9. Organisms and Environment - I

- **Ecology:** It is the field of science that deals with the interrelationship between biotic and abiotic factors.
  - It includes four levels of biological organisation: **organisms, populations, communities and biomes.**
  - **Major abiotic factors:** Light, temperature, water, air, soil, etc.
  - **Eurythermal:** Organisms that can tolerate wide range of temperature
  - **Stenothermal:** Organisms that live in a narrow range of temperature
  - **Euryhaline:** Organisms that can tolerate wide range of salinity
  - **Stenohaline:** Organisms that live in a narrow range of salinity

- **Responses of organisms to abiotic factors –**

- **Regulators** are organisms that have the ability to maintain their constant body temperature. Example: birds and mammals
- **Conformers** are organisms that cannot maintain their constant body temperature with respect to their surrounding environment.
  - The heat gain or heat loss from the body of an organism is the function of the body surface area relative to volume.
  - Therefore, the smaller organisms have larger surface area relative to their volume, and tend to lose body heat at a faster pace. Hence, small-bodied animals are rarely found in the Polar Regions.
- **Migration** is the ability of an organism to move away temporarily from a stressful habitat to a hospitable habitat
  - Example: migratory birds
- **Suspend** involves suspension of metabolic activities of organisms during unfavourable conditions. It includes:
  - **Hibernation (winter sleep):** Example, Polar bear.
  - **Aestivation (summer sleep):** Example, some snails and fishes.
  - **Diapause (stage of suspended development):** Example, many zooplanktons.

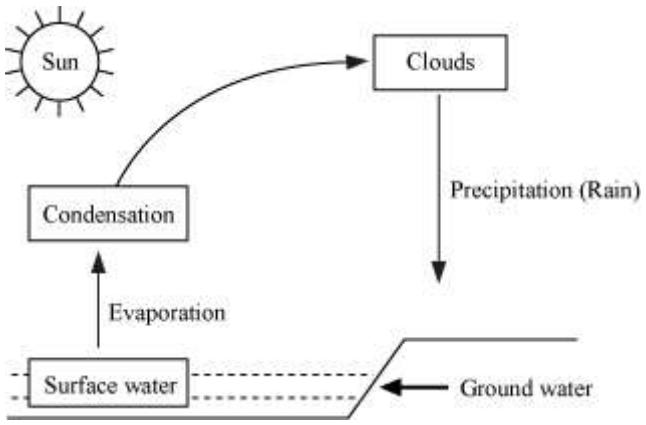
- **Ecosystem** includes the biological community and the non-living components of an area. Example, forest, grassland, pond
- **Components of ecosystem:**
  - **Abiotic or non-living** components include light, temperature, water and air.
  - **Biotic or living** components include producers, consumers and decomposers.
- Aspects of ecosystem are –
  - **Productivity**
    - It is the rate of production of organic matter by producers.
    - **Primary productivity**: It is the amount of organic matter produced by producers per unit area over a period of time.
    - **Secondary productivity:** It is the rate of production of organic matter by consumers over a period of time.
    - **Net primary productivity** (NPP): Gross primary productivity – Respiration

NPP = GPP – R

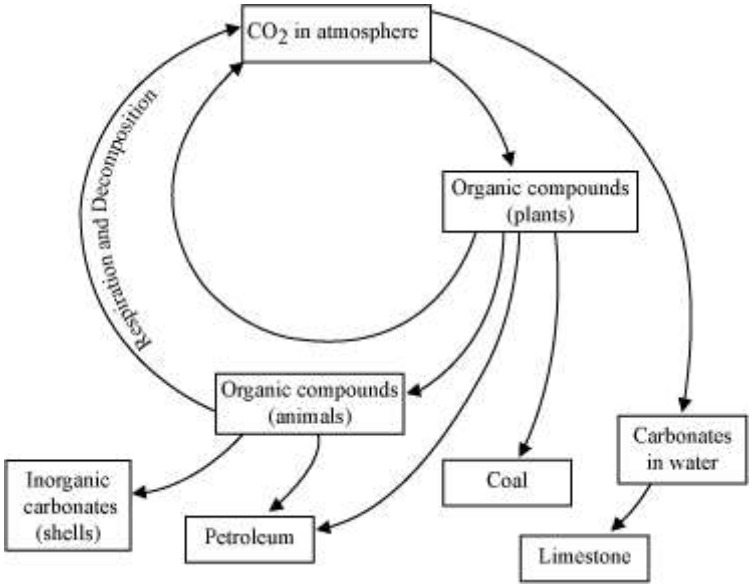
- **Decomposition**
  - It involves the breakdown of organic matter or biomass from the body of dead plants and animals with the help of decomposers, into inorganic raw materials such as CO_2 and H_2O, and some nutrients.
  - The raw material for decomposition is detritus.

- The energy relationship between the different trophic levels is represented by the **ecological pyramids**.
- Their base represents the producers or the first trophic level while the apex represents the tertiary or top level consumer.
- Ecological pyramids are of 3 types:
  - Pyramid of number
  - Pyramid of biomass
  - Pyramid of energy
- The pyramid of energy is always upright while the pyramid of numbers can be inverted for a ecosystem when, say, a large tree is eaten by small insects.
- The pyramid of biomass is upright with an exception of the pyramid of biomass in sea. The pyramid of biomass is inverted in an ocean ecosystem since a small standing crop of phytoplankton supports a large number of zooplankton.

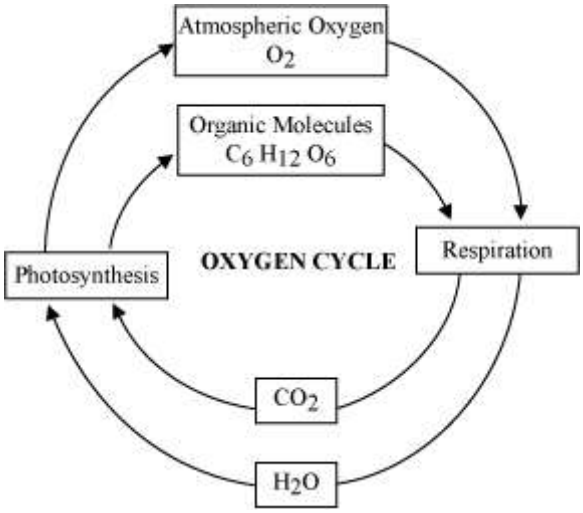
- **Ecological succession:** It is the gradual, predictable change in the species composition of an area.
- Two types of succession can be seen in an area –
  - **Primary succession:** It occurs in an area where no life forms have ever existed, such as bare rocks or sand dunes.
  - **Secondary succession:** It occurs in an area where soil is intact.
- Xerarch succession takes place in dry areas while the process of Hydrarch succession occurs in water.
  - Xerarch succession: xeric condition → mesic condition
  - Hydrarch succession: hydric condition → mesic condition
- The first community of organisms that invade bare rocks is known as the **pioneer community**.
- **Water Cycle**

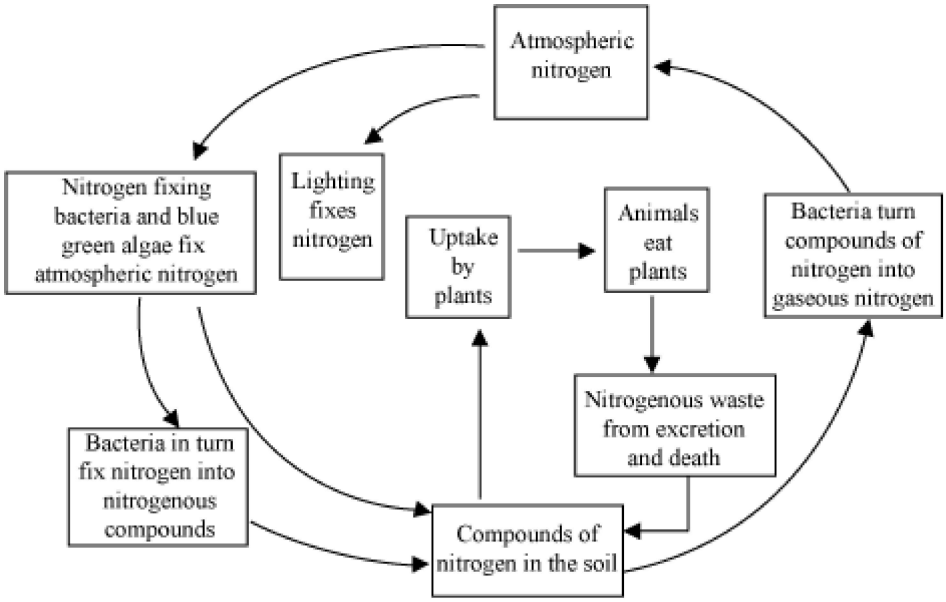


- **Carbon cycle**



- **Oxygen cycle**



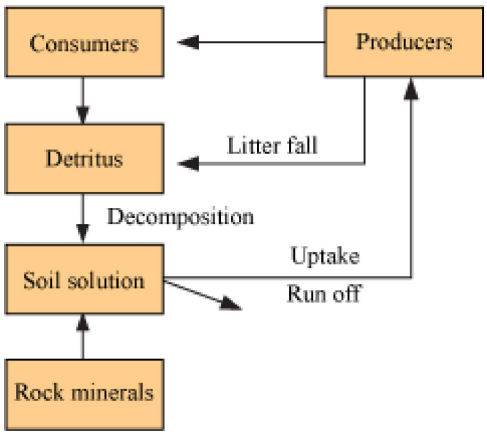


Nitrogen cycle

Phosphorus cycle is a sedimentary cycle.

Phosphorus Cycle

- Phosphorus is an important constituent of cell membranes, nucleic acids, and cellular energy transfer systems.
- Rocks contain phosphorus in the form of phosphate.
- When rocks are weathered, some of the phosphate gets dissolved in the soil solution and is absorbed by plants.
- The consumers get their phosphorus from the plants.
- Phosphorus returns back to the soil by the action of phosphate-solubilising bacteria on dead organisms.



Solid wastes:

- Municipal solid wastes are generated from schools, offices, homes and stores. They are generally rich in glass, metal, paper, food, leather, etc.
- A method for the safe disposal of solid wastes is a **sanitary land fill**.
- **Biodegradable wastes** can be either aerobically on anaerobically broken down using microbes.
- **Non-biodegradable waste** can be recycled, reused, or dumped in landfills.

- **Electronic wastes** include electronic goods such as computers. Such wastes are rich in metals such as copper, iron, silicon.

Agrochemical wastes

- Agrochemicals are the chemical substances like fertilizers, pesticides, weedicides etc used to increase the crop yield.
- The prolonged use of these chemicals have led to the soil and water pollution.
- To check the adverse effects of agrochemicals, organic farming is used.
- It involves use of natural materials and techniques such as organic manure (cow dung manure), compost, biological pest control, and crop rotation.

Radioactive waste

- It is produced during the process of generation of nuclear energy from radioactive materials.
- It is recommended that nuclear wastes be stored for pre-treatment in suitable shielded containers, which are then buried within rocks.

- **Degradation of natural resources** occurs due to improper resource utilisation practices.
- Excessive irrigation of crops increases the concentration of salts in soil (soil salinity).

- **Air pollution**
  - The major cause of air pollution is the burning of fossil fuels in industries and automobiles.
  - **Electrostatic precipitator:** It is used for the removal of particulate matter produced in the exhaust of factories. Scrubber can be used for removing gases like sulphur dioxide.
  - According to CPCB, particulate size 2.5 micrometer and less in diameter (PM 2.5) are harmful to human health.
  - **Catalytic converter:** It is used for removing un-burnt hydrocarbons produced in automobiles.

- **Measures for preventing air pollution –**
  - Planting more tree
  - Using clean, renewable sources of energy such as CNG and bio-fuels
  - Minimising the use of fossil fuels
  - Using catalytic converters in automobiles and electrostatic precipitators in thermal power plants.

- **Global warming**
  - It is defined as the increase in the average temperature of earth's surface.
  - It occurs due to increased concentration of greenhouse gases in the atmosphere.
  - The greenhouse gases include carbon dioxide, methane and water vapour.
  - The maximum contribution towards global warming is caused by carbon dioxide and methane.
  - Global warming is mainly a result of industrialisation, the burning of fossil fuels and deforestation.
  -
- **Effects of global warming:**
  - It disturbs the natural water cycle, which results in changes in the patterns of rainfall.
  - It also results in the melting of polar ice caps and mountain glaciers, thereby resulting in the rise in sea level.

- **Ozone depletion**

- Ozone can be classified as good ozone and bad ozone.
- Good ozone is present in the stratospheric region of the atmosphere while bad ozone is produced by the interaction between the various primary pollutants in the tropospheric layer.
- The thickness of ozone is measured in terms of Dobson units (DU).
- The thinned layer of ozone over Antarctica region is referred to as the ozone hole.

Chlorofluorocarbons or CFCs have caused damage to the stratospheric layer, leading to the formation of the ozone hole.

- High dose of UV-B radiations causes corneal cataract and inflammation of cornea in human beings. The inflammation of cornea is known as snow blindness or sunburn of cornea.
- **Montreal Protocol** is an international treaty signed for controlling the emission of ozone-depleting substances. It was signed in the year 1987.

Water pollution

- The common sources of water pollution are domestic sewage, industrial effluents, thermal wastewater discharge.
- **Eutrophication:** It is the natural ageing process of a water body due to nutrient enrichment. It increases the ecosystem's primary productivity.
- **Domestic sewage** is rich in nitrogen and phosphorus. These compounds act as nutrients for the growth of algae in contaminated water bodies. This accelerates the rate of eutrophication in the water bodies.
- **Oil Spills -** The accidental discharge of oil or petroleum in water bodies is called oil spills. This results in the death of a lot of marine lives.
- The algal bloom causes the microbial population to increase, which consumes larger amount of oxygen dissolved in the water bodies. As a result, the level of dissolved oxygen in the water bodies decreases, and biological oxygen demand of the water bodies increases.
- **Industrial effluents** contain inorganic toxic substances, which may undergo **biomagnification.**
- Thermal wastewater discharge involves release of heated water from thermal power plants that increase the temperature of the water body. It causes damage to the indigenous biodiversity of the water body.
- Biological magnification: It is the increase in the concentration of pollutants or harmful chemicals with the increase in each trophic level. DDT shows the phenomenon of biomagnification.
- Integrated wastewater management is the possible solution for controlling water pollution. In this approach, the water is first treated by conventional means such as filtration, sedimentation, and chlorine treatment, followed by bioremediation.

- **Deforestation** leads to the loss of the top fertile soil, which contains humus. It also leads to the gradual transformation of an inhabitable land into desert **(desertification)**.
- **Reforestation** is the process of restoring a deforested area.
- **Role of people and communities in the conservation of forests:**
  - **Chipko movement** was started in the Garhwal region, in the Himalayas, when the local women prevented trees from being cut by hugging them.
  - **Bishnoi Community** in Rajasthan showed the courage to move forward and stop soldiers from cutting down trees.