

All Inclusive Static Crash Course Prelims 2022

Class-18 : Environment

Corrections

Class-17 Page-114 (Science)

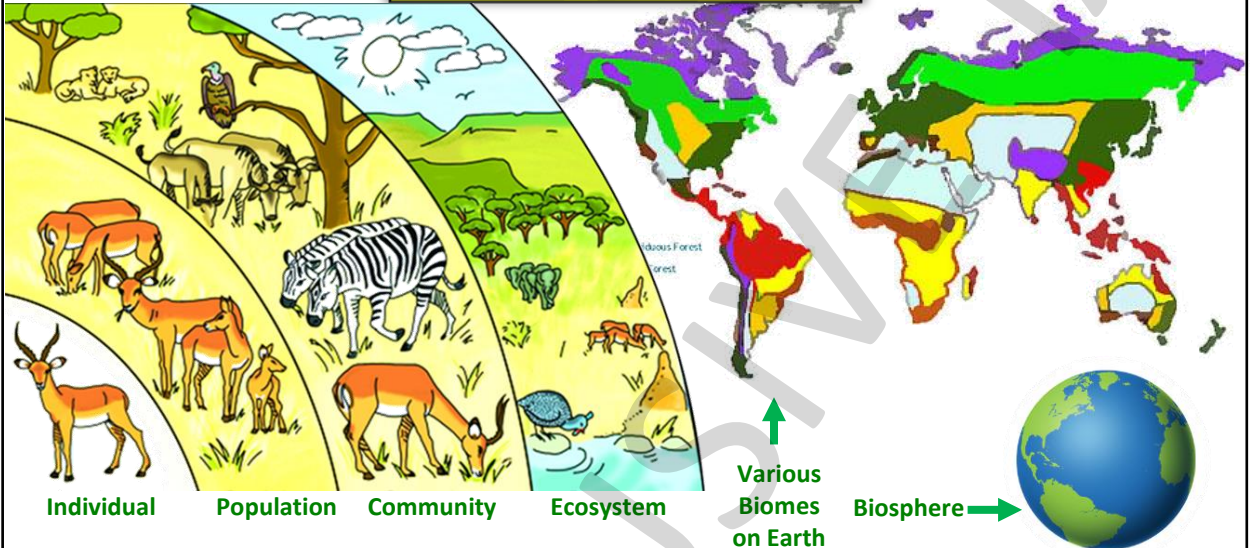
Weight at poles: more than that at equator

Class-7 Page-47 (Polity) 2005 PYQ

Both statements are wrong.

Article 229: administrative expenses of HC, including all salaries, allowances and pensions of officers and servants of the Court, are charged upon Consolidated Fund of State

Ecological Organization



Population:

❑ group of individuals of **same species** in an area

Community:

❑ Group of populations of **different species** in an area

Ecosystem:

- ❑ Community and its environment;
- ❑ Interaction of **biotic and abiotic** things;
- ❑ Structural and functional unit of Biosphere

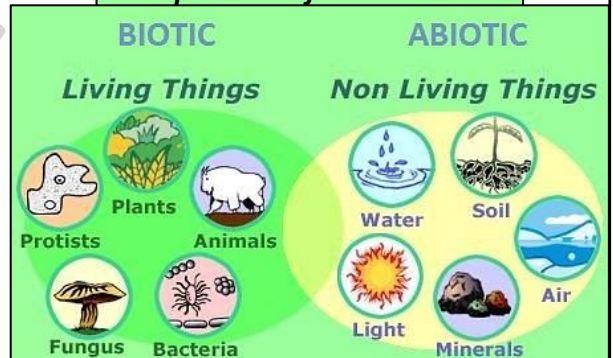
Biome:

❑ Community of plants and animals having **common characteristics** for their environment.
e.g. Tundra, Desert, Rainforest, etc.

Biosphere: (aka ecosphere)

❑ Part of earth where **life** exists

Components of Environment



Biomass:

- ❑ Renewable **organic** material from plants and animals
- ❑ Biomass can be measured by a **bomb calorimeter**

Biota:

refers to flora and fauna in ecosystem

Standing crop: amount of biomass in ecosystem

Standing state: amount of inorganic nutrients in ecosystem

Carrying capacity of Ecosystem:

largest population of a species that can sustain with available resources

Biocapacity of Ecosystem:

Ecosystem's capacity to generate resources, and absorb wastes

Biotope:

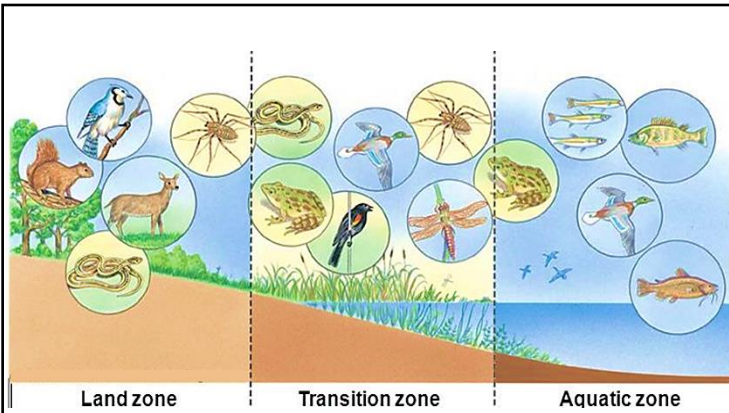
area of uniform environmental conditions

Ecotype/Ecospecies?

genetically adapted to environmental conditions

I read I forget, I see I remember

See explanation of this PDF on [YouTube](https://www.youtube.com/c/allinclusiveias) www.youtube.com/c/allinclusiveias



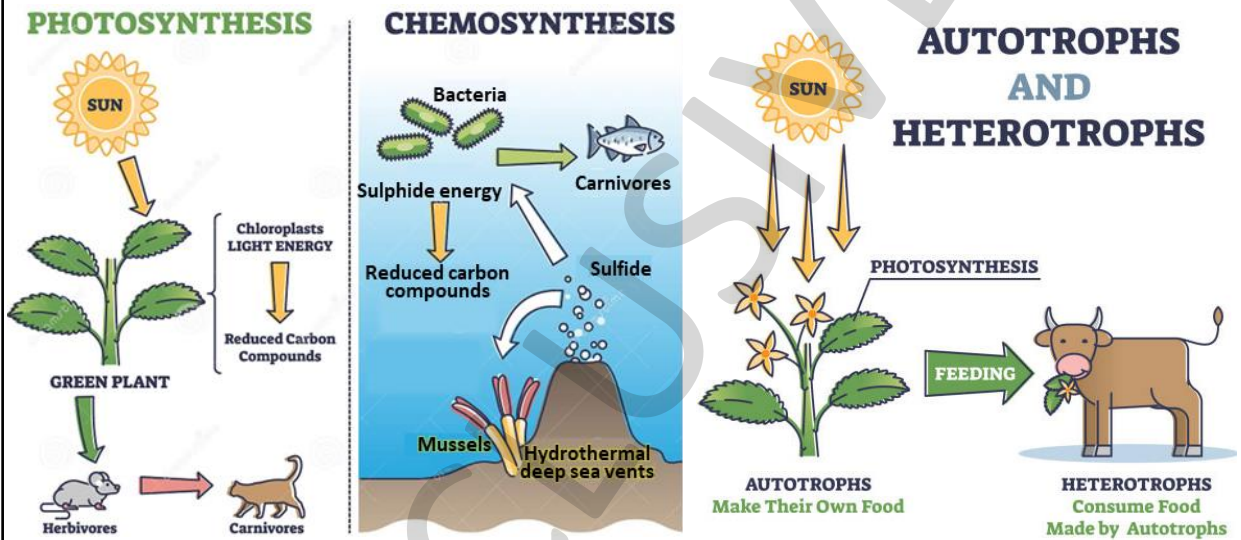
Ecotone:

- Junction b/w two or more ecosystems e.g. estuary, mangrove forests
 - Has more no. of species (**Edge effect**)
 - May even have entirely new species
 - More biota / productivity / biomass
- Ecocline?** Similar to Ecotone, difference not relevant for Prelims

Ecological Niche:

- Role** of species in ecosystem
- No** two species have **identical** niche
- To conserve a species we must understand its niche (habitat, food, competition, etc.)

Autotrophs vs Heterotrophs

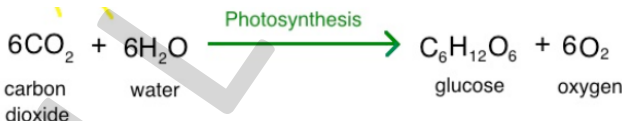


Two types of autotrophic nutrition: (food is created)

- Photosynthesis:** plant uses sunlight
- Chemosynthesis:** bacteria uses chemical energy

Photosynthesis:

- **Only 1%** of sun's energy falling on leaves is converted into chemical/potential energy and stored
- Food is stored as **carbohydrates** (sugar/glucose/starch) (Calvin cycle creates carbohydrates from CO₂)



Chemosynthesis:



Autotrophs (Primary Producers) (plants, phytoplankton) creates carbohydrates from simple inorganic materials (like CO₂, H₂O) in presence of sunlight by photosynthesis

Heterotrophs / Phagotrophs (Consumers) can't make own food, depends on food made by Autotrophs

Note:

- Some **plants** can be partly **heterotroph** e.g. insectivorous plants.
- They lack power to take nitrogen from soil, so they **catch insects to get nitrogen**
- But they are still **Autotroph**, because they make their **own food** (In absence of insects, they will not die, but growth will slow down)

Productivity

rate of generation of biomass (per area per time)

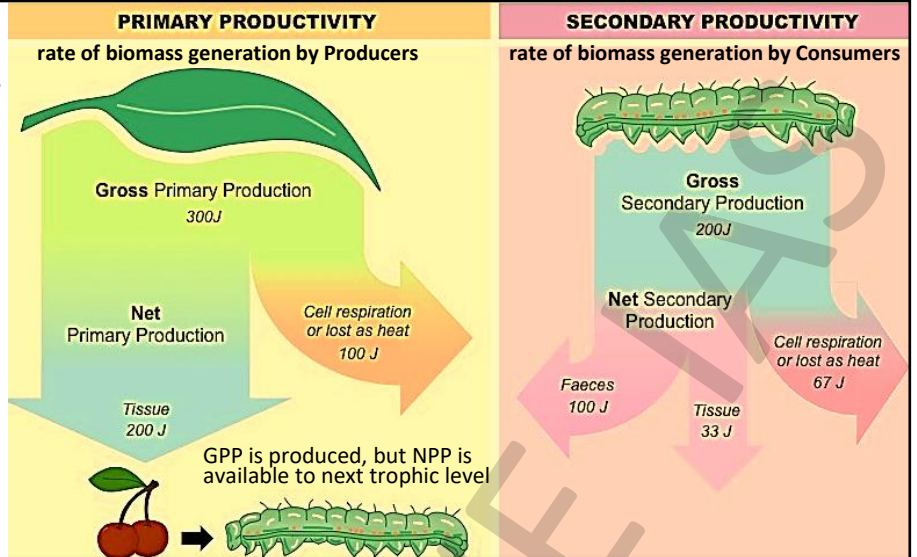
GPP - Losses = NPP

GSP - Losses = NSP

(Gross > Net)

Decreasing productivity:

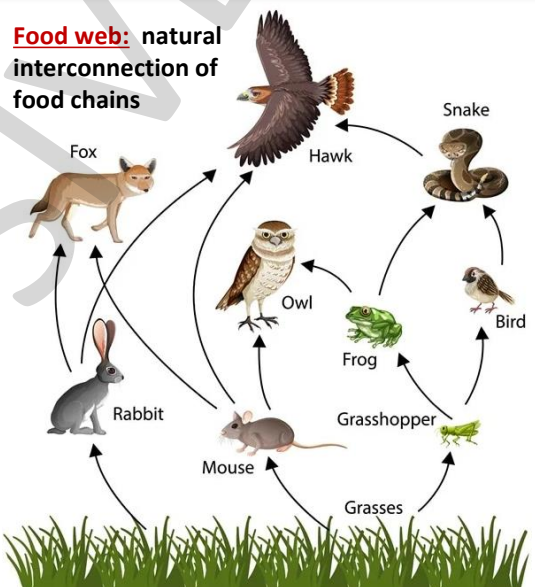
Coral reefs
Estuary/Mangrove
Rainforest
Temperate forest
Taiga
Grassland
Lake
Ocean
Desert
Tundra



Food Chain

| Trophic Level | Grassland Biome | Pond Biome | Ocean Biome |
|---------------------|-----------------|-----------------|---------------|
| Primary Producer | grass | algae | phytoplankton |
| Primary Consumer | grasshopper | mosquito larva | zooplankton |
| Secondary Consumer | rat | dragonfly larva | fish |
| Tertiary Consumer | snake | fish | seal |
| Quaternary Consumer | hawk | raccoon | white shark |

Food web: natural interconnection of food chains



Food chain shows one path of energy/nutrient transfer

Food web shows multiple/all paths.

They both show order in which species eat each other. But they don't show number of organisms being eaten.

Grazing food chain:

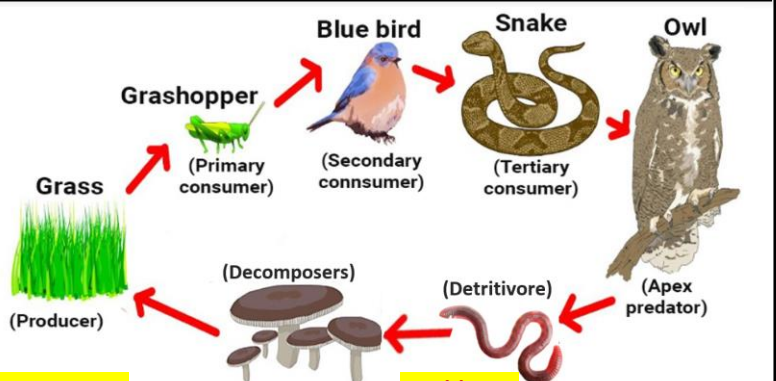
energy at lowest trophic level comes from photosynthesis

Detritus food chain:

energy at lowest trophic level comes from dead organic material (detritus)

When any organism dies, it is eventually eaten by detritivores and broken down by decomposers and the exchange of energy continues.

Mould and Mushroom are type of fungi



Decomposers

- Protozoa/Protist, bacteria, fungi
- They break down organic matter into minerals and nutrients
- They are heterotrophs

Detritivores

- They eat dead organic matter
- Many invertebrates/vertebrates (e.g. vultures, earthworm, crabs)
- They are heterotrophs

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Ecological pyramid aka Eltonian pyramid

| | | |
|---------------------------|--------------------------|--|
| Pyramid of Number | Upright, Inverted, Mixed | total number of all organisms at each trophic level |
| Pyramid of Biomass | Upright, Inverted, Mixed | total dry weight of all organisms at each trophic level |
| Pyramid of Energy | Upright | total energy stored at each trophic level |

Limitations of Ecological pyramids:

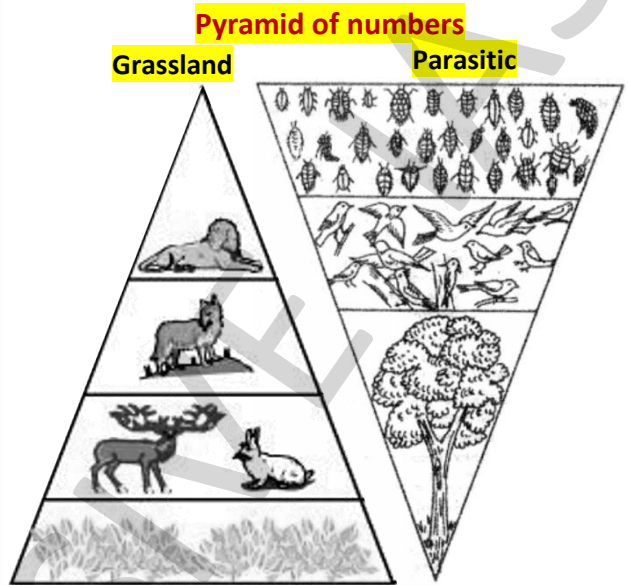
- Difficult to depict **Omnivores**, **Food web**, etc.
- Ignores **Saprophytes** and **Detritus**
- Ignores change in productivity due to **seasons**
- Doesn't show **rate** of energy transfer b/w levels

Species in higher trophic level:

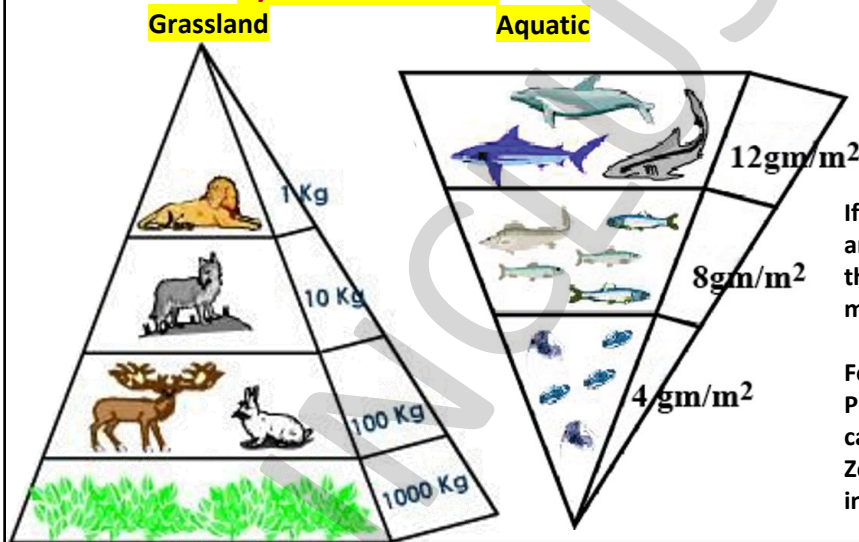
- are **generalist** (not specialist) in eating habit, as they **eat from many** lower trophic levels
- are **more efficient** in using food supply

Biodilution:

- aka **bloom dilution** as it mostly happens during **algal bloom**
- **decrease in concentration** of pollutant with an increase in trophic level



Pyramid of biomass



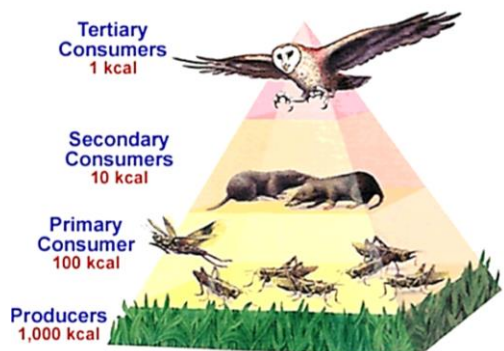
If primary producers grow rapidly, and are consumed rapidly, then biomass at any one moment may be low.

For example, Phytoplankton (producer) biomass can be low compared to Zooplankton (consumer) biomass in the same area of ocean

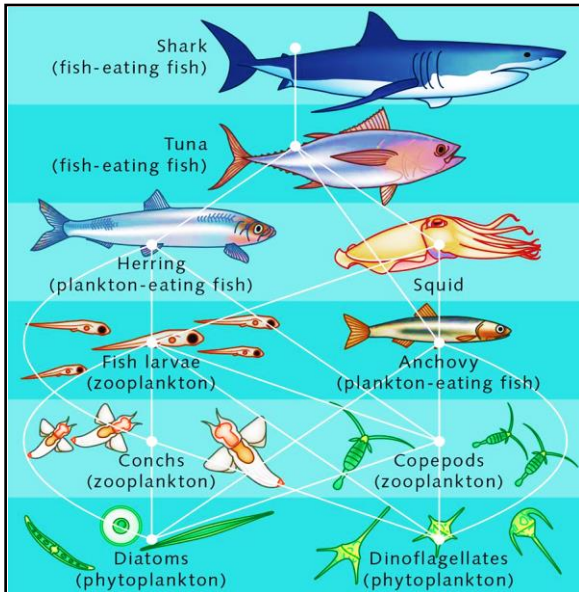
Pyramid of energy or productivity

- Energy **always** flows from **lower to higher** trophic level.
 - There is **loss of energy** at each trophic level.
 - After 5-6 levels, very **little energy is left**.
 - Hence, usually there are **only 5-6 levels**.
- 10% rule:** only 10% goes to next level, 90% used in respiration, growth, lost as heat, etc.

Why is it always upright? Due to 2nd law of thermodynamics (heat loss happens when energy is transferred / transformed)



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Neuston/Pleuston:

- Lives at surface
- Some insects / spiders

Plankton:

- Too weak to swim against current
- Exist in a drifting state
- Phytoplankton are plants
- Zooplanktons are animals

Nekton:

- strong swimming animals

Benthos:

- creeping and burrowing organisms on seafloor

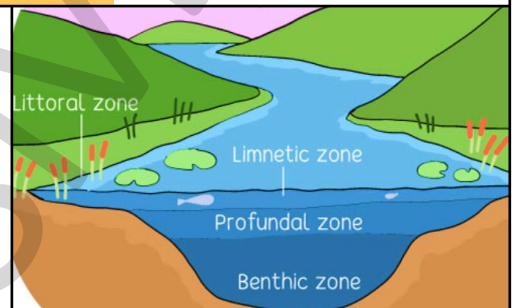
Phytoplankton:

- They float on ocean surface; they absorb CO₂ from air
- They create food by **photosynthesis**
- They are eaten by zooplankton & fish

Dinoflagellates use a tail (flagella) to move through water

Diatoms rely on ocean currents (instead of flagella) to move

Both have thin shells, hence threatened by ocean acidification



Crustacean

- they eat microscopic plants & animals
 - they are important source of food for fishes
 - they have exoskeleton
- (CO₂ → acidic oceans → shell destroyed)

Copepod, Decapod, Branchiopod, Isopod, Amphipod, Krill, Shrimp, Prawn, Barnacles, Fish Lice, Remipedes

Shrimp and Prawns are popular sea food of humans

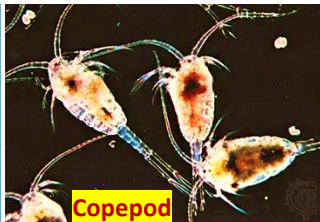
Krill and Copepods probably have greatest biomass on earth



Shrimp



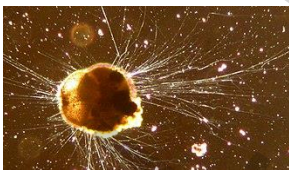
Krill



Copepod



Barnacles on whale



Foram / Foraminifera

- Type of **zooplankton**
- aka **armored amoebas**
- Single-celled organism
- have tiny shell of chitin
- Strings help capture food (diatoms)
- Found from surface to seabed

Prelims 2012: The **acidification of oceans** is increasing. Why is this phenomenon a cause of concern?

1. The growth and survival of calcareous **phytoplankton** will be **adversely affected**
2. The growth and survival of **coral** reefs will be **adversely affected**
3. The survival of some animals that have **phytoplankton** larvae will be **adversely affected**
4. The **cloud seeding** and formation of clouds will be **adversely affected**







Which of the statements are correct?

- (a) 1, 2 and 3 only (b) 2 only (c) 1 and 3 only (d) 1, 2, 3 and 4

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Biotic interactions

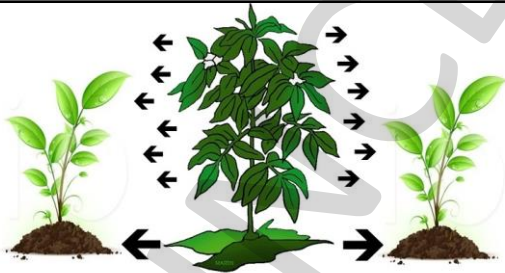
| | | | | |
|---|--------------|---|---|---|
|  | Mutualism | + | + | <ul style="list-style-type: none"> ➤ Pollinator and plant ➤ Coral (Polyps) and Algae (Zooxanthellae) ➤ Leguminous plants and nitrogen-fixing rhizobial bacteria ➤ Rumen bacteria in cow's digestive tract helps in digestion ➤ Mycorrhizae fungi gives nutrient/water, roots give carbohydrates |
|  | Commensalism | + | 0 | <ul style="list-style-type: none"> ➤ Beetles benefiting from cow dung ➤ Orchid growing as an epiphyte on mango tree ➤ Crab living inside oyster's shell ➤ Barnacle growing on back of whale ➤ Sucker fish attaches itself to shark, and eats falling pieces of food |
|  | Predation | + | - | <ul style="list-style-type: none"> ➤ Tiger eating deer ➤ Bird eating plant seeds <p style="text-align: right;"><i>Remember: Predator kills; Parasite does not kill</i></p> |
|  | Parasitism | + | - | <ul style="list-style-type: none"> ➤ Leeches, ticks, bedbugs, lice/lice suck blood of humans/animals ➤ Female mosquito is not parasite because it needs blood for reproduction, not for nutrition |
|  | Amensalism | 0 | - | <ul style="list-style-type: none"> ➤ Big tree's shade restricts growth of small plant ➤ Walking of cattle tramples grass ➤ Antibiosis |
|  | Competition | - | - | <ul style="list-style-type: none"> ➤ Competing for same resource: food, territory, mate, etc ➤ Different herbivores competing for same grass ➤ Trees in tropical forest competing for sunlight |

Symbiosis:

- Close and long-term biological interaction
- Can be mutualistic, commensalistic, parasitic

Brood parasites:

- Organisms that **rely on others to raise their young**
- Koel** lay their eggs in crow nests
Koel eggs resemble those of the crow in pattern and colour
Such **mimicry** is seen in other parasitic bird species as well



Allelopathy:

- Direct/indirect **positive/negative** effect of one organism on the other, through release of chemicals (allelochemicals) into the environment.
- It is generally used to describe chemically-mediated competition between plants.

Antibiosis: (think of it as negative allelopathy)

- negative effect** of one organism on the other, through release of chemicals
- e.g. interaction between Penicillium and bacteria
Mould Penicillium secretes penicillin which kills bacteria



ECTOPARASITES

living on hosts' bodies



ENDOPARASITES

living inside host organism

Arachnida:

- Type of Arthropods (invertebrate animal with exoskeleton)
- They usually have 8 legs
e.g. Spider, scorpion, ticks, mites

Biotic potential:

- maximum reproductive capacity
- insects >>> humans

Penicillin antibiotics:

- Discovered in 1928 by Scottish scientist **Alexander Fleming**
- For this he got 1945 Nobel prize in Medicine/Physiology



Biocontrol: (aka biological control)

- Using some organism to control pest like insect, mites, weeds, and plant disease
 - Natural enemy** of the pest is deliberately introduced
 - It is based on predation, parasitism, etc.
- Some biological control agents:
Birds, wasps, bacteria, fungi, virus

Bioassay:

- method to **calculate concentration** of a substance by its **effect on living cells**
- e.g. to monitor water quality, or impact of wastewater on environment

Bioindicators: (Indicator species / Biomonitor / Biological monitor)

- Living organisms that **indicate health of environment**
- Their presence/absence can indicate pollutants (no need of any physical chemical tests)
- Disappearance of **lichens** indicates **sulfur dioxide** (and also nitrogen oxides)
- Amount of **algae** in water indicates organic pollution and **nutrients** like nitrogen/phosphorous
- Tubifex** worm, abundant near sewer outlets, indicates **water pollution**
- Frogs** are sensitive to pollutants; **American crows** sensitive to **West Nile Virus**
- xxxxx is bioindicator? Yes

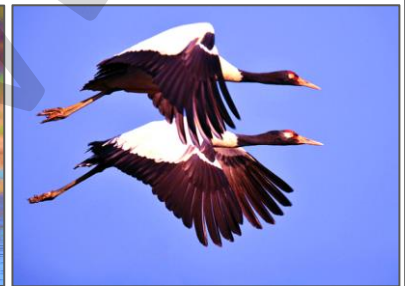
Prelims 2014:

If you walk through countryside, you are likely to see some birds stalking alongside the cattle to seize the insects disturbed by their movement through grasses. Which one of the following is/are such bird/birds?

1. Painted Stork
2. Common Myna
3. Black-necked Crane

Select the correct answer

- (a) 1 and 2 **(b) 2 only** (c) 2 and 3 (d) 3 only



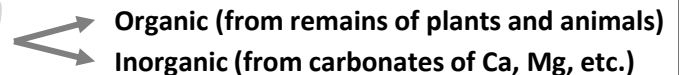
Myna
eats insects disturbed by cattle movement

Cattle Egret
eats ticks/flies present on cattle



Carbon in Soil

Carbon in soil



Benefits of Soil Organic Carbon:

- more **nutrient** absorption by plants
- better soil **aeration**
- better **moisture** retention
- reduced water **run-off**

Why do tropical soil have less SOC?

- Microbes thrive in hot & humid conditions
- More microbes → faster decomposition
- Portion of carbon of dead organic matter gets converted to inorganic carbon



Carbon in dead organic matter



Organic carbon

Inorganic carbon (CO₂)

Soil Organic Carbon is the largest carbon pool in the terrestrial biosphere (and second largest after oceans)

Tropical soil have low Humus:

- **Hot & Humid** climate leads to **quick decay** of organic matter

Tropical soil are poor in nutrients

- Plants** grow very fast, hence **rapidly consume nutrients**
- Heavy **rain wash away nutrients**, so soil becomes infertile and acidic

Tropical forest have only few pure stands of tree

- High **species diversity** because good **solar insolation** gives ample energy and stable climate gives lots of time for species to diversify

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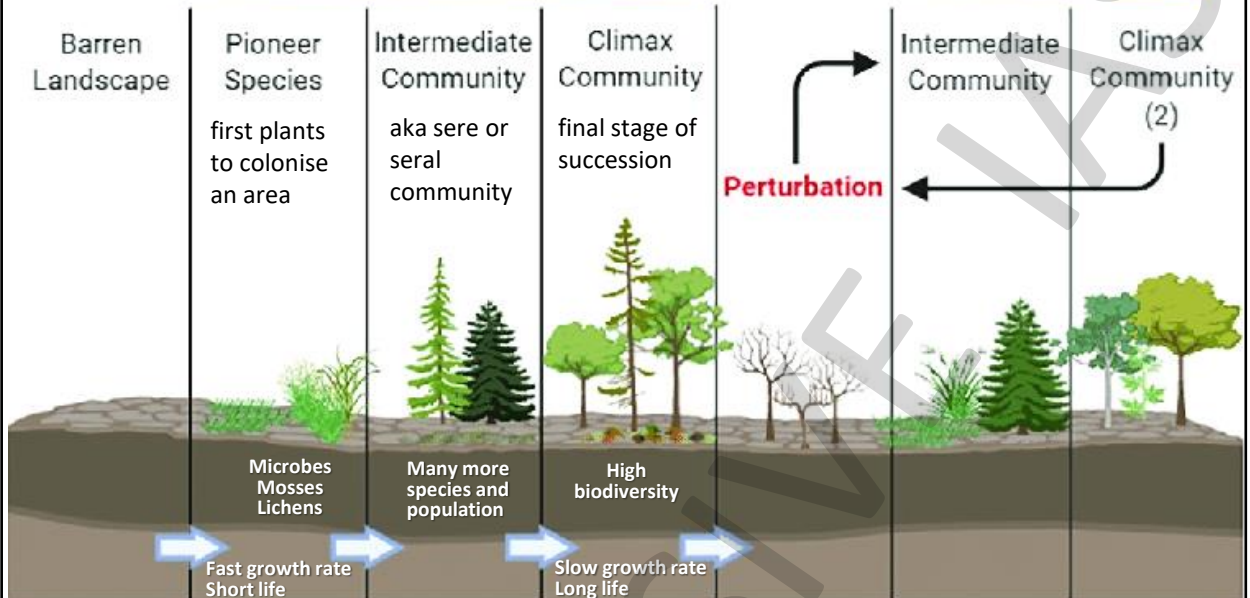
Ecological succession

Primary Succession

Takes hundreds of years

Secondary Succession

Fast, as the soil is already present



Impact of Pioneer community:

- Alters the habitat
- Release organic **acids** which release **nutrients** from rocks
- Leave **organic matter** on death

Autogenic succession:

- Driven by the **biotic** factors themselves
- Nitrogen fixation
- Detritus produced

Allogenic succession:

- Driven by **abiotic** factors
- Flood, drought, volcano



Autotrophic succession:

- driven by Autotrophs

Heterotrophic succession:

- driven by Heterotrophs



Succession is faster in middle of continents as propagules/seeds of seres will reach much faster

Following happens during succession:

- ✓ Shift of **nutrients** from reservoirs
- ✓ Increase in **Productivity**
- ✓ Increase in **diversity** of organisms
- ✓ Increase in **niche**/role of organisms
- ✓ Increase in **complexity** of food web

Why don't forests occupy all land on earth?

- Succession stops when sere is in **equilibrium with environment**
- So, different regions have different type of climax community, i.e. different **biomes** have different type of vegetation.
- Tundra:** very low temperature → mosses and lichens
- Grasslands:** less water, frequent fires → more grass, less trees



Xeric



Mesic



Hydric

Xerarch succession

Pioneer community: **Lichens**

Hydrarch succession

Pioneer community: **Phytoplankton**

Ozone

Chlorofluorocarbons (CFCs)

- ❑ **Non-toxic**, non-flammable chemicals
- ❑ Classified as **halocarbons** (Halogens: fluorine, chlorine, bromine, iodine, Astatine)
- ❑ Commonly known as R-124, Freon-12, etc.
- ❑ **Uses:** Refrigerant in AC/fridge, Aerosol cans, fire extinguishers, fumigant, solvent, etc

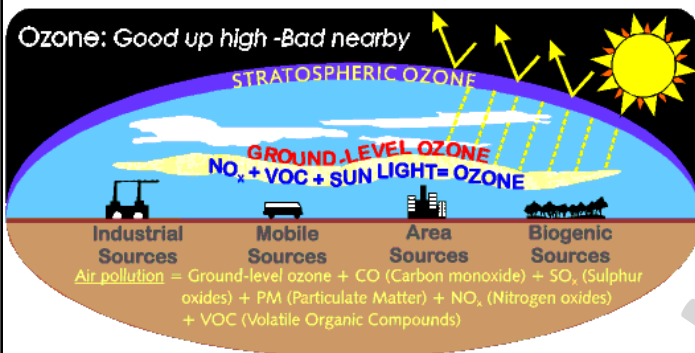
Prelims 2012:

Chlorofluorocarbons, known as ozone depleting substances are used

1. In the production of **plastic foams**
2. In the production of **tubeless tyres**
3. In **cleaning** certain **electronic** components
4. As pressurizing agents in **aerosol cans**

Which of the above statements are correct?

- (a) 1,2 and 3 only (b) 4 only
(c) 1, 3 and 4 only (d) 1, 2,3 and 4



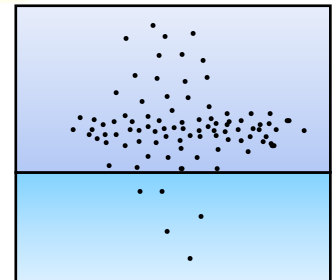
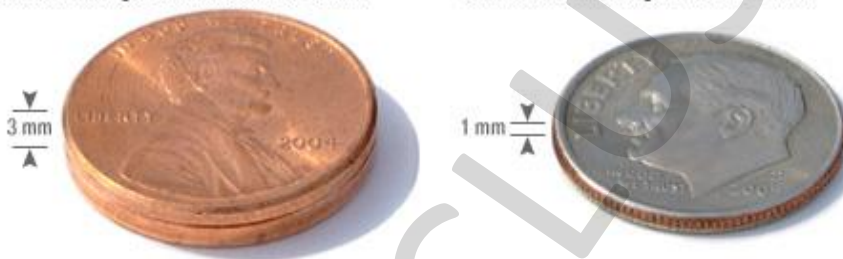
Tropospheric ozone: (Ground-level ozone)

- It is a **secondary pollutant**
- Sunlight + NO_x + VOC + (CO + CH₄) = Ozone
- Short lived climate pollutant
- Colourless gas, Powerful GHG
- Harmful for health, damages vegetation
- Trees can remove O₃? Yes, but they also release VOCs which creates O₃

Ozone hole refers to reduction in thickness of ozone layer in stratosphere

Global Average Ozone: 300 DU=3 mm

Ozone Hole Average: 100 DU=1 mm



One Dobson unit = molecules of Ozone needed to make 0.01 mm thick layer of pure Ozone

Why is ozone hole mostly formed over South Pole, and not North Pole?

- Because Antarctic is much cooler than Arctic.
- So, PSC are easily formed over Antarctic, but not over Arctic.

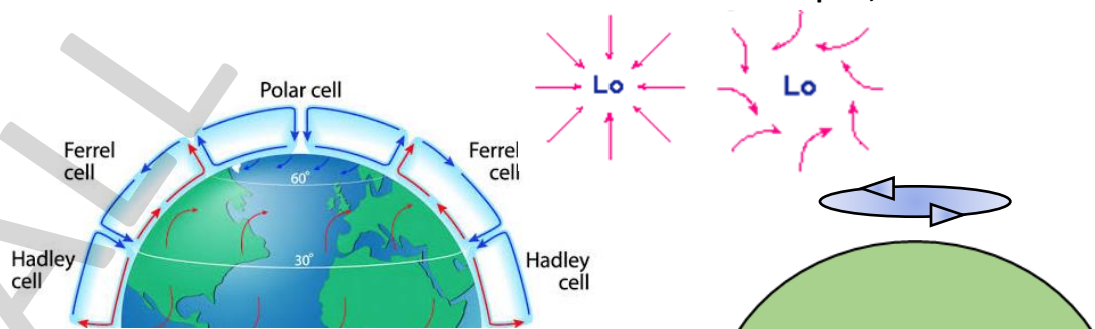
Polar front:

boundary b/w polar cell and Ferrel cell around 60° latitude

Polar Vortex:

Low pressure area in stratosphere above the poles.

Rotates counter-clockwise at north pole; clockwise at South pole



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Polar Stratospheric Clouds:

- Clouds in **winter polar stratosphere**, at altitude of 15-25 km
- They form at very low temperature, **below -78°C**
- They have super-cooled droplets of water, which provide place for chemical reaction that **destroys ozone**.



Sudden Stratospheric Warming:

Polar Stratosphere temperature rises by tens of degrees, within few days.

- Polar vortex is circled by **polar night jet** (in the stratosphere)
- Polar night jet acts like an air curtain, **preventing warm air from outside** entering the polar vortex.
- Sometimes, upward travelling **Rossby waves** from troposphere, can **disturb the Polar night jet**.
- Such breakdown leads to **sudden warming** of stratosphere, up to 50°C in few days.
- SSW mostly happens over Arctic, not Antarctic, why?
 - **Rossby waves** are generated by air flow over **mountains**.
 - Antarctic is not surrounded by land.

