Handwritten Notes

On

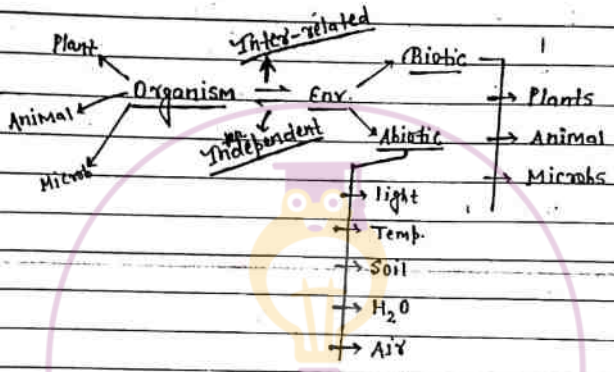
Ecology

Ecology

Oikos = Home / Habitat

logos = Study

Note:→ Earth = Global ecosystem



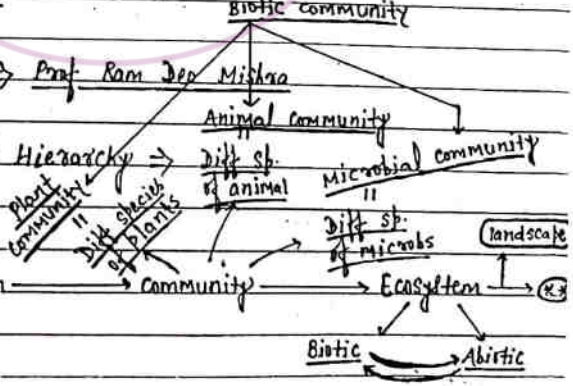
Eg - Habitat, Forest, Grassland, Pond, Desert etc.

Term ⇒ Haeckel

Father ⇒ Reiter

Indian father ⇒ Prof. Ram Dev Mishra

Ecological order / Ecological Hierarchy ⇒



Insof Ali Sir

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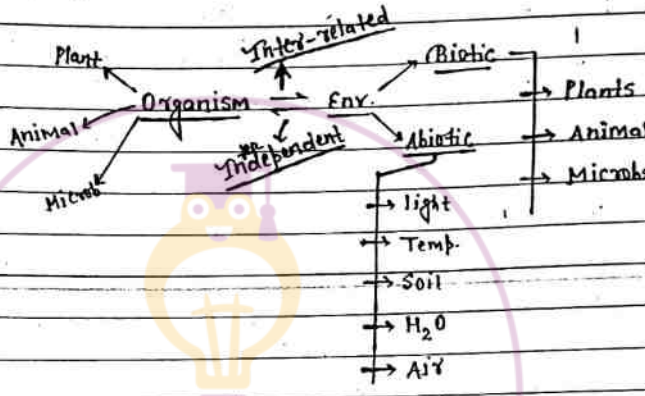

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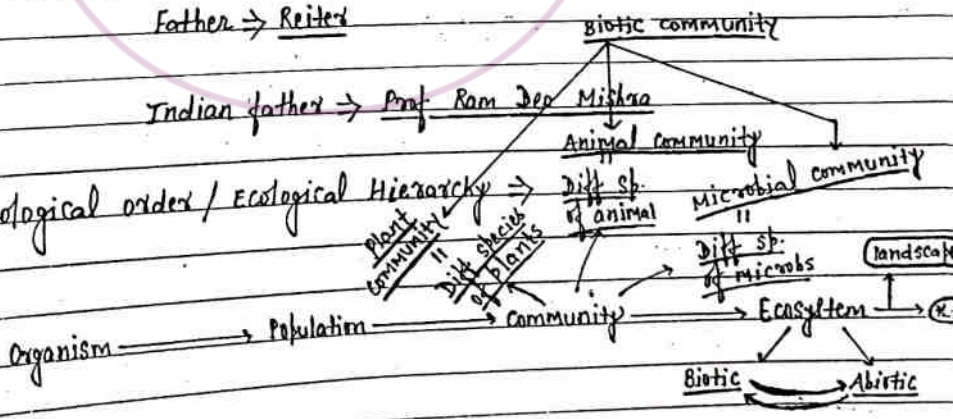

Intro to Ecology

Ecology

Oikos = Home / Habitat

logos = Study

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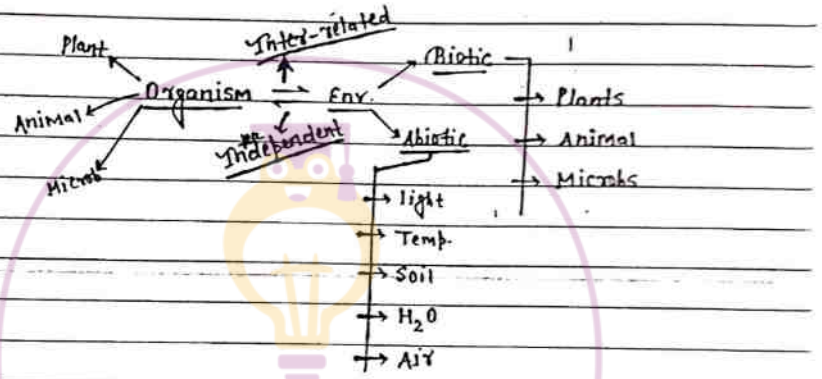

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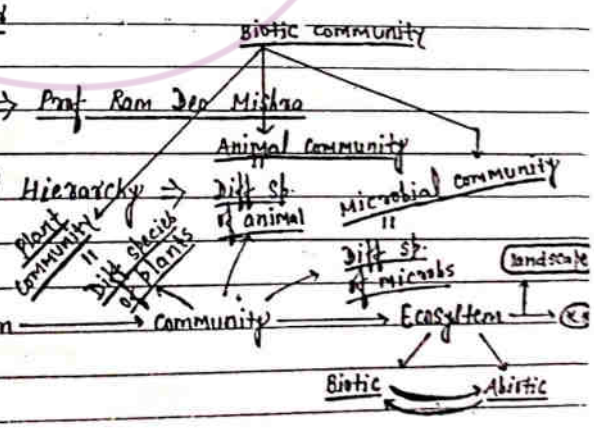
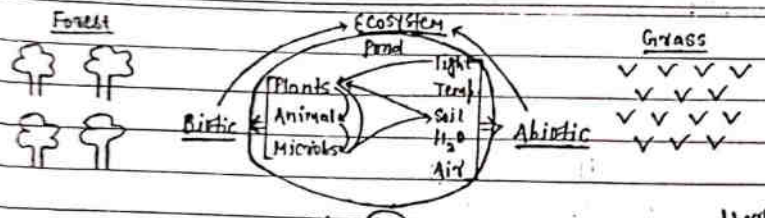


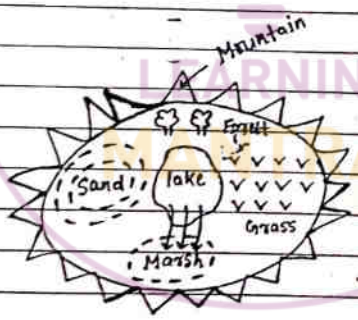


Size (FSE) →
Complexity (FSE) →

Biome → large ecosystem
e.g.- Desert
Ocean
Tropical Rain forest

Biosphere → Atmosphere, lithosphere, Hydrosphere
living sphere
Earth

landscape :-



Note :- Ecosystem is a unit of landscape.

	landscape	Biome
Complexity	↑	↓
Size	↓	↑

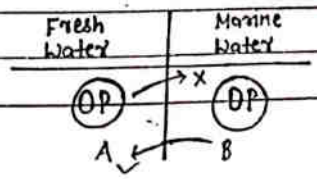
Branches of Ecology → on the basis of organization

Autecology
Single Species ⇌ Env.
Individual
unit of Study ⇒ Single Species
E.g. Effect of Global Warming on Human.
Species ecology
Population ecology
Ecology of individual

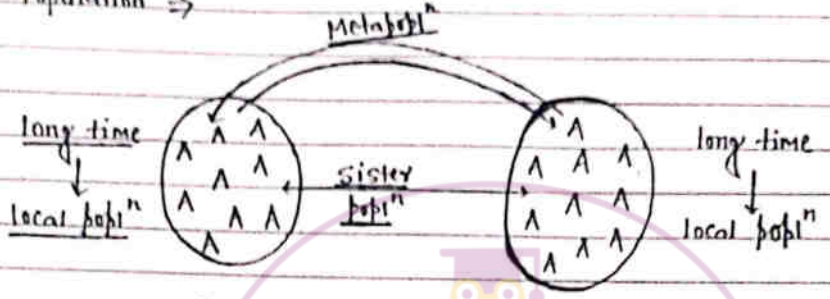
Synecology
Group of diff. Species ⇌ Env.
unit of Study ⇒ Community
Community Ecology
E.g. Effect of Global Warming on living organism

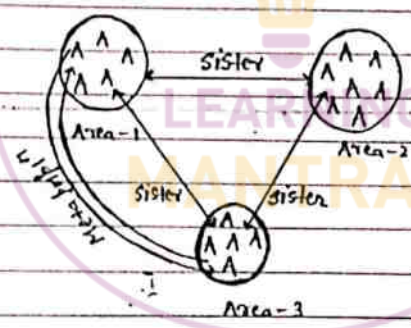
Organism ⇒
→ Small or large
→ Unicellular or Multicellular
→ Basic unit of Ecological Study
→ Smallest unit of ecological order
⇒ At organism level Ecology → Physiological Ecology

Branches of ecology
Aquatic
Terrestrial
→ Fresh Water Ecology — called → Limnology
(Running Water) → Lotic
(Standing Water) → Lentic
→ Marine Ecology
→ Estuarine Ecology

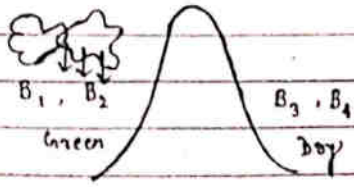


→ Population ⇒



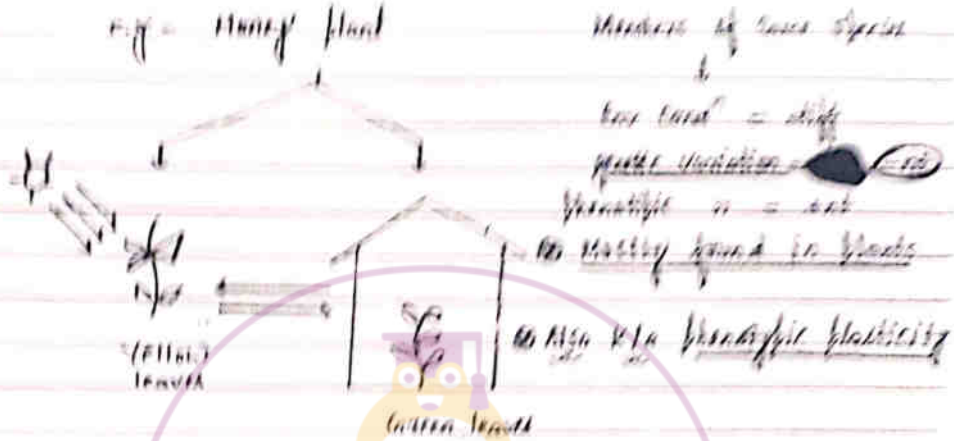


→ Ecotype / Ecospecies :-



Members of same species
↓
Environmental cond^n = Diff
Genetic variation = (+nt)

=> Ecads / Ecophene :-



=> Species =>

(i) Endemic species :-

=> Found only in a predicted area

=> Number (↓) (least no in nature & Rare Species)

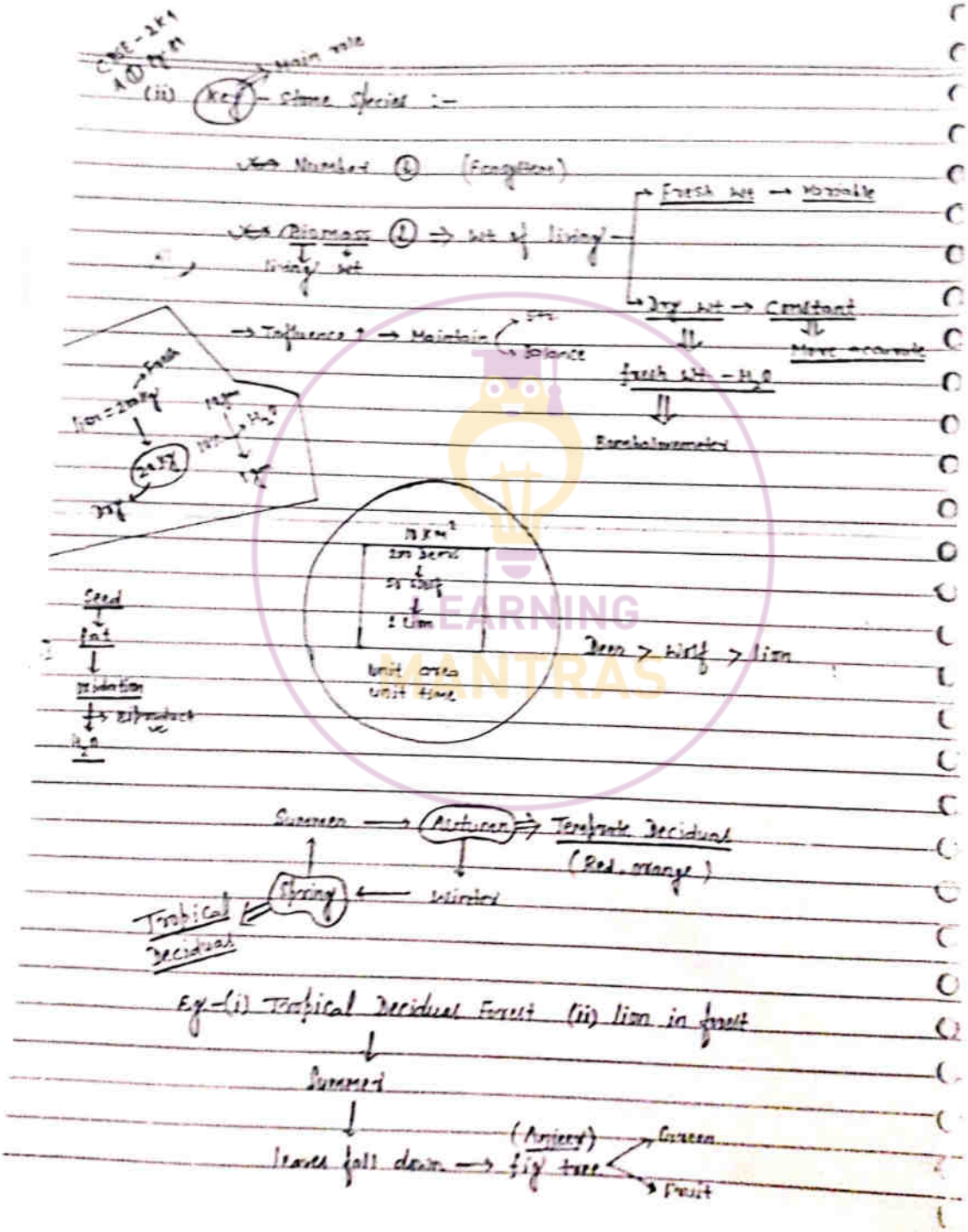
=> Chance of Extinction (↑)

=> Formation => Due to Continental Drifting

e.g. - Kangaroo => Australia

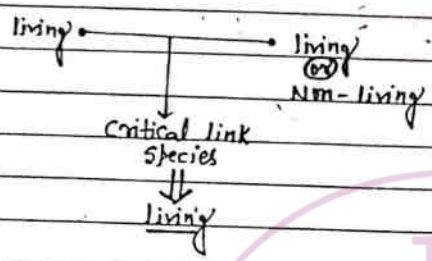
Kiwi => Newzealand

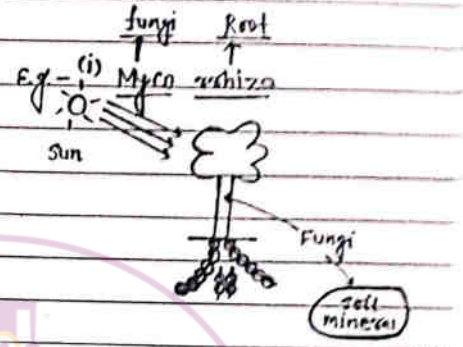
Metasequoia => China valley



(iii) critical - (link) species :-

Essential ⇓ Mediator ⇓



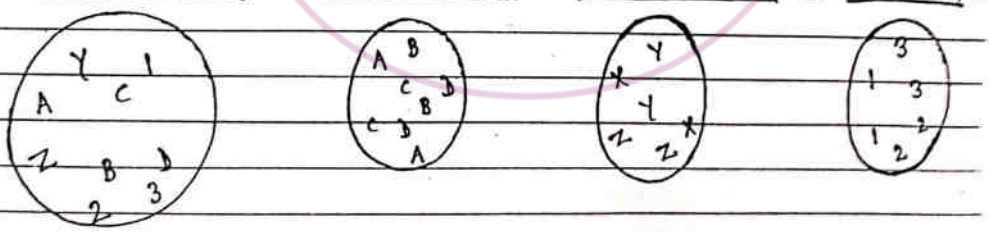


Note ~~⇒~~ All symbiotic sp. are critical link (but) all critical links are not symbi.

eg - (ii)

Community ⇒

Biotic community = Plant community ⊕ Animal community ⊕ Microbial community

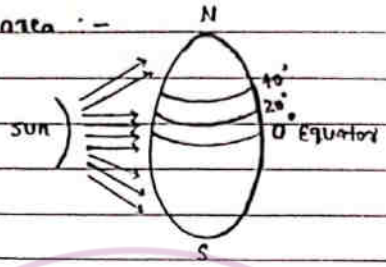


Characters / structural :-

(i) Species Diversity ∝ No of species

Factors –

(i) Type of area :–



∵ latitude ⇒ Dist from equator ↑ Temp ↓ Diversity ↓

Altitude ⇒ Height above Sea level ↑ Temp ↓ ,, ↓

1000 m (1KM) Height ⇓ 6.5°C temp ↓ → Temp. lapse rate

(ii) Climate :– Affect the enzyme activity → Diversity & Distribution of Plant Species.

- Temp. → 1st imp. factor
- Rainfall → 2nd imp. factor
- light → Photosynthesis (Productivity)

(iii) Type of Soil :– Soil related factors

↓

Edaphic factors

↓

Edifose → uppermost layer of earth

(iv) Size of Area ↑ ∝ Diversity ↑

But upto a limit

Quadrate Method → Method to measure the diversity.

Q. A, B, C → Bird Sp.

X → Mammal

↑ → Insect

A	A	B
C	A	A

Area - 1

Related

3 Species

A	B	C
A	B	C

Area - 2

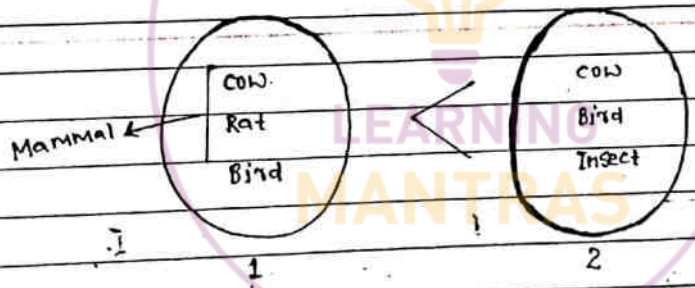
Related

3 Species

A	X	↑
A	X	↑

unrelated

3 Species



Species Diversity

||

No of Species

(Species richness)

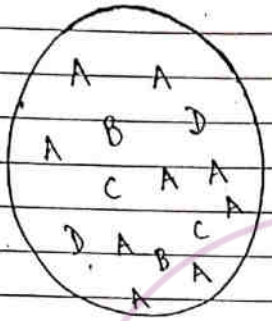
⊕

Evenness / Equatibility

⊕

Taxonomically unrelated

(iii) Dominance :-



E.g.- Pinus Community = Himalaya

Prosopis " = Aravali

Mangrove " = Sunderbans (W.B)

A = Community

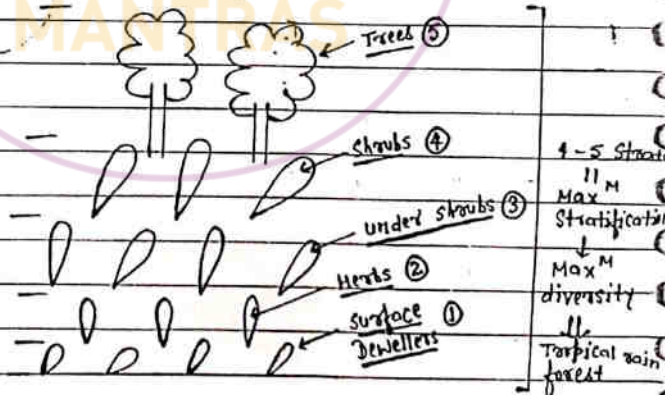
Note :-

(i) Tree to tree comparisim = Number

(ii) Tree to Grass " = Biomass

(iii) Stratification :-

Strata = layer



Heliophyte → Sun loving plant

Sciophyte → Shade loving plant

Why stratification occurs in plant ?

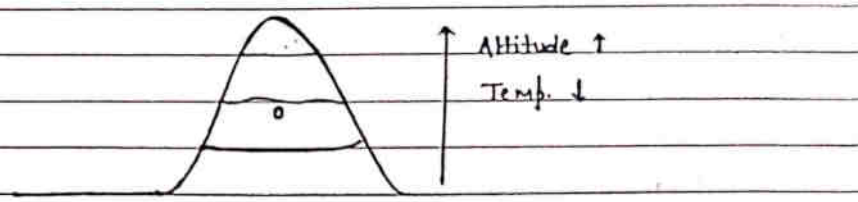
Ans :-

A/c need of light

OR

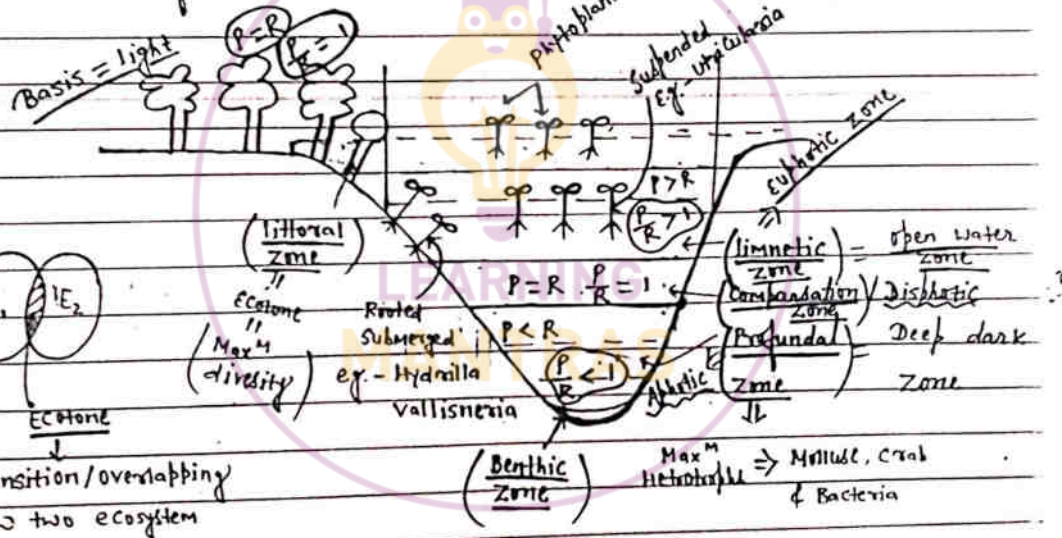
For efficient use of resource of habitat

Eg:- (ii) Mountain stratification :-



Topography → Physical str. of earth

Lake Stratification



$\frac{P}{R}$ = Photosynthesis by Autotrophs / Resp. by organism (Microbes) = O_2 ↑ / O_2 ↓

(Red Algae) → (Phycocyanine = Blue)
(Red Algae) → (Phycoerythrine = Red)

Note:- Clear Stratification is found in Tropical Rain forest so K/a Multistoried forest

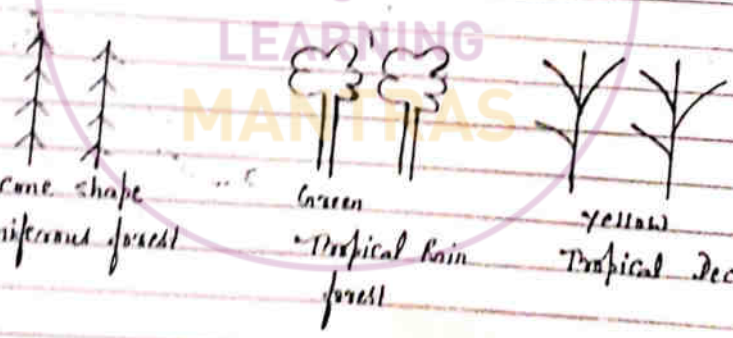
lake	Ocean
(i) littoral zone.	(i) littoral zone (Intertidal zone)
(ii) limnetic zone	(ii) Pelagic zone
(iii) Profundal zone	(iii) Abyssal zone

(iv) Physiognomy :-

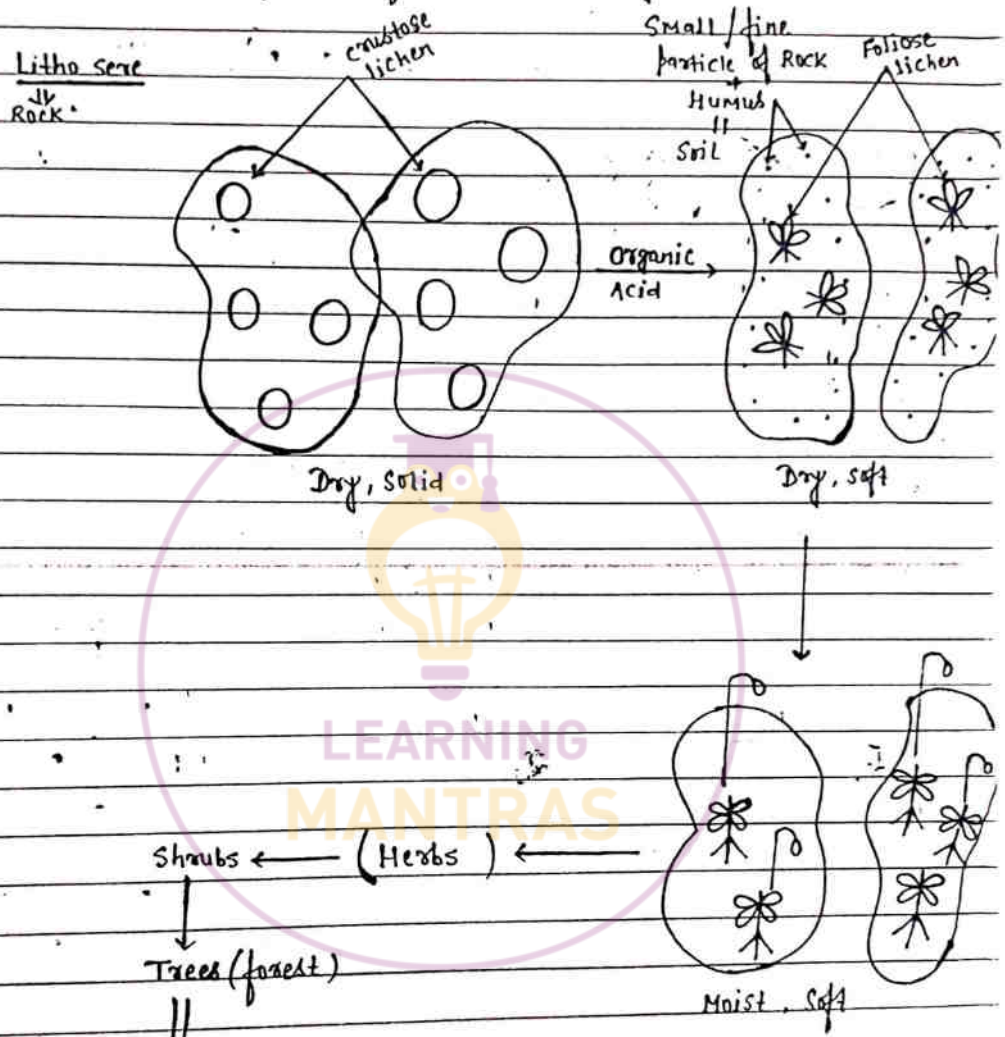
First appearance or looking of plant community called as physiognomy

⇒ It is determined by dominant plant species.

e.g.

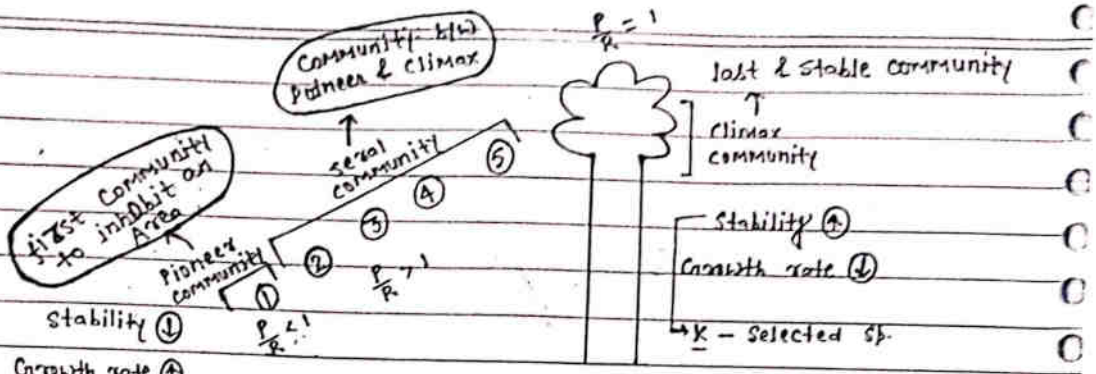


✳ Succession :- Development of Plant Community on barren area.



→ Ecological Succession or Biotic Succession are never Stable

During Succession → $\frac{P}{R} > 1$



Pioneer + Seral + Climax = Sere

K :- Short lived → long lived
Less stable → More Stable

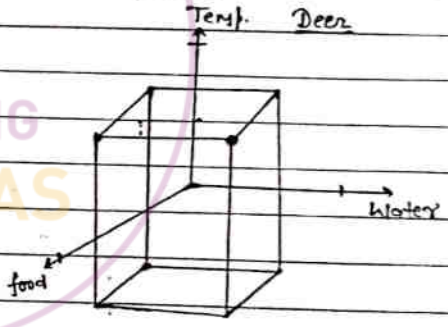
Stability :- Pioneer < Climax

→ Diversity ↑
→ Humus ↑
→ Biomass ↑

→ Niche specialization ↑

Work = Functional role

Work place



→ Causes of Succession :-

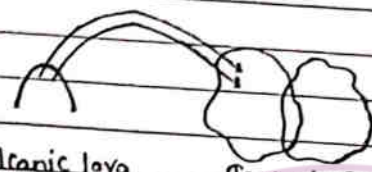
(i) living / Biotic / Autogenic → self community

(ii) Physiographic / Allogenic → External factors

e.g. - flood, landslide, volcanic lava etc

→ Types of succession ⇒

(i) Primary succession → Slow process
→ 1000 A of year



→ Crustose → Soil formation
lichen

Volcanic lava — Igneous Rock

Tree ← Shrubs ← Herbs ← Mosses ← Foliose lichen

E.g. - → Volcanic lava
→ Newly formed land
→ Bare Rock
→ Sand Rock

(ii) Secondary succession → fast process
→ 100 - 200 A of year

Forest → Forest fire → Destroy

Tree ← Shrubs ← Pteridophyta
↓
Underground Stem
↓
Rhizome

E.g. - → Burn / cut forest
→ Flooded Area
→ Abandant Farm lands

Progressive →

Rock / Soil → Forest

Primary Secondary

Forest —(Natural / Human Process)→ Soil / Desert

Retrogressive →

⇒ Succession in Dry Area

↓

Xerosere = Xeric

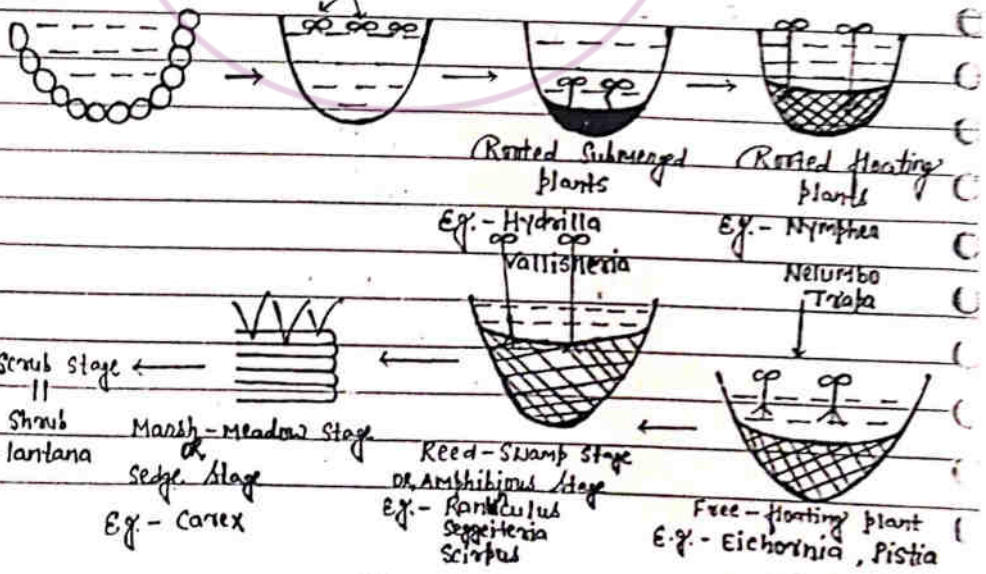
- Rock = Litosere
- Sand = Psammosere

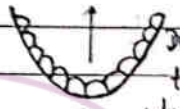
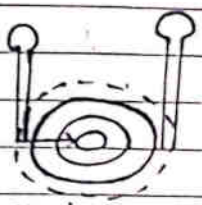
⇒ Succession in Water

↓

Hydrosere = Hydric

- Acidic = Oxalosere
- Salty = Halosere



Xerosere	Hydrosere
(i) Pioneer → Crustose lichen	(i) Pioneer → Phytoplanktons
(ii) Dry → Mesic cond^n (xeric env.)	(ii) Water → Mesic cond^n (Hydric env.)
(iii) Comparative slow	(iii) Comparative fast
(iv) Uniform	(iv)  Downward to upward  Margin to centre

Note :-

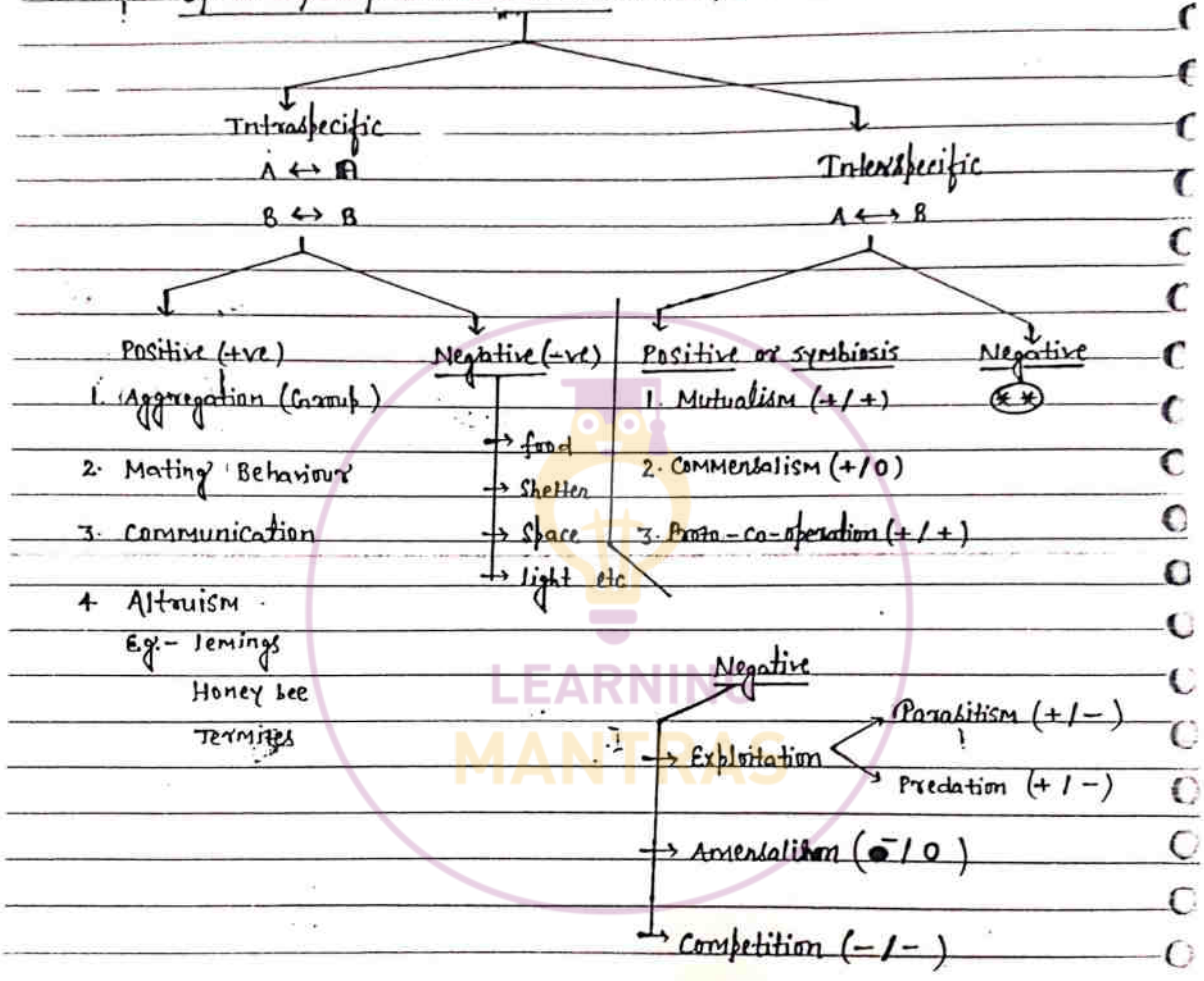
(i) Plant succession → Autotrophic succession

(ii) Animal " → Heterotrophic "

(iii) Microbial " → Serula

Character	Seral	Climax	
(i) Size of individual organism	Small	large	
(ii) Ecological Niche	Generalized	Specialized	
(iii) Community organization	Simple	Complex	
(iv) Food web / chain	Simple	Complex	
(v) Energy use efficiency	low	High	
(vi) Nutrient conservation in living organism	low	High	
(vii) P/R ratio	$P > R$	$P = R$	$P < R$ for Biome
(viii) P/B ratio	High	low	

Species / Population Interactions ⇒

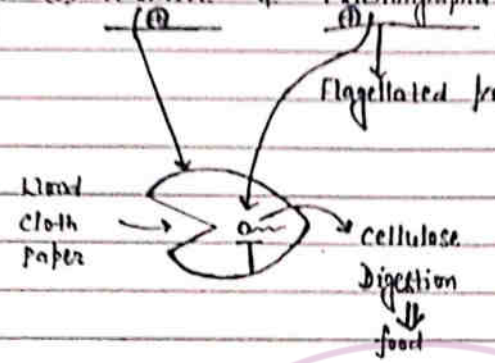


All +ve relationship → Symbiosis

(+ / +)

Mutualism / Symbiosis / obligate Mutualism :-

E.g. - (i) Termite & Trichonympha



(ii) Mycorrhiza = fungi + Higher plant Root

fungi (Root) → Mineal & water absorption + Protection

Higher plant Root → Provide food

(iii) lichen = fungi + Algae

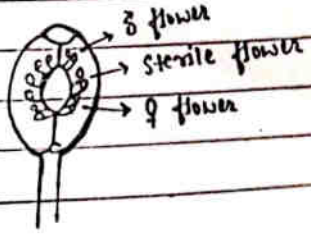
Algae → Green Algae, BGA

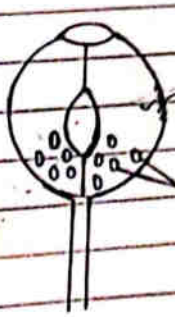
fungi → Mineral & Water absorption + Protection

Algae → food for M

Helotism = Master + Slave

(iv) fig tree & Wasp (Anjeer)





Oviposition site
Egg laying site

Eat seeds of fig fruit → Adult

Characteristics of Mutualism

- Co-evolution → Change for each other / Develope with each other
- Co-existence →
- Co-extinction →

Exception

(v) orchid & Bee / Bumblebee

Ophrys → Pseudocopulation

Pollination

♂ Bee → Sexual Deceit

→ Co-evolution

Mimic = Petal → Mimicry

Model = ♀ Bee.

Ophrys

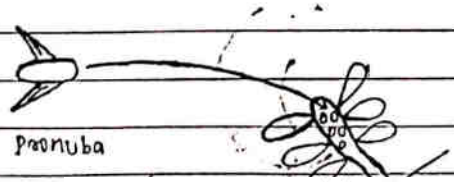
Co-existance ~~Co-existance~~

Co-extinction ~~Co-extinction~~

(vi) Yucca plant & Pronumba moth

flower → ovary ← Egg laying site

Ovary → Eggs → larva → Adult



Pronuba

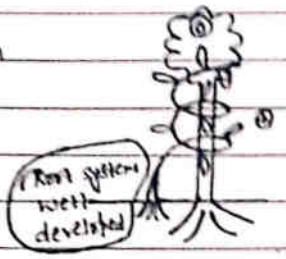
(+/0)

Commensalism

Eg:- (i) Lianas / Woody climbers / Woody vines

→ Tropical Rain forest

→ eg:- Bauhinia



→ light

↓↓

Can perform photosynthesis

(ii) Epiphyte

→ Tropical rain forest

→ e.g:- Orchid

→ Mycorrhiza

light, Moisture

Hanging root (Velamen)

→ Capture environmental moisture

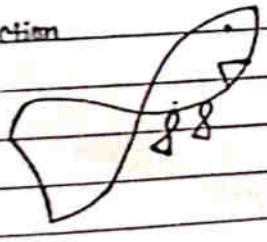
(iii) Epizoans / Epizoic –

(a) Sucker fish ⊕ & Shark ⊗

→ Transportation

→ Food

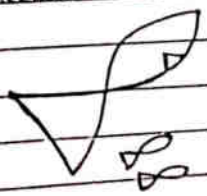
→ Protection



(b) Pilot fish ⊕ & Shark ⊗

→ food

→ Protection



Predator > Prey

Parasite < Host

(c) E. coli (+) Human intestine (0)

→ food
→ Shelter
→ Protection

(d) Clown fish (+) & anemone (0)

Protection

(e) Barnacle (+) & Whale (0)

(Crustacean) (filter feeder)

→ Shelter
→ Protection
→ New food site.

(f) Cattle (+) egret Bird & Cattle (0)

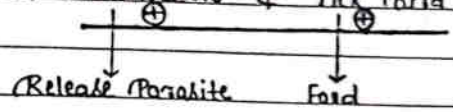
food

Due to grazing & locomotion, soil insect comes outside

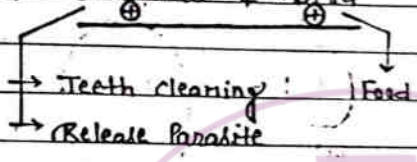
(+/+)

Proto-co-operation / Non-obligatory Mutualism / Facultative Mutualism

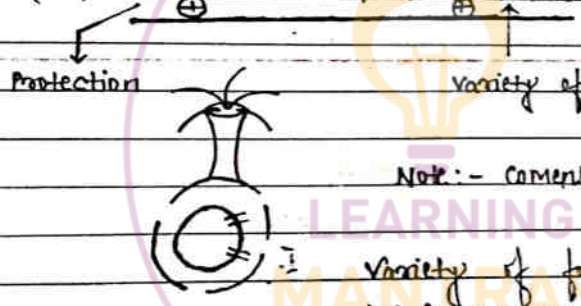
E.g.- (i) Rhinoceros & Tick Bird



(ii) Crocodile & Bird



(iii) Hermit crab & Sea anemone

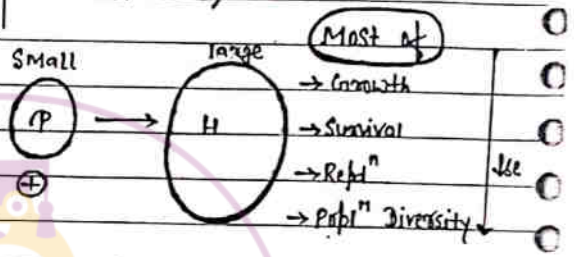


Note:- Comensalism → NEET 2K13

Variety of food is not a countable benefit for sea anemone i.e why this relationship is also k/a Comensalism.

Negative / Antagonism / Detrimental

① Exploitation (+/−)
- Parasitism (+/−)
- Predation (+/−) → Parasitism →



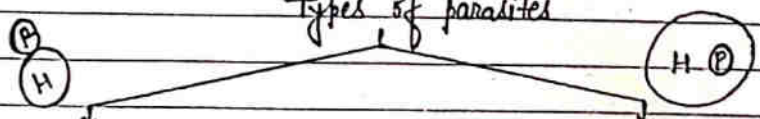
→ Parasite do not directly kill their host

→ True Parasite → complete use of Host → food, Shelter, protection etc.

→ Successful parasite → complete use → Minᴹ loss of Hose

→ Parasites are indirectly helpful to predator by making their host weak.

Types of parasites



Ectoparasite
↓
lives on the body of host

Endoparasite
(More complex)
Due to
Extreme specialisation

Endoparasite

e.g. - Ascaris
Taenia
Entamoeba
Plasmodium etc

Ectoparasite

Ectozoic

e.g. → Ticks on dog
→ Human lice
→ Cattle bugs (Bovicola)
→ Other type :-

Ectophytic

e.g. Aphids
Plant lice (Aphids) - Stem
Red cotton bug
Lac insect

(i) Hyperparasite ⇒ The (A) parasite living on another parasite

(virus)
Bacteriophage ← Bacteria ← organism
‖ ‖
Hyperparasite Parasite

(ii) Holoparasite ⇒ Parasite which totally depend upon Host

Leaves & chlorophyll Degenerated

Complete

(a) Total stem parasite ⇒

E.g. - Cuscuta
(Amarbel)

leaves & Chlorophyll are not

(b) Total root parasite ⇒

carrion fly helps in pollination.

E.g. - Rafflesia ——→ largest flower

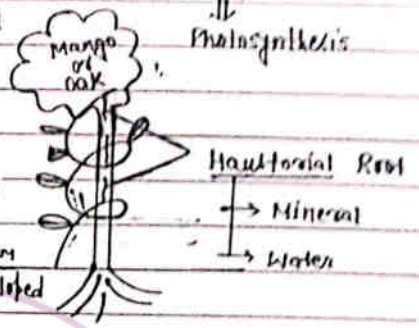
Most of parasites are Host Specific.

✓Crab-Succulity ⇒ Parasitism

(iii) Hemiparasite ⇒ (Partial = parasite which are [redacted] partially depend on Host)

Leaves & Chlorophyll Developed ⇓ Photosynthesis

(a) Partial stem parasite



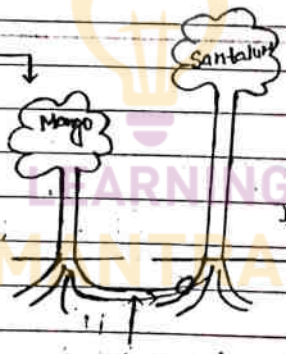
Parasite — Host

Loranthus → Mango

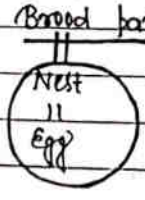
Viscum → Oak

(b) Partial root stem

E.g.- Santalum (Chandan)



(iv) Brood parasitism



→ Indirect parasitism

→ Not a true parasite

E.g.- Cuckoo & Crow

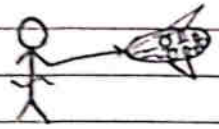
→ Also called "Social parasitism"

Arceuthobium → is → Smallest Angiosperm parasite

Note :-

(i) ⇒ ♀ Mosquito

→ Not a true parasite



Human

→ It does not take any shelter on human body

→ Human blood → Not actually nutrition for female mosq

→ It uses blood for body warming & Egg incubation

(ii) ⇒ Human foetus → Commensalism

→ Not a true parasite

→ It does not take life time shelter

→ Generally, parasitism occur in Interspecific interactions but this is an intraspecific

→ It does not cause any big harm to mother

NCERT

① Human liver fluke

(Snail) A → (fish) B → (Human) C

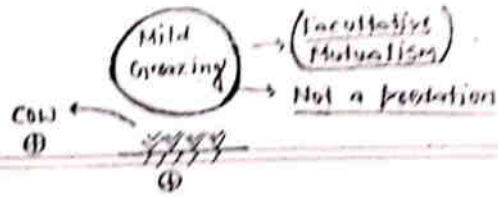
Excreta

Human → Pr. host

Snail, fish → Sec. / Intermediate / vector Host

② Plasmodium → Human

→ ♀ Mosquito



Adaptation →

(i) loss of unnecessary sense organ

(ii) Presence of hooks & suckers

(iii) loss of Digestive System.

(iv) High reproductive potential.

Predation
(+ / −)

Catch, kill & Eat

||

Eating by hunting

Deer → Tiger

|| Prey || Predator

|| Small || large

Grazing → Predation

Seed → Sparrow

|| Embryo || Predation

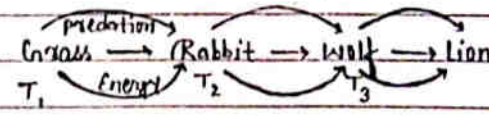
|| complete life

Grass → Goat

|| Prey || Predator

Significance :-

(i) Energy flow



Trophic level rep^{n} functional level not a species.

To eat living → Predation

To eat dead → Scavenging

To eat living with slow power → Parasitism

Source

(i) → Predators acts as a conduit for Energy transfer across trophic level

(ii) Maintain Ecosystem Balance → By keeping prey population under control.

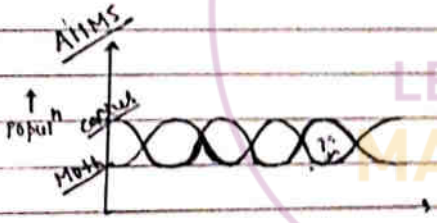
Grass → Deer → Lion

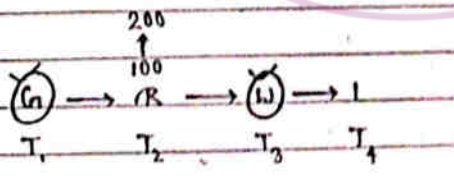
Lion → Exotic, Indigenous

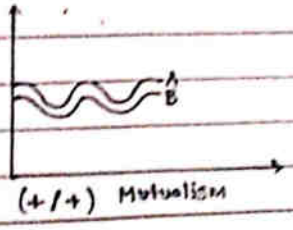
Eg → In Australia (1920)

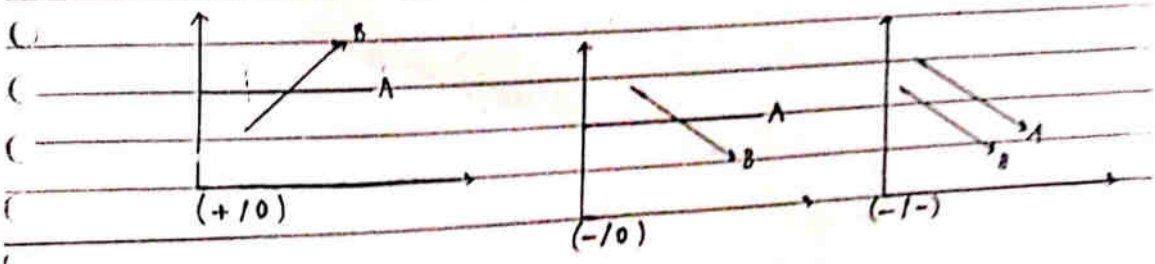
Prickly Pear Cactus → Natural Predator → Insects → It Cause havoc in millions of hectare (Rangeland (Grassland)) → Cactophagous = Moth

(Predator) → Are not prey specific



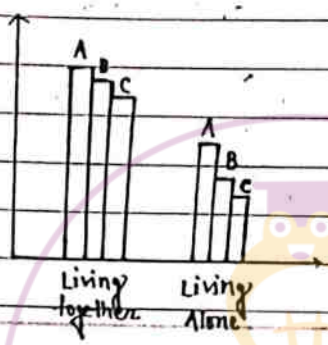






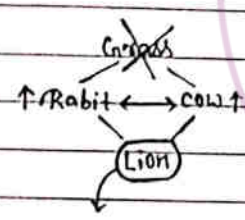
→ At any trophic level no of organism depends on → Available food / (No of org^{m} at prev. trophic level)

→ Long term stability of an ecosystem depends on → Predation



→ Protocooperation / Mutualism

- (iii) Maintain Species diversity → By reducing competition among prey pop^{n}.



Ex: NCERT American Pacific coast

↓

Rocky intertidal area

↓

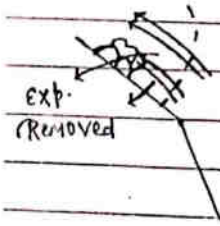
Predator (Starfish / Pisaster)

↓

Exp: Removed

↓

10 invertebrate Species Extinct within a year due to heavy interspecific competition.



control one living org^m to another living org^m.

(iv) Biological control methods → Based on predation.

E.g. - (a) Gambusia fish —control→ Mosquito by eating mosquito larva

(b) Hawk —"→ Birds

(c) Anthribotrys / Dactylla —"→ Pest

Entomophagous = Insect

Note :- Predators are Prudent in nature.

समझदार

⇓ B'coz

They do not overexploit their prey

⇓

Defence

Plants

(i) Acacia, Cactus → Thorns

(ii) Calotropis → Cardiac Glycosides

(iii) Nicotin, Caffein, Opium, Quinine, Strychnine

⇓

Nux vomica

≈ 30% → Animal species

22% → Plant species

Plant organism > Animal organism

Plant diversity < Animal diversity

⇓ Because

They face predation

70% Animal are → Insect species

25% insect are → Phytophagous

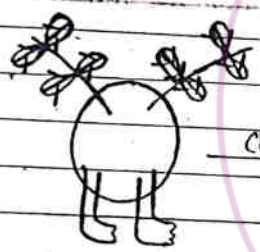
Animal

(i) Camouflaged → Frog
                → Insect

(ii) Monarch Butterfly → Highly Distasteful → Caterpillar stage → Eat seeds of Poisonous Weed.

Predator = Bird

(2) Amensalism (-/0)



Organism

Chemical → Plants → Allelopathy → Parthenium (Congress grass) = Carrot grass (secretes) → Transcinamic Acid

Sunflower, Ocimum, Barley → Smother Corn

Animal, Microbs → Antibiosis

→ Fungi = Penicillium notatum → Penicilline kill → (Staphylococcus Bacteria)

→ BGA – Microcystis → Hydroxil-amine → (Aquatic animal (fish))

→ Green Algae → Chlorella → Bacteriocide → Bacteria

Note :- Autopathy E.g.- Silver Oak

Competition
(-/-)

- Intra Specific
- Inter Specific

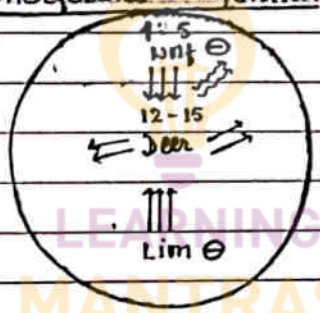
Generally
Competition ⇒ Two closely related species

⇒ Resources limited

E.g. – South America → Shallo Water lake

Interference competition

Indirect competition



→ Resources unlimited

→ Superior

Gause's Competitive Exclusion Principle

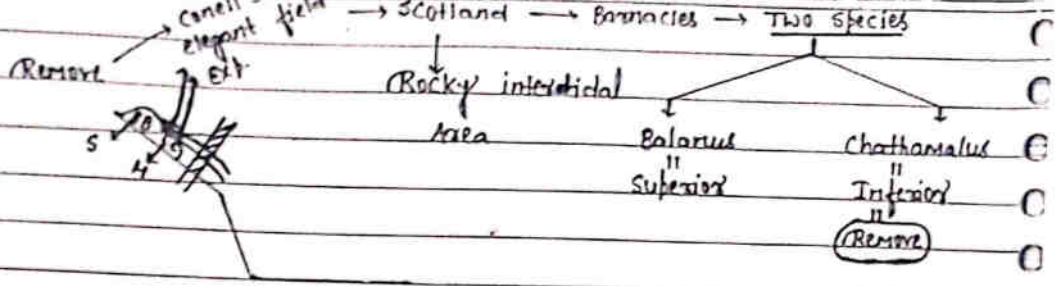
Resources limited

In the presence of superior species → Inferior

- Remove (**) Next page
- Extinct → Galapagos Island → Abingdon Tortiese ‖ Herbivore ‖ Grass

Tortoise Extinct With in a decade ← Resources limited ← Goat Introd.

Note :– Niche overlapping Less.



Resource Partioning

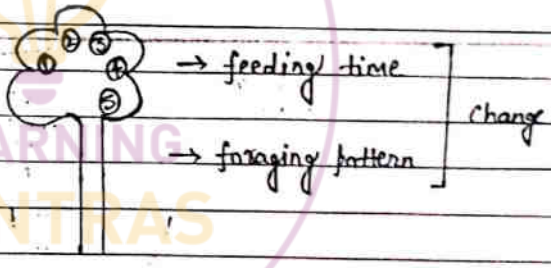
Co-existance

Resource unlimited

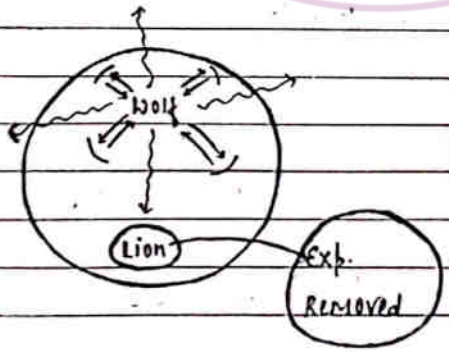
Niche overlapping present

Mac Arthur

Warbler Bird → 5 species



Competitive Release



(Reproductive ability → Individual

(Biotic pot → Population

↓

$r = b - d$

Some Terms

Ecotone ⇒ Transition zone b/w two communities.

E.g. – (i) Littoral zone

(ii) Estuaries – Fresh water + Marine water
organism organism

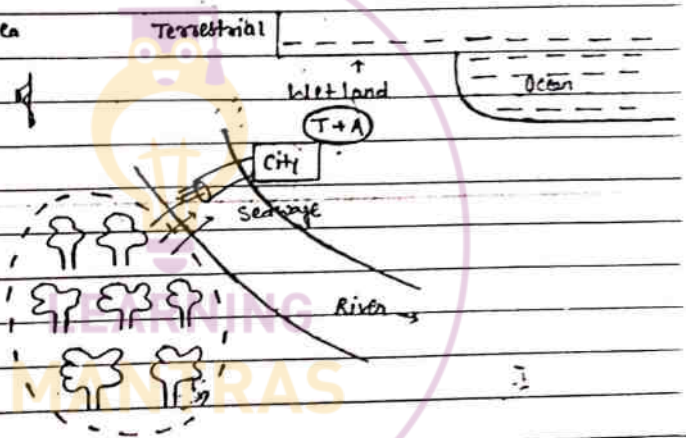
(iii) Wet land

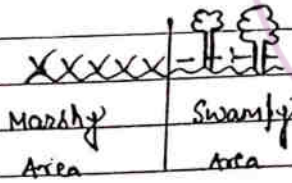
⇓

6% Area

⇓

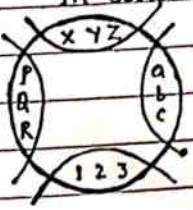
Kidney of Earth



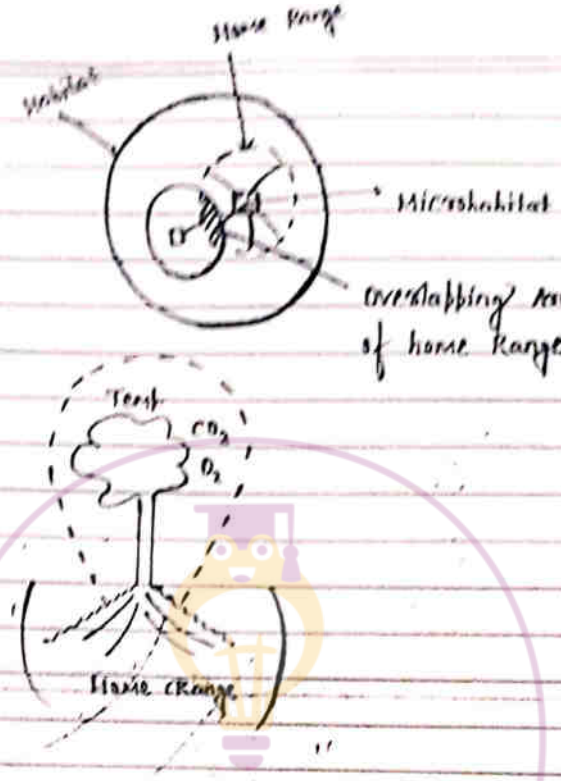


Riverine Wetland

Edge effect ⇒ Species which occur most abundantly & spend their time in ecotone.



Eg:- Bird



Ecosystem

Specific Biotic ⇄ Specific Abiotic

Term → Tansley
Father → Odum

Karl Mobius = Biocoenosis = Community of living group

Biogeocoenosis = Ecosystem

Ecosystem may be :-

→ Natural or Artificial (Man made)

→ Complete or Incomplete

→ Permanent or Temporary

→ Small or large
- Drop of water = Nano Eco.
- Ocean = Mega Eco.

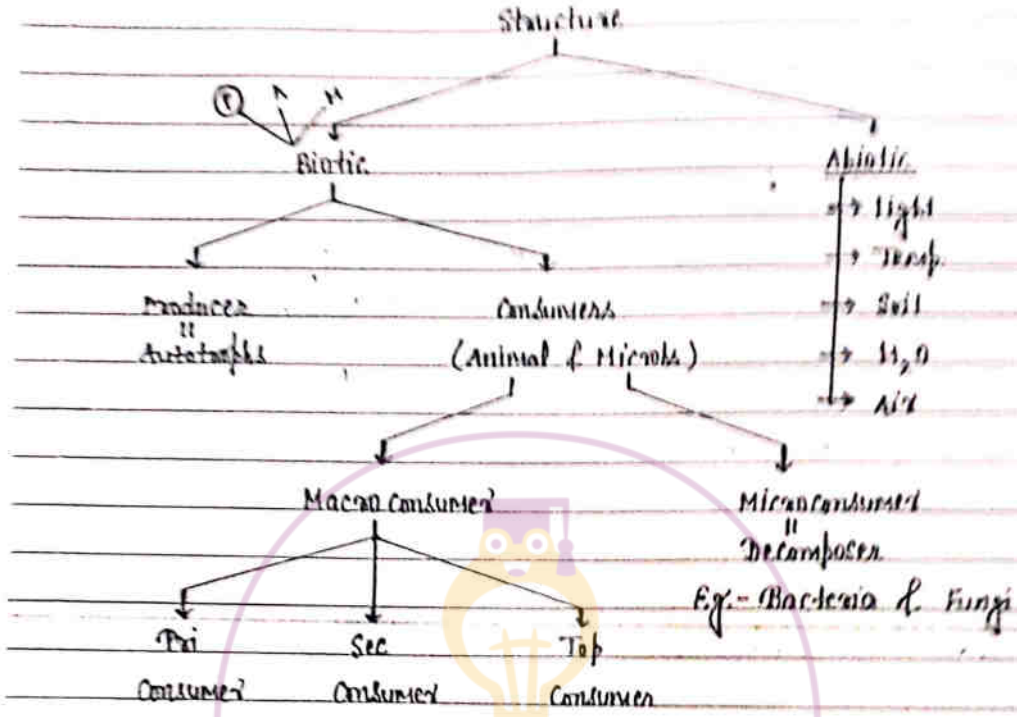
⇒ Natural → Complete → Permanent (Stable) → Self Regulatory / Self Sustained / Self Maintained

Eco.
- Terrestrial
  - forest
  - grassland
- Aquatic
  - river
  - Pond
  - lake, Ocean

⇒ Artificial → Incomplete → Temporary → Human Support

Eco.

eg.- Aquarium
crop land
Grass land



Functions ⇒

1 Productivity

2 Energy flow

3 Decomposition

4 Bio geo chemical cycle

Gaseous

Mineral

1. Producer / Autotrophs / Converter / Transducer

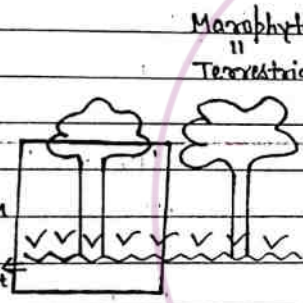
↓

Mostly

Green plants

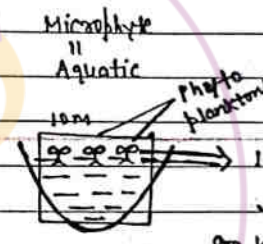
Note :-

Photoautotrophic, Chemoautotrophic } Bacteria



⇓

1000 Kcal / unit area / yr



⇓

800 Kcal / unit Area / yr

Productivity = unit Area / unit Time

Productivity → Terrestrial → Biomass ↑, Chlorophyll ↑, Photosynthesis capacity ↑

Productivity → Aquatic → Biomass ↓, Chlorophyll ↓

2. Consumer

Macroconsumer / Animals / Phagotrophs / Holozoic

↓

first → Ingest
then → Digest

Carnivore

Scavenger — Predator

E.g. - Vulture, Crow, Arctic fox etc

Primary Consumers ⇓ Directly depend on Producer ⇓ Herbivores

E.g. - Rabbit, Cow, Deer, Goat, Rat etc

Secondary Consumers ⇓ Depends on Pri. Consumer ⇓ Carnivore

E.g. - Wolf, Fish, frog, Snake, Dog, Cat etc

Top Consumers ⇓ They can eat others but not eaten by others.

E.g. - Lion, Hawk, Shark, Tiger, Eagle, Man, Crocodile, Vulture, Peacock etc

T_1 Grass → T_2 Insect → T_3 frog → T_4 Snake → T_5 Hawk

⇓ Producer ⇓ Pri Consumer ⇓ Sec Consumer ⇓ Tertiary Consumer ⇓ Top Consumer

T_1 → Producer → T_2 Pri Consumer → T_3 Sec Consumer → T_4 (X) → Tertiary / Top

Except ⇒ Lion → Starts from T_3

(Elephant → Pri. Consumer
Whale → Sec. Consumer)

Special –

1. Plant Parasite

Ex. – Cuscuta, Rafflesia

⇓

Pri. Consumer

2. Animal Parasite

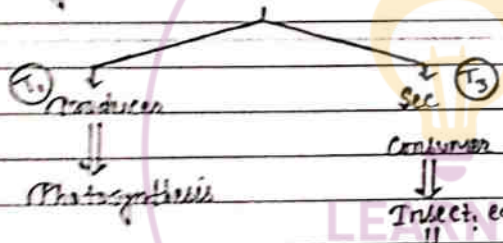
Ex. – Leach, Sand fly

⇓

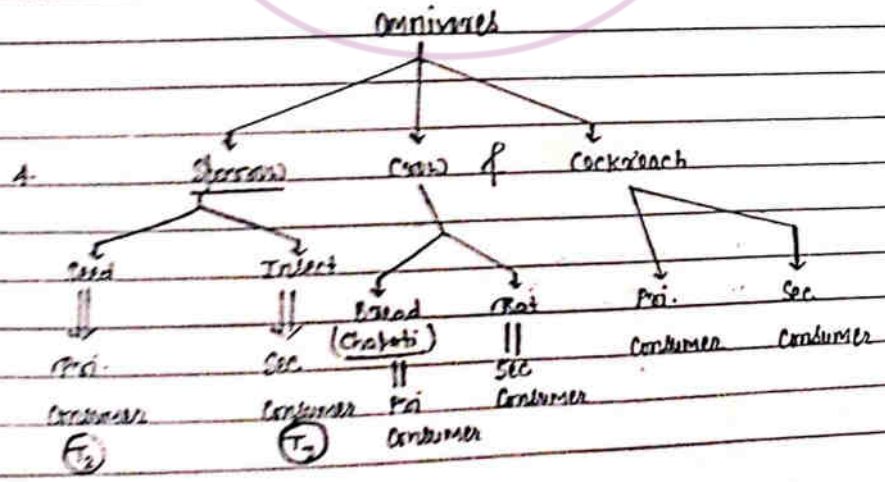
Sec. Consumer

3. Insectivorous Plant

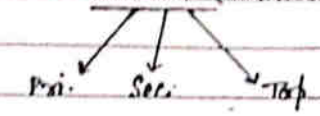
Ex. – Utricularia, Nepenthes, Drosera etc



4. Sparrow



5. Human (Omnivore)



(a) Plant (T_1) → Man (Pri.) (T_2)

(b) Grass (T_1) → Goat (T_2) → Man (Sec.) (T_3)

(c) Grass (T_1) → Rabbit (T_2) → Wild Pig (T_3) → Man (Top) (T_4)

⇒ Man is a top consumer

6. Milk & Milk products

⇓

Sec. Consumer

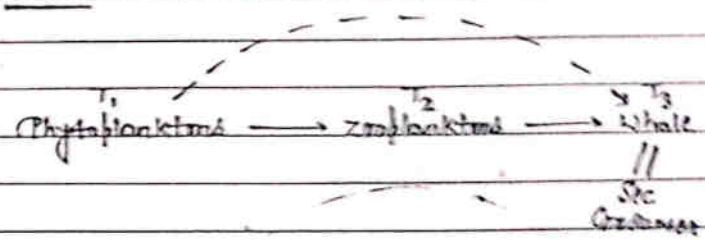
Q.① Pg 74 AIIMS-2K3

(a) Grass (T_1) → Cow (T_2) → [Sec ‖ Calf T_3]

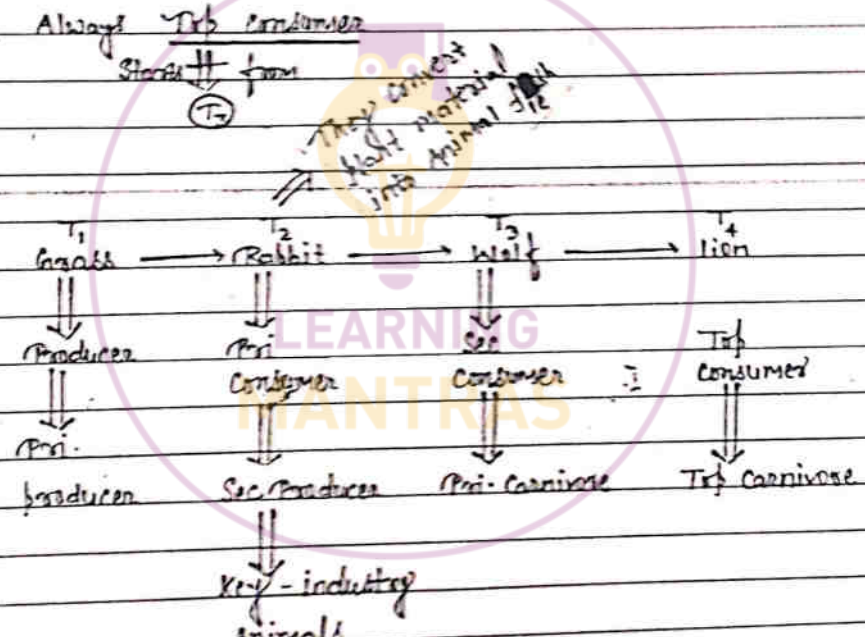
(b) Milk (T_1) → Bacteria (T_2) → [Mr. X T_3]

To eat → Consumer
To drink → Consumer

7. Whale



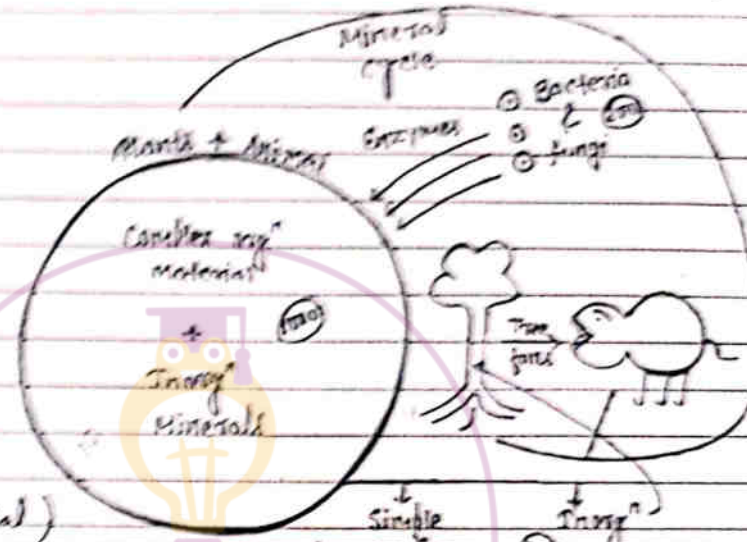
8. Lion



Microorganisms / Decomposers / Detritivores / Saprotrophs / Reducers / Transformers

↓

Bacteria
fungi



Detritus → Plant Material

Detritus

(Plant + Animal + Fecal)

Dead Material

(Detritus)

⇒ Out of total released minerals some minerals are tied-up with microbial biomass that become immobile this is called as nutrient immobilization. It is temporary

Similar trophic level में feeding नहीं होती

Food Chain ⇒

Sequence / Arrangement of organism according to their food habit

Grass ⟶ Rabbit ⟶ Wolf ⟶ Lion

Trophic level :-

⇒ Specific position / place of an organism in food chain.

⇒ Trophic level represents function level not a species

T_1 Grass ⟶ T_2 Insect ⟶ T_3 frog ⟶ T_4 Snake ⟶ T_5 Peacock

T_1 Grass ⟶ T_2 Rat ⟶ T_3 Snake ⟶ T_4 Hawk

T_1 → Producer

T_2 → Pri. consumer

T_3 → Sec. consumer

T_4 → Tertiary / Top consumer

⇒ long food chain = Not good

⇒ 3-4 trophic levels = Healthy food chain

⇓ B'coz

Energy transfer from one trophic level to another trophic level occur according to 10% Energy transfer law of Lindeman (Trophic kinetic concept)

$C_6H_{12}O_6 + 6O_2 + 6H_2O$

$\downarrow$

$6CO_2 + 12H_2O + 686$ Kcal

36 ATP $\times$ 7.6 Kcal $= x$

$\frac{x}{686} \times 100 = 40-42\%$

Trophic kinetic concept
(Energy flow)

100 | 10 | 1 | 0.1

T_1 Grass $\longrightarrow$ T_2 Rabbit $\longrightarrow$ T_3 Wolf $\longrightarrow$ T_4 Lion

100 Kcal $\xrightarrow{10\%}$ 10 Kcal $\xrightarrow{10\%}$ 1 Kcal $\xrightarrow{10\%}$ 0.1 Kcal

$\downarrow$ 90%

Resp. = 20% Resp. = 30% Resp. = 60%

Other = 70% Other = 50% Other = 30%

Metabolic activities

$T_1 \longrightarrow T_4$

$\therefore$ $\Rightarrow$ Trophic level Energy use

100 Kcal $\longrightarrow$ 10 Kcal $\longrightarrow$ 1 Kcal $\longrightarrow$ 0.1 Kcal

$\Rightarrow$ % Respiration use

20% $\longrightarrow$ 30% $\longrightarrow$ 60%

$\Rightarrow$ Trophic level Biomass $\propto$ use

$\Rightarrow$ Individual org^{n} Biomass $\propto$ use

$\Rightarrow$ Decomposers are not considered in food chain

$\Downarrow$ B'coz.

(a) T_4 Lion $\longrightarrow$ T_5 Decomposer.

0.1 Kcal $\xrightarrow{10\%}$ 0.01 Kcal

(b) Producer $\xrightarrow{\frac{E}{M}}$ 1° Cons. $\xrightarrow{\frac{E}{M}}$ 2° Cons. $\xrightarrow{\frac{E}{M}}$ Trh Cons.

M E M E M E M E

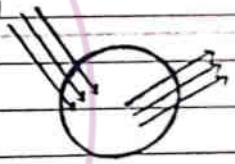
Minerals (Soil) ← Decomposers

⇒ Mineral flow = Cyclic

⇒ Energy flow = unidirectional

⇒ Ecosystem / food chain follow 1st & 2nd law of Thermodynamics.

(a) First law of Thermodynamics (FLOT)

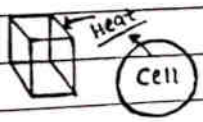


Sun → Producer → Consumer

Light Energy

Chemical Energy → Heat energy, Mechanical energy, Kinetic energy

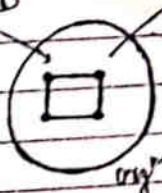
(b) Second law of Thermodynamics (SLOT)



$T_1 \rightarrow T_2$

Heat → Molecule → Randomness ↑ = Entropy ↑ = Disorder

Energy



org^m

Types of food chain

1. Grazing food chain (GFC) / Predatory food chain

Small Producer → large Producer

Terrestrial –

Grass → Rabbit → Wolf → Lion

Aquatic

Phytoplanktons → zooplanktons → Small fish → large fish (Shark)

2. Parasitic food chain (PFC)

large Producer → Small Producer

Tree → Birds → Parasites

Exception

3. Detritus food chain (DFC) → Rate of flow of energy is slow.

Terrestrial

T_1 — Detritus (Leaf + Animal) — T_2 — Bacteria & fungi — ✗

Note:- In Aquatic Ecosystem → Flow of energy through GFC > DFC

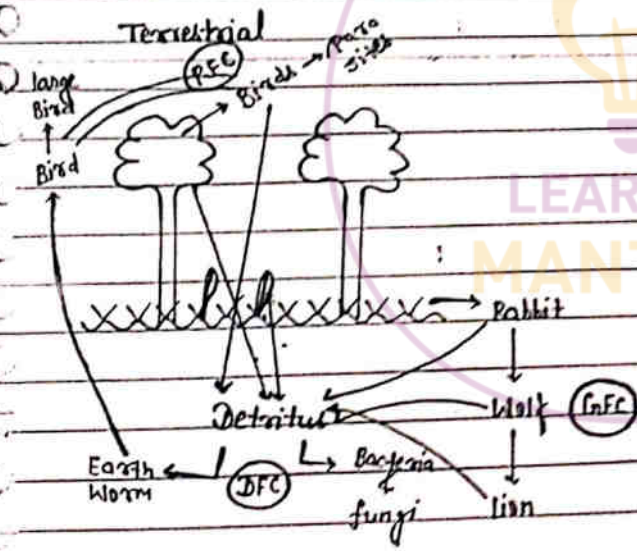
In Terrestrial Ecosystem → Flow of energy through DFC > GFC

Aquatic

Detritus → (Bacteria / fungi) → larva of (Mollusca / Nematode) → Small fish → (Bird / large fish)

Sundarbans / Mangroove

Detritus → (Bacteria / fungi) → larva of (Mollusca / Nematode) → Small fish → (Tiger / Bird)



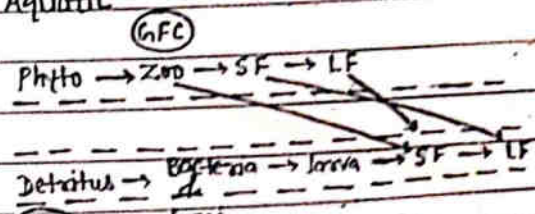
Main food chain → DFC

Decomposer ↑

Detritus > living material

(Non-living)

Aquatic



Decomposer's ↓

Phytoplankton ↓

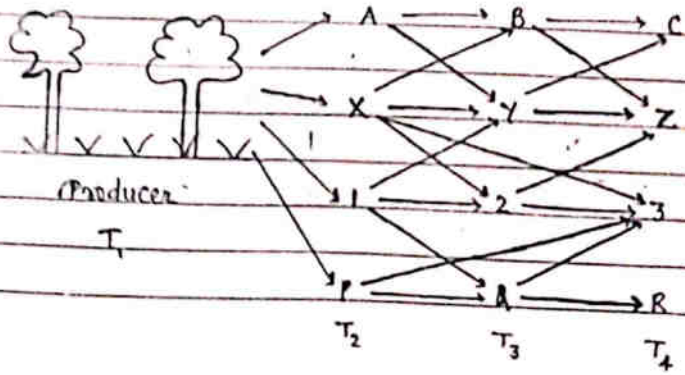
Multiplication ↑

Main food chain → GFC

GFC	DFC
1. Starts from producers	Starts from Detritus
2. Directly depend on Plants	Indirect depend on plants
3. Decomposers are not considered	Decomposers are considered
4. 10% Energy transfer law applicable	Not applicable
5. Energy flow fast	Energy flow slow
6. Magⁿ low ↓ Distribution of Energy in no. of organism	Magⁿ High
7. Unidirectional flow	Cyclic flow

Food Web

Network of Interconnected food chains.
(Facility of taste & choice)



Biodiversity ↑
||
Nb of species ↑

→ Food Web → complex ∝ Stability

Note :- David Tilman → Diversity ↑ → Productivity ↑

E.g. - Tropical Rain Forest

⇒ less impact of Allien species

⇒ less year to year Variation in biomass.

Nb of species ↓
Biodiversity ↓
↓
Food web
↓
Simple E.g. - Arctic / Tundra
↓
less Stable

Paul Ehrlich
↓
Rivet Popper Hypothesis

Airplane → Ecosystem
Rivets → Screw / species
Wings → key - stone specie

Stable ecosystem ⇒ Change → Resistance
||
Resilience

Homeostasis

Self regulation / Self control of an ecosystem that resist changes called as Homeostasis.

⇒ Science that deals with the study of homeostasis of an ecosystem is called "Cybernetics"

⇒ Food Chain do not exist

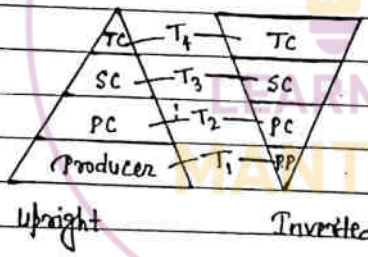
Q. Ecosystem have :-

(a) food web (b) food chain (c) Both (d) None

Ethonian's Pyramid
(OR)
Ecological Pyramids :-

Graphical rep^{n} of ecological parameteres like – No., Energy & Biomass

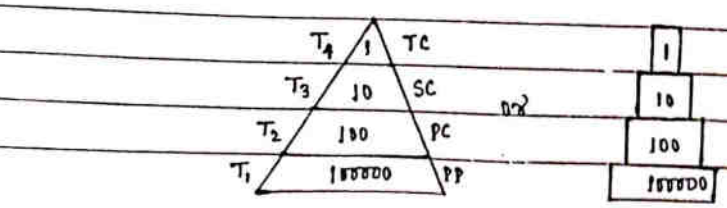
	Grass	→ Rabbit	→ Wolf	→ lion
Number →	100000	100	10	1
Energy →	100 KCal	10 KCal	1 KCal	0.1 Kg
Biomass → (Dry wt)	120 Kg	80 Kg	60 Kg	20 Kg



A. Pyramid of Number

E.g.- (i) Grassland Eco.

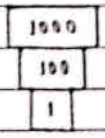
	Grass	→ Rabbit	→ Wolf	→ lion
No. →	100000	100	10	1



(ii) Tree Ecosystem

Tree ⟶ Bird ⟶ Parasites

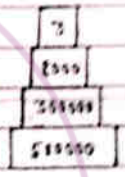
1 100 1000



(iii) Aquatic Ecosystem

Phyto ⟶ Zoo. ⟶ S.F ⟶ L.F

500000 200000 1000 3

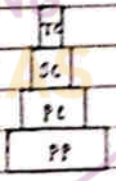


AIPMT-2010

Forest Ecosystem
(Number)

PP ⟶ PC ⟶ SC ⟶ TC

(Trees, Shrubs, Herbs etc)



Q. Which pyramid is not in

(a) Pond (c) Grassland

(b) Forest (d) Lake

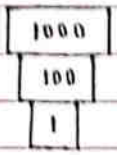
Tree Dominating forest

Tree ⟶ Birds ⟶ Parasites

(ii) Tree Ecosystem

Tree ⟶ Bird ⟶ Parasites

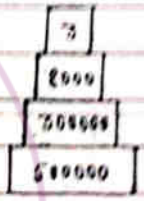
1 100 1000



(iii) Aquatic Ecosystem

Phyto ⟶ Zoo. ⟶ S F ⟶ L F

600000 300000 8000 3

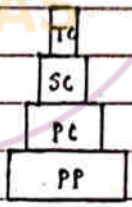


AIPMT 2K10

Forest Ecosystem
(Number)

PP ⟶ PC ⟶ SC ⟶ TC

(Trees, Shrubs, Herbs etc)



upright

Q. Upright pyramid of no. of in

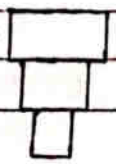
(a) Pond (c) Grassland

(b) forest (d) lake

Tree Dominating forest

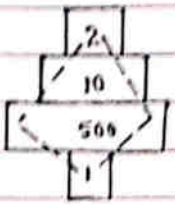
Tree ⟶ Birds ⟶ Parasites

Inverted



Tree → Insect → Small Bird → Large Bird

1 500 10 2



Spindle Shaped

B. Pyramid of Energy :-

10% energy transfer law applicable

↓

Higher tropical level Energy use

↓

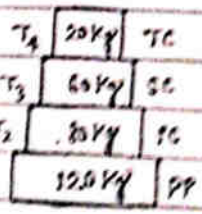
Always upright

C. Pyramid of Biomass -

(i) Grassland -

Grass → Rabbit → Wolf → Lion

12.0 Kg 60 Kg 20 Kg 2 Kg



(ii) Tree ecosystem

Tree → Birds → Parasites

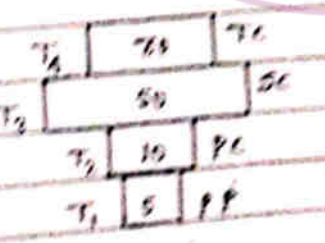
(iii) Aquatic Ecosystem

(a) Ocean –

Phyto → Zoo → Sh → Wh (Shark)

(b) Lake ecosystem

Phyto → Zoo → Sh → Wh



Special points –

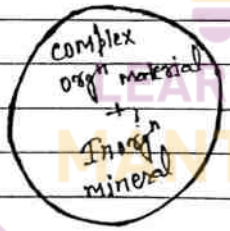
1. Most of Pyramides are upright

But Inverted → Tree = No.
→ Aquatic = Biomass

2. Pyramid of no. represents = Biotic pot

3. Pyramid of Biomass represents = Standing crop

Standing crop



living
↓↓
Dead

Simple org^n material

Inorg^n minerals (Soil) = Standing State / Standing quality

⇒ Total amount of living org^n material in a particular area at a particular time.

E.g.- (i) Class $\frac{A+B+C+D}{4} = 100\ Kg$

200 Students

20,000 Kg

↓

fresh wt

↓ H_2O

2000 Kg

||

Dry wt

(ii) T_1 Gr → T_2 R → T_3 W → T_4 I

120 Kg, 80 Kg, 60 Kg, 20 Kg

Q.

PC | 2.1 | T_2

PP | 4 | T_1

Above Pyramids ref^n –

(a) Tree = Number

(b) Grassland = Biomass

(c) Aquatic = Biomass

(d) Tree = Biomass

Demerits –

1. Food chain ✓
   Food web ✗

2. Decomposers / Saprophyte ✗

3. Organism :- More than one trophic level

E.g.- Insectivorous plant → Producer, Sec. consumer

Productivity

Unit Area / Unit time → Total production

- Primary productivity = Producer
- Secondary productivity = Consumer

Total production:
- Mass → Kg/m²/yr ; g/m²/yr / g/m³/yr / g/m⁻¹ yr⁻¹
- Energy → KCal/m²/yr

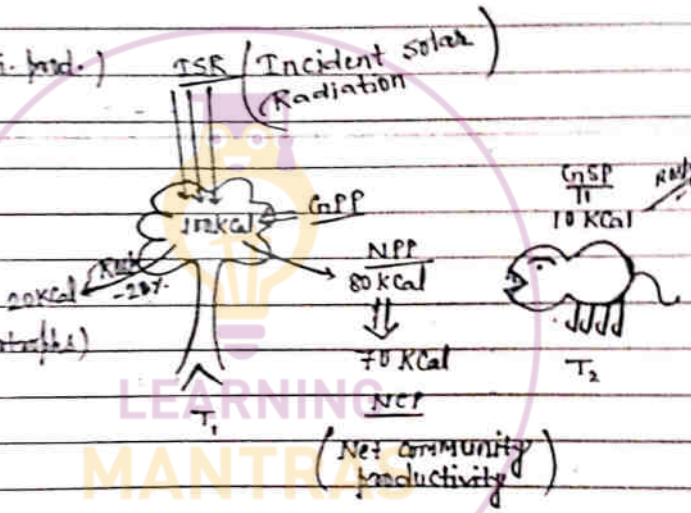
GPP (Gross pri. productivity)

NPP (Net pri. prod.)

$NPP = GPP - R$

$\Rightarrow GPP = NPP + R$

$NCP = NPP - HB$ (Heterotrophs)



NCP (Net community productivity)

GPP ⇒ Total amount of organic food formed by producer of an ecosystem in unit area at unit time.

= Total photosynthesis

= Total energy fixed

NPP ⇒

Total amount of stored food in producers of an ecosystem after respiratory loss.

OR,

Rate of New Tissue formation.

NCP ⇒

Total amount of stored food in producers of an ecosystem after heterotrophic use.

OR,

that is not used by heterotrophs

Mangroves = estuaries

Terrestrial

Max^M ⇒ Tropical Rain forest

↓

Tropical Deciduous

↓

Temprate Deciduous

↓

Coniferous forest

↓

Tundra / Desert

Aquatic

Max^M ⇒ coral reefs

↓

lake / pond

↓

River

↓

Ocean / Deep lake (open)

Note:- Ocean = N_2 - Deficiency

↓

N_2 fixing microbes - nt

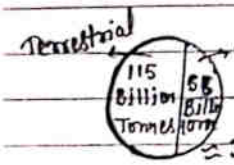
lake = P - Deficiency

Rocks - nt

Croplands

Sugarcane > Rice
due to
C_4 Plant

Total biomass
⇓
170 billion tonnes



Note :-

1. Ecological efficiency / Trophic level efficiency / Transfer efficiency

$$T_1 \xrightarrow{\%\ =\ ?} T_2$$

$$Ee = \frac{T_2}{T_1} \times 100 \quad \text{or} \quad \frac{GSP}{GPP} \times 100$$

$$Ee = \frac{10}{100} \times 100 = 10\%$$

2. Net Production Efficiency
⇓
New biomass
=
NPP

$$Npe = \frac{NPP}{GPP} \times 100$$

3. Photosynthetic Efficiency

$$\eta_e = \frac{GPP}{ISR} \times 100$$

ISR = 1000 Kcal , GPP = 100 Kcal

$$\eta_e = \frac{100}{1000} \times 100 = 2.5\%$$

ABIOTIC FACTORS

A. Light

Green Algae → O O O O _ _ _ _

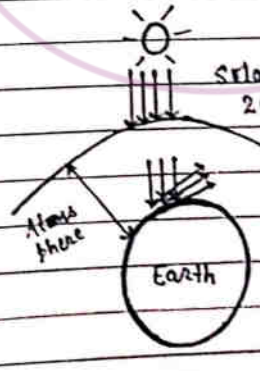
Brown Algae → O O O O _ _ _ _

Red Algae → O O O O _ _ _ _

Complex Cell wall

⇒ Archaebacteria

Complex cell membrane

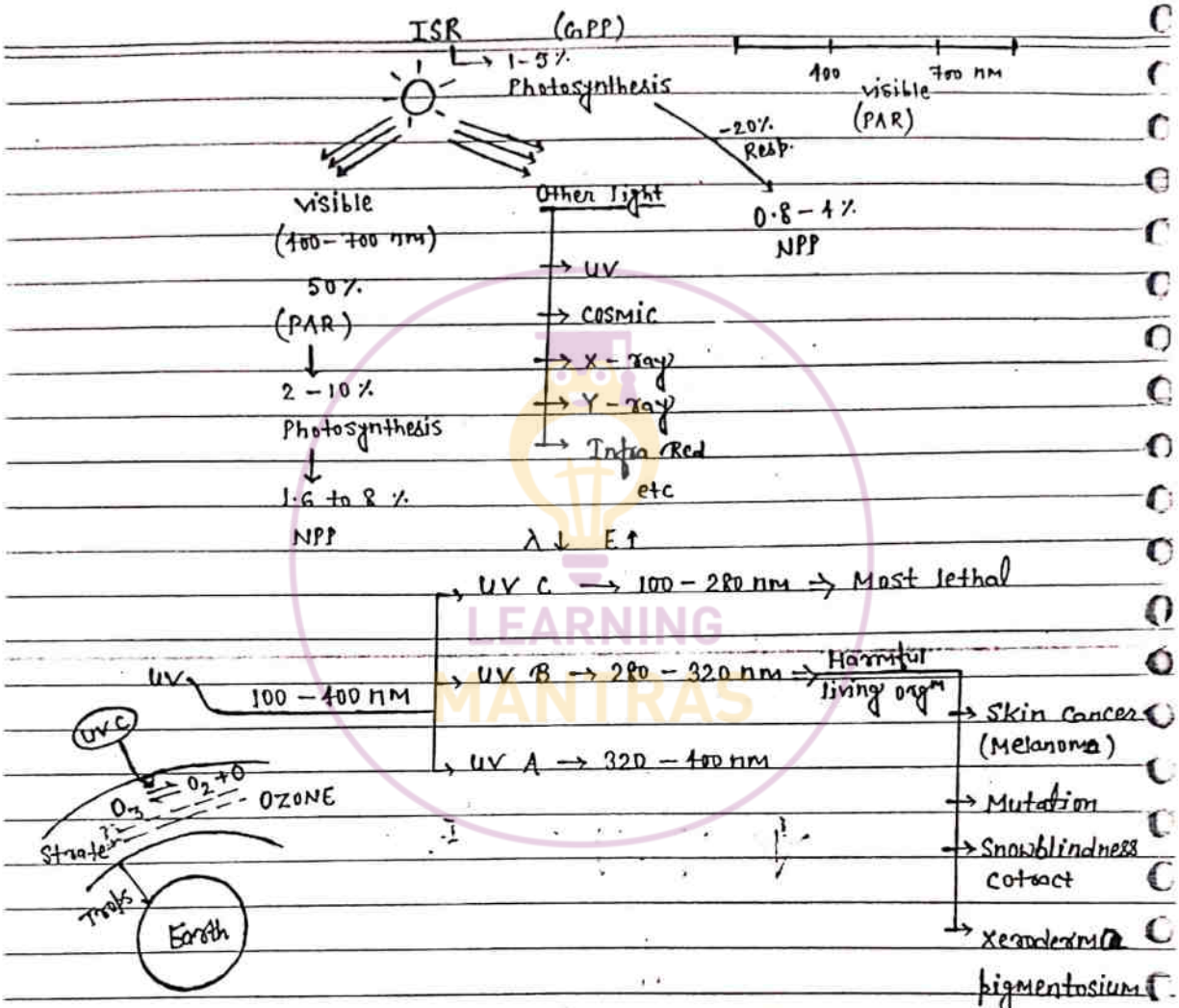


Snow = 80% (Max)

Sand = 20-30%

Forest = 5-10%

High Albido → low Albido



Factors -

1. Temp ↑ Decomposition ↑
   (25 - 35°C)

2. Moisture ↑ Decomposition ↑

3. Chitin, Lignine, Suberine = Slow Decomposition
   (complex)

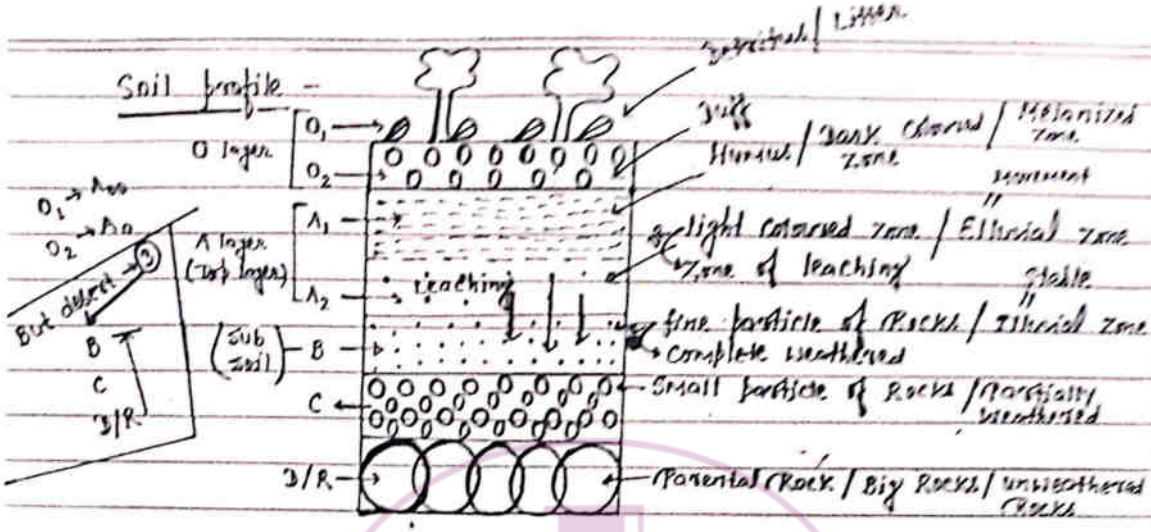
4. Nitrogen & Sugar containing = fast Decomposition
   Simple Substance

5. Aerobic cond^n = fast Decomposition

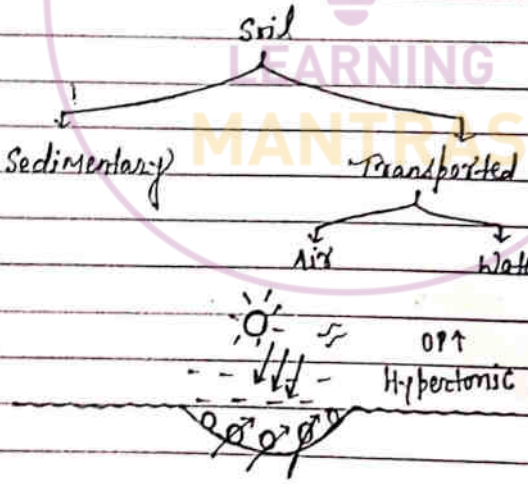
6. Anaerobic cond^n = Slow Decomposition

7. Acidic pH = Slow Decomposition = Big particle = More Humus of Humus
   (pH = 3.5 - 4)

8. pH (= 5.5 - 6.5) = fast Decomposition = fine particles = Mull Humus of Humus



Note:- Water loging causes salinity & this type of soil is called Usar soil.



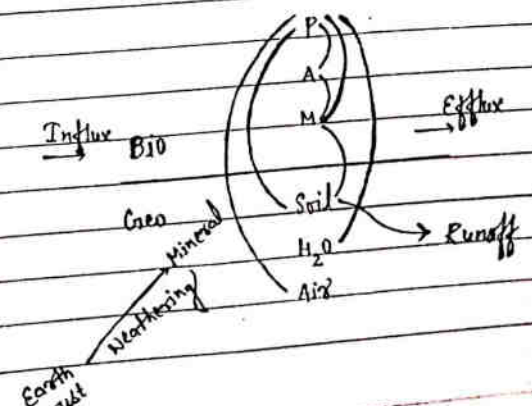
Water

Salt conc^{n} = ppt

		Percent
E.g.:- 1. Inland Water (fresh water)	$\frac{< 5 \text{ (Salt)}}{1000 (H_2O)}$	< 0.5
2. Oceanic Water	$\frac{30 - 35}{1000}$	3.0 - 3.5
3. Hypersaline lagoons	$\frac{> 100}{1000}$	> 10

Biogeochemical cycle

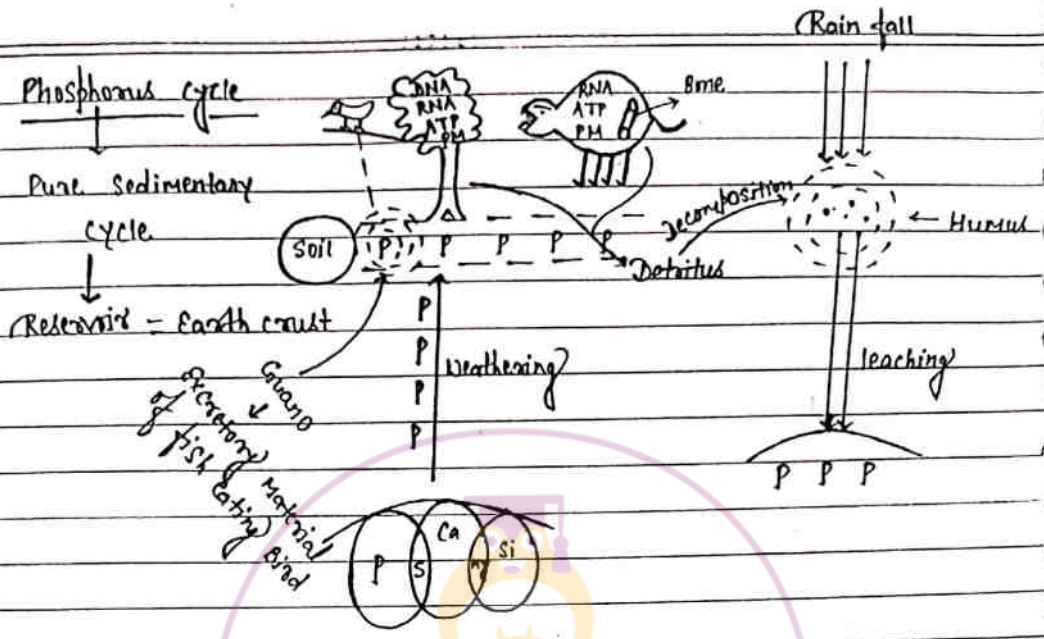
- Biotic
  - → Plants
  - → Animals
  - → Microbs
- Abiotic
  - → Soil / Rock (lithosphere)
  - → H_2O (Hydrosphere)
  - → Air (Atmosphere)
- Mineral
  - E.g.:- (P), S, Ca, Mg etc
  - ⇓ Reservoir = lithosphere = Earth crust
  - ⇓ Sedimentary cycle
  - Pure Sedimentary cycle
- Gaseous
  - Reservoir = Atmosphere
  - (C), H, (N), O
  - → Atm. = CO_2
  - → Litho = Coal, Petrole
  - → Hydro = Carbon

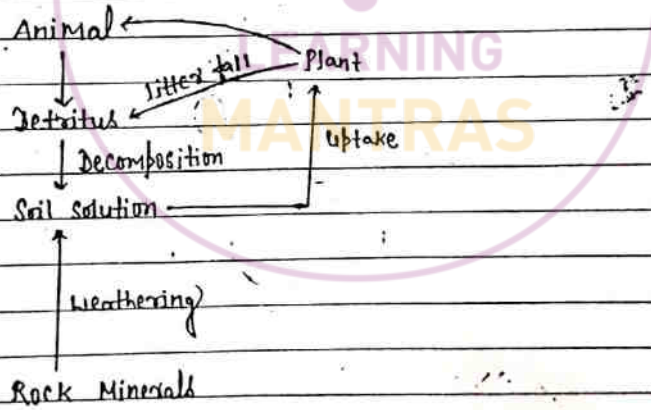


Phosphorus cycle

Pure Sedimentary cycle

Reservoir = Earth crust

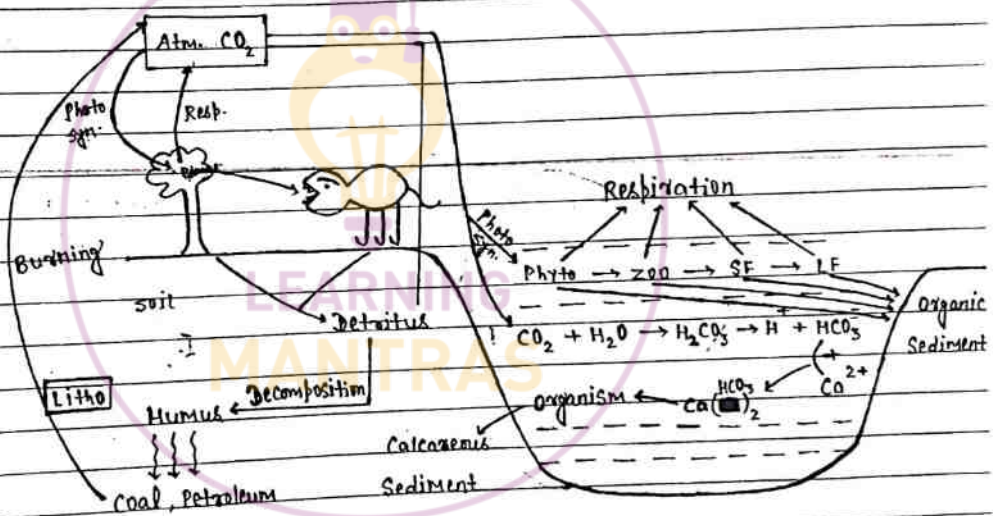




Carbon cycle

Reservoirs

1. Atmosphere = CO_2
2. Lithosphere = Coal, petroleum, limestone, Dolomite
3. Hydrosphere = carbonate



Biosphere

↓

Annual total carbon fixation in photosynthesis

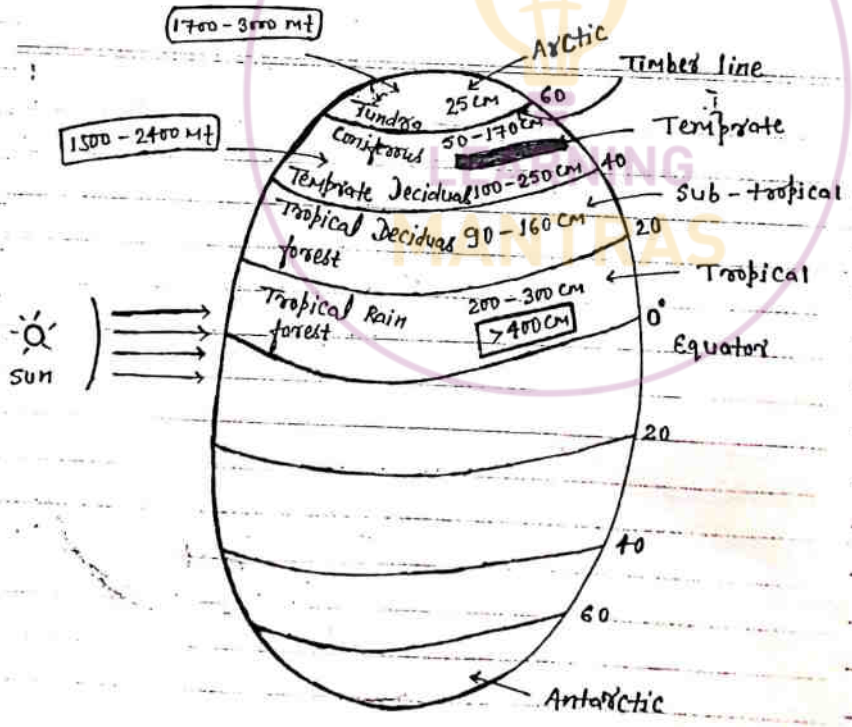
⇓

4×10^{13} kg

Biome –

large ecosystem

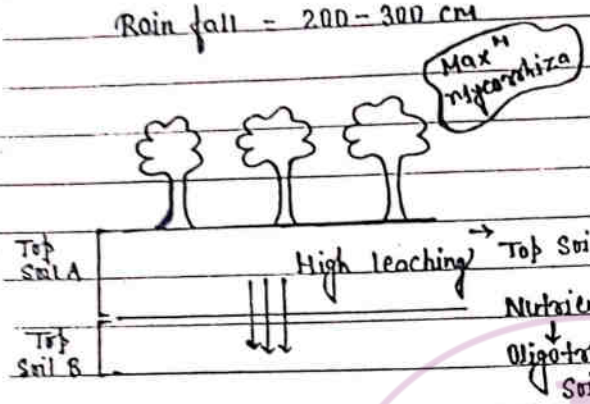
- Biotic (Specific)
  - Plants
  - Animals
  - Microbs
- Abiotic (Specific)
  - light
  - Temp. ↓
  - Soil
  - H_2O ↓
  - Air



latitude ↑
Temp ↓
Rainfall ↓
Diversity ↓
Productivity ↓
light ↓

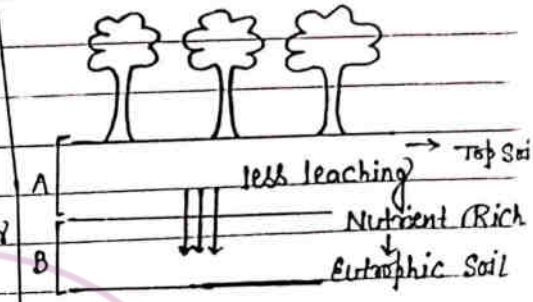
Tropical rain forest

Rain fall = 200 - 300 cm

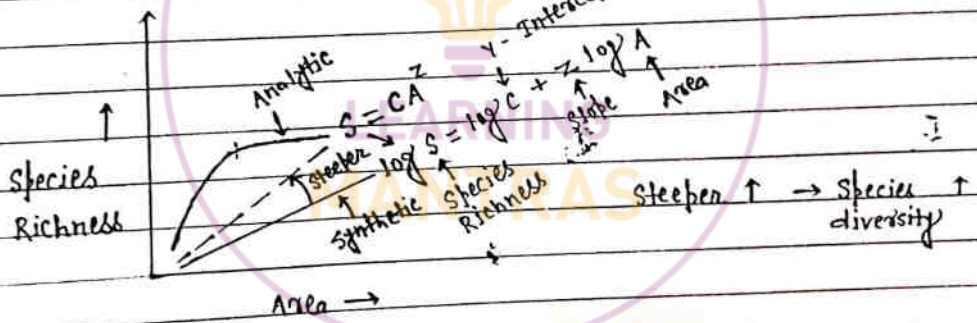


Temprate Deciduous

Rain fall = 100 cm



Species - Area (Rel^n) =>



z for :-

(i) Small Area = 0.1 - 0.2

(ii) large Area = 0.6 - 1.2

(iii) Tropical rain forest = 1.15
(fruit eating bird)

Loss of Biodiversity

Tropical Pacific Island → Human colonies → 2000 Native Bird Species Extinct

IUCN → last 500 years

789 Species Extinct

- 338 vertebrates
- 359 invertebrates
- 87 Plants

Rescent Extinction

1. Dodo (Bird) → Mauritius
2. Quagga (Zebra) → Africa
3. Thylacine (fox tiger) → Australia
4. Stellar's Sea Cow (Aquatic Mammal) → Russia
5. Bali, Javan, Caspian (Sub Species of Tiger)

last 20 years → 27 species

Recent

12% Birds 23% Mammals 32% Amphibian 31% Gymnosperm	Threat of Extinction

Threatened species

- Critically Endangered
  - ⇓
  - Immediate future
  - ||
  - Danger
  - E.g. Boeberia nilghiriensis (Plant)
  - Pitcairnia (Animal)
- Endangered
  - ⇓
  - Near future
  - ||
  - Danger
  - E.g. Bentinckia nicobarica (Plant)
  - Red panda (Animal)
- Vulnerable
  - ||
  - Number ↑
  - ||
  - Over Exploitation
  - E.g. Cupressus Cashmeriana (Plant)
  - Black buck (Animal)
- Rare
  - ↓
  - least no.
  - is nature

T = CE + E + V + R

Threatened Plant + Animal ⇓ Red data book

Threatend plant ⇓ Green data book

Cause of biodiversity loss – "Evil Quartet"

(i) Habitat loss & fragmentation → Major (iii) Alien species Invansion

(ii) Over exploitation (iv) Co-extinction

Biodiversity conservation

- In-Situ
- Ex-Situ

1. Biodiversity Hot spot (Megadiversity zone)

- High level of species richness
- High degree of threat ∝ (Habitat loss)
- High level of Endemism

Total Biodiversity Hot spot
= 25 + 9 = (34)

INDIA = (3)
- Western Ghat (Srilanka)
- Indo-Burma (Border)
- Himalaya

2. Biosphere Reserve

(Biotic + Abiotic) → (14)

Recently → (12) AIIMS

3. National Parks

Biotic → (90)

4. Wild life Santuaries

Animal → (448)

5. Sacred groove

20th century ⇒ India

30% land Area
↓ forest cover
19.4% forest Cover
↓
12% Dense forest

1988 ⇒ National Forest Policy

→ 33% Plains
→ 67% Hills

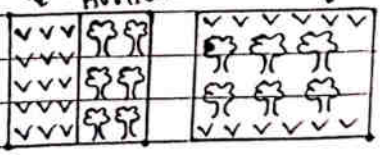
Forest - Conservation

Protection forestry
||
Conservation

E.g. - 1 Biosphere Reserves
2. Natural parks
3. Silent valley ⇒ National Reserve forest

Production forestry
||
Commercial forestry

E.g. - 1. Social forestry
2. Agro forestry → Taungya System
↓ Horticulture



1980 ⇒ JFM (Joint forest Management)

1972 ⇒ Wild life protection Act India

1974 ⇒ Chipko Movement

1992 → Earth Summit ⇒ Brazil

↓↓

UNCED (United Nation Conference on Env. & Development)

2002 → World Summit ⇒ South Africa

↓

Sustainable Development

2010 ⇒ Biodiversity Year

2002 → Biodiversity Act in India

Note:- WWF → World Wide Life Fund

Biodiversity

Edward Wilsm

Total

1. Gene Diversity → Single Species → Diff Genes

2. Species Diversity → Single → Diff

Community Species

Eg.- 1 Rauwolfia vomitoria

↓

Chemical

↓

Reserpine

3. Ecological / Ecosystem Diversity

Single landscape

↓

Diff Ecosystem

2. Mango = 1000 Varities

3. Rice > 50,000 Strains

Note:- Amphibian Species diversity of (Western Ghat > Eastern Ghat)

Ecological diversity of (India > Norway)

Types of ecological biodiversity :

Desert, Rain forest, Mangroves, coral reefs, Wet land, Estuaries & Alpine Meadows

IUCN (2004) → Total Discovered species

⇓

> 1.5 million

(1.7 – 1.8 million)

Total species ⇒ Robert May — 22%

⇓

7 million

Total discovered

Animal

> 70%

⇓

Max^M → Insect — 7 insect / 10 Animal

Plants

22%

⇓

Max^M → Angiosperm

India ⇒ 2.4% land Area

↓

8.1% Diversity

Total Discovery → 45000 Plants

Total Discovery → 90,000 Animal

45000 + 90,000 = 135000 species

400,000

→ 1 lakh plant

→ 3 lakh Animal

560,000 — 22% → 135000 species

70 lakh — 8% → 560,000

Pollution

→ Any undesirable change in physical, chemical or biological composition of Air, Water & Soil

Types -

Non-biodegradable	Biodegradable
⇓	⇓
Eg:- DDT	Quantity ↑ = Pollution
BHC (Benzene Hexa Chloride)	Eg:- Sewage
Al, Hg	Live Stock
Plastic	Garbage

Pr. Pollutant

CO, CO_2, HC → 3,4 Benzo-pyrine; HC → Benzene

Coal Smoke → CO, CO_2, HC, NO_x, SO_x, Pb

DDT

Sec. Pollutant

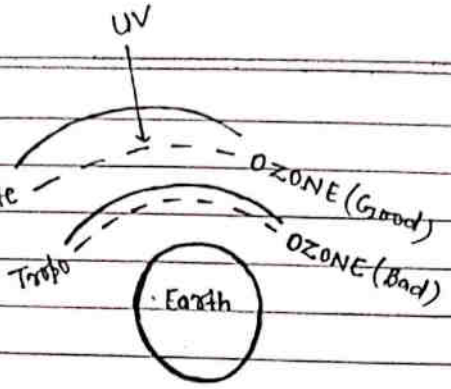
1. SO_x, NO_x ⇈ Coal + H_2O → Synergism

Smoke → Chimney

H_2SO_4, HNO_3 → Acid rain (Sec)

2. $HC + NO + O_3$ → PAN + NO_2 + O_3

PAN: Peroxy acetyl Nitrate; + NO_2 + O_3 : Sec



Quantitative Pollutant

↓

Part of Nature

↓

Quantity use

||

Pollutant

Eg - CO_2

(NO_x)

SO_x

Qualitative Pollutant

⇓

Not a part of Nature

↓

Small quantity

||

Pollutant

Eg - CO

CN

DDT

Natural Pollutant

(i) CH_4

Marshy Area

(ii) SO_2

Volcanic lava

(iii) forest fire → CO_2

Anthropogenic (Man-made)

(i) Industrial Smog

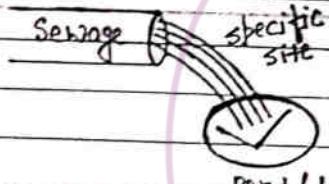
(ii) Vechicular (Automobile) Smoke

Note:- Type of Pollution

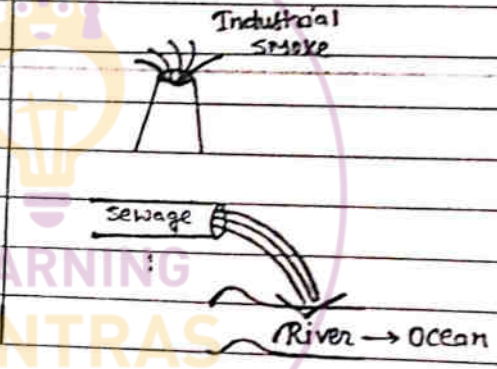
Positive pollution → undesirable substance
1. Over fertilizing
2. Land filling

Negative pollution → desirable substance
1. Soil Erosion
2. Over grazing
3. Deforestation

Point - Source Pollution



Non-point Source Pollution



Outdoor Pollution
1. Automobile Pollution
2. Industrial Pollution

Indoor Pollution
1. Mosquito killer → Insectiside
2. Newspaper → Ink ⇒ Pb → CNS

Air Pollution

- **Gaseous Air Pollution**
  - E.g. - CO, CO_2, NO_x, SO_x
- **Particulate Air Pollution**
  - **Settleable** — Size 10 μm ↑
    - CPCB
    - SPM Size 2.5 μm ↓
  - **Suspended** — Size 10 μm ↓
    - **Solid**
      - E.g. - Dust, Pollen grain
      - Soot (Carbon particles in Smoke)
    - **Liquid**
      - E.g. - Fog / Mist / Aerosols

Pr. Air Pollutants

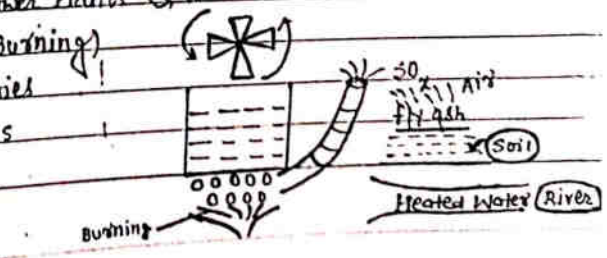
(i) NO_x →

Source :- → Automobile Smoke
→ fertilizer industry (Urea)
→ Agriculture field

Harmful effect :- lung cancer

(ii) SO_x →

Source :- → Thermal Power Plants (Coal Burning) → Air pollution, Soil, Water
→ oil refineries
→ ore Smelters

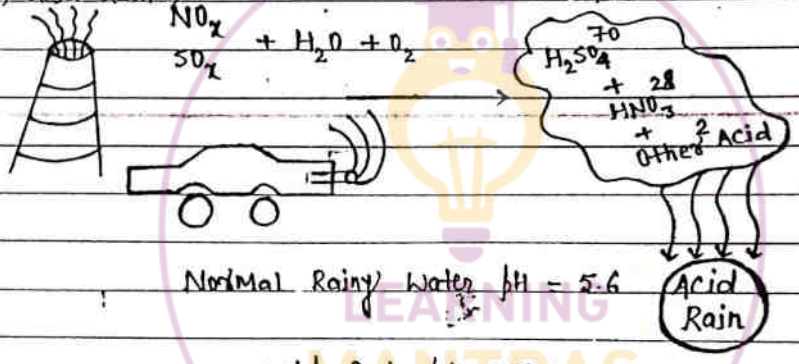


(iii) Hydrocarbons →

VOCs → Volatile organ compd.
- → 3, 4 - Benzopyrene ⇒ Unburn hydrocarbon → Automobile smoke
- → Benzene
- → HCHO → Dry cleaners
- → CH_4 → Paddy field / Marshy Area
  ↓↓ Carcinogenic

Secondary Air Pollutants

(i) Acid Rain ⇒



H_2SO_4 : HNO_3
70 : 30

Normal Rainy Water pH = 5.6 → Acid Rain

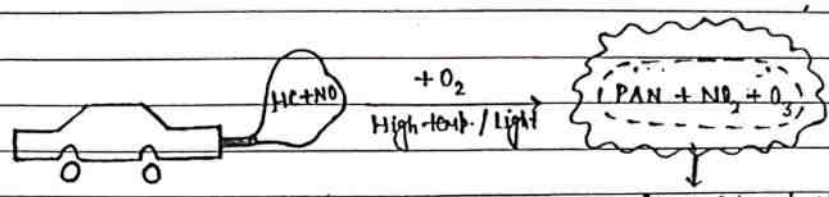
Acid Rain pH < 5.6

Harmful effect :-
Air, Water & Soil becomes Acidic

Historical Moments :→ Taj Mahal
↓
Stone
↓
Yellow
↓
Stone leprosy

(ii) Fog + Smoke ⟶ Smog (Sec.)

(i) Los Angeles Smoke / Photo Chemical Smog / light induced Smog / oxidizing Smog ⟶



Brown Coloured Air
||
Photochemical Smog

Note :- low temp ⟶ Grey Coloured Air ⟶ Incomplete Photochemical Smog

PAN (Peroxy acetyl Nitrate)

→ Eyes, Skin – Irritation

→ Plants – PS – II – e⁻ flow Block

OZONE

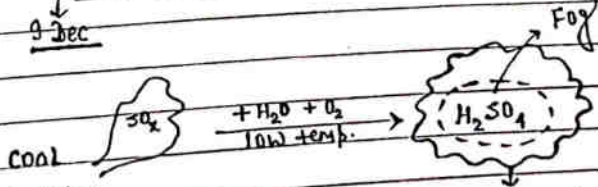
→ Emphysema

→ Respiratory tract ⟶ Rigid mucus Membrane

(ii) London Smog / Coal induced Smog / Industry Smog / Classical Smog / Reducing Smog ⟶

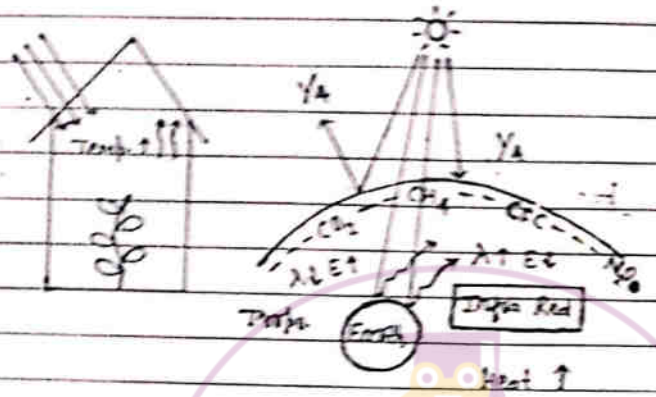
1952

5 Dec
↓
5 days Smog
↓
9 Dec



Yellow coloured Smog (Air)
||
London Smog

Greenhouse effect



Greenhouse Gases

	1956	2001	Present
CO_2 Conc^n	280 ppm	368 ppm	394 ppm

- CO_2 = 60%
- CH_4 = 20%
- CFC = 14%
- N_2O = 6%

} Radiatively Active Gas

Note :- NO_2, SO_2, O_3 & Water vapour

CO_2 gas → Earth → Extra → Global
Conc^n Surface Warm Warming

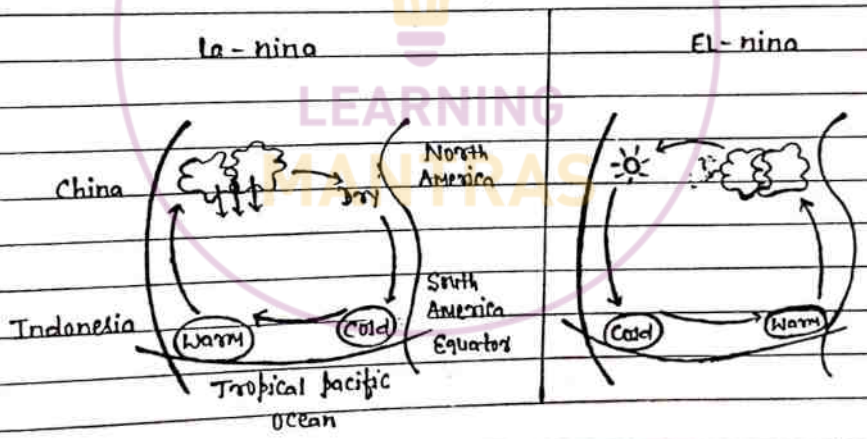
CO_2 fertilizing effect

Rubisco

CO_2 ↑se conc^n → C_3 - plants → Photosynthesis ↑se → Productivity ↑se

CO_2 ↑se conc^n → Partial Closing of Stomata → Transpiration ↓se

Stomatal ↑se Density



1992 → Earth summit

↓

1995 → COP - I → Berline, Germany - fail

↓

1996 → COP - 2 → Geneva, Swis → Agreement - fail

NEET-UG 2013

1997 → COP - 3 → Kyoto, Japan → Kyoto protocol

2002 → COP - 8 → New Delhi, India

Aipmt & Re-Aipmt

2011 → COP - 17 → Durban, South Africa

2012 → COP - 18 → Doha, Quatar

↓

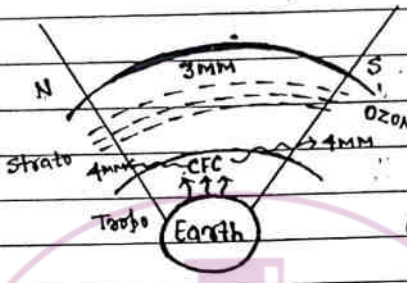
2020

2013 → COP - 19 → Warsaw - Polland

2014 → COP - 20 → Lima - Peru

2015 → COP - 21 → Paris - Frans → Dec

OZONE DEPLETION



ODS → OZONE Depleting Substance

CFC > CH_4 > N_2O (Max)

$CF_2Cl_2 \xrightarrow{h\nu} CF_2Cl + \dot{Cl}$

Ozone thickness = Dobson unit

$\dot{Cl} + O_3 \longrightarrow ClO + O_2$

$ClO + [O] \longrightarrow \dot{Cl} + O_2$

Max. accumulation of CFC ⟶ low temp.

Antarctica ozone hole ⟶ Every year

↓

late Aug – late oct

1987 → Montreal protocol – Canada

↓

1989

Air Pollution Control

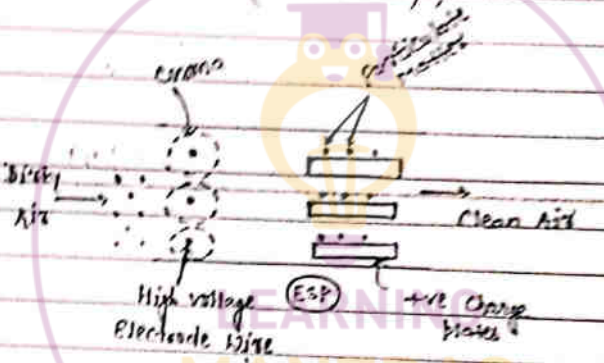
Gaseous

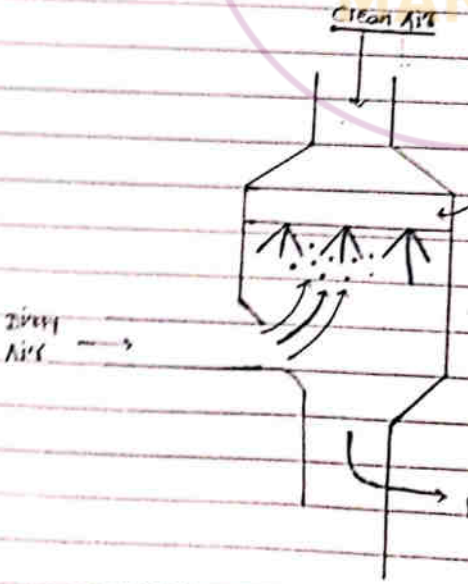
Particulate

Mechanical

Scrubber

ESP (Electrostatic Precipitator)





Euro Norms –

1. Euro I → June 1999

2. Euro II / Bharat Stage II – 1st April 2000
   ↓
   11 major Polluted Cities

3. Euro III / Bharat Stage III – April 2005
   ↓
   Rest of India → Euro II 11 major Polluted Cities

4. Euro IV / B.S IV – April 2010
   ↓
   13 Major Polluted cities
   ↓ ↓
   Solapur Lucknow

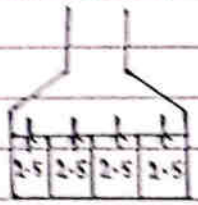
   Oct 2010 → Rest of India = Euro III
   2. 3. 1.
   Wheelers

Euro I / II	Euro III / IV
Sulphur	Sulphur
Petrol = 150 ppm	Petrol → 50 ppm
Diesel = 350 ppm	Diesel → 50 ppm
HC = 42%	HC = 35%

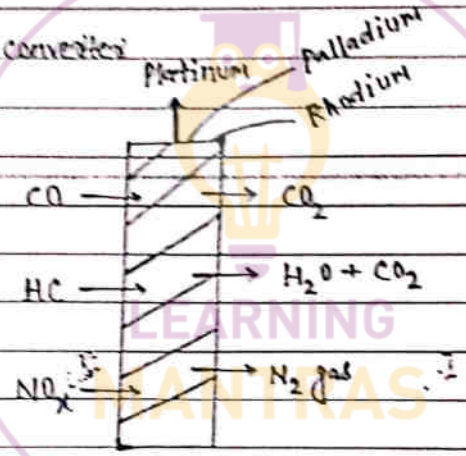
Engine -

1. Multipoint fuel injection

For Efficient Burning of hydrocarbon



2. Catalytic converter



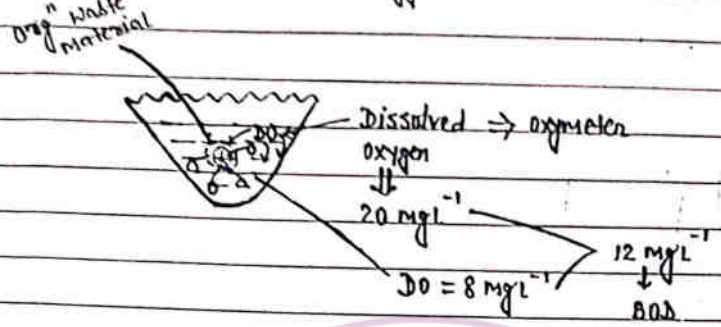
Unleaded petrol

↓

Green petrol

Water Pollution

1. BOD → Biochemical oxygen Demand



Water

DO < 8 mgl^{-1} → Polluted Water

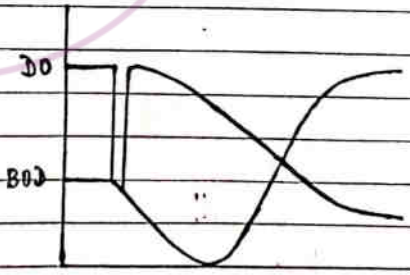
DO < 4 mgl^{-1} → Heavy Polluted Water

Orgⁿ Waste Material $\propto$ BOD $\propto \frac{1}{DO}$

Fresh Water BOD < 1 mgl^{-1}

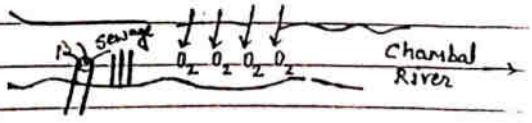
Fresh Water indicator

- Daphnia
- Trout fish
- larva of Stone fly

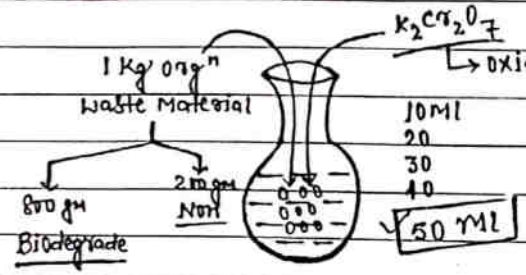


Polluted Water indicator

- E. Coli
- Tubifex (Annelid)
- Sludge Worm

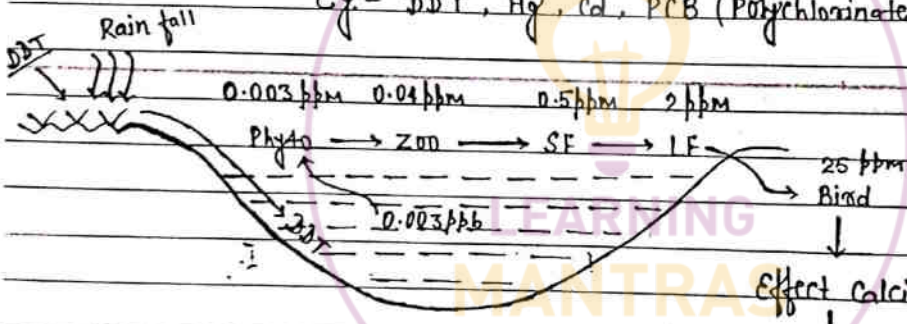


2. COD → Chemical oxygen demand



3. Biomagnification

Eg - DDT, Hg, Cd, PCB (Polychlorinated Biphenyles)



Effect Calcium Metabolism

↓

Egg shells become thin

↓

Premature Breaking → Bird population ↓se

Hg → Minamata disease

Cd → Ouch - ouch disease (Itai - Itai)

Rachel Carson

⇓

Book → Silient Spring

↓

Pesticide Population

4. Eutrophication

Mineral Enrichment

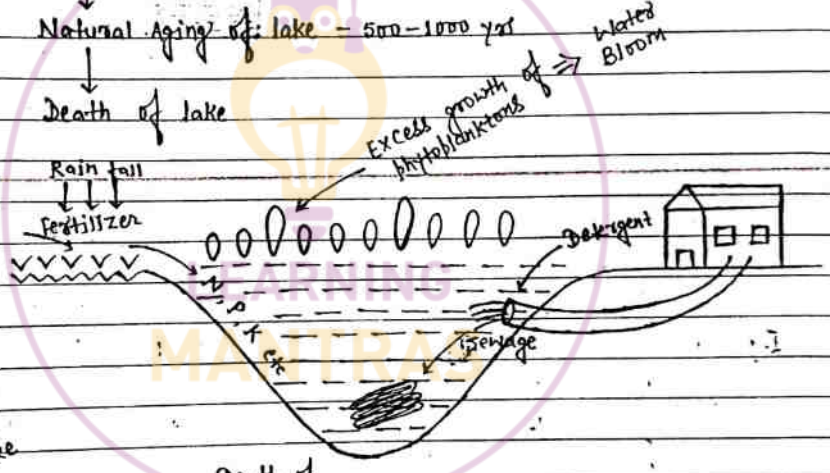
Aquatic body (lake)

High growth of orgm

Natural Aging of lake – 500–1000 yrs

Death of lake

☆☆ Human induced Eutrophication
= Accelerated Eutrophication (100–250 yrs)
= Cultural Eutrophication



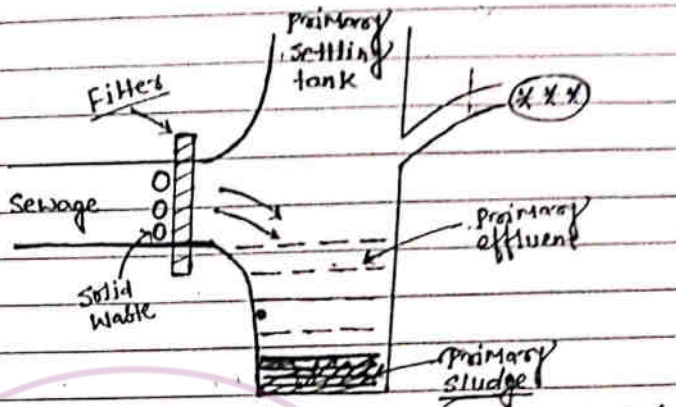
Death of lake
Aging of lake
Lake become Shallower & warmer
Death of Aquatic organism

Sewage Treatment

A. Primary treatment (Physical)

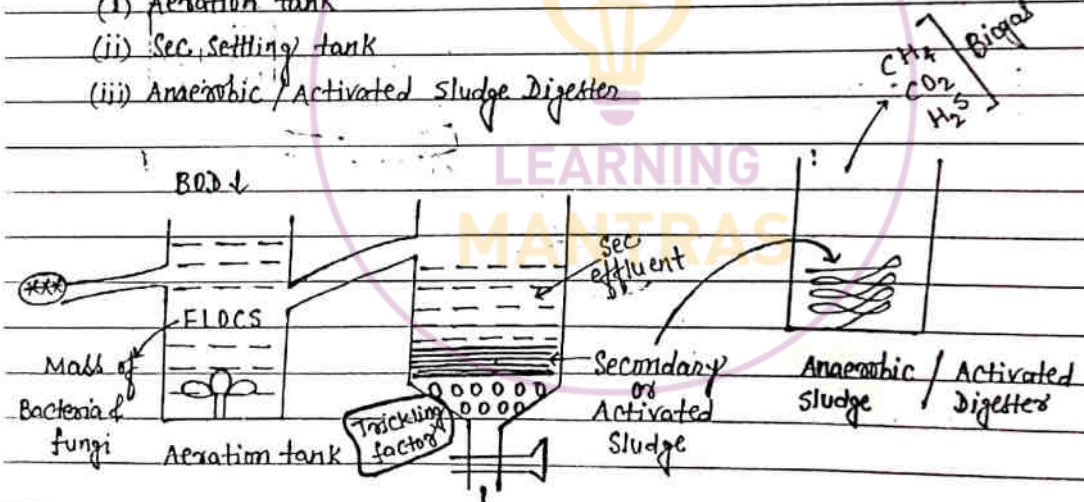
(i) Filtration

(ii) Sedimentation

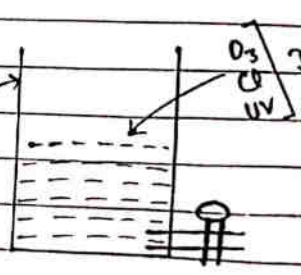


B. Secondary treatment (Biological)

(i) Aeration tank
(ii) Sec. Settling tank
(iii) Anaerobic / Activated Sludge Digester



C. Tertiary Treatment (Physio-Chemical)



Demography → Scientific Study of Human popl^n.

Census → Official counting of human population in each decade, very first year, first and months.

	2001	2011	
India	1.02 billion	1.21 billion	17%
World	6 billion	7 billion	

Population density → (N)

$$P.D = \frac{\text{Total no of Individual}}{\text{Unit Area}}$$

↓

Km/hec. / m^2 / cm^2

World = 33 person / km^2

India = 382 person / km^2

Max^M, Bangladesh = 1142 person / km^2

Min^M, Greenland = 15 person / km^2

Note :-

(i)

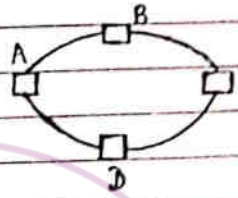
400 – Pinus	Dominant → Max^M density
200 – Deodar	
100 – Abies	

(ii)

(iii) Population density

- Absolute
- Relative

(i) Fishes in Pond



$\frac{A+B+C+D}{4} = P$

(ii) Bacterial Culture (Biomass)

(iv) Tiger census

- Pug Mark
- Fecal Matter

Birth Rate – (Natality)

$$BR = \frac{\text{Total no. of Birth in a Year}}{\text{Population}}$$

Q. 20 lotus Plants $\xrightarrow{1 \text{ year}}$ 28 lotus Plants

$$BR = \frac{8}{20}$$

Crude Birth Rate – (CBR)

$$CBR = \frac{\text{Total no. of Birth}}{\text{/yr/1000}}$$

India CBR – 21/yr/1000

Death Rate – (Mortality)

$$DR = \frac{\text{Total no. of death in a year}}{\text{Population}}$$

Q 10 Insect —1 Month→ 36 Insect

$$DR = \frac{4}{40} = 0.1 \text{ / Month}$$

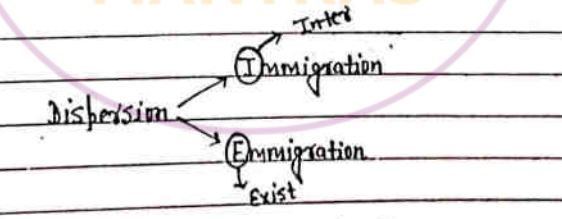
Annual Growth Rate – (AGR)

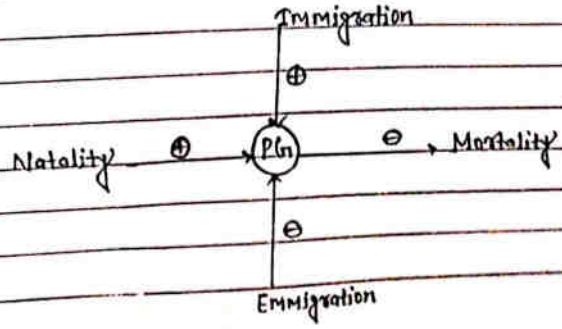
$$AGR = CBR - CDR$$
$$= 24 - 8$$

India AGR = 16 /Yr/1000

% AGR = 1.6 %

Sweden % AGR = 0 %





$P_G = (B+I) - (M+E)$ or $(B+I) - (D+E)$

$B+I = D+E \Rightarrow$ Zero growth

$B+I > D+E \Rightarrow$ +ve growth

$B+I < D+E \Rightarrow$ -ve growth

$N_{t+1} = N_t + [(B+I) - (D+E)]$

↑ Population after unit time ↑ Present

$N_t = 100$ 1 yr $\begin{bmatrix} B = 20 & I = 10 \\ D = 10 & E = 5 \end{bmatrix}$

$N_{t+1} = 100 + (30 - 15) = 115$

Note:- Vital Index $= \frac{\text{Natality}}{\text{Mortality}} \times 100$

$VI > 100 \Rightarrow$ +ve growth

$VI < 100 \Rightarrow$ -ve growth

$VI = 100 \Rightarrow$ Zero growth

Infant Mortality Rate (IMR)

$$IMR = \frac{\text{Total no of Death of infants in a Year}}{\text{Total living birth}} \times 1000$$

Socio - Economic

Developed IMR < 10

Developing IMR > 10

Sex Ratio ⇒

Total no of females / 1000 Males

World = 1 : 1

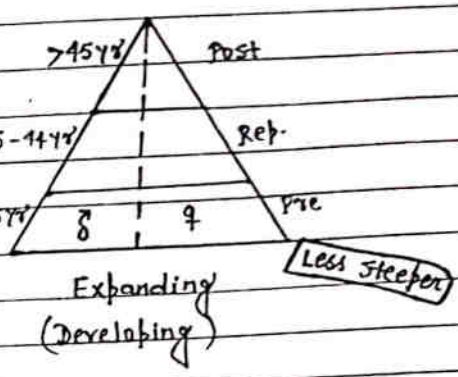
India = 933 : 1000 (2001)

940 : 1000 (2011)

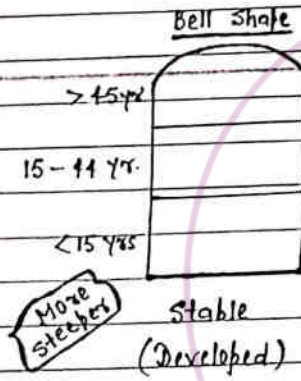
Age - Sex Pyramids ⇒

Age - Groups -

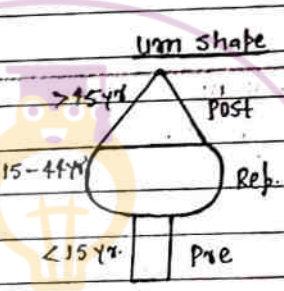
1. < 15 yrs = Pre - Reproduction
2. 15 - 44 yrs = Reproductive
3. > 45 yrs = Post - Rep.



Expanding
(Developing)



Stable
(Developed)



Declining
(China)

Growth Curve

- When Resources are unlimited
  - J Shape
    - Geometric
    - Exponential
- Resources limited
  - S - Shape
    - Sigmoid
    - logistic

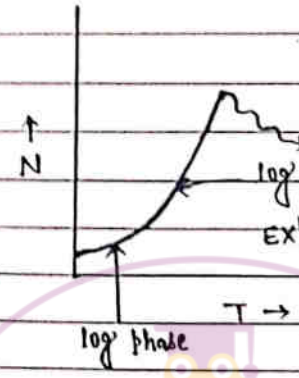
Climax Community → K selected

1. J - Shape ⇒

Biotic potential (b-d)

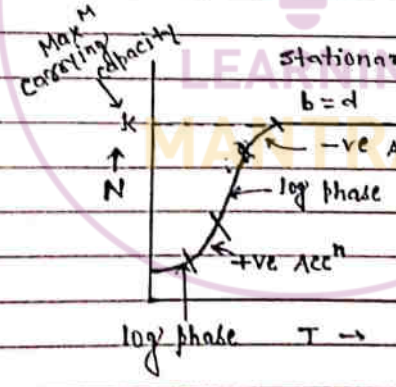
$\frac{dN}{dt} = rN$

$N_t = N_0 e^{rt}$



E.g. → Rainy Insect
→ Algal Bloom
→ fungi

2 S - Shape ⇒



$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

Env^tal Resistance

NCERT Ques. ⑥

Present population = x

After 3 yrs = 2x

$N_t = N_0 e^{rt}$

$\Rightarrow 2x = xe^{3r}$

$\Rightarrow \log_e 2 = 3r \log e$

$\Rightarrow 3r = \log 2$

$r = \frac{0.69}{3} = 0.23$