Ecosystem

↓ It is a self sustaining unit where functional interaction b/w biotic and abiotic component

↳ interaction b/w biotic and abiotic component
functional

Ecosystem - Unit
Ecology - Study

• Term coined by AG Tansley

Basic structure of ecosystem

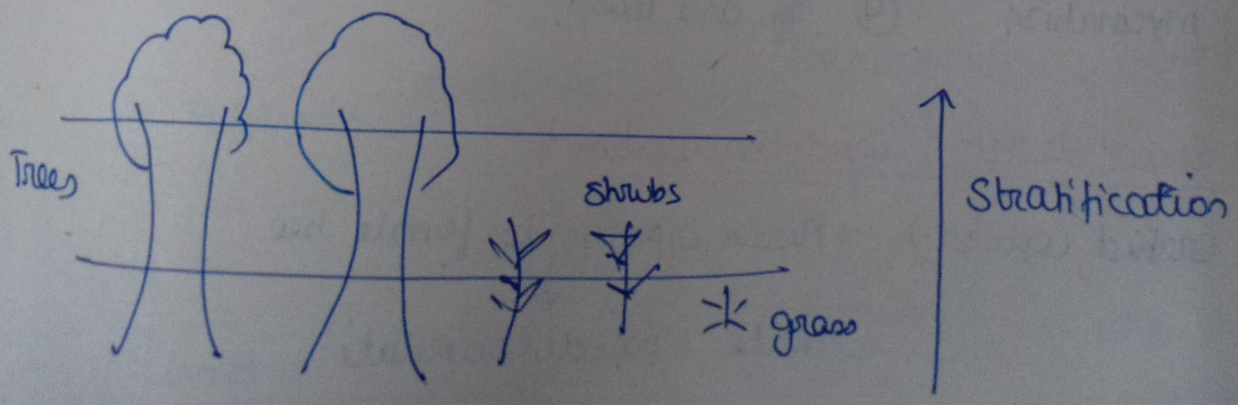
① Abiotic and biotic component → They form structure of ecosys.
↓ ↓ ↳ I
water, light, nutrient — Plant - producer, Animal - consumer, decomposers

② Functional component - due to interaction of biotic and abiotic some function occur in ecosystem.
Abiotic → ← Biotic
a) Productivity
b) decomposition
c) Energy Flow
d) Nutrient flow

③ Standing state and standing crop -
ecosystem → Total amount of biomass of one trophic level in given time
Soil - amount of inorganic nutrient in given time

④ ### Stratification ##

• It is vertical distribution of species in any ecosystem



Pond ecosystem

→ shallow water → aquatic ecosystem

Structural component → Abiotic + Biotic component

- water
- dissolve minerals
- Sunlight
- Temperature
- Light, season

Biotic component:
- Phytoplankton
- Floating plant
- Plant on edges

→ Producers

- zooplankton
- floating animal

→ consumers

Bacteria, fungi, → Decomposers

In pond ecosystem - phytoplankton and other plant → Productivity

→ Energy flow occur in food chain

→ Decomposition

Type of ecosystem

I on the basis of size → a) Mega ecosystem
b) Macro "
c) Micro "
d) Nano "

II can be complete or incomplete

↓ Forest, desert, ocean

↓ aquarium, deep sea → producers absent

III man made and natural ecosystem

↓ agricultural field

↓ Forest

Biosphere → global ecopystem → difficult to study

↙ Aquatic (Pond, river, ocean,)

↘ Terrestrial (Forest, grassland, desert)

GPP - Total biomass produce

NPP - Net primary # productivity

→ Respiration rate

GPP - R = NPP

↳ produce total

Q How to calculate GPP ?

⇒ R - calculate and NPP calculate then add.

Q Can NPP be zero ?

⇒ In winter plant don't show any increase in biomass

GPP = R and NPP = 0

↳ due to low photosynthesis and GPP is low

Q Can NPP = GPP ?

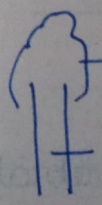
⇒ No because plant is living, some respiration ~~loss~~ loss.

Q Can GPP = 0 ?

⇒ No

Ratio importance # → $\frac{NPP}{GPP}$

↳ $\frac{NPP}{GPP} = \frac{GPP - R}{GPP}$ → ratio is high when



green plant

brown plant

- Both plant respire and green part show photosyn.

more ratio is of herb because it has more green part → means less value of R

$\frac{NPP}{GPP}$ → always less than 1

NPP - actually visible outside

for next trophic level → Herbivore → only NPP available for them

→ decomposer

Secondary productivity

→ amount of biomass increase at primary consumer / Herbivore level
(Note It is not secondary prod.)
↳ NO GRASS

Compare standing crop and primary productivity

standing crop → actual available biomass at given time
let – 10,000 g
↓ 1 year later
~~1010~~ 10100

primary productivity → Increase in pro biomass in given time
10000 – 10100 = 100 kg

Comparison of primary productivity

① Earth → primary productivity – 170 billion ton annually
- water has 55 billion ton (70% area occupy)
- land – 115 billion ton (30% area – land)

Land primary productivity is high

Reason:
① vertical stratification is better
② In water light penetration imp. factor.

Factors affect primary prod. #

① Type of plant species
② Habitat
③ condition
- light penetration
- H_2O, CO_2
- minerals

Q Which mineral is responsible for algal bloom?
⇒ Nitrate.

Highest primary productivity → coral reef (shallow water clear)

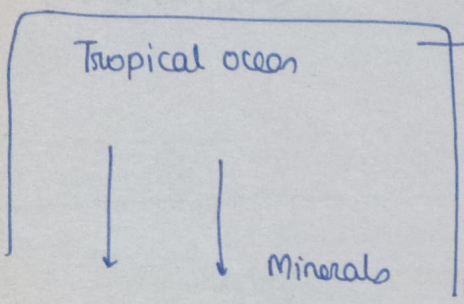
High 1° productivity → Coral reef > Eustuaries > Tropical forest

④ In land → Tropical > Temperate > Grassland > desert > archic Tundra

⑤ In ocean - coral reef > Eustuaries > Temperate ocean > Tropical ocean

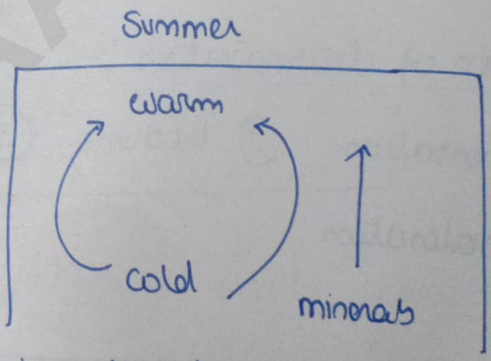
Q Reason why tropical ocean has ~~more~~ less productivity than temperate ?

⇒ Tropical ocean → close to equator → NO season



Phytoplankton to food (minerals) nahi milenge

But in temperate ocean → season change



Mixing of water due to upwelling

water move upward → minerals more

Phytoplankton get food

High productivity → coral reef, eustuaries, tropical forest

Medium " → Temperate forest, Sugarcane → max prodo crop

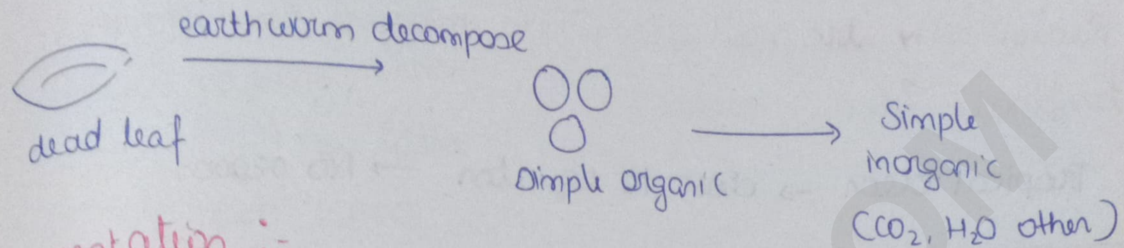
low " → grassland and other crop

very low - desert > tropical ocean > archic tundra

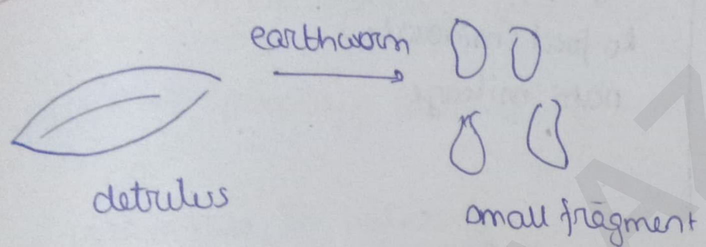
Decomposition # - biological process to convert dead organic into simple inorganic

Primary productivity → yaa toh wo → Decomposition hojayega
Primary productivity → ya → Food chain me chale jaaye

Detritus → dead organic (dead leaf, flower stem, dead animals)



Fragmentation :-

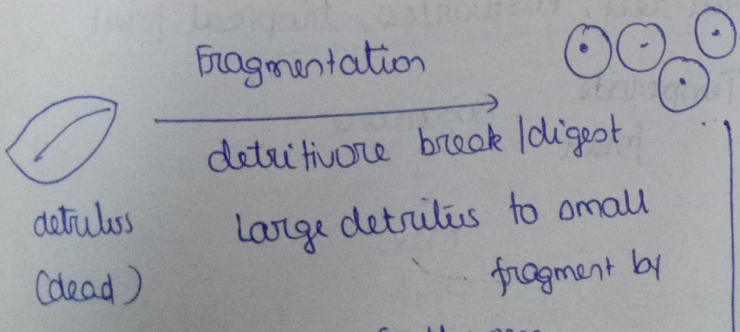


Five step of decomposition :-

(1) Fragmentation (2) Leaching (3) Catabolism (4) Humification
(5) Mineralisation

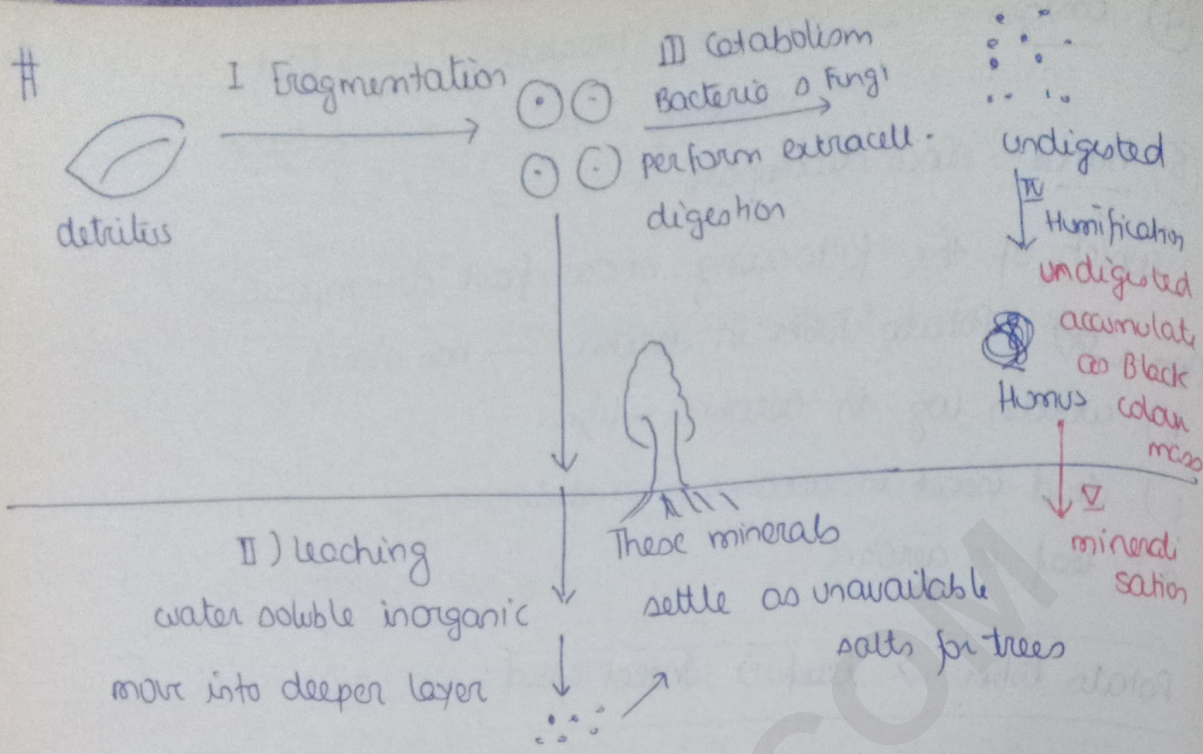
(1)–(3) ↳ occur in upper layer of soil in fresh dead material

Humification and mineralisation occur just beneath fresh dead and organic matter



detritivore break/digest large detritus to small fragment by Earthworm

(2) Leaching water soluble inorganic move into deeper layer



I, II, III occur simultaneously occur in upper layer

Humus :- undigested black colour mass
- amorphous, microbial resistant
- slow decompose, it break slowly so act as a reservoir of minerals

IV, V step occur in lower layer

Q which step produce minerals which is mostly unavailable ?
⇒ Leaching

Factors affecting decomposition

① Chemical nature of detritus ⟶ if detritus has sugar and nitrogen → Fast decomposition
If lignin and chitin ⟶ low decomp.

② Moisture : → Humidity — growth of decomposers (enzyme active)

③ Temperature — 25-30°C - good T for decomposition

at Low Temp. → Biomass accumulate

④ Oxygen ⟶ aerobic breakdown ⟶ Fast
anaerobic " ⟶ Slow

⑤ Humus - slow decompose

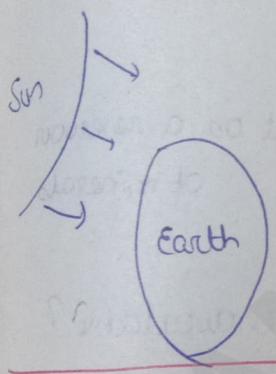
Q which of the following show fast decomposition ?

a) Potato Tuber in aerobic ⟶ has otarch
b) wooden log in aerobic - lignin
c) dead insect in aerobic ⟶ chitin
d) leaf in aerobic

Potato tuber > leaf > Insect wood

Energy flow

Except deep sea → ultimate source of energy is Sun.



From sun → wavelength comes

390 - 760 nm → out of which 400nm - 700nm called PAR (photosynthetically active radiation)

Out of total wavelength to ⟶ less than 50% is PAR

Energy is fixed by plant + Chemoautotroph + Cyanobacteria ⟵ out of PAR plant able to fix 2-10%.

For energy flow → both law of thermodynamic is applicable

1st law :- One form of energy is converted into another form. (Plants ⟶ through light energy convert it into chemical energy)

2nd law: as in food chain ⟶ Respiration loss

2nd law :- as in food chain → Respiration occur → entropy is increasing

To counter increasing entropy → continous input of energy

Energy input → By sun

Energy flow → In any ecosystem energy flow by food chain

Food chain

- linear relationship b/w different organism to explain dependency of organism for food.

Grass T_1 • Primary Producer → (T_1 - First trophic level)
or Transducer → Grass, Herb, trees, phytoplankton

↓

Grasshopper - T_2 - Primary consumer
Secondary producer
Herbivore → Ex - Bird, mammal, insect, mollusc

↓

Snake - T_3 → Secondary consumer
Tertiary producer or 1° carnivore

↓

Bird. T_4 → Tertiary consumer or Secondary carnivore or Top consumer.

Birds → eat Grain - Herbivore consider - T_2
→ if eat insect - carnivore - T_3 consider.

Bird is omnivore.

Type of food chain

→ Terrestrial food chain
→ Aquatic food chain

• Grassland

Grass → Grasshopper → Bird → Snake

Forest - Tree → Bird

Phytoplankton → Zooplankton → Small fish → Large fish

Type of food chain :

GFC - Grazing food chain

1st trophic level - T_1

(primary producer - live plants)

- Grassland food chain

forest " "

- aquatic " "

DFC (detritus food chain)

→ 1st trophic level par dead plant or animal hogaa.

→ T_1 = dead / detritus

→ T_2 = Earthworm / Fungi

⟹ PFC (parasitic food chain)

• T_1 - Host , T_2 = parasite

On land GFC is not major conduit of energy it move through DFC

Land ecosystem or aquatic ecosystem - In both GFC & DFC both present

• Land productivity is greater than water

↓

more biomass produce

↓

more biomass available to herbivore to eat.

↓

most of the biomass undergo decomposition

as not eaten by Herbivore

Concept of Trophic level

• meaning - it is not physical presence

- it is nutritional role of any organism

that's why one organism can occupy more than one trophic level.

Energy change :- 10% law → only 10% energy transfer to next trophic level.

Standing crop :- total amount of biomass in given time (Fresh wt or dry wt.)

Ex - Grass, trees, shrubs → total biomass of grass, trees, shrubs in given time.

T_1 standing crop should be greater than T_2
- T_1 → primary producer
- T_2 → Herbivore

Ecological pyramids :- Eltonian Pyramids

Grass → Grasshopper → Snake
10,000 → 500 → 3

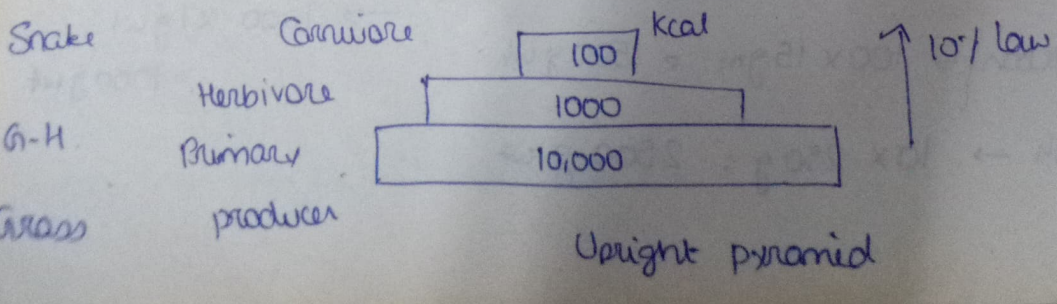
Definition - it is graphical representation b/w different trophic level of food chain in terms of no., biomass, energy

- Consideration while drawing ecological pyramids →
  1. Base of pyramid par primary producer hogaa.
  2. All member of one trophic level should be counted
  3. It is drawn for food chain → mainly for food chain

- Pyramid of Energy :

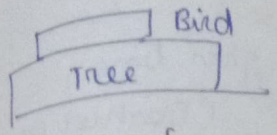
1. Grassland →

Grass → Grasshopper → Snake

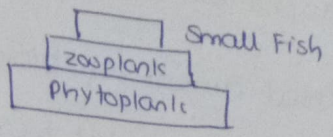


Pyramid of energy is always upright.

② Forest



③ Aquatic

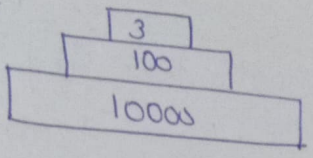


Pyramid of number

① Grassland :- S.C

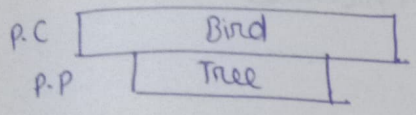
P.C

P.P

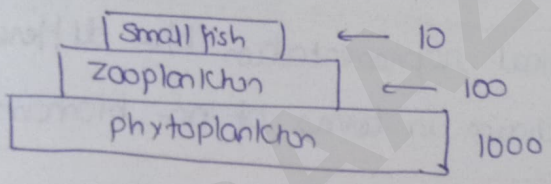


→ a large no. of producer support carnivore

② Forest - Inverted



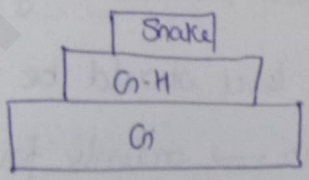
③ Aquatic -



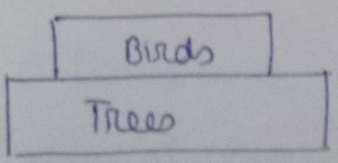
Pyramid of Biomass

① Grassland :-

Upright



② Forest :



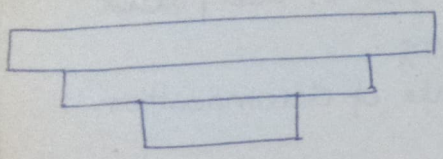
③ Aquatic - Let phytoplankton → 1000 in number and 1g wt

→ 1000 x 1g wt

= 1000g wt

Zooplankton → 100 x 15gm = 1500g wt

Small fish → 10 x 250g = 2500g wt



→ Inverted

∴ Inverted graph is of forest in number and biomass in aquatic.

Q Why aquatic pyramids of biomass is inverted ?

⇒ at any given time → no- of phytoplankton is not very high ①

Reason :- aquatic productivity is low

② life span of phytoplankton is low

Drawback or limitation of ecological pyramid

① Ecological pyramids are drawn for food chain but in nature food web exists.

② One member can occupy more than one trophic level (For ex - Omivore ⟶ double counting)

③ It is drawn for GFC but in nature DFC is also very important

Biogeochemical cycle # / Nutrient cycle :-

• This represent change occur in both biotic and abiotic phases.

① Carbon : → Biotic phase :- CO_2 ⟶ plant tissue ⟶ food chain

↓

abiotic phase → decomposed carbon

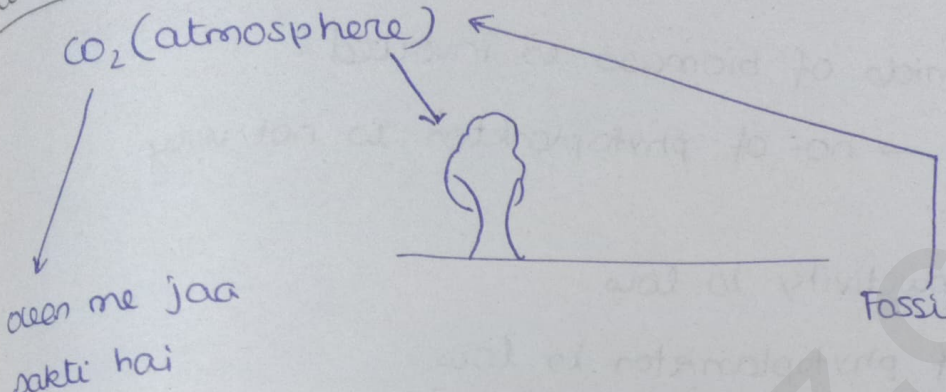
Bio = living

Geo = non living (soil, water, air)

Standing state

- amount of inorganic nutrient at any given time in soil / water.
- It is not constant ⟶ It keeps on changing
  a) Environment b) Rate of decomposition
  c) Type of plant

- Concept of reservoir # :-



Reservoir is a component of biogeochemical cycle which either act source or sink.

- Main reservoir ⟶ it adjust amount of that minerals.

Atmosphere adjust amount of CO_2.

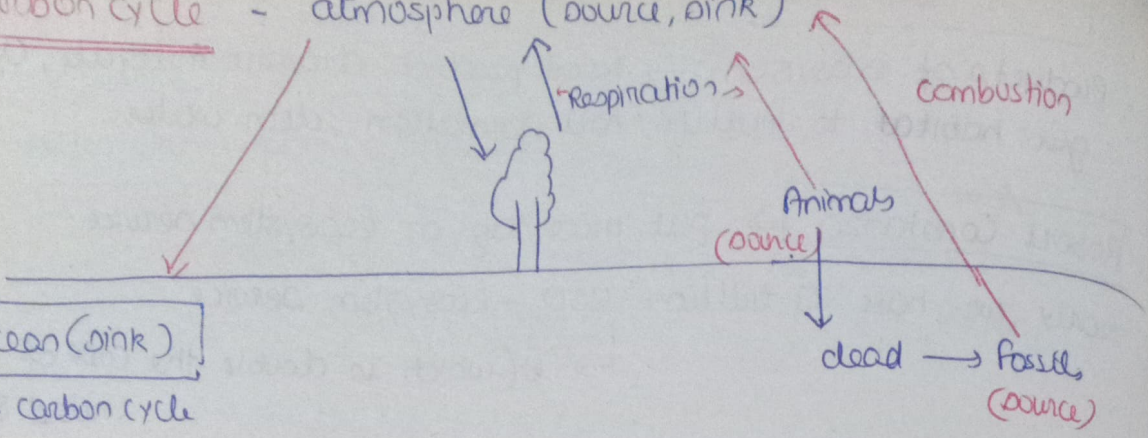
- If excess CO_2, CO_2 moves in atmosphere.
- Low CO_2 ⟵ It is taken from atmosphere

⇒ Two type of biogeochemical cycle :-

① Gaseous cycle – main reservoir is atmosphere
Ex- Carbon cycle, N cycle, O_2 cycle, water cycle

② Sedimentary cycle – main reservoir is soil
Ex- Phosphorus cycle, sulphur cycle, Iron cycle

Carbon cycle - atmosphere (source, sink)



71% carbon cycle Molluscs me $CaCO_3$ shell carbon se hi banegi

Sink of CO_2 → ocean, forest

Source of CO_2 → animal, dead organism, fossils

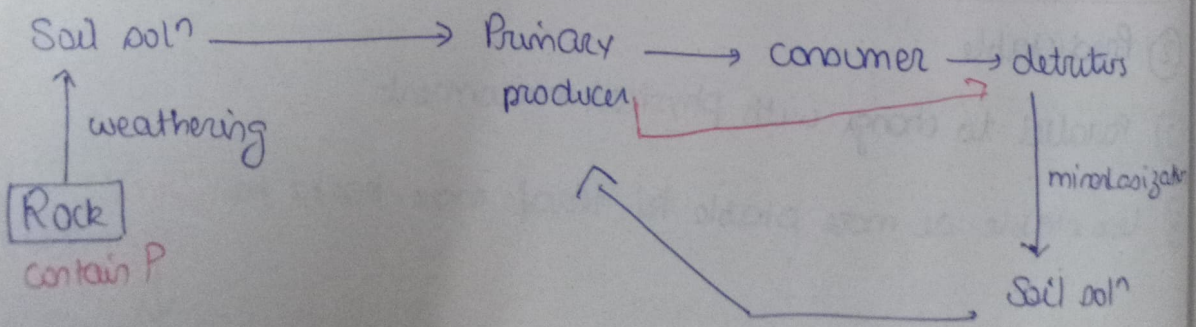
atmosphere → main reservoir

- 49% of dry wt. is carbon
- 4×10^{13} kg CO_2 fix annually
- 71% of CO_2 is present in ocean

Phosphorus cycle

→ Phosphorus → (present in) lipid bilayer, DNA, RNA, ATP, nucleotide, Bone, teeth

- Rain contribution of P is low



Ecosystem service

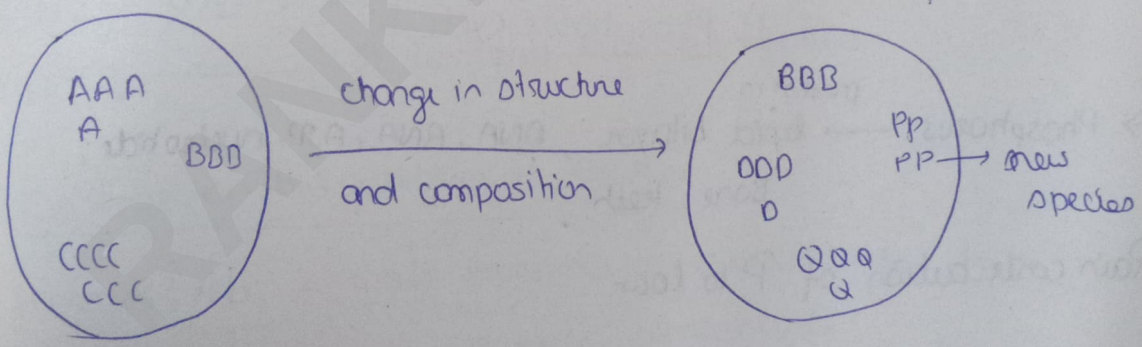
- Products of ecosystem → Forest product, drought mitigate, O_2, give habitat to wildlife, soil formation, clean water

- Robert Constanza ⇒ put price tag on ecosystem service
  yearly we have 33 trillion USD - ecosystem service
  ↳ ₹ (which is double the GDP of united state)

- Most costly ecosystem services ₹
  1. more than 50% of cost → soil formation
  2. Recreation and mineral cycle → less than 10%
  3. 6% - climatic regulation + wildlife habitat

Ecological succession → deal at community level

Community - group of different population
↳ leads change in structure and composition of community with change in physical environment



Features of succession :- (1) Sequential and ordered change

(2) Predictable

(3) Parallel to change with physical environment

(4) less stable se more stable ki taraf move karta hai (Climax community)
↓
most stable
and near eq^{m} with environment

(5) No. of species increase ⟶ Productivity increase
(Biodiversity increase) of

(6) Species change from r-selected to K-selected
↳ life span more
⟶ large size
Ex - elephant

r-selected
- short life span
- no sudden increase when food unlimited
⟶ small size
Ex - Flour beetle

(7) Initially simple niche ⟶ more complex niche

Succession and evolution are parallel process

Evolution → new species evolved ⟶ lakh of year required

Succession ⟶ Species move to new area and colonise ⟶ hundred to thousand year required

• Along with evolution, older species they move to colonise new area

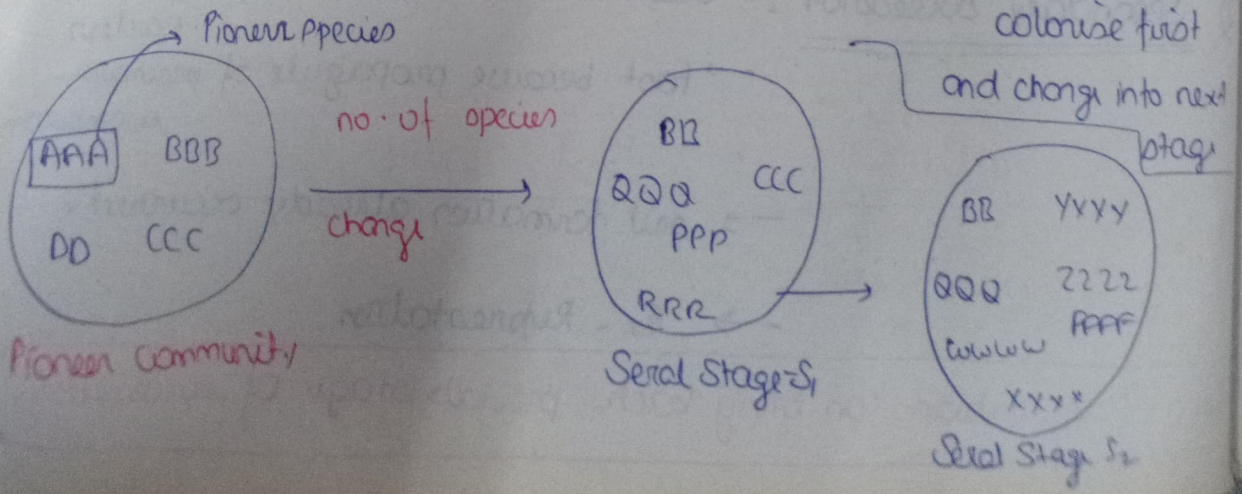
Steps in succession

(1) Invasion :- move to new habitat (For succession all species come from outside)

(2) Reaction | competition with existing

(3) Establishment

Seral Stages # :- Pioneer stages | Pioneer community ⟶ less stable slow grow colonise first and change into next stage
(Jo sabse pehle aaya)



Seral stage

Pioneer stage → S_1 (seral stage) → S_2 (seral stage)

↓

Climax community (most stable)

- Sere :- Sequence of these seral stages is known as sere
- Hydrosere - succession in water
- Xerosere - " " desert
- Lithosere - " " land
- Psammosere - " " sand

- Succession is mainly studied in plants

Plants - responsible for food formation & finally → animals and decomposers type decide hote hai

- Type of succession #

① Primary succession :- it occur in area which was not inhabited earlier.

- Example - newly cooled lava
  New formed Pond, Bare rocks (Khaali rocks)

→ soil formation occur - it takes time

→ Propagules of previous succession absent

② Secondary succession :- occur in area which was inhabited earlier

→ Fast because propagule of previous succession.

→ soil formation already occurred.

→ Ex - Reforestation

Human intervention can bring back previous stage of succession

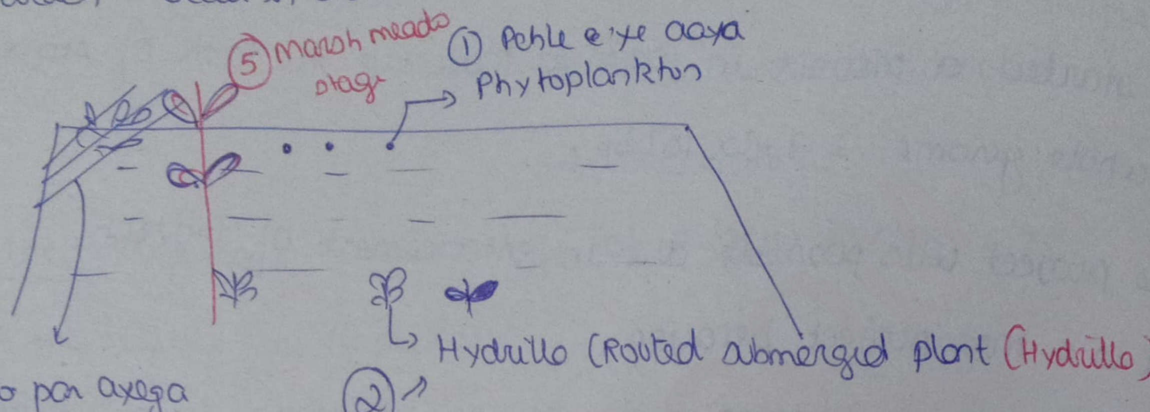
• Forest cut by human ⟶ Grassland ban dige ⟶ desert

previous succession of (pre)

Type of succession #1

① Hydrach – occur in water

②



④th no par aaega

Reed swamp stage
Ex – Typha

③ Free floating plants

⑥ Shrub Stage ⑦ Trees, woodland stage and forest

• Type of succession (Xerach) → desert me succession

① Lichen (on root)

Pioneer – produce lichenic → acid ⟶ which break rock into soil form

② Bryophyte :- Moss – they can grow in little soil
– organic matter contribute

③ Anual grass stage

④ Perennial grass

⑤ Shrub ex – Zizipus

⑥ Forest

Both Xerarch and Hydrach lead to mesic condition
↓
Forest form