FREE NOTES · NCERT + NEET LEVEL

Eco system

Ecosystem structure and function, productivity, decomposition, energy flow, food chains and webs, ecological pyramids, and ecological succession.

01 Ecosystem: structure and function
02 Productivity
03 Decomposition
04 Energy flow and food chains
05 Ecological pyramids
06 Ecological succession
07 Extra: nutrient cycling + ecosystem services
08 Important Q&A
09 Common mistakes
10 Practice (NEET style)
11 Quick revision

01 Ecosystem: structure and function

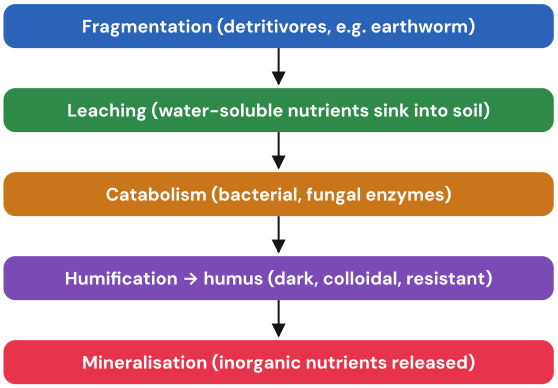
- Functional unit of nature where living organisms interact among themselves and with physical environment. Terrestrial (forest, grassland, desert) and aquatic (pond, lake, wetland, river, estuary); man-made: crop fields, aquarium.
- Structure: biotic and abiotic components; **stratification** (vertical distribution: trees top, shrubs, herbs and grasses bottom).
- Four functions: productivity, decomposition, energy flow, nutrient cycling.
- Pond: abiotic (water, soil deposit), producers (phytoplankton, algae, floating/submerged/marginal plants), consumers (zooplankton, free-swimming and bottom-dwelling animals), decomposers (fungi, bacteria, flagellates).

02 Productivity

- **Primary production**: amount of biomass/organic matter produced per unit area over time by plants (g m^{-2} or kcal m^{-2}); rate = **productivity** (g m^{-2} yr^{-1} or kcal m^{-2} yr^{-1}).
- **GPP** = rate of production of organic matter in photosynthesis. **NPP = GPP − R** (respiration losses); NPP available to heterotrophs.
- **Secondary productivity**: rate of formation of new organic matter by consumers.
- Annual NPP of whole biosphere ~170 billion tonnes (dry weight); oceans (70% of surface) only ~55 billion tonnes.

03 Decomposition

- Decomposers break complex organic matter into inorganic substances (CO_2, water, nutrients). Raw material = **detritus** (dead leaves, bark, flowers, dead animal remains, faecal matter).
- Rate is controlled by chemical composition of detritus (slow if lignin, chitin rich; fast if nitrogen, water-soluble sugars rich) and climate (warm, moist = fast; low temperature, anaerobiosis = slow, build-up of organic matter).
- Humus decomposes very slowly; reservoir of nutrients.

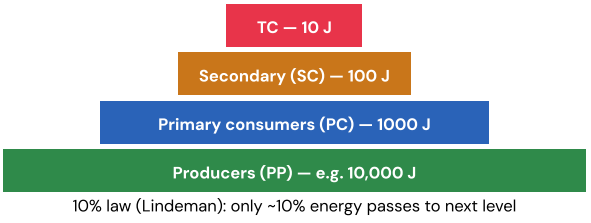


Steps of decomposition

04 Energy flow and food chains

- Sun is the only source of energy (except deep-sea hydrothermal ecosystems). Less than 50% of incident solar radiation is **PAR** (photosynthetically active radiation); plants capture only 2–10% of PAR.
- Energy flow is **unidirectional** (sun → producers → consumers); obeys second law of thermodynamics.
- **Grazing food chain (GFC)**: grass → goat → man. **Detritus food chain (DFC)**: begins with dead organic matter; decomposers (saprotrophs). In aquatic ecosystems GFC is major conduit; in terrestrial, more energy flows through DFC.
- **Food web**: interconnected food chains. Trophic levels: producers (1st), herbivores/primary consumers (2nd), carnivores (3rd, 4th). **Standing crop**: biomass at a trophic level at a time.

05 Ecological pyramids

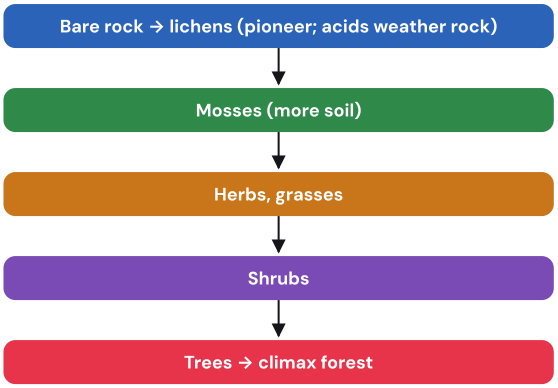


Pyramid of energy (always upright)

- Three types: number, biomass, energy. Base = producers.
- Pyramid of **energy** is always upright (energy lost as heat at each step).
- Pyramid of **numbers** is inverted in a tree ecosystem (one tree, many insects). Pyramid of **biomass** is inverted in sea (small standing crop of phytoplankton supports large biomass of fish).
- Limitations: do not consider same species at two or more trophic levels; assume simple food chain; saprophytes not given a place although they play vital role.

06 Ecological succession

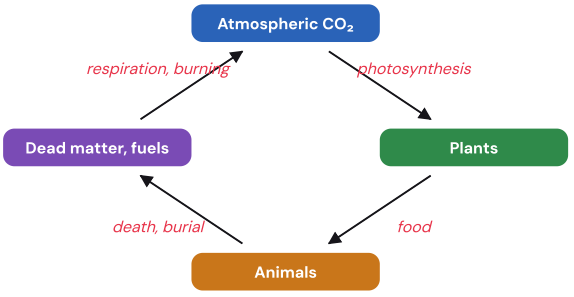
- Gradual, predictable change in species composition of an area ⇒ **climax community** (in near equilibrium with environment). Sequence of communities = **sere**; each = seral stage.
- **Primary succession**: area with no life (bare rock, newly cooled lava, new pond); very slow. **Secondary succession**: area where life existed but was destroyed (abandoned farm, burned/cut forest, flooded land); faster (soil present).
- **Hydrarch** (in water: phytoplankton → submerged plants → floating → reed swamp → marsh-meadow → scrub → forest) and **xerarch** (dry areas); both lead to **mesic** (medium water) climax.
- Pioneer species on rock: lichens; in water: phytoplankton.



Primary succession on bare rock (xerarch)

07 Extra: nutrient cycling + ecosystem services

- Nutrients cycle; energy does not. **Standing state** = amount of nutrients in soil at a time.
- **Gaseous cycles** (reservoir in atmosphere: carbon, nitrogen) vs **sedimentary cycles** (reservoir in earth's crust: phosphorus, sulphur).
- Carbon: ~49% of dry weight of organisms; 71% of global carbon dissolved in oceans; ~4 × 10^{13} kg fixed yearly by photosynthesis.
- Phosphorus: from rock weathering; no respiratory release of P into atmosphere (unlike CO_2).
- **Ecosystem services**: purification of air and water, pollination, soil formation, nutrient cycling, wildlife habitat. Robert Costanza estimated about **US$ 33 trillion** per year (soil formation ~50%).



Carbon cycle (simplified)

08 Important Q&A

Q1. If GPP is 100 kcal m^{-2} yr^{-1} and respiration loss is 30, find NPP.

NPP = GPP − R = 100 − 30 = 70 kcal m^{-2} yr^{-1}.

Q2. Why is the pyramid of energy always upright?

At each transfer only ~10% energy passes on; rest is lost as heat, so energy always decreases upward.

Q3. Why is secondary succession faster than primary?

Soil and some organisms/seeds are already present.

09 Common mistakes

- Saying pyramid of biomass in sea is upright (inverted).
- Thinking energy flow is cyclic (it is unidirectional; nutrients cycle).
- Writing NPP = GPP + R.
- Calling humus fast-decomposing.

10 Practice (NEET style)

1. Pioneer on bare rock?
2. % of PAR captured by plants?
3. Inverted pyramid of numbers in?
4. NPP formula?
5. Who gave 10% law?

ANSWERS

1) Lichens · 2) 2–10% · 3) Tree ecosystem · 4) GPP − R · 5) Lindeman

11 Quick revision: 5 minutes before the exam

PRODUCTIVITY

- NPP = GPP − R
- Biosphere NPP ~170 bn t
- Oceans ~55 bn t

DECOMPOSITION

- Fragmentation → leaching → catabolism
- Humification, mineralisation
- Warm moist = fast

ENERGY

- Unidirectional, 10% law
- GFC vs DFC
- Energy pyramid always upright

SUCCESSION

- Primary slow, secondary fast
- Lichens / phytoplankton pioneer
- Mesic climax

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.