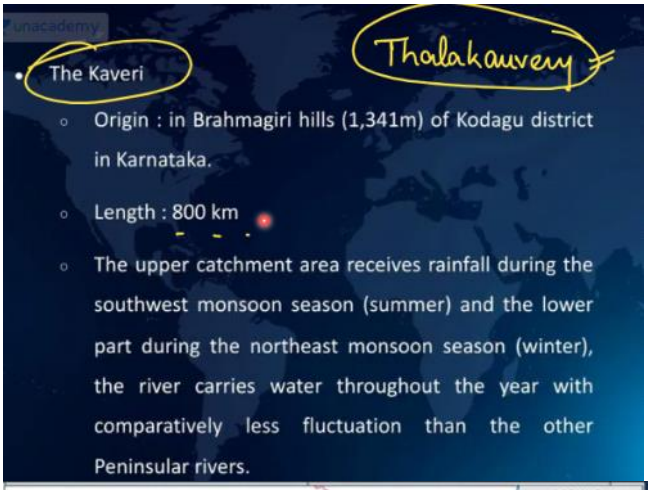
- One of the largest rivers of the world, has its origin in the Chemayungdung glacier of the Kailash range near the Mansarovar lake.
- Formation of riverine islands -> Due to sedimentary acculamtion because of river
- Largerst riverine :
- Subansiri : Dam created on river



PENINSULAR DRAINAGE	• Mahanadi, Godavari, Krishna

Mahanasi System	 Left Tributaries : Sheonath, Hasdeo, Mand, Ib Right Tributaries : Ong, Jonk, Tel
Godavari System	  • Manjra : Storage Structure , Singur + Nizam Sagar
Krishna System	 • Musi drains through Hyderabad

Kaveri System

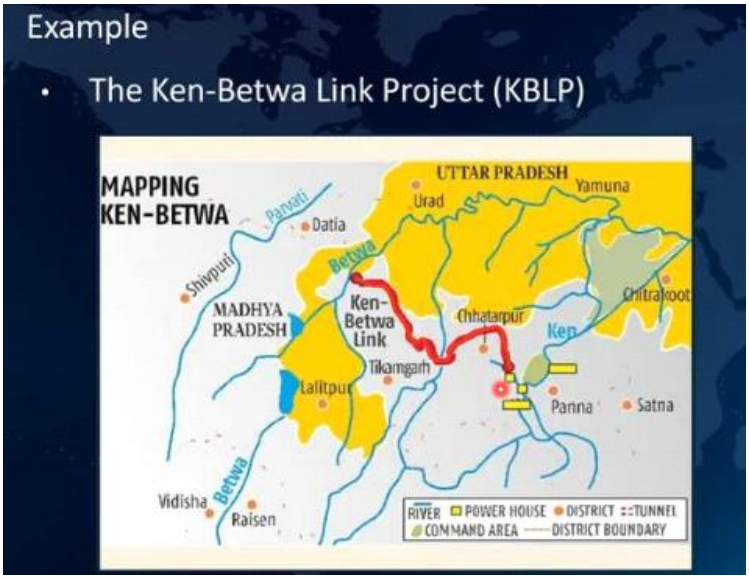


- River caries water through put year
- States : Kerala (3%), Karnataka (41%) and Tamil Nadu (56%).
- Tributaries : the Kabini, the Bhavani and the Amravati.

INLAND RIVERS	That don't empty into seas

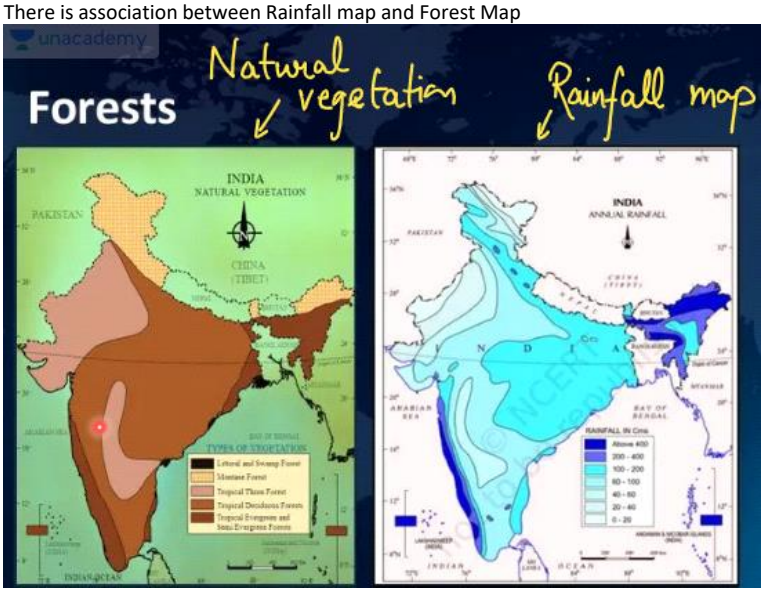
River Luni	 • Near Pushkar Ajmer Distt, Aravalli • Upper Coarse : Freshwater • Lower Coarse : saline water, high evaporation

Interlinking of Rivers	• Sir Arthur Cotton idea • Same time some region have flood and some region have draught • Idea : To move the surplus water to needed stream
Consequences	<table><tr><td>In favour</td><td>Against</td></tr><tr><td>Tackle the twin issue of flood and draught</td><td>Huge Cost ($183bn)</td></tr><tr><td>Provide water sufficiency</td><td>Land Acquisition</td></tr><tr><td>More area can be irrigated</td><td>Relocation of population</td></tr><tr><td>Channels can be used for inland navigation</td><td>Submergence of forest, Deforestation</td></tr><tr><td>Energy generation potential</td><td>Biodiversity loss</td></tr><tr><td>Ground water recharge</td><td>Impact on Tribals</td></tr><tr><td>Aquaculture</td><td>Natural flow of water gets disturbed</td></tr><tr><td>Generate jobs</td><td>Distribution of water scarcity</td></tr></table>
Map	

Example	 Example • The Ken-Betwa Link Project (KBLP) MAPPING KEN-BETWA UTTAR PRADESH Yamuna Urad Panwari Datia Betwa Shivpuri MADHYA PRADESH Ken-Betwa Link Chhatarpur Chitrakoot Ken Tikamgarh Lalitpur Panna Satna Vidisha Betwa Raisen RIVER POWER HOUSE DISTRICT TUNNEL COMMAND AREA DISTRICT BOUNDARY

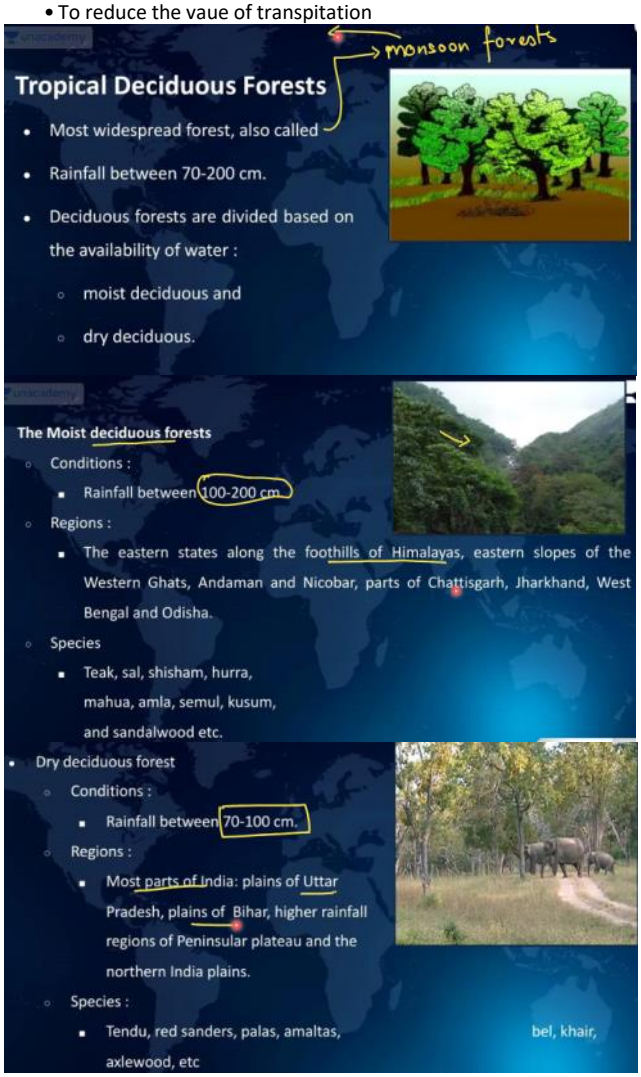
S31 Forest

02 September 2024 08:18 PM

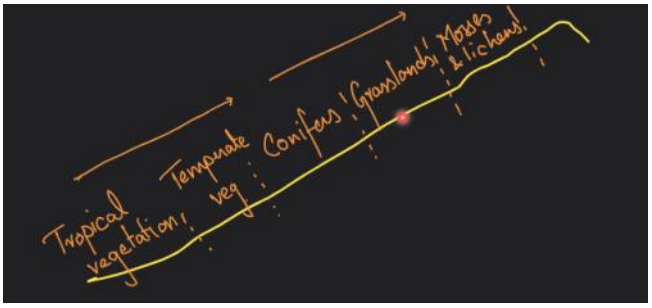
- Rainfall and Forest
  - There is association between Rainfall map and Forest Map
  - 

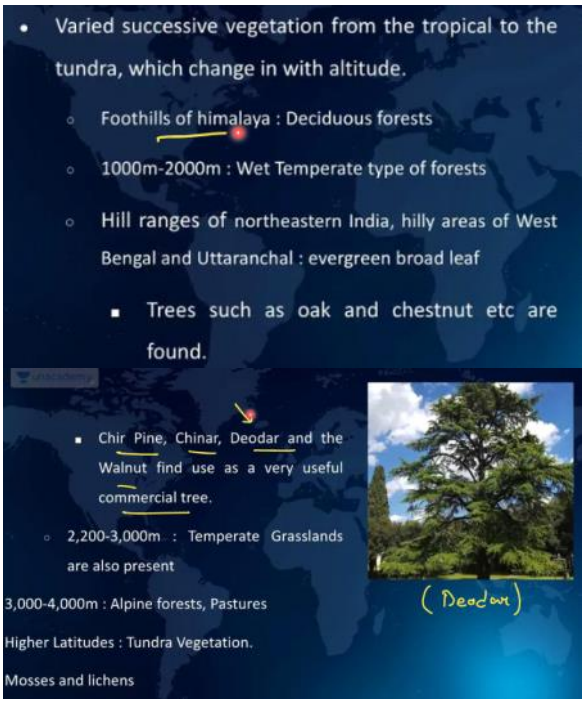
Types of Forest	• Tropical Evergreen and Semi Evergreen forests
	  • Annual Rain >= 220 cm
	
	• Tropical Deciduous forests
	  • Monsoons
	  • Moist Deciduous : 100-200 cm rainfall
	  • Dry Deciduous : 70-100 cm rainfall
	
	• Tropical Thorn forests
	  • 40-70 cm rainfall
	
	• Montane forests
	  • variety of forest in mountain region
	
	• Littoral and Swamp forests.
	  • Coasts, islands, deltas, inland lake

Tropical Evergreen Forest	• Do not shed their leaves at the same time • Canopy cover is very dense  

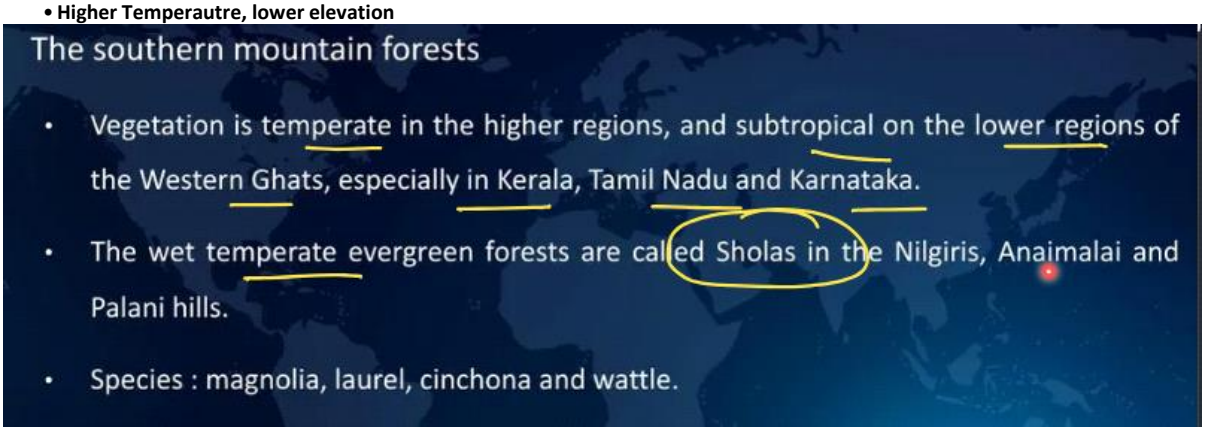
Semi Evergreen Forest	
Tropical Deciduous Forest	• Shed their leaves during dry season • To reduce the vaue of transpitation 
Tropical Thorn Forest	 Region : Rajasthan, Gujarat, MP, Parts of Maharashtra and KA, Haryana and Punjab, Western UP, Parts of Telangana

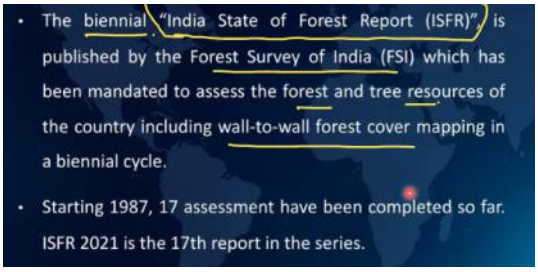
Montane Forest

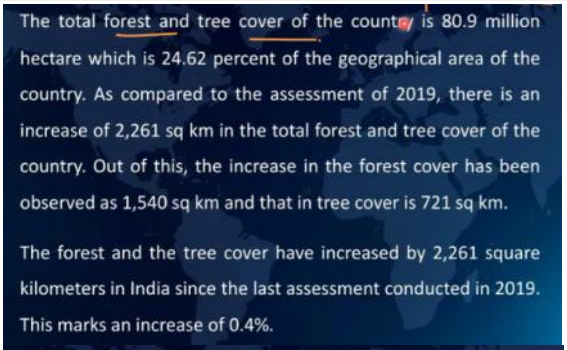




• Higher Temperautre, lower elevation

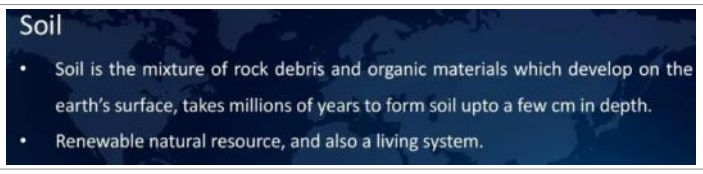
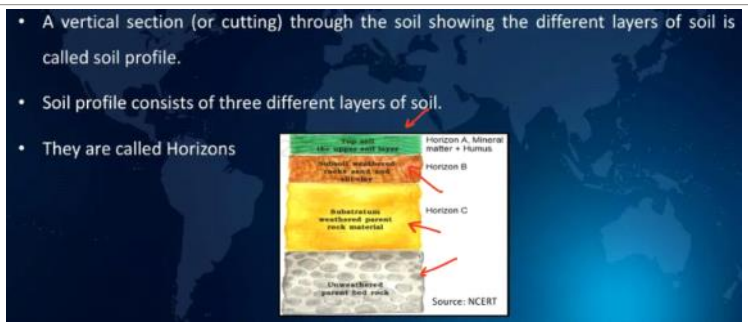


Littoral and Swamp Forest	 • Coastal States, Deltas, Estuaries, Islands, Rann of Kutch, large Inland Lakes • Ex : Sundarbanes 
Status of Forest in India	 • 1988 : Forest Policy : 33% of land area under forest • 17 States already achieved it
	• Forest is considered as ○ If vegetation is greator than > 1 hectare ○ Canopy Cover > 10% • Else considered as tree cover Forest and Tree cover of India in 2019 **Class** / **Area (sq km)** / **Percentage of Geographical Area** **Forest Cover** Very Dense Forest — 99,278 — 3.02 Moderately Dense Forest — 3,08,472 — 9.38 Open Forest — 3,04,499 — 9.26 **Total Forest Cover*** — **7,12,249** — **21.67** Tree Cover — 95,027 — 2.89 **Total Forest and Tree Cover** — **8,07,276** — **24.56** Scrub — 46,297 — 1.41 Non-Forest# — 25,28,923 — 76.92 **Total Geographic Area** — **32,87,469** — **100.00** * Includes 4,975 sq km under Mangrove Cover # Non-forest includes Tree Cover (Percentage rounded off) 
Forest Graphology	

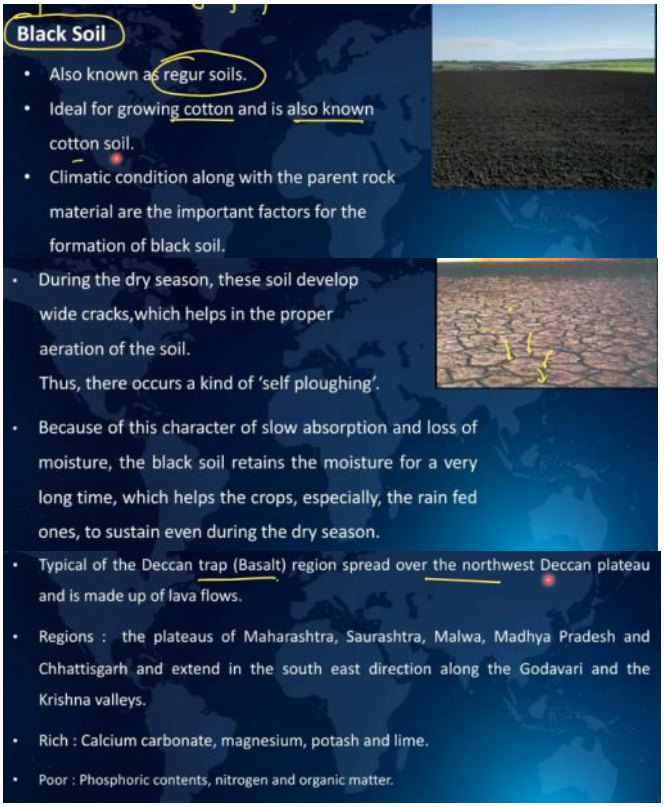
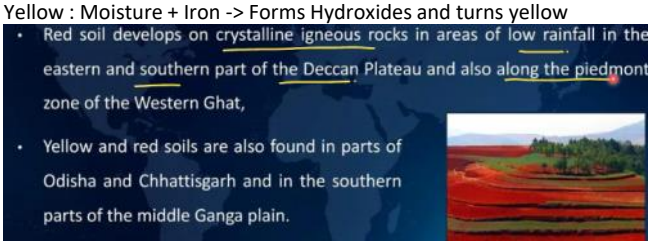
	
Forest report 2021	  

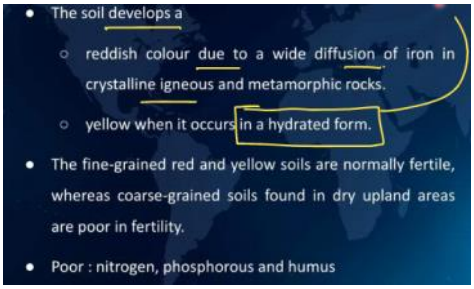
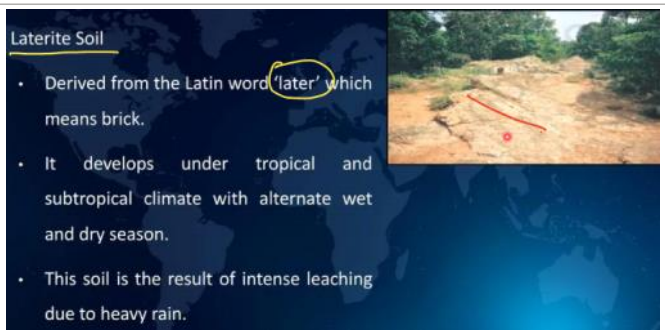
S32 Soils Topography

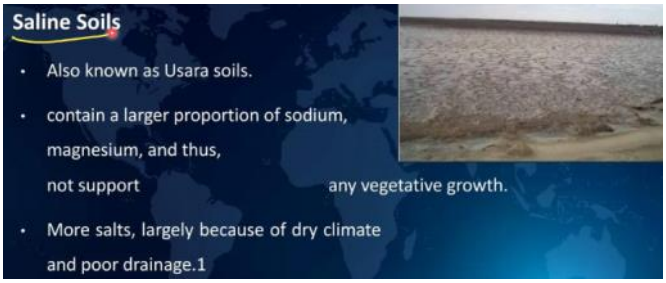
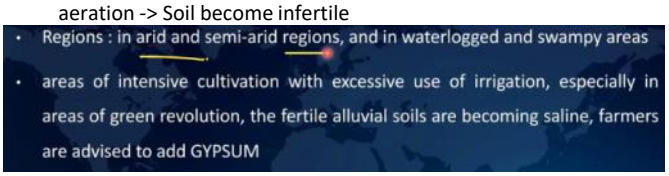
02 September 2024 11:24 PM

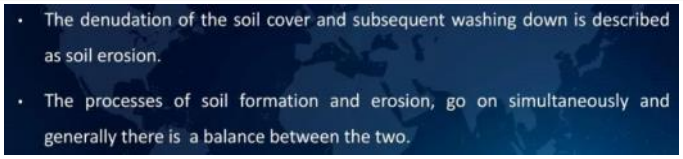
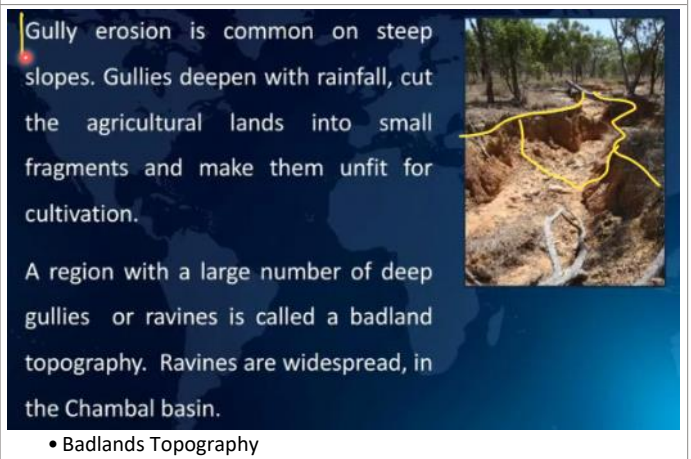
Soil and associated Problem	
Factors	Factors affecting the formation of soil are • Parent rock or bedrock ○ Flood Basalt -> Black Soil ○ Iron Rocks -> Red and yellow soil • Climate ○ Influence rate of weathering ○ Influence Fertility • Vegetation and other forms of life ○ Influence texture and Organic Content ○ Presence if earthworm ○ Presence of finer particles -> Ability ti retain air and moisture -> • Time ○ Influence texture ○ Greater time -> Finer the particle • Actions of running water, wind and glaciers ○ Deposition • Activities of decomposers etc. ○ Organic content of soil -> To affect fertility • Chemical and organic changes which take place in the soil are equally important.
Layers of soil	
Classification of Soil	 • Alluvial , Black, Laterite, Red and yellow soil

Alluvial Soil	

	
Black Soil	• Weathering of flood Basalt • Good Ability of retaining moisture -> Fine Particles • Rain fed Crops : Good for crop depending on rainfall for availability of moisture 
Red and Yellow soil	• Red : Dry + Iron • Yellow : Moisture + Iron -> Forms Hydroxides and turns yellow 

	
Laterite Soil	 • Not Fertile -> Nutrients carried to the sub soil region during rain • Top soil turns acidic -> as salts drain to the lower areas 
Arid Soil	 • Lack Humus -> due to dry condition
Forest and Mountain Soils	

Saline soils	 • Occurs in areas experiencing water logging where excessive water brings salt to the surface • When water evaporates -> salts harden -> Soil become impervious -> Poor aeration -> Soil become infertile  • Gypsum added -> to improve soil texture -> retention of moisture increases -> adds the availability of salts

Soil Erosion	
Causes	• Very Strong force by agent of nature (rain, river etc) • Lack of vegetation to bind the soil
Splash Erosion	• Each drop of drain erode top layer
Sheet Erosion	
Gully Erosion	 • Badlands Topography

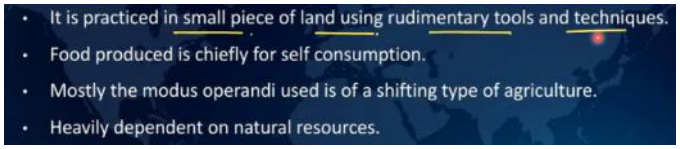
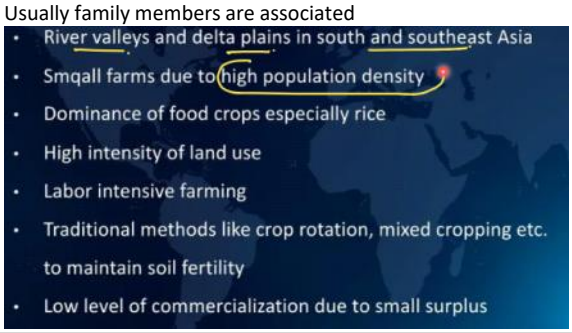
Stream bank Erosion	 • Proper afforestation of entire area
Wind Erosion	 • In the arid / semi arid regions

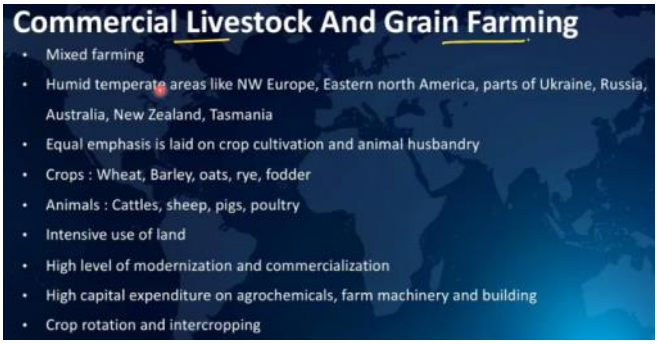
Soil Degradation	• Soil degradation can be defined as the decline in soil fertility when the nutritional status declines and depth of the soil goes down due to erosion • Soil Erosion • Decline in fertility
Factors	• Excessive irrigation / Water Logging • Excessive chemicals (Fertilizers + Pesticides) • Lack of Crop diversification • Soil Pollution (Solid waste dumping), Waste emission • Jhoom Farming • Factors leading to soil erosion
Desertification	• Expansion of existing deserts • Degraded region turns into Wastelands -> turns into deserts
Soil Conservation	 • Mulching :Covering with grass, straw, haze, etc • To cover top soil

S33 Agriculture

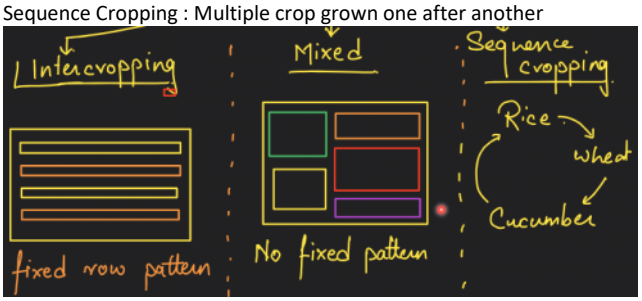
03 September 2024 01:33 AM

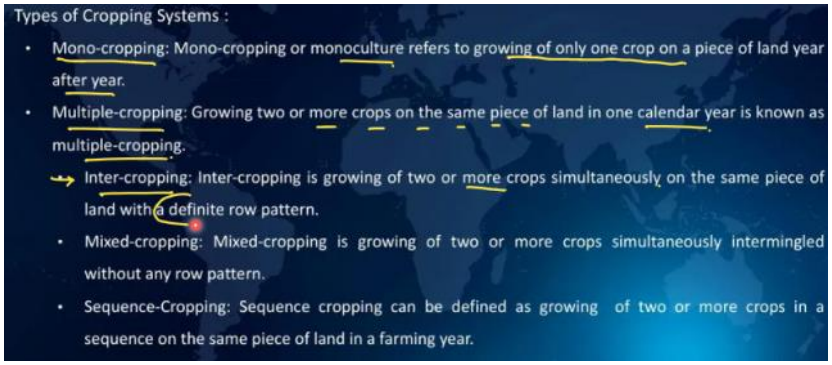
<table>
<tr><td>AGRICULTURE</td><td>• India has been agrarian economy for long time
• 45-50% people are related to agriculture
• 15% of GDP is contributed by the agriculture
•
 

• Almost similar production was observed in 22-23</td></tr>
<tr><td>Types of Agriculture</td><td>
<table>
<tr><td>Primitive Subsistence Farming</td><td>• Cultivation for self-consumption
• Low level of technology used, Traditional farming techniques is used
• Shifting form of Cultivation
• Mostly observed in Hilly and tribal area
• Reliance on natural factor
• Lack of irrigation : Rain fed
• Size of farmland is small -> Production is less
•
 
</td></tr>
<tr><td>Shifting Cultivation</td><td> 
</td></tr>
<tr><td>Intensive Subsistence Farming</td><td>• Low Productivity but done on Land that is naturally fertile
• Usually family members are associated
 
</td></tr>
<tr><td>Commercial Farming</td><td>• Very large land, labour force is used -> Cheap migrant labours are used
• Advance technology used
• Value addition to crops by processing infrastructure
 
</td></tr>
</table>
</td></tr>
</table>

	Commercial Livestock and Grain Farming	

Cropping Pattern

Mono-Cropping	• Singe crop grown in one season
Multi-Cropping	• Multiple crops are grown in 1 year Types • Intercropping : Multiple crop grown together in fixed row pattern • Mixed : No set pattern or arrangement in the field • Sequence Cropping : Multiple crop grown one after another 

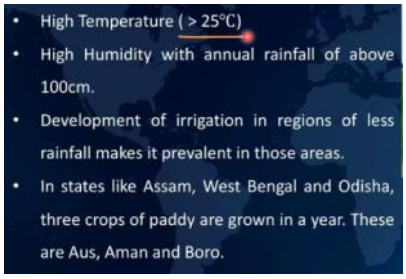
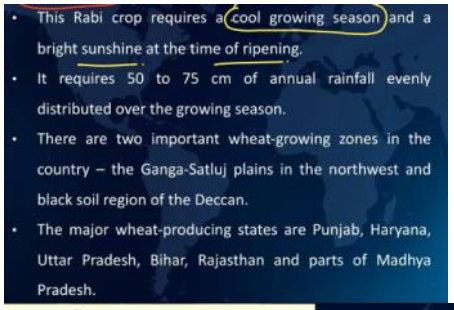
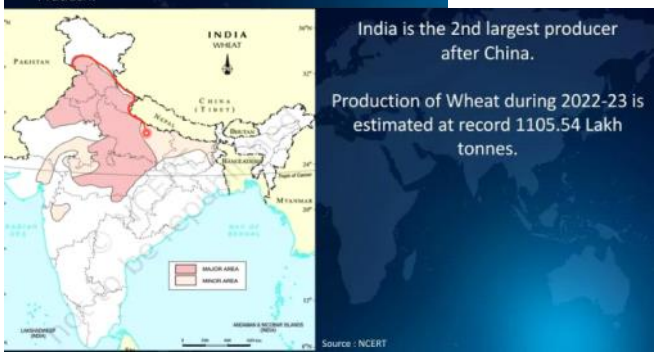


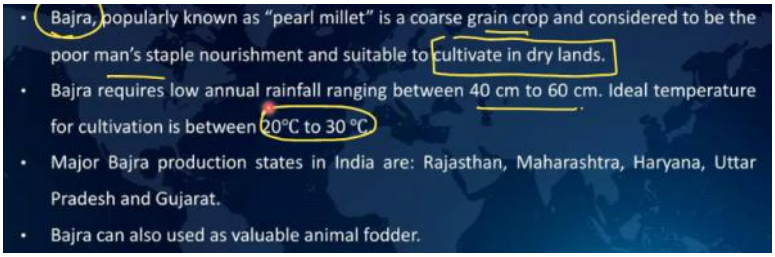
- Cropping pattern in India has changed and is now being dominated by sequence cropping (in Green Revolution areas)
- Monocropping is practiced in Nilgiris, Himalaya etc.

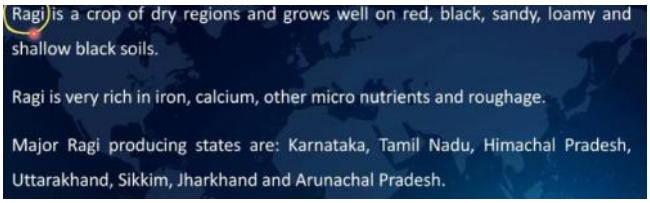
Cropping season

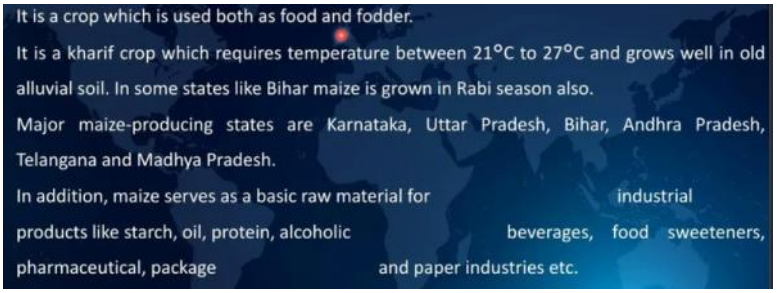
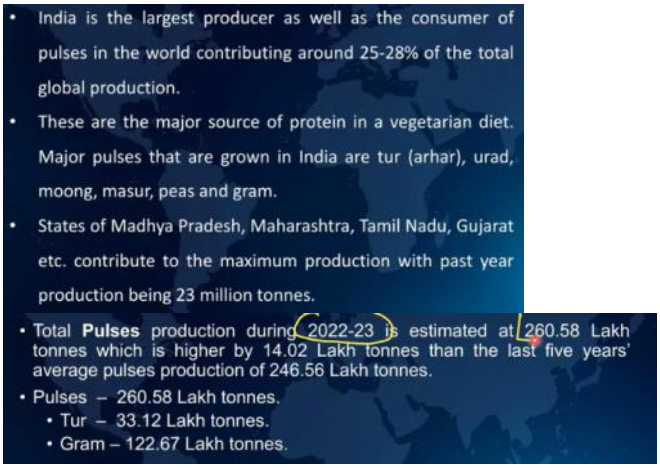
Rabi	• Winter Crop • Sowing : in Nov Dec • Harvesting : in March April • Example : Mustard, Wheats, Barley, Peas
Kharif	• Monsoon Crops • Sown in June July • Harvested in Sept Oct • Example : Rice, Maize, Jowar, Cotton, Tur, Paddy, Groundnut, Soya Bean
Zaid	• Summer Crops • Sown in April may • Harvested in June • Example : Watermelon, Cucumber, Musk melon

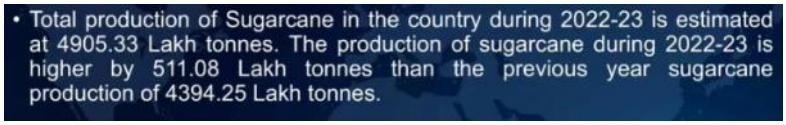
CROPS

Rice	 • Rainfall around : 120-100 cm ○ But now grown in area with 50cm because of irrigation 
Wheat	  • Reduced Production of wheat ○ Western Disturbance Induced rain at time of harvest causes significance losses ○ Incidence of extreme heatwave like condition during March- April also reduces productivity
Millets	• Poor Farmers Friends : Do not need special condition • No irrigation required : Rain Fed • Highly Nutritious than wheat/rice • Used as fodder (food for animals) • Kharif crops 





Maize	• Corn 
Pulses	• Can be grown in older alluvial • Can be grown in rain fed condition 
Sugarcane	 • Byproducts -> Molasses, Bagasse • Used in Industries like Paper, Packaging, Biofuel Sugarcane production is shifting to southern India • Favourable condition are present ○ Growing season extends for 8-10 months of the year • Sucrose content is higher • Better infrastructure ○ Farm to mill connectivity ○ Less Wastage ○ Better Cooperative structure

PLANTATION CROPS

Tea	• Require 150+ cm annual rains • No Standing water -> Slopes required • Temp 21*C - 27*C • Regions : HP, WB, Sikkim, NE States, Nilgiris
Coffee	• Require 150+ cm annual rains • No Standing water -> Slopes required • Temp 25*C - 30*C • Grows in shade, Not in direct sunlight • People grow trees in field for shade • Regions : Karnataka, AP, Kerela

S34 Agriculture II

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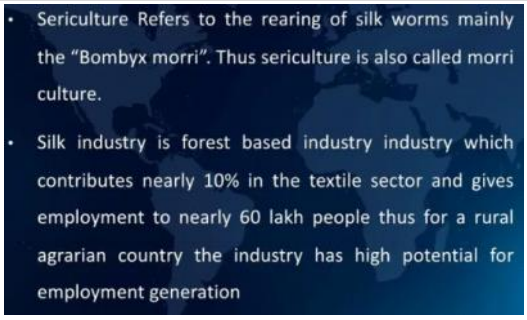
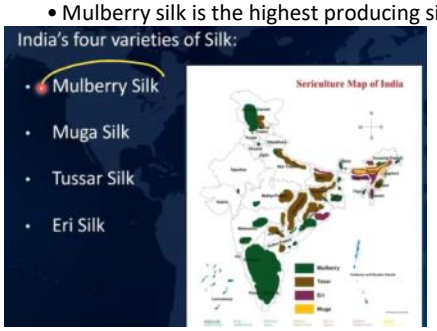
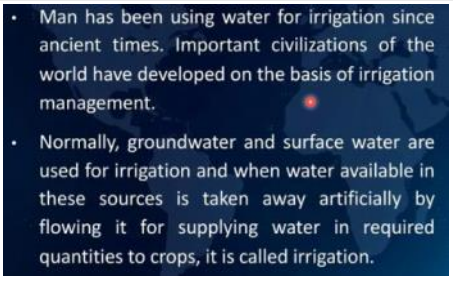
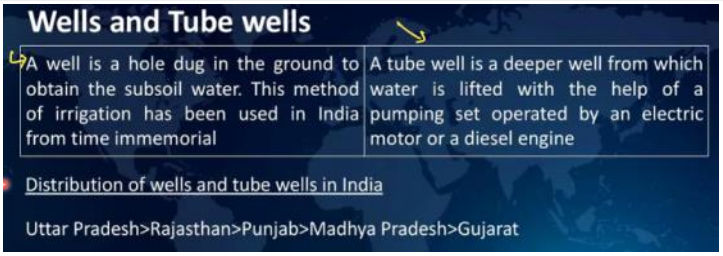
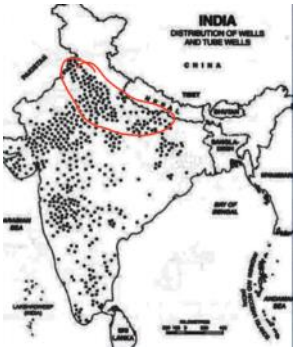
FIBRE CROPS

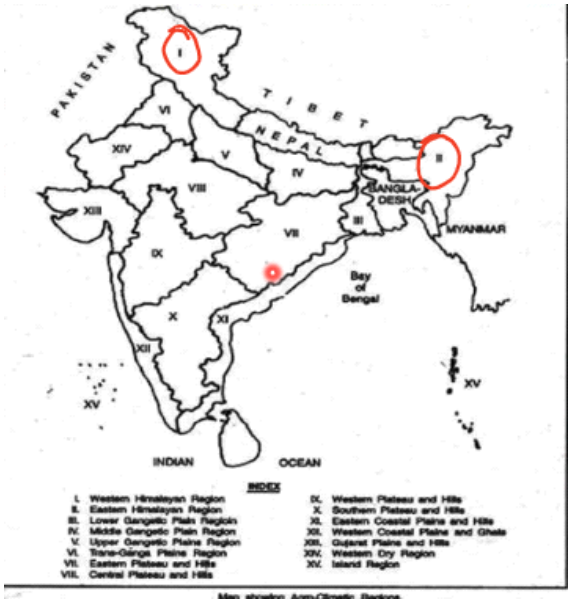
Cotton	• Kharif Crop, Rainfall : 50-70 cm • Temp : 25*C-32*C • 7 months of growing period, need to frost free • Grows well in black soil, well drained alluvial (no water logging) • Region : Maharashtra, Gujrat, MP, Punjab
Jute	• Rainfall 150+ cm • Temp : 25*C - 30*C • Grows well in newer alluvial soil • Regions : WB, Assam, Bihar, Jharkhand, Odisha, Coastal AP • Technology is old, Lack of investment as compared to Bangladesh
Sericulture	 • Labour intensive culture -> Can help lower strata income societies -> Economic Upliftment • Mulberry silk is the highest producing silk in country, Tami 

IRRIGATION	 • 1960 Canal irrigation dominated • Tubewell became then most dominant mean of irrigation till today
Wells and tube wells	

	
Canals	• Canals used to be the most important source of irrigation up to 1960, but in the 1970's they yielded first place to wells and tube wells and now constitutes the second most important source of irrigation in India  
Sprinkler and drip irrigation	• Modern Irrigation technique • Can also be used to spread fertilizers
Tanks	• Tank consists of water storage which has been developed by constructing a small bund of earth or stones build across a stream. • The water impounded by the bund is used for irrigation and other purposes • Tank irrigation is popular in the peninsular plateau area where Andhra Pradesh,Telangana and Tamil Nadu are the leading states. Andhra Pradesh is the largest state of tank irrigation, where it has about 29% of tank irrigated area of India

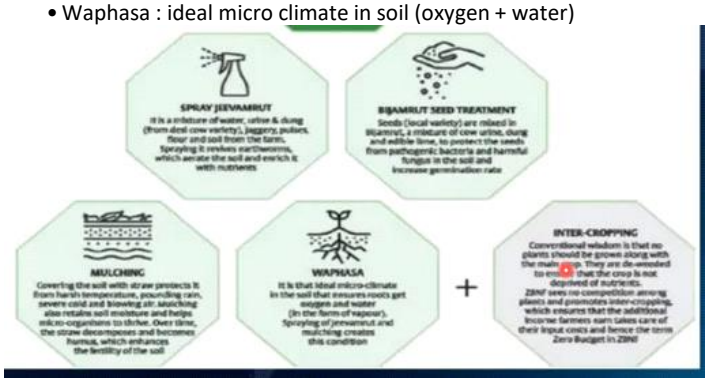
Agriculture Productivity and efficiency	• Efficiency = Yiled/Hectare **Agricultural Productivity And Efficiency** • Agricultural productivity is the quantitative measurement of the capacity of a land in relation to the crop yields. • Productivity is not simply the physical quantity of the land to provide greater yield per hectare. however the simplest method to measure productivity is per hectare yield, it is dependant on two factors- physical and technological fact
Cropping intensity	• Cropping Intensity : Refers to the number of time crops are cultivated in a farmland in one season • CI = Total area cultivated in 1 year / Area of the Farmland • Refers to the number of times a piece of land is cultivated in a given year across cropping seasons. • It is calculated as a ratio of gross cropped area upon the net sown area and is calculated in percentage. CI = (gross cropped area / net sown area) x 100

	Spatial patterns of cropping intensity; • Very High Cropping Intensity - 175 (Punjab, Haryana, WB, TN) • High Cropping Intensity- 150 to 175 (UP, Bihar, Assam, Kerala) • Moderate Cropping Intensity- 125 to 150 (Karnataka, MH, AP, MP, Chattisgarh) • Low Cropping Intensity- < 125 (Gujarat, Rajasthan, J&K, N.E States, Odisha, Jharkhand, H.P)
Agro and Social Forestry	■ The National commission on agriculture of the Indian Government used the term Social Forestry for the first time in 1973. ■ Social Forestry scheme can be categorised as farm forestry, community forestry, extension forestry and agroforestry. ■ Agroforestry is a collective name for land use systems involving trees combined with crops and/ or animals on the same unit of land Objectives of Social forestry and its role in rural economy: • Increasing forest area and restoring ecological balance • Meeting basic rural needs • Better returns • Controlling pollution • generation of employment
Agro Climatic Zones	• Regions are classified as 15 different zoned based upon • Topography • Micro Climate / Regional Climate • Reason : Provide agriculture self sufficiency • In 1964 the planning commission divided India into 15 Agro-humidity regions based on the ecological approach. In 1989 in the 7th plan appraisal the agro climatic region was proposed and during the 8th plan in 1991 it was implemented. • This regionalisation was a unique approach as it included the physico climatic variable and the socio-cultural ethos for the construction of agri regions. This approaches were adopted for the 4 fold purposes: ○ Food sufficiency of the country ○ Commercialisation of agriculture Surplus output for commercialization and exports ○ Agri-Ecology



Green Revolution	• Increasing food grain production in third world countries • HYV seeds, Irrigation , Fertilizers, Pesticides • Green revolution refers to the multiple growth in crop production in the third world countries based on the use of modern inputs, technology, HYV seeds and mechanization as well as irrigation facilities. • Green Revolution was termed by prof. William Gadd in 1958 in a seminar in Washington, over a seminar titled "The food crisis in the Third world countries". • The Mexican food crisis was the stimuli as prof. Norman Borlaug developed the HYV seeds by genetic modification and cross fertilisation of the good quality wheat. It was successful in Mexico and wheat production doubled in a span of 7 years and self sufficiency was achieved • In 1961 M.S.Swaminathan invited Norman Borlaug who suggested similar revolution in Indian agriculture . The Basis of green revolution: • High Yielding Varieties (HYV) • Commercialization • Use of Chemical fertilizers • Irrigation Facilities, Mechanization • Rural electrification • Land holdings and consolidation • Rural Credit and Micro-financing • Use of pesticides, insecticides, and weedicides
Limitation	• Excessive use of Chemicals • Excessive irrigation -> Saline Soil + Ground water depletion • Excessive reliance on HYV seeds, Indigenous varieties got ignored • Lack of crop diversification -> Rice wheat Cycle -> Soil Degradation • Regional Inequality : Only implemented in North-West India
BGREI	• Bringing Green Revolution to East India

Organic Farming	As per FAO (Food and Agricultural Organization), "Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs". **Characteristics of Organic Farming** • Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity, and careful mechanical intervention. • Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms. • Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock manures.

Zero Budget Natural Farming	• A method to carry out organic farming
	• Farm Income = Selling Price - Input Cost
	  • Reduce Input Cost to 0
	Zero Budget Natural Farming (ZBNF) is a farming practice that believes in natural growth of crops without adding any fertilizers and pesticides or any other foreign elements.
	
	• Basic Principles
	  • Jeevamrut : Treatment of soil : to improve microfauna, Soil organism (Earthworm + Organic Matter)
	  • Beejamrut :Treatment of seed : to get rid of bacterial and fungal infection. Also to increase germination rate of the seeds
	  • Mulching : Covering with grass and hay : To preserve the soil fertility
	  • Waphasa : ideal micro climate in soil (oxygen + water)
	 

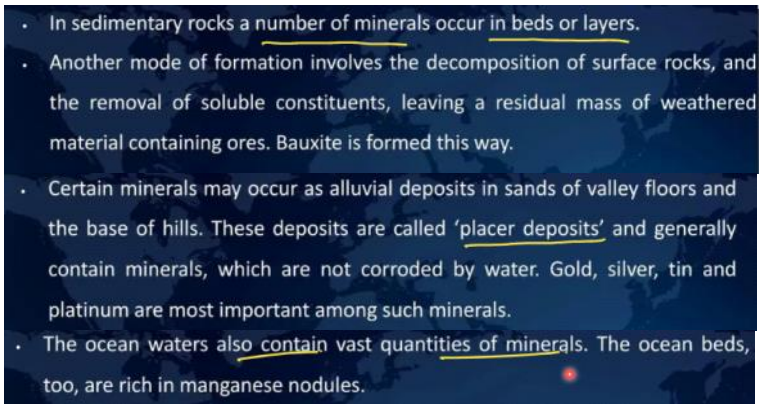
Mulching	A mulch is natural or artificially spread layer of plant residues or other material on the surface of the soil. The important objectives of mulching in agriculture are namely moisture conservation, temperature control, prevention of surface compaction, reduction of runoff and erosion, improvement in soil structure and weed control.

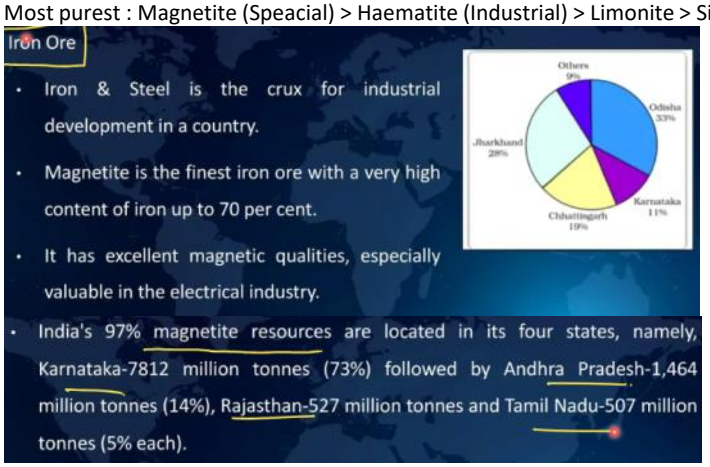
S35 Minerals and Industries

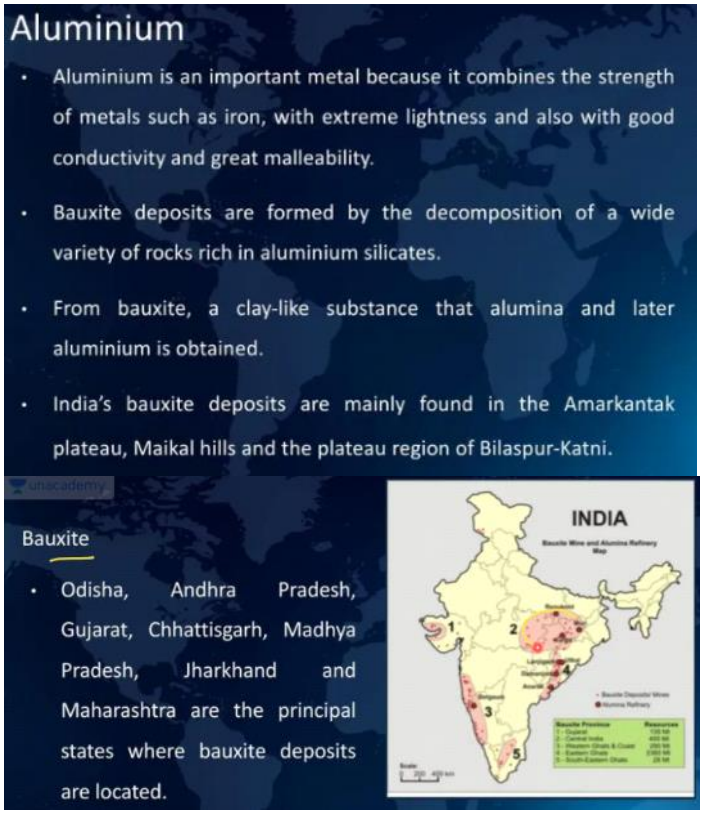
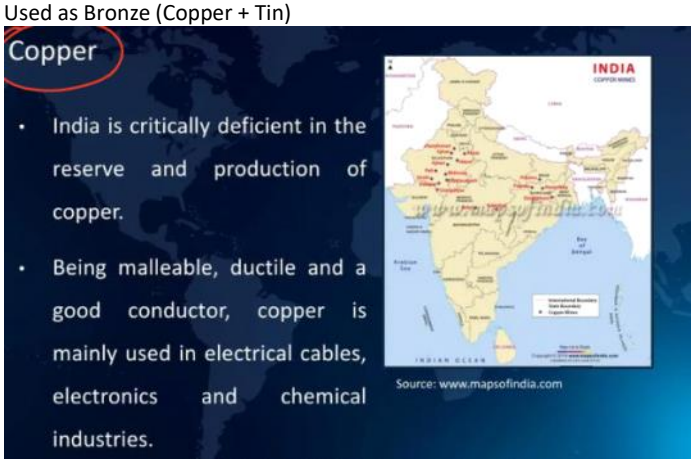
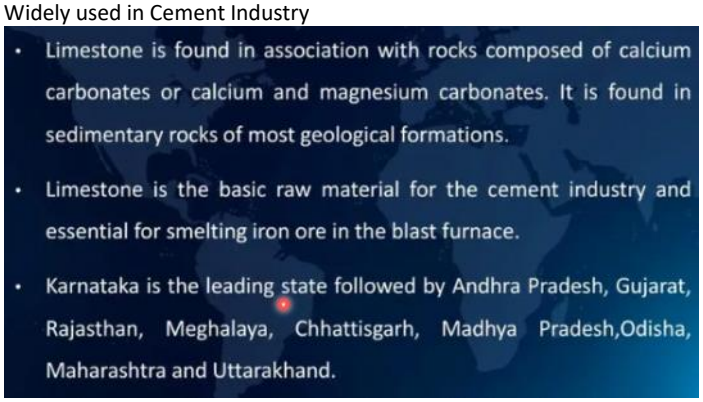
03 September 2024 10:44 PM

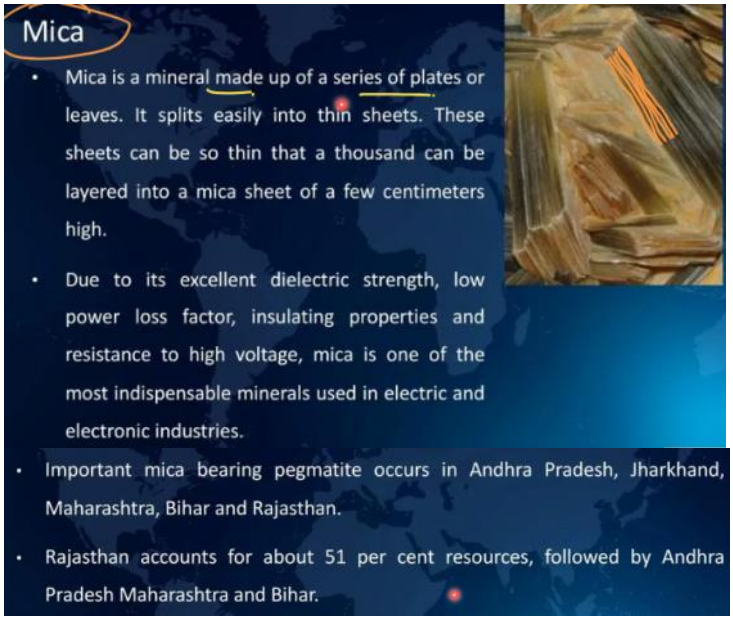
Minerals	Minerals are an important part of our everyday life and make up most of the earth; they are defined as naturally occurring substances that have a crystalline

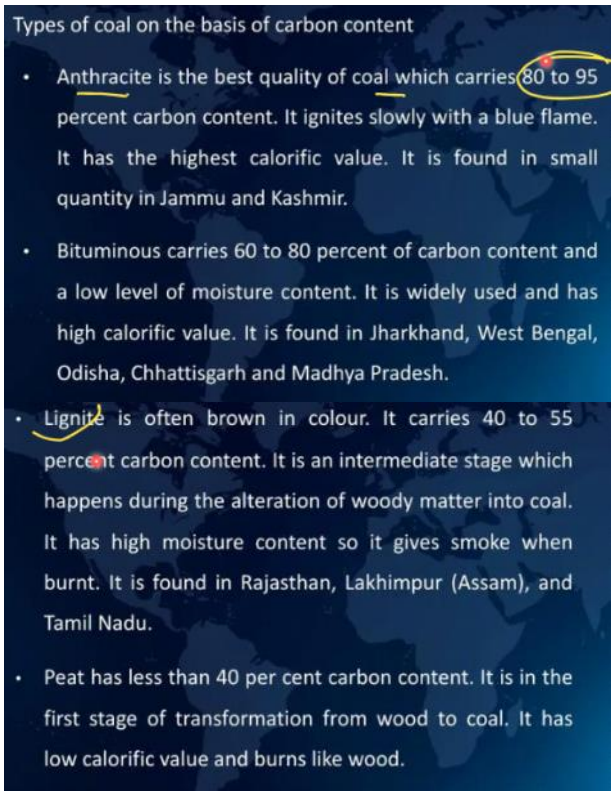
Types	• Metallic
	  • Ferrous : Iron Ore, Manganese, Nickel, Cobalt
	  • Non Ferrous : Copper, Lead, Tin
	  • Precious : Gold, Silver, Platinum
	• Non Metallic
	  • Mica, Salt, Potash, Granite, Limestone, Marble, Sandstone
	• Energy Minerals : Coal, Petroleum, Natural gas

Location of Minerals	• In igneous and metamorphic rocks minerals may occur in the cracks, crevices, faults or joints. • Known as Veins (Lines) and Lodes (Chunk of Minerals) • Detected using Sonar and Seismic Waves  • Polymetallic Nodules
Mineral Distribution in India	• 11 states account for 90 % of the total number of operational mines • Old Plateau Regions

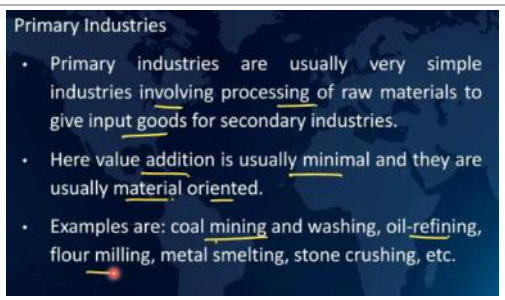
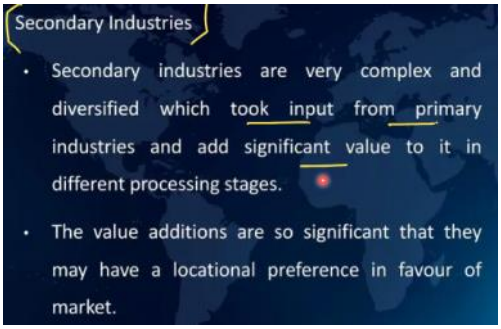
Iron Ore	• Very Important for development • Most purest : Magnetite (Speacial) > Haematite (Industrial) > Limonite > Siderite   • Singhbhun Mayurbhanj Belt : Odisha Jharkhand Belt

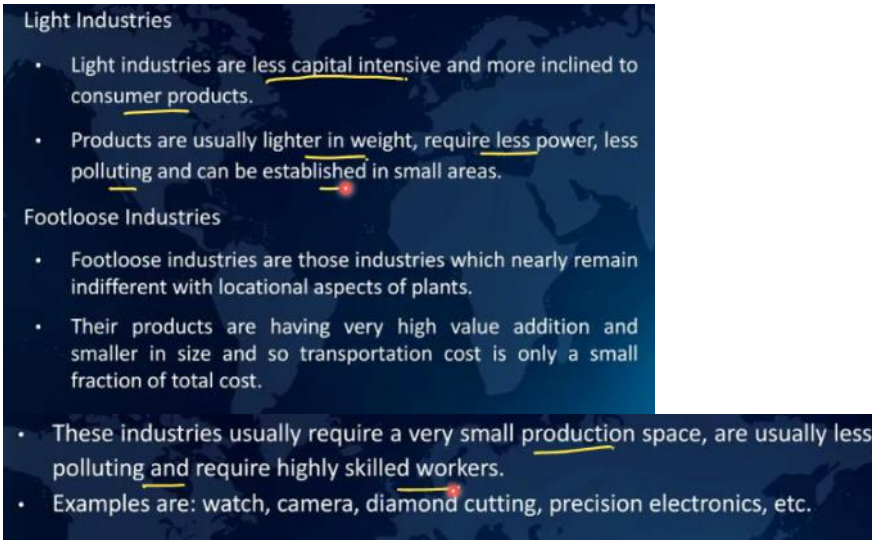
Aluminium	• Strength of iron and light weight • Used in Aircraft 
Copper	• Used in India for Millennia • Used as Bronze (Copper + Tin) 
Limestone	• CaCO3 • Widely used in Cement Industry 

Mica	

Coal	• Fossilization of trees -> Carbonification • Greter time period -> better carbon content • Anthracite > Bituminous > Lignite > Peat • Indian Coal Sulphur content is very high -> high ash -> less energy produced  

	• Rat Hole mining : • In 2010 8000Crore lost because of rat hole mining • Creating manmade of one people size hole to mine coal • Many people drawn, fire starts

Industries	
Primary Industries	
Secondary Industries	 • Heavy Industries :Ship building / Local • Light / Footloose 



Tertiary Industries

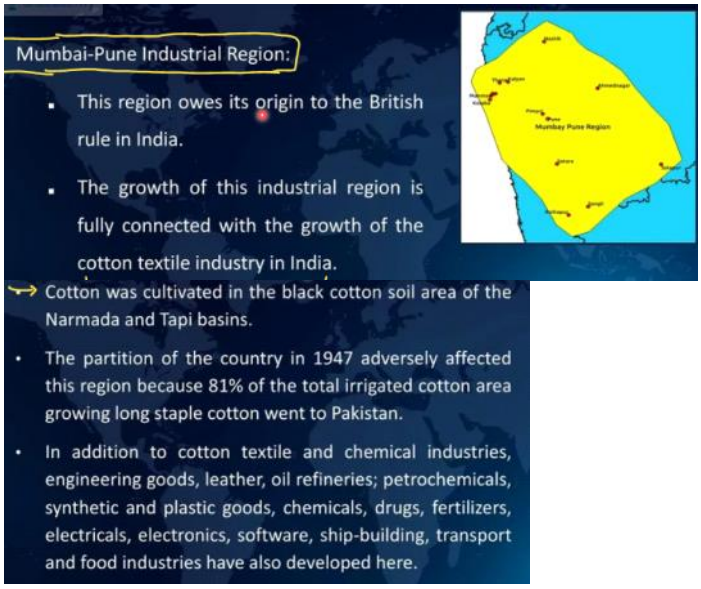
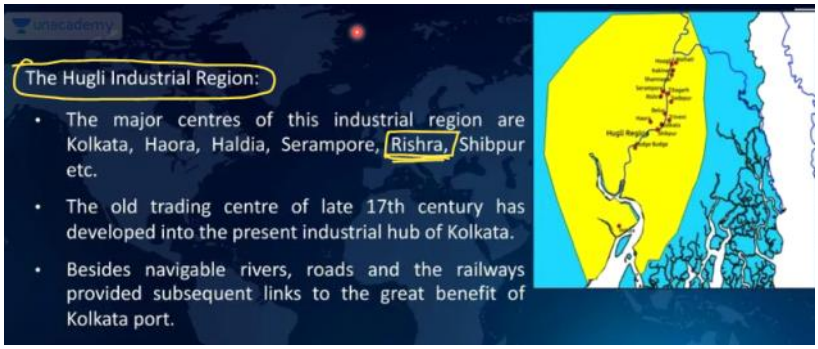
Locational Factors

- In industrial geography, locational aspects of an industry are very important.
- Generate Profit

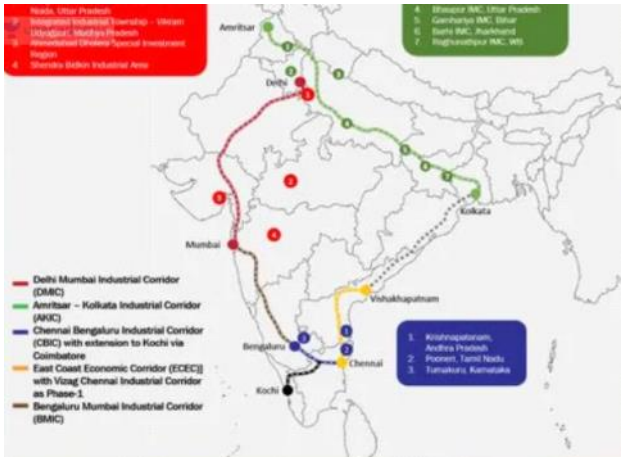
- Weber Industrial Location Theory
  - Raw Material
  - Transportation cost
  - Availability of Market

Weight Gaining Industries	Weight losing Industries
Finished product are heavier than raw material	Finished products are lighter than raw material
Locomotive, Ship Building	Paper, Sugar
Ideal location close to Market	Ideal location near Raw material

- Factors Affecting
  - Raw materials : Affordable and reliable : ensures continue productivity
  - Fuel and power : Some factories like semiconductor need proper power supply
  - Human resources
    - Skilled :
    - Unskilled : replaced by machine
  - Transport
  - Market : Availability of demand
  - Capital : Woking funds
  - Government policies
    - Taxation Structure
    - Ease of doing business
    - Infrastructure
    - Law and Order

Major Industry Region	 • Mumbai Pune : Started with Cotton + textile • Chemical industry setup (Base used by other Industry) • Cheap labour + Transport + Market • Bangalore Chennai Belt : Started by Silk • Addition of hydroelectricity • Migrant worker • Hugli region : because of Jute Industry
Mumbai Pune	 • Transportation corridor through Thalghat and Bhorghat gaps allowed the industrialisation of Nashik and Pune
Hugli Region	

	• The discovery of coal and iron ore in Chotanagpur plateau • Tea plantations in Assam and northern parts of West Bengal • The processing of deltaic Bengal's jute. • Cheap labour could be found easily from the thickly populated states of Orissa, Bihar, Jharkhand and eastern part of U.P. • Location of petroleum refinery at Haldia. • The construction of Haldia port in the lower reaches of Hugli to the south of Kolkata.
Chotanagpur Region	Chotanagpur Industrial Region: • The birth and growth of this region is linked with the discovery of coal in Damodar Valley and iron ore in the Jharkhand-Orissa mineral belt. • Besides raw materials, power is available from the dam sites in the Damodar Valley and the thermal power stations based on the local coal. • This region is surrounded by highly populated states of Jharkhand, Bihar, Orissa and West Bengal which provide cheap labour. • Heavy engineering, machine tools, fertilizers, cement, paper, locomotives and heavy electricals are some of the other important industries in this region. Important nodal centres of this region are • Hazaribagh • Jamshedpur • Daltonganj • Bokaro 
Gurgaon Delhi Meerut region	Gurgaon-Delhi-Meerut Industrial Region: • It consists of two industrial belts adjoining Delhi. • One belt extends over Agra- Mathura- Meerut and Saharanpur in U.P. and the other between Faridabad- Gurgaon- Ambala in Haryana. • The industries are light and market oriented. • Field Refineries ○ Panipat ○ Mathura • Badarpur Thermal power Plant • Delhi add node of important transportation network • Sugar, agricultural implements, vanaspati, textile, glass, chemicals, engineering, paper, electronics and cycle are some of the important industries of this region. → Software industry is a recent addition.

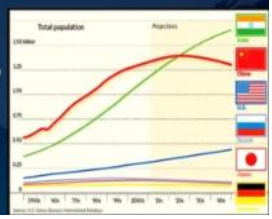
Industrial Corridors	
Metallic Minerals	
Non Metallic Minerals	

S36 Population, Settlement, Transport

04 September 2024 01:25 AM

Population	• Population means the number of people in a geographic area. • Population distribution refers to the way people are spaced over the earth's surface. Broadly, 90 percent of the world population lives in about 10 percent of its land area. • The population of the world is unevenly distributed.
	Region wise population density *Region wise Density of Population* Region | Population (2018) | Land Area (Km²) | Density (P/Km²) | World Share (in percentage) Asia | 4,545,133,094 | 31,033,131 | 146 | 59.5% Africa | 1,287,920,518 | 29,648,481 | 43 | 16.9% Europe | 742,648,010 | 22,134,900 | 34 | 9.7% Latin America and the Caribbean | 652,012,001 | 20,139,378 | 32 | 8.5% Northern America | 363,844,490 | 18,651,660 | 20 | 4.8% Oceania | 41,261,212 | 8,486,460 | 5 | 0.5%

Factors Influencing The Distribution Of Population	• Geographical Factors
	  • Climate: moderate
	  • Water availability
	  • Topography : Plain areas preferential
	  • Fertility of soil
	
	• Economic Factors
	  • Availability of economic opportunity
	
	• Social and Cultural Factors
	  • Openness in society
	  • Non-discriminatory society
	  • Social harmony

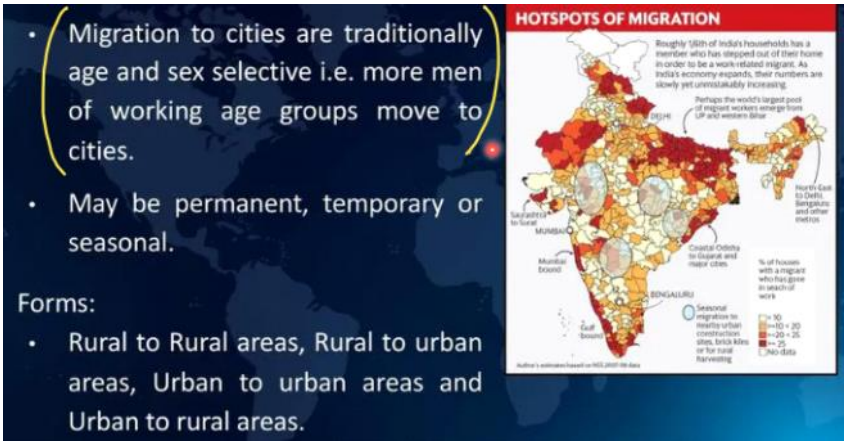
Population Growth	**Population Growth**
	Growth of Population :
	• Change of population in particular area between two points of time is known as growth of population.
	Natural Growth & Actual Growth of Population:
	 
	  • Positive : Incerase in population
	  • Negative : Decrease in population
	
	  • Natural Growth : Birth Rate - Death rate
	  • Actual Growth of population : BR -DR + People immigration - People Emigration

Migration	• Movement of people for a permanent/ semi-permanent basis is called migration.
	• Bihar (Place of Origin) -> Mumbai (Destination)
	
	• Push Factors (Character of Place of Origin)
	  • Geographical
	  ○ Water availability
	  ○ Fertility of soil

- Natural hazards
- Climate change

- Economic
  - Lack of opportunities
- Socio Cultural
  - Discriminations
  - Social Disorder
  - Wars
  - Lack of acceptance

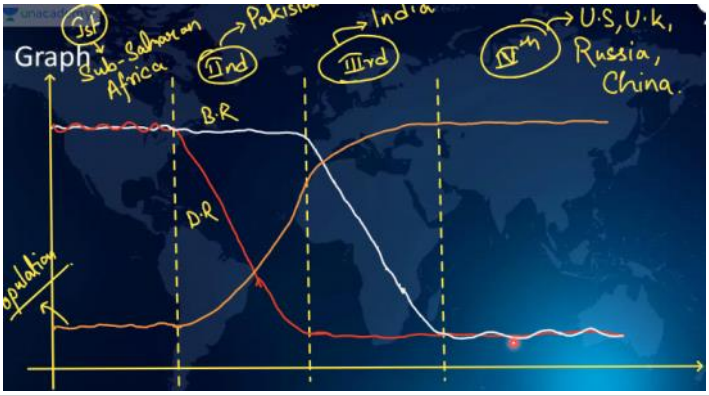
- Pull Factors (Character of Destination)
  - Economic
    - Job Opportunities
  - Socio Cultural
    - Health and education
    - Religious belief
    - Open Societies :Mumbai Cosmopolitans

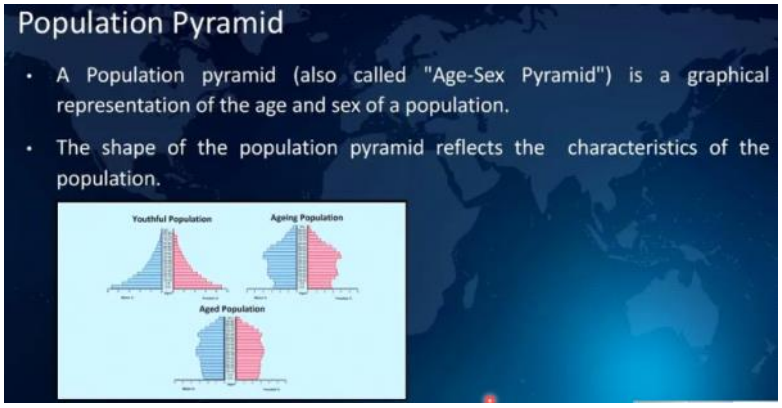


Indian Population	 • Census Exercise carried in every 10 year • Last time carried out in 2011, delayed because of Covid and Election • Estimated : 1.4 Billion in 2024 • 65% are rural : Most problem India is facing is rural problem
Growth rate	**Population Growth Rate** • Decline during 1921 ○ Famine

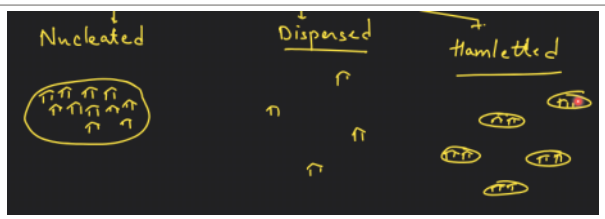
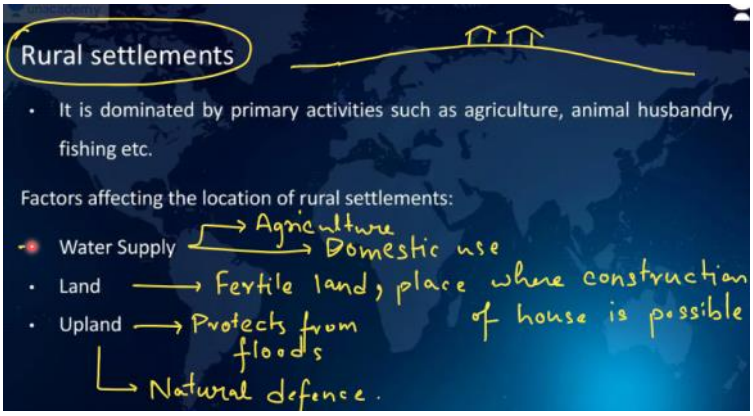
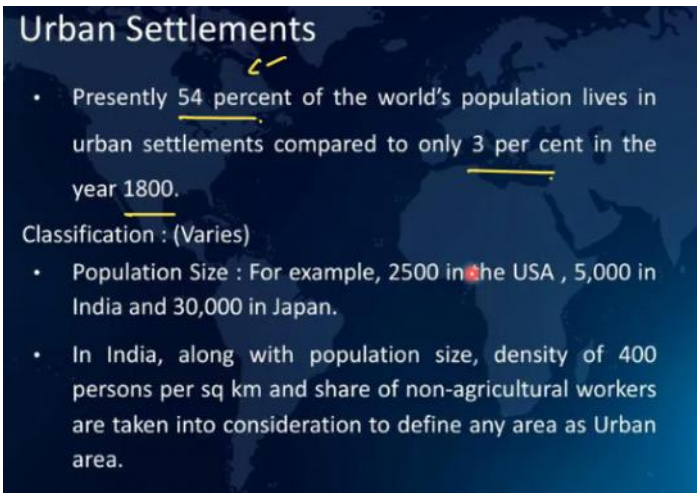
Year	India
1901	23,83,96,327
1911	25,20,93,390
1921	25,13,21,213
1931	27,89,77,238
1941	31,86,60,580
1951	36,10,88,090
1961	43,92,34,771
1971	54,81,59,652
1981	68,33,29,097
1991*	84,64,21,039
2001	1,02,87,37,436
2011	1,21,01,93,422

	○ Spanish flu ○ Causality in WWI • Growth reason : Population explosion ○ Increase in Life expectancy : because of better medical facility
Demographic Transition	 • Change in population parameters observed in changing condition of society

Stage I	• No Medical facility -> High Death Rate • People Creating more offspring to increases chance of survival • Stagnant Population growth • Ex: Sub Saharan Africa
Stage II	• Starting Medical Facility -> Death rate falls • Birth rate reduce with lower rate, After a generation • Population Explosion • Ex : Pakistan
Stage III	• Population Explosion • Birth rate > Death rate • Ex : India
Stage IV	• Stagnant Population growth • Ex : Russia, UK, China
	

India Demography	• Demographic Dividend : Youthful Population • Crisis of Employment -> Demographic Disaster
Total Fertility rate	• On an average number of kids/ offsprings that a women has in her reproducing years • Replacement Rate TFR = 2.1 -> Stagnant Population • Kerala = 1.3, Bihar = 3
Population Pyramid	 • Youthful ○ Better Education, Employment ○ India

	• Ageing ○ Pension, Cost of living ○ China • Aged Population ○ Healthcare ○ Japan

SETTLEMENT	
Dispersement Category	
Rural settlement	• Less Population • Dominance of Primary Sector • Less Population Density 
Urban Settlement	• Dense Population • Dominance of Secondary and Tertiary (75%) 

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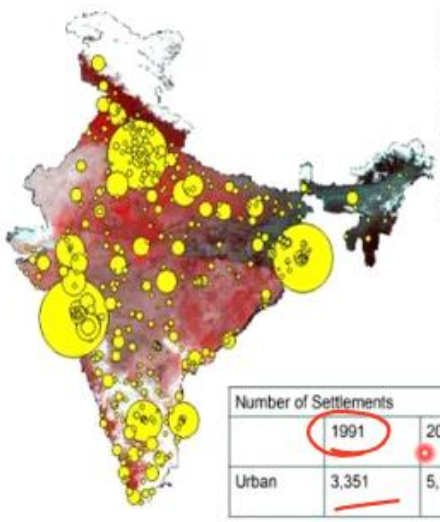
<tr><td></td><td> 

<table>
<tr><td colspan="4">Number of Settlements</td></tr>
<tr><td></td><td>1991</td><td>2001</td><td>2011</td></tr>
<tr><td>Urban</td><td>3,351</td><td>5,161</td><td>7935</td></tr>
</table></td></tr>
<tr><td>Problems of Human Settlement</td><td>Problems of Human Settlements in Developing Countries
Problems o Urban Settlements:
• Shortage of housing, growth of slums
○ Hygiene and sanity
• Economic Problems
○ Oversupply of labour
○ Low level of income, labour available for less wages
• Environmental Problems
○ Urban heat island
○ Urban Slims
○ Pollution</td></tr>
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