Ecosystem → Term By → Tansley

(Ecosystem) → functional Unit of nature where living organisms interact among themselves and with surrounding physical environment.

Ecosystem → natural / Man-made → Crop field, aquarium

Terrestial	Aquatic
Forest, grassland, desert.	Pond, lake, wetland, river and estuary

→ Structure of Ecosystem →
1. Input (productivity)
2. Transfer of energy (food chain/web, nutrient cycling).
3. Output (degradation and energy loss).

→ Vertical distribution of different species occupying different levels is Stratification → Trees, Shrubs, Herbs/Grasses

Components of Ecosystem: →
1. Productivity
2. Decomposition
3. Energy Flow
4. Nutrient Cycling

An aquatic Ecosystem →
pond – shallow water body.
→ self sustainable ecosystem
→ Abiotic component → Water, with dissolved inorganic and organic components.
→ Solar input, cycle of temp., day-length, climatic conditions → Rate of function of entire pond.
→ Autotrophic Components.
↳ phytoplankton, Some algae, floating submerged and marginal plants.
→ Consumers → Zooplankton, free swimming, bottom dwelling forms.
→ Decomposers → Fungi, Bacteria, flagellates.
1. Inorganic → Organic (with help of radient energy by autotrophs)
2. Consumption of autotrophs by heterotrops.
3. Decomposition and mineralisation of dead matter.

→ Unidirectional movement of energy towards higher trophic levels, with 10% loss.

Productivity

1. Primary Productivity.
↳ amount of biomass / organic matter produced per unit area over time period by plant during photosynthesis.
Unit → gm^{-2} / Kcal m^{-2} / $gm^{-2}yr^{-1}$ / $Kcal\,m^{-2}yr^{-1}$
Rate of biomass production → productivity
2. Gross primary productivity
↳ Rate of production of organic matter during photosynthesis.
(GPP's some amount is used by plants in respiration)
3. Net Primary productivity
GPP − R = NPP (R = respiratory loss)
↳ available biomass for consumption of heterotrophs.
4. Secondary productivity.
↳ Rate of formation of new organic matter by consumers.

Primary productivity → plant species inhabiting particular area.
→ environmental factors, availability of nutrients, photosynthetic capacity of plants.

Annual NPP of whole Biosphere (170 billion tons) → (dry organic weight).

Oceans NPP	Land NPP
(55 billion tons)	(115 billion tons)
(70% surface)	(30% surface)

Decomposition

Decomposers break down, Complex Organic matter → Inorganic Substance (CO_2, H_2O, nutrients)

Decomposition

Dead plants, bark, flowers, animals, fecal matter → Detritus (raw material for decomposition)

(1) Detritivores (earthworm) break down detritus into small particles.
→ Fragmentation

(2) Leaching → Water soluble, inorganic matters enter the soil, and gets precipatated as unavailable salts.

(3) Catabolism → Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

(4) Humification → Accumulation of dark coloured amorphous substance Humus.
↳ Highly resistant to microbial action.
→ Decomposition ↓↓ → Reservior of nutrient.

(5) Mineralisation → Humus further degraded by some microbes and release inorganic nutrients.

Decomposition → O_2 requiring procss
depends on ↳ Chemical nature of detritus
↳ Climatic conditions

Decomposition Rate (NS)

Slower if detritus rich in → Lignin and Chitin (LC) (★)

Faster if detritus rich in → Nitrogen and water-soluble substances like sugar

Soil moisture and temperature.

Warm and Moist → Faster

Cold and dry → Slower

Energy Flow

Source of Energy → Sun, deep-sea hydro thermal ecosystem.

Incident light → <50% (★) Photosynthetically active Radiation (PAR) (★)

2-10% (★) Captured by plants → Sustains the world → all organisms dependent on producers, directly/indirectly → Unidirectional flow of energy

Some by photosynthetic bacteria

→ Ecosystem need constant supply of energy to synthesize molecules they require, to counteract the universal tendency towards increasing disorderliness

Green plant in Ecosystem → Producers

Terestrial → herbaceous, woody plants.

Aquatic → phytoplankton, algae, higher plants.

→ Starting from plants, food chain or webs are formed such that animal feeds on plant or on another animal and in turn is food for another

↓

Food Chain/Web is formed because of this interdependency

↓

No energy is trapped inside organism

↓

Death of organism is beginning of detritus food chain/web. (★)

Simple Grazing Food Chain

Producers → Phytoplanktons, plants.

↓

Secondary producers/ Primary Consumers → Zooplanktons, Herbivors

↓

Secondary Consumer → Birds, fishes, Wolf →

↓

Top Carnivore → Lion, Man

Detritus Food Chain →

↳ Begins with dead organic matter.
→ Made up of decomposers (fungi, bacteria)
also known as Saprotrophs
↳ meet their energy requirements by degrading dead organic matter/ detritus

→ In an aquatic ecosystem, GFC (★) is major conduct for energy flow.

→ Terrestrial ecosystem – major energy flows through detritus food chain. Vimp

Food Web → Natural interaction of food chain
→ Some organism of DFC are prey to GFC animals

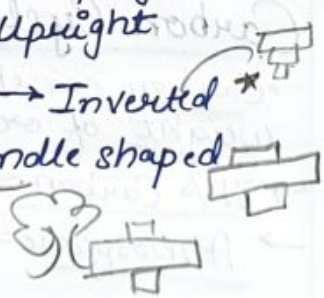
Trophic Level → Based on source of nutrition, organisms occupy specific place in food chain.
→ 1st trophic level → 1° producer
→ 2nd trophic level → 1° consumer
→ 3rd —"— → 2° consumer
→ 4th —"— → 3° consumer
→ amount of energy decreases at successive trophic level.
→ Organism dies → detritus/dead biomass, that serve as energy source for decomposers

Standing Crop → Mass of living material at particular trophic level.
→ Measured as:- biomass/no. in a Unit area.
→ Biomass expressed in terms of fresh/dry weight

10% Law → (Lindmann)
↳ Only 10% of energy is transferred to each trophic level, from lower trophic level.
→ ∴ No. of Trophic levels in GFF are restricted.
→ Nearly 90% energy loss.

Ecological / Eltonian Pyramid → *

① **Pyramid of Number** →
Terrestrial Ecosystem → Upright
Aquatic Ecosystem → Upright
Parasitic food Chain → Inverted *
Tree Ecosystem → Spindle shaped
→ pyramid taken as →



no. of 3° consumer
no. of 2°
no. of 1°
no. of producers

② **Pyramid of Biomass**
Terrestrial → Upright
Aquatic → Inverted (Sea), Spindle (lake).
Tree → Upright
→ measured in dry weight ($Kg\ m^{-2}$)

③ **Pyramid of Energy**
↳ always Upright *
→ no exception.
→ measured in Joules (10% law)

→ any calculations of energy content, biomass/numbers has to include all organism at that level
→ Trophic level represents functional level, not a species as such.
→ Given species may occupy more than 1 trophic level in same ecosystem at same time.

Limitation of Ecological pyramids →
→ Doesn't take into account the same species belonging to two or more trophic levels.
→ Assumes a simple food chain ✓
→ Does not accomodate food web ×
→ No place for saprotrophs. ×

Ecological Succession →
Gradually and fairly predictable changes in species composition of given Area.

Climax Community → Community that is near in equilibrium with environment.
→ During succession, some species colonize an area and their population become more numerous whereas populations of other species decline and even disappear

Sere → The entire sequence of communities that successively change in a given area.
→ Seral Stages/Communities

Succession → Starts in area where no living organisms are there

Primary Succession

→ Succession at area where no living organism ever existed. ★

→ eg. → Bare Rock, Newly Cooled Lava, Newly created pond.

→ Succession is slow.

Secondary Succession

→ Succession at area which lost all living organisms that existed there.

→ e.g. – abondoned farm lands, Burned or Cut forest. Flooded area.

→ Succession is faster as some soil is already present

Human Induced disturbances can convert particular seral stage of succession to an earlier stage.

Succession Of Plants →

Pioneer Species → Species that invade bare area.

① Hydrarch Succession

↳ Succession of plants.

→ Take place in wet areas

→ Hydric → Mesic (medium, no too dry, too wet ↳ Water.

Phytoplankton → Submerged plant stage

↓

Submerged free floating plant stage

↓

Red Swamp Stage

↓

Marsh meadow Stage

↓

Scrub Stage

↓

Forest

→ All succession wheather taking place in water, or in land, proceeds to similar climax community ↳ Mesic

Xerarch Succession

→ Take place in dry areas

→ Xerarch → Mesic (Rock)

Lichens → secreate acid to dissolve Rock → Weathering → Soil formation

↓

Bryophytes → holds the soil

↓

Higher plants

→ During ecological Succession →

→ Species diversity ↑

→ No. of species ↑

→ No of species ↑

→ Total Biomass ↑.

Nutrient Cycling → ★

Standing State → Amount of nutrients such as C, N, P, Ca present in soil at any given time.

also called Biogeochemical Cycle.

Nutrient Cycle

Gaseous

Reservoir is atmosphere

e.g. – N_2, O_2..

Sedimentary

Reservior is located on Earth.

e.g. – Sulphur, phosphorus cycle.

→ function of reservoir is to meet with the defect which occur due to imbalance in rate of influx and efflux

Carbon Cycle → ★

→ Carbon constitute 49% of dry wight of organism

→ 71% Carbon → dissolved in Oceans.

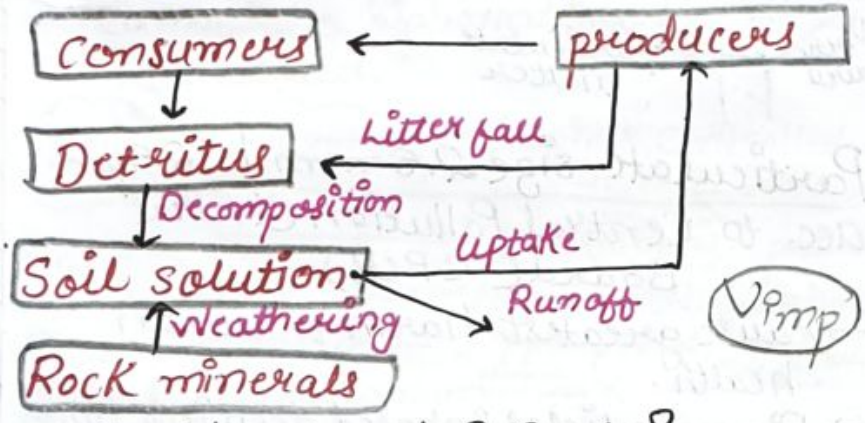
→ Atmosphere = 1% of total global carbon

→ Fossil fuel also represent reservoir of C

→ 4×10^{13} Kg of C is fixed anually in biosphere through photosynthesis

Phosphorus Cycle

→ Phosphorus — Major Constituents of
  → Biological membrane.
  → Nucleic Acid.
  → Cellular energy transfer system
→ Reservoir of P → Rock
→ There is no respiratory release of P into atmosphere.



→ Diff. b/w C and P Cycle?
→ Atmosphere Input of phosphorus through Rainfall are much smaller than C inputs.
→ Gaseous exchange of P b/w organisms are ecosystem are negligible.

Ecosystem Services

Products of ecosystem processes.

→ Robert Constanza → price tags on nature's life support services. ★
→ Avg. price tag → US $33 trillion a year
→ Global Gross National product → US $18 trillion. ★
→ Out of total Cost of ecosystem services,
Soil formation → 58%
→ Recreation, Nutrient Cycling → <10% ★
→ Climatic Condition and habitation of Wildlife → 6%.