ENVIRONMENTAL BIOLOGY

1.1 Ecology

Ecology deals with the various principles, which govern the relationships between organisms and their environment. **Reiter** first used the term ecology in 1868. **Ernst Haeckel** (1886) first correctly defined ecology as "the science dealing with reciprocal relationship of organisms and the external world". **Prof. R.Misra** is known as "Father of ecology in India". Other famous Indian ecologists include **G.S.Puri, S.C.Pandeya.** Dudgeon (1921) started ecological studies in India.

Branches of ecology

- **Autecology :** Ecology of individuals.
- **Synecology :** Study of relationships between communities and environment.
- **Genecology :** Study of ecological adaptations in relation to genetic variability.
- **Paleoecology :** Study of relationship between organisms and environment in the past.
- **Applied ecology :** Application of ecological concepts for human welfare.
- **Systems ecology :** Interpretation of ecological concepts in terms of mathematical principles.

Units

- Individual $\rightarrow$ Population/species $\rightarrow$ Community $\rightarrow$ Ecosystem $\rightarrow$ Biome $\rightarrow$ Biosphere.
- Individual is most concrete and observable unit which carry out life processes within its body as an entity.

(1) **Species :** It is unit of classification and can be defined as sum total of all populations of the same kind / form of a species.

(i) **Exceptions to species concept**

(a) Difference in the morphology of developmental stages of an individual.

(b) **Sexual dimorphism :** Occurrence of two forms among the organisms of the same species is known as dimorphism. Plants such as the date plam have male and female individuals which bear different types of flowers. Man and woman, peacock and pea hen are two sexual forms of same species. They show sexual dimorphism.

(ii) **Polymorphism :** The occurrence of many forms of individuals within the same kind of organism (species) is known as polymorphism. e.g. :

(a) Colonies of social insects.

(b) Colonies of coelentrates and *Volvox*.

(c) Different human races (Negraoids, Caucasoids, Mongoloids, Indian, Australoid, Polynesian).

(iii) **Speciation or Origin of species :** May be

(a) Due to physical barrier (Allopatric)

(b) Due to reproductive barrier (Sympatric)

(c) Mutation

(d) Polyploidy

(e) Genetic (Wright effect)

(iv) **Home range :** A space to live is a basic need of an organism. Several members of a species may cover a defined area in search of food and mates, which is called home range.

(2) **Population :** Geographically localised group of individuals of the same kind at a particular time represents population e.g., Population of Delhi in 2000 year.

$$\text{Population density (D)} = \frac{\text{No.of individuals (N)}}{\text{Space (S)}}$$

N= Total no. of individuals, S= No. of units of space m^2 / m^3

(i) **Factors affecting population**

(a) **Natality :** Birth rate.

(b) **Mortality :** Death rate.

(c) **Population growth :** Shows two types of curve :

- S. shaped curve.
- J. shaped curve.

(d) **Emigration :** Permanent outward movement. Decreases population.

(e) **Immigration :** Permanent inward movement. Increases population.

(f) **Migration :** Two way movement of entire population. Does not change the size of population.

(g) **Biotic factors :** Growth rate of certain population decreases with the increase in density (density dependent) before the carrying capacity of the environment is reached, predators also keep the size of a population under check.

(h) **Carrying capacity :** of an environment is the maximum number of individuals of a population which can be provided with all the necessary resources for their healthy living.

(i) **Biotic potential :** Maximum capacity of a population to reproduce under ideal conditions (environmental).

(ii) **Control of population :** It is by three factors :

(a) Geographic factors (b) Demographic factors (c) Socioeconomic factors.

(3) **Community :** An association of a number of different interrelated populations belonging to different species in a common environment, which can survive in nature, is known as biotic community (e.g. different species of organisms occurring in a pond constitute the pond community. The members of a community have different type of inter relationship.

1.2 Environment

The environment is the aggregate of all those things and set of conditions which directly or indirectly influence not only the life of organisms but also the communities at a particular place. The

environmental conditions which influence the life and development of plants are grouped into four main classes (ecological factors) which are as follows :

(1) **Climatic factors :** The study of climatic factor is known as climatology. The chief climatic factors are :

(i) **Water :** Rainfall is the chief source of soil moisture. Water exchange between earth surface and atmosphere is called hydrological cycle. Humidity of the air is expressed in terms of relative humidity. It is measured by **hygrometer** (Psychrometer). Epiphytes and cryoptogamic plants grow in those regions where relative humidity is high.

Annual rain fall determines the types of vegetation in any region such as :

(a) The area where rainfall is scanty are seen with deserts and **xerophytic vegetation**.

(b) The tropical area with heavy rainfall throughout the year consists of evergreen forests.

(c) The area with heavy rainfall during summer and low during winter consists of **grasslands**.

(d) The area with heavy rainfall during winter and low during summer consists of **sclero-phyllous forests** (The plants are shrubs stunted in height with leathery, thick evergreen leaves).

(ii) **Light :** The radiant energy of sunlight carries out all important functions, without this life except few bacteria would disappear. On this basis of relative light requirements and the effect of light on the overall vegetative development, plants are classified ecologically into following categories :

(a) **Heliophytes :** These plants grow best in full sunlight. In these plant internodes are short, leaves are small narrow, thick and with cuticle and hair.

(b) **Sciophytes :** These plants grow best in lower light intensity. In these plant internodes are long, leaves are large broad and thin, leaf surface is dull.

The plants grow in total darkness are called etiolated (Long thin, weak and yellow in colours).

(iii) **Temperature :** Temperature had a marked effect on the growth of plants. Due to high temperature plants suffer solarization and due to low temperature plants suffer freezing or frost injury.

On the basis of temperature the plants are classified as below :

(a) **Megatherms or Climate or Tropical :** The vegetation growing in the condition in which high temperature prevails throughout the year (30-40°). The dominant vegetation is tropical rain forest. They are in South America (on the side of Amazon river), Middle Africa (on the side of Congo River) and S.E. Asia.

The effect of altitude and latitude is similar upon plant vegetation. It is due to similar change of temperature is these two places.

The tropical rain forests are the most dense forests of the world.

(b) **Mesotherms :** Climate-subtropical, the high and low temperature alternates. The dominant vegetation is tropical decidous forest type. Those plants in which leaf fall takes place once in a year are called decidous plants *e.g. Ficus religiosa* (Sacred tree).

(c) **Microtherms :** The vegetation growing in the low temperature (10-20°*C*) condition. (The temperature remains low throughout the year). The vegetation is mixed coniferous forests type (Teiga).

(d) **Hekistotherms :** The vegetation growing in the very low temperature (0-10°*C*) conditions. The dominant vegation is Alpine vegetation (Tundra).

The plants growing at very low temperature are called **cryophytes** or **psychrophytes**.

(iv) **Wind :** High wind velocity causes soil erosion, breakage and up rooting of trees. Most of the pollutants are dispersed through the medium of air. Wind do harm is blossom trees because it prevents working of insects.

Wind modifies the humidity. Dry winds cause dwarfing of plants. Wind helps in pollination, dispersal of fruits and seeds and prevents frost damage. If the areas subjected to strong winds the leaves of plants become small and rolled and these plants develop an overall shape that offer resistance to wind.

Sometimes shrubs and trees are planted to protect the field against wind. Such structures are known as wind breaks or shelter belts. These plants (Trees) are planted at 90° to the wind velocity.

Absolute and relative humidity vary with changes in temperature. Absolute humidity is maximum near equator and gradually decreases towards the poles. This indicates that relative humidity is affected by temperature as well as latitude. Temperature, rainfall and humidity are three major factors which effect and control the climate.

(2) **Topographic or Geographic factor :** Topographic factors are concerned with the physical geography of the earth in an area. The chief topographic factors are as follows :

Micro climate refers to local combinations of factors such as wind, rate of evaporation, humidity, temperature which differ from regional climate.

(i) **Altitude :** Height of mountain chains. With the increase in altitude climate changed as decrease in temperature, increase in humidity, increase in precipitation and increase in wind velocity.

Earth's vegetation can be divided into different zones based on altitude :

(a) **Upto 1800 feet :** Tropical rain forest.

- Tropical moist deciduous with 1000-1500 *mm* rainfall.
- Tropical moist evergreen with 2500 *mm* rainfall.

(b) **1800-4000 feet :** Grassland or desert, savanna.

(c) **4000-7500 feet :** Temperate deciduous forest. Oak is common.

(d) **7500-12000 feet :** Coniferous forest (Temperate evergreen forests) *e.g.*, *Pinus*, *Abies*, *Picea*.

12000 feet is regarded as tree or timber line. Above this height of plants decreases.

(e) **12500-14500 feet :** Alpine vegetation (tundras) *Rhododendron, Betulla*. Cushion shaped dwarf shruby vegetation.

(f) **145000 upward :** Snow line.

Generally the vegetation that develops on base of mountain to top is Tropical → Temperate → Taiga → Tundra. Species diversity generally increase as one proceeds from high altitude to low altitude and from high latitude to low latitude.

(ii) **Steepness of the slopes :** Steep slopes cause fast running of water which result in erosion and do not permit the accumulation of humus so the soil becomes denuded. In such soil plants can not grow properly and vegetation changes to xerophytic plants.

(iii) **Exposure of slopes :** Exposure of slope to sun and wind affects very much the kind of plants growing there. Generally the slopes exposed to sun and wind supports vegetation. That's why green houses and hot beds are always built in a way to face sun or southern slopes which receive greater amount of solar energy.

(iv) **Direction of mountains chain :** Mountains steer or deflect winds into different dierctions. Outer Himalayas show frequent rains with luxurient vegetations while the middle and inner Himalayas are dry with poor vegetation. The southern slopes of Himalayas *e.g.* Kullu valley are directly exposed to sunlight and has luxurient mesophilous vegetation due to mansoon wind. Where as Northern slopes of Himalayas *e.g.* Lahul valley exposed to weak light and strong dry wind, thus they have xerophilous vegetation.

(3) **Edaphic factor :** The study of soil is called **edaphology** or **pedology**. The soil can be defined as "the upper crust of earth surface in which plants roots are anchored." The term soil is derived from the Greek work solum.

(i) **Soil formation :** It is derived from rocks by weathering which is of three types :

(a) **Chemical weathering :** It is caused by oxidation, hydrolysis or carbonation.

(b) **Mechanical weathering :** It is caused by living organisms, *e.g.* lichens, grazing animals or earthworm.

Weathering results into conversion of rocks to small fragments. Humus accumulated and now this can be called as soil. The development of soil is called **pedogenesis**. Soil is of two types :

- **Residual soil :** If the soil remain at the same place where it is formed.
- **Transported soil :** This soil brought from their place of origin to other place by some agents. It may be :

Alluvial soil **:** Carried by running water (rivers).

Colluvial soil **:** Carried by gravity.

Eolian soil **:** Carried by wind.

Glacial soil **:** Carried by glacier.

The soils of planes of India is mainly alluvial. In India the principal residual soil types are :

- Reddish soil of Vindhyas and South.

- Black soils of South West India.
- **Calcareous soil :** With 20% $CaCO_3$.
- **Laterite soil :** Oxides of iron and aluminium.
- **Peat soil :** With high percentage of humus 90%.
- **Black soil :** Predominantly with clay and humus (very fertile because most of minerals are present in it).

(ii) **Soil profile :** A fully formed soil shows different layers called horizons. The sequence and nature of these layers is called soil profile (Cross section of soil) which consist of following horizons.

(a) **Horizon 'O' :** It is uppermost horizon made of organic matter. It has both fresh or nondecomposed as well as partially decomposed matter. It consist of following two sub-layers :

❑ **O_1 region (Aoo) :** It is uppermost layer which consists of freshy added organic matter such as dead leaves, branches, flowers and fruits.

❑ **O_2 region (Ao) :** It is present below O_1 region. It consists of organic matter which is in different stages of decomposition.

(b) **Horizon 'A' :** It is rich in mineral elements. A large amount of completely decomposed organic matter is present in this region. It shows downward loss of soluble salts clay, aluminium and iron. So this region is called zone of leaching or zone of eluviation.

(c) **Horizon 'B' :** It is dark in colour due to accumulation of leached substances like clay, iron and aluminium from horizon. So it is called as zone of accumulation or zone of illuviation.

Horizon 'O', A and B are together called as top soil.

(d) **Horizon 'C' :** It consists of partially weathered parental rock material. It is called as sub soil.

(e) **Horizon 'R' :** It is the lowermost layer of soil which consist of bed rocks (unweathered).

(iii) **Composition of soil :** The garden soil is made up of :

(a) **Mineral matter (40%) :** They are derived from rocks (by disintegration). The soil, derived from lime stone, is called **chalky** soil.

❑ **Size of mineral particles :** Depending upon their size, the mineral particles are of following types :

- Coarse gravel : More than 5.0 *mm*.
- Fine gravel : 5.0 to 2.0 *mm*.
- Coarse sand : 2.0 to 0.02 *mm.*
- Slit : 0.02 to .002 *mm.*
- Clay : Less than 0.002 *mm*.

Sandy soils have more coarser particles and lower water holding capacity and better aeration. Sand is most porous. Clayey soils have fine particles which have high water holding capacity and very poor

aeration. Clay is least porous (water logged). Loam (50% sand + 25% clay + 25% slit) are best for plant growth.

The best apparatus used to analyse the soil is sieving.

(b) **Organic matter :** Humus is total organic matter in the soils. It is rich in N P K. The humus is formed from decay and decomposition of dead plant and animal matter. It is in colloidal state and increase water holding capacity of the soil. The formation of humus is called **humification** which is caused by microbial activity. The humus soil is the best soil as it has got high water holding capacity, high porocity, aeration and high organic matter content. The complete decomposition of humus forms minerals. The formation of minerals is called mineralization. So, humus is the secondary source of minerals in the soil.

The three distinct layers of humus in soil of forests are :

- **Litter :** All dead fresh organic matter fallen (undecomposed) recently to the ground is called litter.
- **Duff :** The layer, where decomposition is just started, is called as duff as duff layer. Partially decomposed litter is called duff.
- **Leaf mold or Real humus :** When the litter is modified into dark, finely divided, amorphous organic matter by the activities of micro-organisms living in soil is called **humus**. Humus is maximum in peat soil (90%).

(c) **Soil solution :** The soil solution is the primary source of inorganic nutrients for plants. Soil solution helps in exchange of ions. pH of fertile soil is 6 to 7. *pH* below 5 inhibits bacterial activity. The plants prefer to grow in acidic soil are called oxylophytes *e.g. Drosera*. The plants prefer to grow in alkaline soil are called halophytes.

The soil rich in nutrients is called **eutrophic** and soil with less amount of minerals is called as **oligotrophic**.

(d) **Soil air :** 20-25% air or O_2 is necessary for proper growth of plants. The well aerated soil support the plant growth well because :

- Root respiration increases.
- The capillary potential of the soil increases.
- The accumulation of CO_2 could not take place.
- The root growth increases.
- Poor soil aeration supresses root hair development and may reduce the rates of absorption of water and minerals.

(e) **Soil micro-organims :** Soil has its own distinctive flora and fauna (bacteria, algae, fungi, protozoans, nematods, earth worms, molluscs, insects etc.) which make the biological system of the soil complex.

These organisms play following important roles in the soil :

- Nitrogen fixation
- Mycorrhizal association
- Soil borne diseases
- Decomposition of organic matter.

(4) **Biotic factor :** Biotic factor means the effect of living organism upon other living organism.

In natural conditions organisms live together and influence each others life *i.e.* show interactions. Interactions may be :

(i) **Positive interactions**

(a) **Mutualism or Symbiosis :** An association of two organism in which both partners are benefitted, (but can not live separately) *e.g.* lichens, mycorrhiza, symbiotic nitrogen fixers, pollination, *Zoochlorella* and *Zooxanthallae*. Ruminant mammals have flagellates and bacteria for cellulose digestion which obtain food and shelter.

(b) **Commensalism :** It is the relationship between two living individuals of different species in which one is benefitted while the other is neither harmed nor benefitted except to negligible extent. *e.g.* epizoic algae, epiphytes and parasitic vascular plants. Jackals follow a lion or tiger while arotic fox follows a seal for obtaining food from pieces or bits left by the predators.

(c) **Protoco-operation :** It is interaction between two living organism of different species in which both are mutually benefitted but they can live without each other. *e.g.* tick bird ox pecker and Rhinoceros.

(ii) **Negative interactions**

(a) **Deforestation :** By deforestation the land is exposed to erosion and desertification. Deforestation in catchment areas causes floods in plains. Deforestation reduces the chances of rainfall.

(b) **Competition :** Competition can be defined as the rivalry between two or more organism for obtaining the same resources. Competition is greatest between the individual of the same species (intraspecific) which make similar demands upon the same supply at the same time in same area (niche).

- **Gause's hypothesis or Principle of competitive exclusion :** Gause noted that out of two species of *Paramecium* grown together, one is eliminated. It is called Gause's hypothesis.

(c) **Grazing :** Constant grazing does not permit the plants to grow. Heavy grazing results in soil erosion (sheet erosion). Selective grazing and browsing a responsible for marked changes in vegetation. The only way grazing animals help vegetation is that they add their excrete to the soil.

(d) **Fire :** Most of the fires are of biological origin. Fires are mostly man caused. Sometimes fire develops due to mutual friction between tree surfaces in forests.

Fire destroy plant communities. A number of grasses are stimulated by a fire or in a burnt forest the grasses first and luxuriently.

(e) **Exploitation :** One species harm another species by making its direct or indirect use.

- **Parasitism :** The parasite grow on other living organism for food and support called host *e.g. Cuscutta, Orobanche*.

- **Predation :** It is an association between members of two species in which members of one species capture, kill and eat up members of other species. The former is called predator and later is called prey. A predator is a free living animal which catches and kills another species for food. Most of the predators are animals but sometimes some plants such as insectivorous plants and some fungi (predaceous fungi or animal traping fungi) *e.g. Datylella, Arthrobotrys*. They feed on small insects, protozoans and nematodes.

(f) **Antibiosis or Amensalism :** One organism inhibits the growth of other organisms through the secretion of antibiotics. It is common in micro-organism. This is based on biological antagonism. It is also called allelopathy. Smoother crops (*e.g.* Barley, rye, millets, alfalfa sun flower) are those which do not allow weeds to grow near by.

1.3 Ecological plants groups

On the basis of requirements **Warming** classified plants into following categories :

(1) **Hydrophytes :** They live in abundance of water. They are of following types :

(a) **Rooted submerged :** Roots in the soil and submerged in water *e.g. Hydrilla, Vallisnaria*.

(b) **Submerged floating :** They are not rooted in the soil but completely submerged and floating *e.g. Ceratophyllum, Utricularia*.

(c) **Rooted with floating leaves :** They are rooted in the soil but the leaves are floating on the surface of water *e.g. Nelumbo, Trapa, Victoria*.

(d) **Free floating :** They float on the surface of water *e.g. Wolfia* (Smallest angiosperm), *Lemna, Spirodella, Pistia, Azolla, Salvinia*.

(e) **Rooted emergent :** Roots are in soil shoots or leaves are partly outside and partly inside the water. Plants show **heterophilly** (Amphibious plants) *e.g. Typha, Ranunculus, Sagittaria, Cyperus*.

Morpholigical adaptations

- Roots of hydrophytes are poorly developed or completely absent in *Wolfia, Ceratophyllum* etc. Root hair absent but root pockets may be present *e.g. Pistia, Eichornia, Trapa*.
- Stem is reduced in free floating plants *e.g. Pistia,* narrow and slender in submerged plants *e.g. Hydrilla, Ceratophyllum* and well developed in amphibious plants *e.g. Typha*.
- Petioles become long, swollen and spongy for floating.
- Leaves are usually long ribbon like *e.g. Potamogeton*, or finely divided *e.g. Ranunculus or thin and broad e.g. Nelumbo, Victoria*.
- In some hydrophytes leaves of different forms are produced by same plant. Aerial leaves are not dissected but submerged leaves dissected (Heterophilly) *e.g. Ranunculuc, Limnophila*.

Anatomical adaptations

- Cuticle absent or poorly developed.

- Stomata are absent in submerged plants. Floating hydrophytes have stomata on upper surface *e.g*. Lotus (epistomatic).
- Air spaces are extensively developed in root, stem and leaves. Well developed **aerenchyma** helps in buoyancy and gaseous exchange.
- Leaves have spongy tissues and palisade is poorly developed. As light difuses from all palisade and spongy tissue. Epidermal cells contain chloroplasts for maximum capturing of difused light.
- Mechanical tissues like sclerenchyma (lignified tissues) and collenchyma are poorly developed or absent.
- Vascular tissues are poorly developed.

Physiological adaptation

- Water and mineral nutrients are absorbed through general body surface.
- Osmotic concentration or osmotic potential of cells is equal to or is slightly higher than external water.

(2) **Xerophytes :** They are adapted to grow in dry habitats. On the basis of pattern of life cycle, xerophytes are of three types :

(i) **Ephemerals :** They complete their life cycle in a very short period, evade dry season by disappearing, leaving their seeds. They are referred as **drought escapers** or drought evaderes *e.g. Cassia toria, Argemone maxicana, Solanum xanthocarpum*.

(ii) **Succulents (Fleshy xerophytes) :** They absorb large quantities of water during rainy season and store water in different body parts. They are common in deserts and referred as **drought avoiding xerophytes** *e.g. Opuntia, Bryophyllum, Euphorbia, Mesembryanthemum* (ice plant).

(iii) **Non succulents :** They are true xerophytes and called as **drought resistant**. They can with stand long drought periods *e.g. Acacia, Calotropis, Casuarina, Nerium, Capparis, Prosopis*.

Morphological adaptations

- Roots of xerophytes are extensively developed to increase water absorption. Roots are much more longer than the shoots. Root hairs and root caps are well developed. The roots reach to great depth.
- Stems of xerophytes is usually stunted (dwarf), woody, dry, hard and covered with thick bark. Stem is modified into flat leaf like phylloclades or cladodes *e.g. Opuntia, Ruscus, Asparagus*.
- Leaves of xerophytes are usually thick may be reduced to spines *e.g. Opuntia*, scales *e.g. Casuarina* or may become needle like *e.g. Pinus* (Microphyllous) or may absent *e.g. Capparis*. Leaves and stem become fleshy (Malacophyllous) *e.g. Bryophyllum*.

Anatomical adaptations

- Stomata are sunken and generally on the lower surface of leaves.
- Epidermal cells thick walled and covered by hairs (Trichophyllous). *e.g. Calotropis*. Epidermis may be multilayered (Multiple epidermis) *e.g. Ficus, Nerium*.
- Palisade generally on both sides (surfaces) of leaves *e.g. Nerium*.
- In leaves spongy parenchyma are absent.
- Water storing parenchyma, conducting tissues and mechanical tissues are well develop.

- Bulliform or motor cells are found in between the cells of upper epidermis. These cells cause rolling and unrolling of leaves *e.g. Poa, Amnophila* (grasses).
- In *Nerium* leaf, upper as well as lower epidermis are multiseriate or multiple and are covered with thick cuticle. Mesophyll is different into palisade and spongy parenchyma palisade tissue occurs near both the epidermis while spongy parenchyma is located in between the palisade.
- In *Ficus* leaf, upper epidermis is multiseriate and is thickly cuticularised. Cystoliths are present is the cells of inner layers of this epidermis.

Physiological adaptations

- Osmotic concentration or osmotic potential of cell sap is high.
- They have resistance to dessication and mucilage to hold water.
- They show less transpiration.

(3) **Halophytes :** They are special types of xerophytic plants which grow on saline soils with high concentrations of salts like *NaCl*, $MgCl_2$, $MgSO_4$ (Physiologically dry soil). Most of these are succulents. They have negatively geotropic roots for gaseous exchange called **Pneumatophores**. Halophytes show **Vivipary** (germination of seeds inside the fruits).

Halophytic communities growing on swamps are called helophilous halophytes which are of two types :

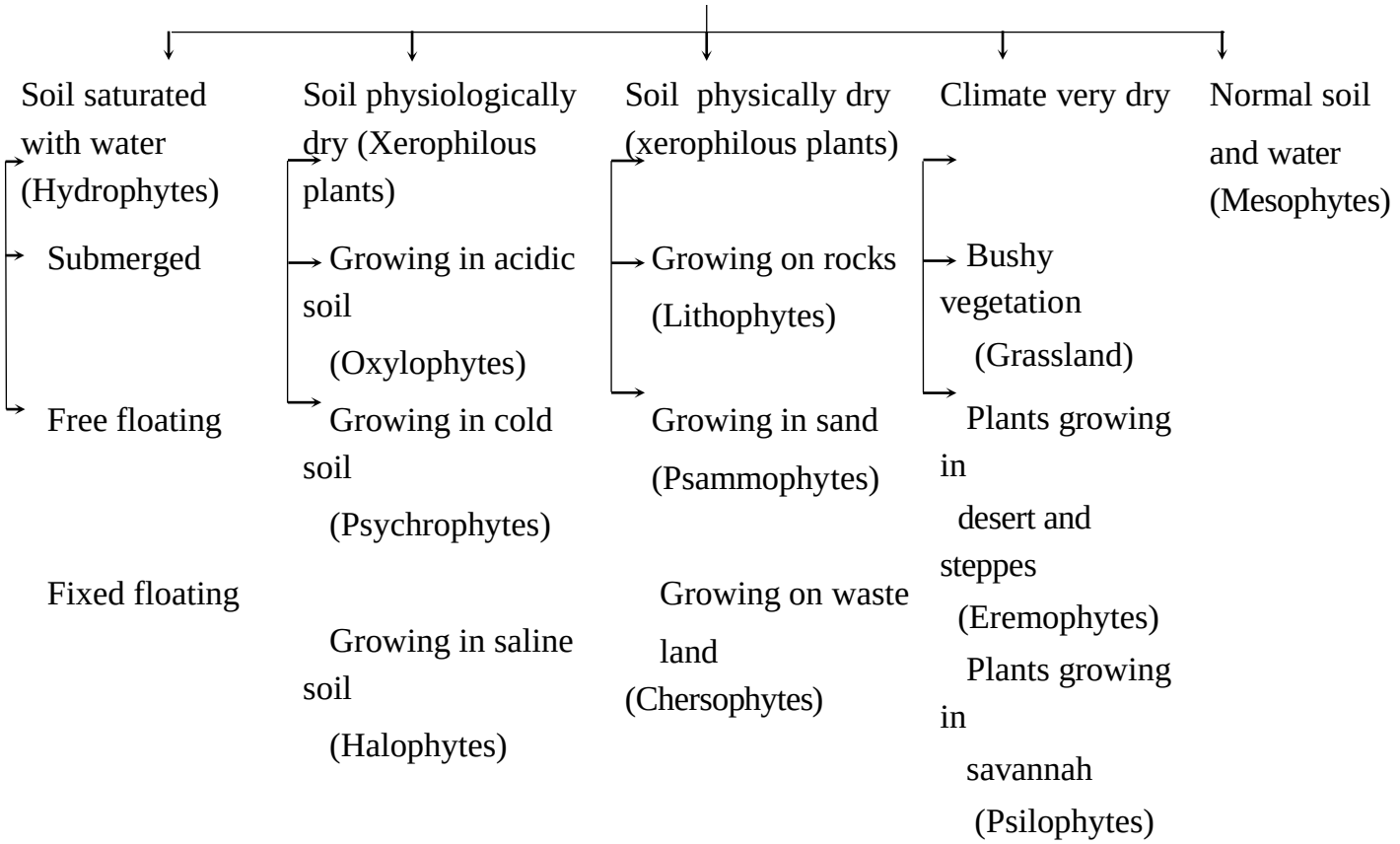
- Salt swamp and salt desert.
- Littoral swamp forests which are most extensive in all tropical areas.
- Swamp forest forms a characteristic vegetation called **mangroves** *e.g. Rhizophora, Sonneratia, Avecenia, Heritiera, Salsola*.

In India mangroves are quite common in sea shores of Bombay and Kerala, an in Andamans and Nicobar Islands.

(4) **Epiphytes :** They are special type of xerophytic plants which grow on other plants only for physical support or shelter. They do not suck the food material from the plant. They are common in Tropical rain forests.

They have aerial hanging hygroscopic roots which have special tissues **Velamen** to absorb moisture from atmosphere. Seeds of epiphytes are very light. They are also known as aerophytes. *e.g. Vanda, Dendrobiumus, Dischidia* or Orchids.

Ecological classification of plants



1.4 Succession

Every community undergoes a series of changes until a group of organisms is established which can live and reproduce most successfully in the area. This is called biotic succession. The term succession was coined by Hult (1885). A biotic community normally undergoes continuous changes. Generally, definite and orderly sequences of communities gradually appear in an area over a period of time. A specific sequence of development of a community is related to particular set of physical and chemical conditions. This is known as sere. The last succession in a sere is called climax or a climatic climax.

Types : Succession is of two types :

(1) **Primary succession :** It includes changes which occur when living things become established on a previously uninhabited area such as a newly exposed sea floor, lake sediments or sand dunes.

(2) **Secondary succession :** It occurs where early communities have been damaged, leaving a few organisms and considerable organic matter. These remnant species, along with some new ones, regenerate a new community. Ecological succession on dry habitat, bare rock, sandy soils and aquatic habitats are called xerosere, lithosere, psammosere and hydrosere, respectively. The first plants to appear in an area are called pioneer plants. In hydrosere (or hydrach), pioneers are phytoplanktons; in lithosere, the pioneers are crustose (Saxicolous) lichens and mosses.

Different stages in Hydrosere with component plants

Phytoplankton stage (blue green and green algae pioneer, Diatoms)
↓
Rooted submerged stage (*Hydrilla, Vallisnaria, Utricularia, Potamogeton*)
↓
Floating stage (*Nelumbo, Trapa*)
↓
Reed swamp stage (*Typha, Sagittaria*)
↓
Sedge meadow stage (*Cyperus, Juncus*)
↓
Wood land stage (*Salix, Populas, ALnus*)
(Community climax)

Different stages in Xerosere with component plants

Crustose lichen stage (Pioneer)
↓
Foliose lichen stage (*Parmelia, Dermatocarpon*)
↓
Moss stage (*Polytrichum, Tortula*)
↓
Herbs stage (*Aristida, Poa*)
↓
Shrub stage (*Phytocarpus, Rhus*)
↓
Mesophytic trees (*Climax*)

(3) **Life forms : Raunkiaer** (1934) has distinguished plants into five forms on the basis of size, shape, branching, crown, life span and perennation.

(i) **Therophytes :** Annual plants which perennate in the form of seeds.

(ii) **Cryptophytes :** Buds are occurs very deep in the soil *e.g.* Bulbs, rhizomes, corm, tubers etc.

(iii) **Hemicryptophytes :** Perennating structures occur at ground level. Aerial shoots die in the onset of winter, e.g. rosette plants.

(iv) **Chemaephytes :** Small plants of cold areas where perennating buds or shoot apices lie at or above the ground level.

(v) **Phanerophytes :** Perennial herbs, shrubs and trees, epiphytes, succulents, lianas, etc., where perennating buds occurs at 10 cm or more height above ground level.

Important Tips

- Habitat is specific place or locality occupied by an organism, population or community.
- Microhabitat is a part of habitat having specific property e.g. Forest floor, tree trunk, tree canopy.
- Ecades / Ecophenes – Individuals which have the similar genetic constitutions.

- Ecotypes / Ecological races – Individuals which have the different genetic constitution.
- Keystone species are species which influence ecosystem and determines it's properties.
- 11^{th} July – World population day.
- Chasmophytes are plants growing in rock cerevices.
- Eremophytes are plants growing in deserts and steppes.
- Chersophytes are plants growing on waste lands.
- Calciphytes / Calcicoles / Calciphiles are plants growing on calcareous soils.
- Ecesis is establishment of organisms in an area into which they have come by dispersal or migration.
- Heaviest rainfall in the world – In Mosin Ram (1147 Cm) and Cherrapunji (1143 cm) in India.
- Eichornia (water hyacinth), troublesome aquatic weed in India has spongy and swollen petiole, originally belongs to America.
- Victoria regia has larger (largest leaves) simple undivided leaves.
- Nymphaea has waxy coating on upper leaf surface hence hydrophobic.

1.5 Ecosystem

The word ecosystem was coined by **A.G. Tansley** in 1935. This term is derived from two words, namely eco and system. Eco refers to environment and system refers to a complex coordinated unit. An ecosystem is a basic functional ecological unit. It consists of living organisms (biotic factors) and non–living substances (abiotic factors). It is an interacting system where the biotic and abiotic factors interact to produce an exchange of materials between the living and non–living factors. An ecosystem is a sum total of living organisms, the environment and the process of interaction between and within all parts of the system (Mathavan, 1974). According to **Odum** an ecosystem is the basic fundamental unit of ecology which includes both the organisms and the non–living environment each influencing the properties of the other and each is necessary for the maintenance of life. Pond is a suitable example for ecosystem. Lake is another ecosystem. Other examples of ecosystem are river, estuary, ocean, forest, grassland, town etc.

(1) **Structure :** The structure of any ecosystem is formed of two components, namely :

(i) Abiotic factors (ii) Biotic factors

(i) **Abiotic factors :** The abiotic factors of an ecosystem include the non–living substances of the environment. eg. Water, soil, air, light, temperature, minerals, climate, pressure etc. The biotic factors of the ecosystem depend on the abiotic factors for their survival.

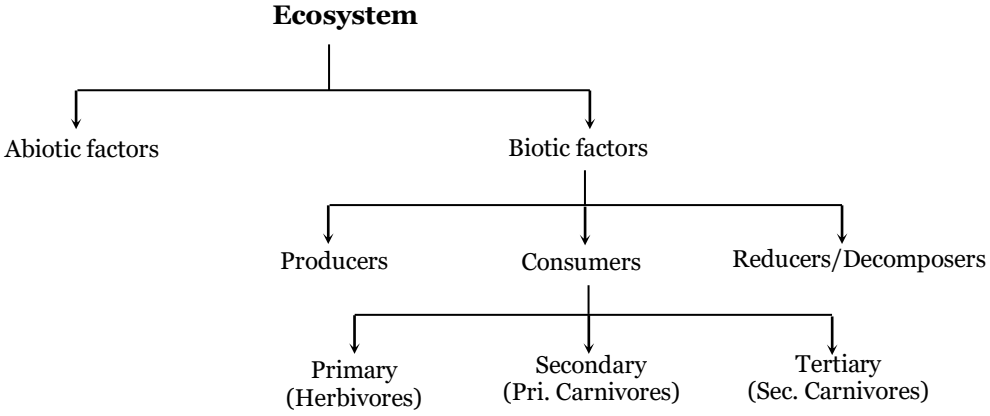
(ii) **Biotic factors :** The biotic factor include the living organisms of the environment. e.g. Plants, animals, bacteria, viruses etc. The biotic factors of an ecosystem are classified into three main groups, namely :

(a) Producers (b) Consumers (c) Reducers or Decomposers.

(a) **Producers :** The organisms which carry out photosynthesis constitute the producers of an ecosystem. eg. Plants algae and bacteria. The producers depend on the abiotic factors of the ecosystem for producing energy. They are provided with chlorophyll. Chloropyll is used in the synthesis of energy rich compounds with the utilization of abiotic factors like light, CO_2, water and minerals. A portion of the energy synthesized, is used by the producers for their growth and survival and the remaining energy is stored for future use.

(b) **Consumers :** Consumers are organisms which eat or devour other organisms. The consumers are further divided into three or more types. They are primary consumers, secondary consumers and tertiary consumers.

- **Primary consumers :** They eat the products like plants, algae and bacteria. The primary consumers are also called herbivores. Elton referred the herbivores as key industry animals. Rabbit, deer, etc., are primary consumers in a terrestrial ecosystem.



- **Secondary consumers :** They kill and eat the herbivores. They are also called carnivores. As these carnivores directly depend on herbivores, they are specifically called primary carnivores. Fox, wolf, etc. are the secondary consumers in a terrestrial ecosystem.

- **Tertiary consumers :** They kill and eat the secondary consumers. They are also called secondary carnivores. e.g., Lion, tiger, etc.

(c) **Reducers or Decomposers :** The decomposers are heterotrophs organisms that break up the dead bodies of plants and their waste products. They include fungi and certain bacteria. They secrete enzymes. The enzymes digest the dead organisms and the debris into smaller bits or molecules. These molecules are absorbed by the reducers. After taking energy, the reducers release molecules to the environment as chemical to be used again by the producers.

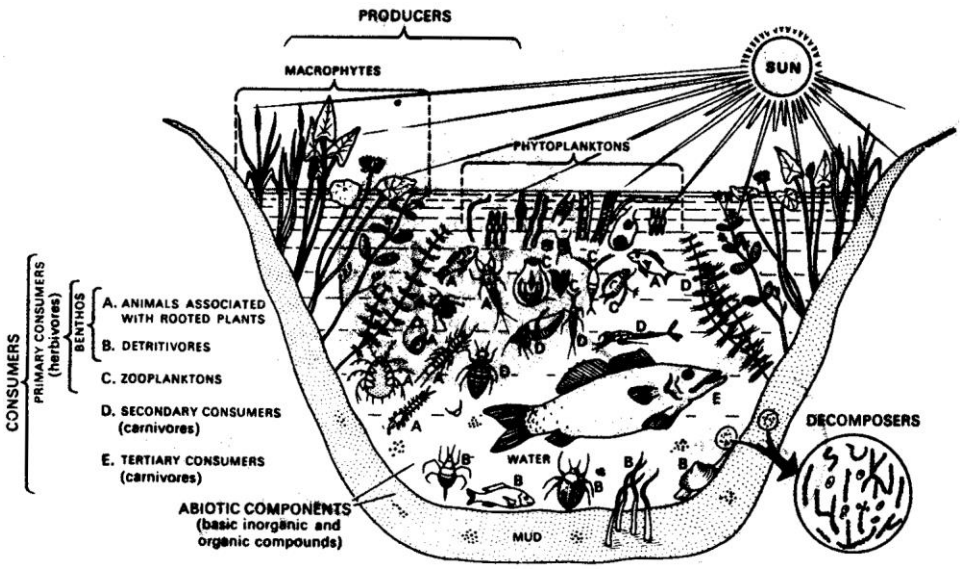
(2) **Typical ecosystem (Pond ecosystem) :** A pond is a suitable example for ecosystem. It is a lentic fresh–water ecosystem. It contains shallow standing water. The pond ecosystem is formed of abiotic factors and biotic factors.

(i) **Abiotic factors :** The abiotic factors of the pond ecosystem are water, CO_2, O_2 inorganic compounds, organic compounds, light, temperature, pressure, *pH* etc.

(ii) **Biotic factors :** The biotic factors of the pond ecosystem are producers, consumers and reducers.

(a) **Producers :** The producers synthesize the energy from abiotic substances. The producers of a pond include phytoplankton like diatoms, blue green algae (*Oscillatoria*), green algae, green flagellates (*Volvox, Euglena, Chlamydomonas*), rooted plants, submerged plants and floating plants.

(b) **Consumers :** Consumers eat other organisms. The organisms which depend on producers are called primary consumers or herbivores. e.g., Zooplankton (*Cyclops, Daphnia,* larvae of *Chironomus* etc), *Dysticus* (insect), *Lymnaea* (snail) etc. The primary consumers are eaten by the secondary consumers of carnivores. These carnivores are called primary carnivores because they are the first carnivores in the food chain. e.g., Small fishes, frogs etc. The secondary consumers are eaten by the tertiary consumers or secondary carnivores. e.g., large fish.



Pond ecosystem

(c) **Reducers or Decomposers :** The decomposers are organisms that break up the dead bodies of organisms and their waste products. They include microbes like bacteria. They secrete enzymes. The enzymes digest the dead organisms and the debris into smaller bits or molecules. These molecules are absorbed by the reducers. After taking energy, the reducers release molecules to the environment as chemical to be used again by the producers.

(3) **Types of ecosystem :** The ecosystem may be large, as large as the world or small, as small as a cow dung ecosystem. The biosphere of (The total life content of the world) is the major ecosystem. It comprises all other ecosystems.

(i) **Mega ecosystem :** The biosphere is formed of four mega ecosystems. They are as follows :

(a) **Marine ecosystem :** It is the largest ecosystem of earth. Fresh water ecosystem are two types :

- **Lotic :** Runing water ecosystem as river.
- **Lentic :** Still water ecosystem such as pond or lake. It includes saline-water ecosystems like oceans, seas, estuaries, brackish waters, etc.

(b) **Limnic ecosystem :** It includes all fresh water ecosystems like ponds, pools, lakes, rivers, streams, etc.

(c) **Terresrial ecosystem :** It includes the ecosystems of air, forests, grasslands, deserts, etc.

(d) **Industrial or Artificial ecosystems :** These are man made ecosystems. e.g., Crop land, city, town, etc.

(e) **Macro ecosystems :** The four mega ecosystem is further divided into sub units called macro ecosystems. e.g., Forests. The terrestrial macro ecosystem is formed of many forest ecosystems.

(f) **Meso ecosystem :** The macro ecosystem is further divided into meso ecosystem. For example, the forest ecosystem if formed of many meso ecosystems like deciduous forest, coniferous forests, etc.

(g) **Micro ecosystem :** The meso ecosystem is further divided into micro ecosystems, e.g., A low land in a forest, a mountain in a forest, etc. All ecosystems in the world are further divided into natural and artificial ecosystems.

(h) **Natural ecosystems :** These are self–regulating systems without much direct human interference and manipulations. e.g., Ponds, lakes, rivers, seas, oceans, grasslands, deserts, etc.

(4) **Dynamics of ecosystem :** The various components of the ecosystem constitute an interacting system. They are connected by energy, nutrients and minerals. The nutrients and minerals circulate and recirculate between the abiotic and biotic factors of the ecosystem several times. The flow of energy, on the other hand, is one way, once used by the ecosystem, it is lost. The continuous survival of the ecosystem depends on the flow of energy and the circulation of nutrients and minerals in the ecosystem. Thus the dynamics (functions) of the ecosystem includes the following :

(i) Energy (ii) Primary production (iii) Secondary production (iv) Food chain

(v) Food web (vi) Trophic levels (vii) Energy flow (viii) Ecological pyramids.

(i) **Energy :** Energy is the ability of do work. The flow of energy is unidirectional in the ecosystem. The main source of energy for an ecosystem is the radiant energy or light energy derived from the sun. The amount of solar radiation reaching the surface of the earth is 2 Cals/sq.cm/min. It is more or less constant and is called solar constant or solar flux. About 95 to 99% of the energy is lost by reflection. Plants utilize only 0.02% of the energy reaching earth. The light energy is converted into chemical energy in the form of sugar by photosynthesis.

$$6H_2O + 6CO_2 + \text{Light} \rightarrow 6C_6H_{12}O_6 + 6O_2$$

The sugar synthesized is utilized for many purposes :

- It can be converted into starch and stored.
- It combines with other sugars to form cellulose.
- It combines with inorganic substances (N_2, P, S) to form amino acids, protein, nucleic acids, pigments, hormones.
- Some amount of sugar is oxidised during respiration and the energy is released to do various functions.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}.$$

(ii) **Primary production :** Plants convert light energy into chemical energy in the form of sugar by photosynthesis. The total amount of sugar and other organic materials produced in plants per unit area per unit time is called gross primary production. During photosynthesis respiration is also going

on side by side. During respiration some amount of sugar is oxidised. Hence it is not easy to measure gross primary production. The total organic material actually present (biomass) in plants is called net primary production.

Net primary production = Gross primary production – Respiration. *i.e.*

$$Pn = Pg - R$$

Where, Pg = Gross primary production

$\therefore$ $Pg = Pn + R$ Pn = Net primary production

R = Respiration

Thus the amount of organic material produced during a given period of time per unit area is called primary production. The productivity is generally expressed in terms of grams or kilocalories per square meter per day or per year. If Pg equals R no storage of energy occurs. When *Pg* is less than *R*, productivity decreases. When *Pg* is greater then R, productivity increases.

Measurement of primary production : Primary production refers to the amount and the rate of energy produced by autotrophs. There are many methods to measure the primary production. They are the following :

(a) **Harvest method :** In this method the plants grown on a particular area are harvested at ground level and their weight is taken. They are dried and again weighed. This is done at regular intervals. The primary production is expressed in terms of biomass or mass per unit area per unit time.

(b) **Carbon-dioxide assimilation method :** Plants utilize carbon dioxide for photosynthesis. So the rate of photosynthesis can be calculated by calculating the amount of carbon dioxide utilized by plants per unit time. The incorporation of carbon dioxide in photosynthesis can be determined by using infrared gas analyzer. With the help of this analyzer, it is possible to measure the amount of carbon dioxide entering or leaving an air tight chamber of known volume.

(c) **Oxygen production method :** This method is used to measure primary production in aquatic ecosytem. In this method the amount of oxygen produced per unit time is taken as an index to measure the rate of photosynthesis. For this, light and dark bottle technique is used. Samples of water containing the autotrophs are collected in a light bottle (transparent bottle) and in a dark bottle. The light bottle allows light to enter in the same depth from which the sample is collected. After a certain period of time the amount of oxygen present in the two bottles is calculated by titration using sodium thiosulphate. (Winkler's method). In dark bottle photosynthesis does not occur but respiration occurs. In light bottle both respiration and photosynthesis occur. The rate of photosynthesis is calculated by calculating the amount of oxygen present in the two bottles.

(d) **Radio isotope method :** This method is similar to the oxygen producing method. In this method a known quantity of C^{14} is introduced into the light and dark bottles along with the sample and the bottles are suspended for six hours. During this period the C^{14} is incorporated into the protoplasm of

the autotrophs. The autotrophs are filtered and dried. After drying the radioactivity is measured. The amount of radioactivity is proportionate to the amount of carbohydrate produced.

(iii) **Secondary production :** The energy trapped by the producers (primary production) is utilized by the consumers. The producers are directly consumed by the herbivores that are eaten by the primary carnivores that in turn are consumed by the secondary carnivores. The consumers store some amount of energy in their tissues. This energy, stored by the consumers, is called secondary production. Only about 10 to 20% of the primary production is converted into secondary production. The remaining 80 to 90% is lost by the consumers in the form of faeces.

(iv) **Food chain :** The biotic factors of the ecosystem are linked together by food. For example, the producers form the food for the herbivores. The herbivores form the food for the carnivores. The sequence of the eaters being eaten is called food chain to another trophic level.

Producers → Herbivores → Carnivores

The various steps in a food chain are called trophic levels. Owing to repeated eating being eaten, the energy is transferred from one trophic level.

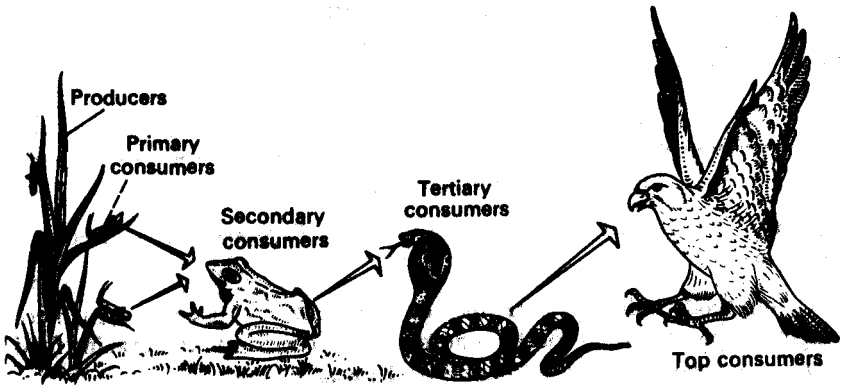
Phytoplankton → Zooplankton → Fishes → Snakes

Tr. L_1 Tr. L_2 Tr. L_3 Tr. L_4

Plants → Mouse → Snake → Hawk = Grassland

Plants → Goat → Man → Lion = Forest

This transfer of energy from one trophic level to another is called energy flow. A typical food chain can be seen in a pond ecosystem. The algae and phytoplakton are eaten by the zooplankton. The zooplankton are eaten by fishes which are eaten by snakes.



A food chain – 1. Producer grass 2. Primary consumer-grasshopper 3- Secondary consumer-Frog 4- Tertiary consumer-snake 5- Quaternary Top consumer-Owl

Types of food chains : The food chains are of two types, namely :

(a) Grazing food chain

(b) Detritus food chain

(a) **Grazing food chain :** This food chain starts from plants, goes through herbivores and ends in carnivores.

Plants → Herbivores → Primary Carnivores → Sec. Carnivores

This type of food chain depends on the autotrophs which capture the energy from solar radiation. A few chains are given below :

Grass → Grasshopper → Lizard → Hawk

Grass → Mouse → Snake → Hawk

Phytoplankton → Zooplankton → Fish → Snake.

The grazing food chain is further divided into two types, namely :

- **Predator chain :** In predator food chain one animal captures and devours another animal. The animal which is eaten is called prey and the animal which eats other animals is called predator. The predator food chain is formed of plants, herbivores, primary carnivores, secondary carnivores and so on.

- **Parasitic chain :** The plants and animals of the grazing food chain is infected by parasites. The parasites derive their energy from their hosts. Thus the parasitic chain within the grazing food chain is formed.

(b) **Detritus food chain :** It starts from dead organic matter and ends in inorganic compounds. There are certain groups of organisms which feed exclusively on the dead bodies of animals and plants. These organisms are called detritivores. The detritivores include algae, bacteria, fungi, protozoans, insects, millipeds, centipeds, crustaceans, mussels, clams, annelid worms, nematodes, ducks, etc. These organisms ingest and digest the dead organic materials. Some amount of energy is trapped and the remainder is excreted in the form of simple organic compounds. These are again used by another set of detritivores until the organic compounds are converted into CO_2 and water.

Dead organic materials → Detritivores → $CO_2 + H_2O$

Linking of grazing and detritus food chains – The two main food chains can not operate independently. They are interconnected at various levels. According to Wilson and Bossert (1971) the stability of the ecosystem is directly proportional to the number of such links. The detritus feeders obtain energy from the dead bodies of animals and plants which are components of the grazing food chain. Again some of the detritus feeders are eaten by the consumers of the grazing food chain. For example, in a pond ecosystem earthworms belonging to the detritus food chain are eaten by fishes belonging to the grazing food chain.

(v) **Food web :** In an ecosystem the various food chains are interconnected with each other to form a net work called food web. The interlocking of many food chains is called food web. Simple food chains are very rare in nature. This is because each organism may obtain food from more than one tropic level. In other words, one organism forms food for more than one organisms of the higher trophic level.

Examples : In a grassland ecosystem, grass is eaten by grasshopper, rabbit and mouse. Grasshopper is eaten by lizard which is eaten by hawk. Rabbit is eaten by hawk. Mouse is eaten by snake which is eaten by hawk. In addition hawk also directly eats grasshopper and mouse. Thus there are five linear food chains which are inter connected to form a food web.

- Grass → Grasshopper → Hawk

- Grass → Grasshopper → Lizard → Hawk
- Grass → Rabbit → Hawk
- Grass → Mouse → Hawk
- Grass → Mouse → Snake → Hawk

This is a very simple food web. But in any ecosystem the food web is more complex. For example, in the grassland itself, in addition to hawk, there are many other carnivores such as vulture, crow, fox, man, etc.

Significance of food web : Food webs are very important in maintaining the stability of an ecosystem. For example, the deleterious growth of grasses is controlled by the herbivores. When one type of herbivores increase in number and control the vegetation. Similarly, when one type of herbivorous animal becomes extinct, the carnivore predating on this type may eat another type of herbivore.

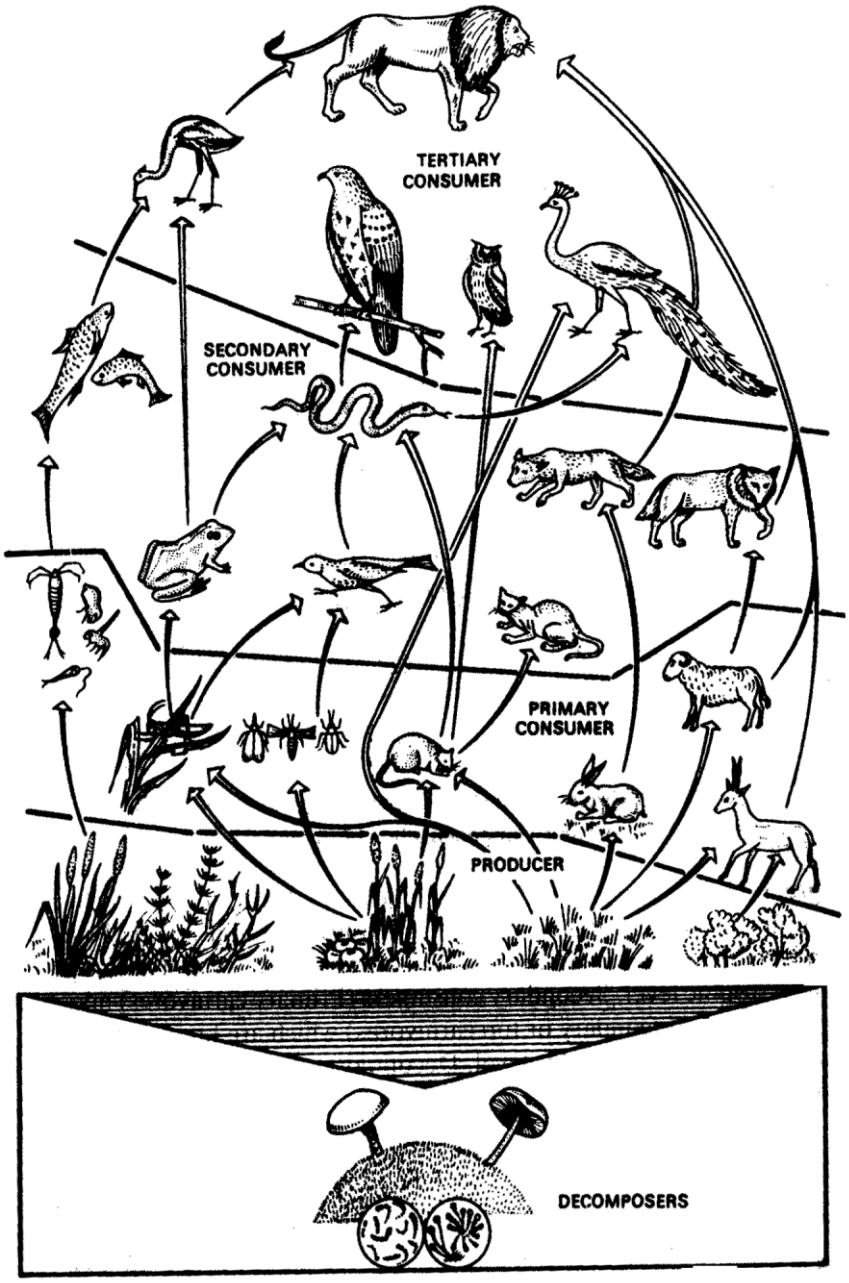


Fig : Food web in a grassland ecosystem (Producers, Herbivores, Carnivores)

(vi) **Trophic levels :** Each food chain contains many steps like producers, herbivores, primary carnivores and so on. Each step of the food chain is called trophic level. The number of trophic levels in a food chain in restricted to 5 or 6. Green plants make first trophic level.

$T_1 \rightarrow$ Producers – (Trees, Plants, Grass)

C_1 or T_2 – Herbivorous – (Cow, Grass hopper, Zooplankton)

C_2 or T_3 – Primary carnivorous (Dog, Frog, Lizard)

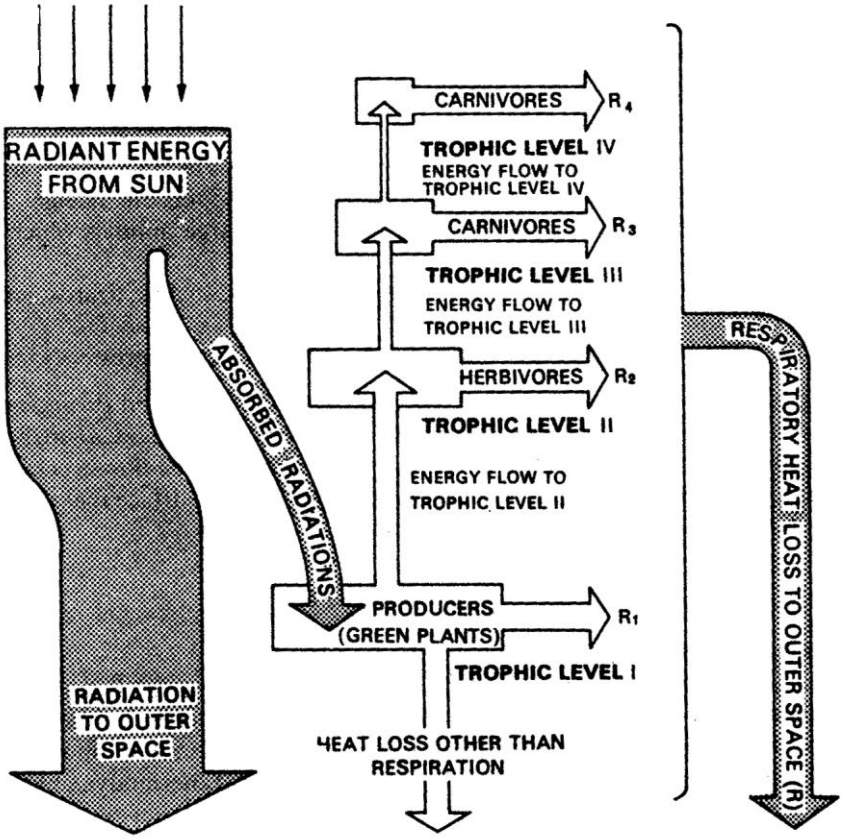
C_3 or T_4 – Secondary carnivorous (Hawk, Fox, Snake)

C_4 or T_5 – Tertiary carnivorous or Top carnivorous (Tiger, Lion, Man)

Phytoplankton $\rightarrow$ Zooplankton $\rightarrow$ Fishes $\rightarrow$ Snakes

Tr. L_1 Tr. L_2 Tr. L_3 Tr. L_4

(vii) **Energy flow :** The transfer of energy from one trophic level to another trophic level is called energy flow. The flow of energy in an ecosystem is unidirectional. That is, it flows from the producer level to the consumer level and never in the reverse direction. Hence energy can be used only once in the ecosystem. But the minerals circulate and recirculate many times in the ecosystem. A large amount of enregy is lost at each trophic level. It is estimated that 90% of the energy is lost when it is transferred from one trophic level to another. Hence the amount of energy available decreases from step to step. Only about 10% of the biomass is transferred from one trophic level to the next one is a food chain. And only about 10% chemical energy is retained at each trophic level. This is called 10% law of Lindeman (1942). When the food chain is short, the final consumers may get a large amount of energy. But when the food chain is long, the final consumer may get a lesser amount of energy. As shown in the figure. about 3000 K cal of light falls on the green plants. Of this approximately 50% (1500 K cal) is absorbed. Of the 50% only 1% (15 K cal) is converted at the first trophic level. Thus the net primary



Energy flow diagram: L = Total light, La = Absorbed light, PG = Gross production, PN = Net production, I = Energy intake, A = Assinilated energy, NA = Non assimilated energy, NV = Unused energy, R = Respiratiory energy loss. Bottom line shows the order of magnitude of energy losses expected or major transfer points starting with the solar in put of 3000 Kcal per square meter per day (ODUM 1963)

production is merely 15K cals. Secondary productivity (P_2 and P_3) is 10% (1.5 K cal & 0.3 K cal) at the herbivores and carnivores level.

(viii) **Ecological pyramids :** The number, biomass and energy of organisms gradually decrease from the producer level to the consumer level. This can be represented in the form of a pyramid called ecological pyramid. Ecological pyramid is the graphic representation of the number, biomass, and energy of the successive trophic levels of an ecosystem. The use of ecological pyramid was first described by Charles Elton in 1927. In the ecological pyramid, the producer forms the base and the final consumer occupies the apex. There are three types of ecological pyramids, namely :

(a) **The pyramid of number :** The number of individuals at the trophic level decreases from the producer level to the consumer level. That is, in an ecosystem the number of producers is far high. The number of herbivores is lesser than the producers. Similarly, the number of carnivores is lesser than the herbivores.

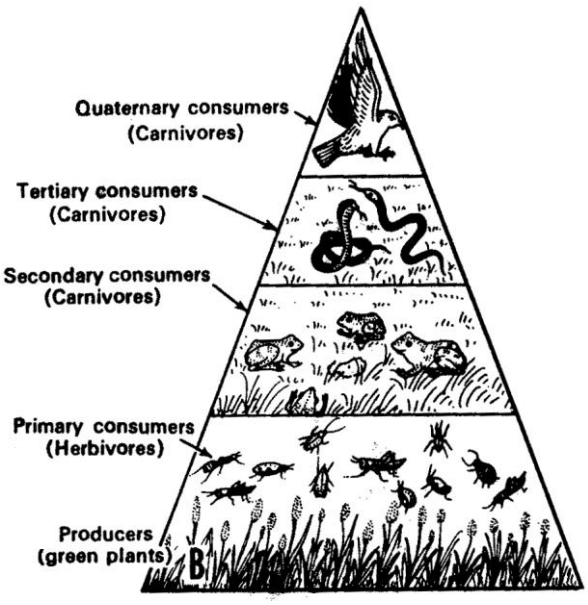


Fig : Pyramid of numbers in a cropland ecosystem

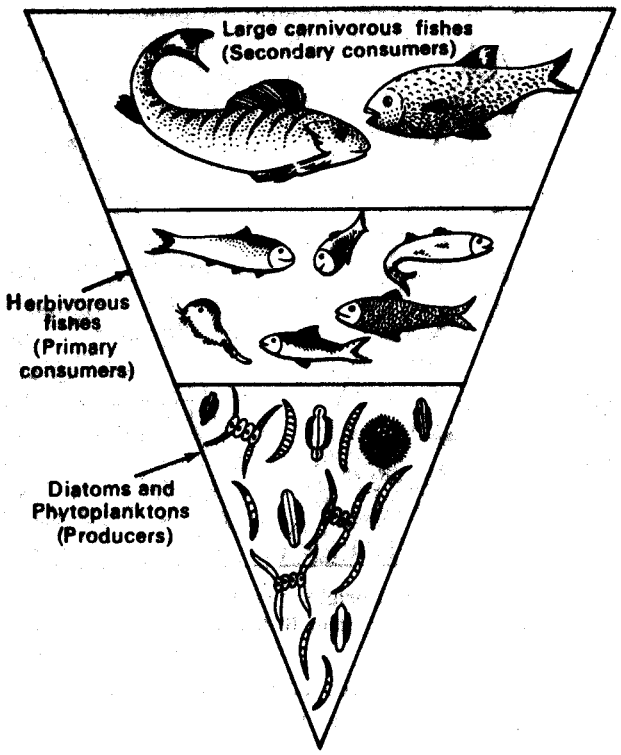


Fig :Pyramid of numbers in a pond ecosystem

- **In a cropland ecosystem :** In croplands the crops are more in numbers. The grasshoppers feeding on crop plants are lesser in number. The frogs feeding on grasshopper are still lesser in number. The snakes feeding on frogs are fewer in number.

Crop → Grasshopper → Frogs → Snakes → Hawks

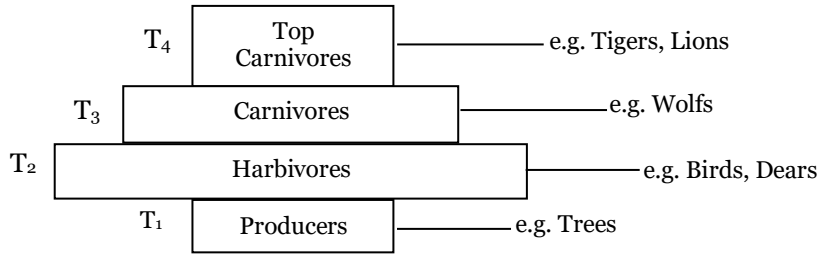
- **In a grassland ecosystem :** In a grassland the grasses are there in large numbers. The consumers decrease in the following order.

Grass → Grasshopper → Lizard → Hawk

Grass → Rabbit → Fox → Lion

- **In a pond ecosystem :** The number in a pond ecosystem decreases in the following order.

Phytoplankton → Zooplankton → Fishes → Snakes



In Forest Ecosystem the pyramid of number is Rhomboidal in shaped

(b) **The pyramid of biomass :** Biomass refers to the total weight of living matter per unit area. In an ecosystem the biomass decreases from the producer level to the consumer level.

- **In a grassland :** In a grassland the biomass of grasses is the maximum, and it gradually decreases towards the consumer level in the following order.

Grass → Mouse → Snake → Hawk

Grass → Grasshopper → Lizard → Hawk

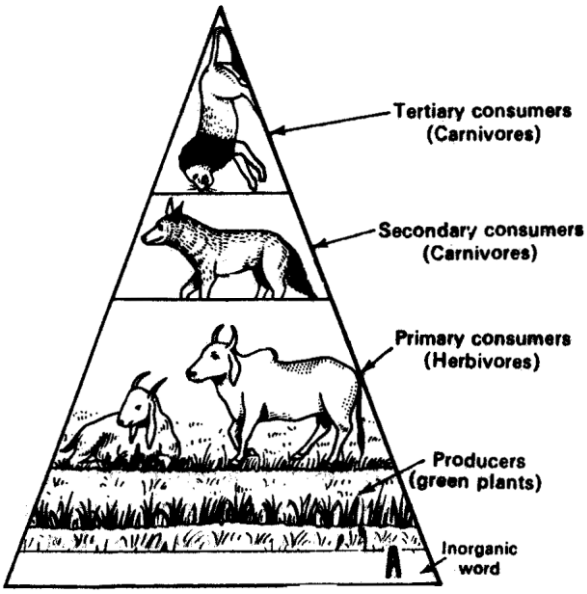


Fig : Pyramid of biomass in a grassland ecosystem

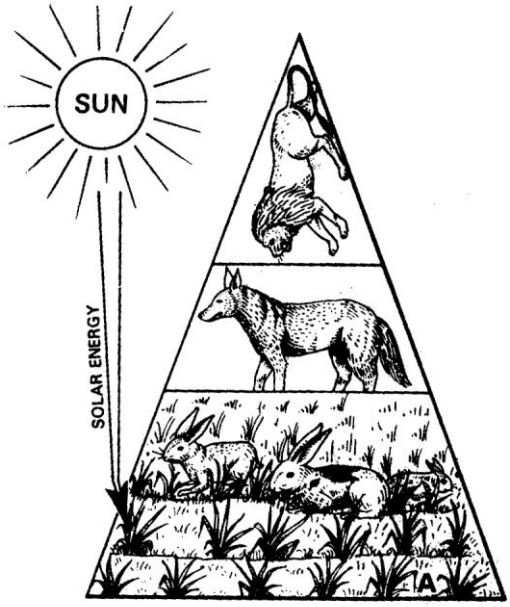


Fig :Pyramid of energy in a forest ecosystem

- **In a forest :** In a forest the biomass or trees is the maximum and the biomass of the top consumer is the minimum. The decrease in weight occurs in the following order :

Plants → Deer → Fox → Tiger

Plants → Rabbit → Fox → Lion

(c) **Pyramid of energy :** The energy flow in an ecosystem from the producer level to the consumer level. At each trophic level 80 to 90% of energy is lost. Hence the amount of energy decreases from the producer level to the consumer level. This can be represented in a pyramid of energy level to the consumer level. This can be represented in a pyramid of energy.

- **In a grassland :** In a grassland green plants trap the maximum light energy. The energy gradually decreases towards the top consumer level.

Grass → Grasshopper → Lizard → Hawk

Grass → Rabbit → Fox → Lion

Grass → Mouse → Snake → Hawk

- **In a pond :** In a pond maximum energy is trapped by the phytoplankton. Then the amount of energy decreases towards the top–consumer level.

Phytoplankton → Zooplankton → Fish → Snake

Phytoplankton → Zooplankton → Small fish → Large fish

❑ **Inverted pyramids :** In most of the ecosystems the number and biomass of producers are more and those of consumers are less. This type of ecosystem has a pyramid where the apex is pointed upwards. This type of pyramid is called upright pyramid. In some ecosystems the number and the biomass of the producers are less and those of consumers are more. This type of ecosystem producers a pyramid where the apex is directed downwards. This type of pyramid is called inverted pyramid. Inverted pyramid occurs in number and biomass. The pyramid of energy is always upright.

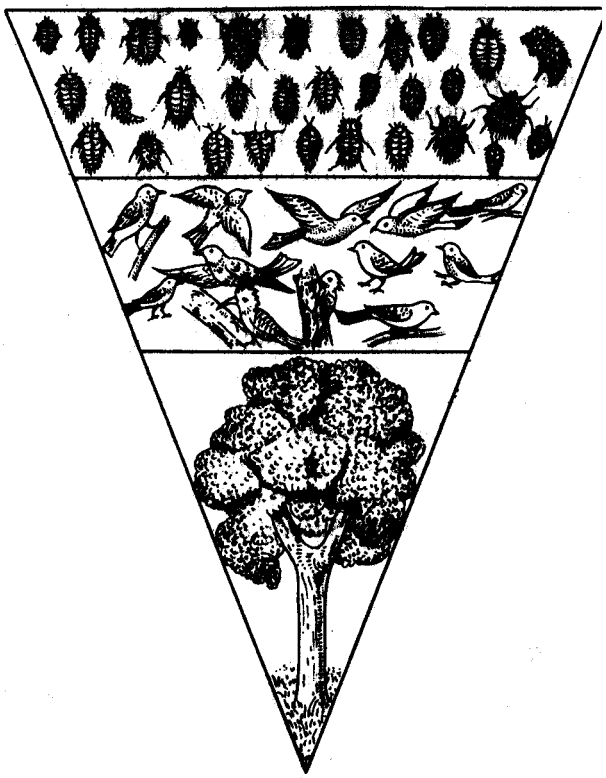


Fig : Inverted pyramid of numbers in a tree ecosystem

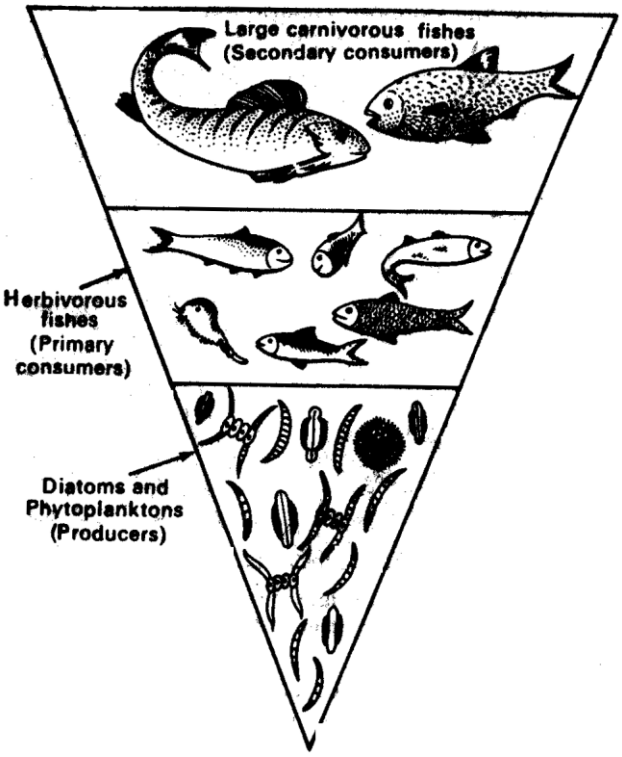


Fig : Inverted pyramid of biomass in a pond ecosystem

- **Inverted pyramid of numbers :** When the ecosystem contains lesser number of producers and more number of consumers, the pyramid will be inverted in shape. Inverted pyramid occurs in a tree ecosystem. A single tree (producer) contains many fruit eating birds (primary consumers). The birds contain numerous parasites (secondary consumers).
- **Inverted pyramid of biomass :** When the biomass of producers is less and that of consumers is more the pyramid will have inverted shape. It occurs in a pond or lake ecosystem. Here the biomass of diatoms and phytoplankton are negligible as compared to that of crustaceans and small fishes.

1.6 Biome

(1) **Definition :** Each of the major terrestrial ecosystems or distinctive terrestrial areas with their group of climax plants and associated animals constitutes biomes. A biome is the largest terrestrial community. Rainfall, temperature range, nature of soil, barriers, latitude and altitude determine the nature and extent of biomes.

(2) **Major biomes of world :** Biomes are often classified in seven categories :

(i) Tropical rain forests (ii) Savannahs (iii) Deserts

(iv)Temperate grasslands

(v) Temperate deciduous forests (vi) Taiga (vii) Tundra

(i) **Tropical rain forests :** The tropical rain forest, a biome occurs in regions of high temperature (average 25°C) and high rainfall (200-450 *cm* per year). These tropical rain forests occur in Central America, around Amazon basin in South America, in Africa and in South-East Asia.

(a) This biome is characterized by multistoried vegetation (upto five distinct layers or storeys of vegetation). Further maximum biodiversity on land is shown by this biome and it is estimated that one half to two-thirds of all species of terrestrial plants and insects live in tropical forests.

(b) Lianas (vascular plants rooted in soil and they only get support of trees for climbing to top) and epiphytes (air plants) are common in this biome due to excess of moisture. Further giant trees of the tropical forest support a rich and diverse community of animals on their branches.

(c) No one species dominates in this biome.

(d) The productivity of this biome is maximum.

(e) The trees of this biome posses buttressed trunks and phenomenon of cauliflory (presence of flowers and fruits on main trunk and main branches) is common in this biome.

(ii) **Savannahs :** Like tropical forests, savannahs are found near the equator but in areas having less annual rainfall (90-150 *cm*/*year*). Some areas near the equator experience prolonged dry seasons. The heat, periodic dryness and poor soils cannot support a forest but have led to evolution of tropical open grasslands with scattered shrubs and trees.

(a) The vegetation of this biome support large grazing herbivores like buffalo, zebra, etc., which are food for carnivores like lions, tigers, etc. The savannah also supports a large number of plant eating invertebrates like mites, grasshoppers, ants, beetles and termites.

(b) The termites are one of the most important soil organisms in savannahs.

(c) Indian tropical grasslands are not true savannahs but these are the result of destruction and modification of tropical deciduous forests by cutting, grazing and fire.

(iii) **Deserts :** These are the biomes that have 25 *cm* (10 inches) or less of precipitation annually.

(a) Sahara of North Africa, Thar of West Asia and Gobi of Asia are most important deserts.

(b) Annual plants are abundant in deserts and tide over unfavourable dry season in the form of seeds. Succulent plants are characteristics of deserts. Trees and shrubs present in deserts have deep roots.

(c) Desert animals have also fascinating adaptations that enable them to adjust with limited water supply.

(d) Desert plants show phenomenon of Allelopathy, i.e., they secret some chemical substances which inhibit the growth of plants growing in their near vicinity.

(e) Deserts show poor biodiversity and their productivity is minimum.

(iv) **Temperate grasslands :** Temperate grasslands experience a greater amount of rainfall than deserts but a lesser amount than savannahs. They occur at higher latitudes than savannahs but like savannahs are characterized by perennial grasses and herbs of grazing mammals.

(a) Temperate grasslands have different names in different parts of the world, e.g., Prairies of North America, Steppes of Russia, Veldts of South Africa, Pampas of South America, Pusztas of Hungary and Tussocks of New Zealand.

(v) **Temperate deciduous forests :** Temperate deciduous forests occur in areas having warm summers, cold winters and moderate amount of precipitation (75 – 150 *cm* annually). The trees of this forest loose their leaves during autumn and remain dormant throughout winter (term 'deciduous' derived from Latin word meaning 'to fall'). These forests are present in Eastern United States, Canada and extensive region in Eurasia.

(a) In temperate forest biome, there is an upper canopy of dominant trees like beech, oak, birch, maple, etc. followed by lower tree canopy and then a layer of shrubs beneath.

(b) Animal life in this biome is abundant on the ground as well as on the trees.

(vi) **Taiga :** The taiga or northern coniferous forests or boreal forests consist of evergreen, cone bearing trees like spruce, hemlock and fir and extend across vast areas of Eurasia, and North America.

(a) The taiga is characterized by long, cold winters with little precipitation.

(b) The harsh climate limits productivity of the taiga community. The cold temperatures, very wet soil during the growing season and acids produced by fallen conifers needles and *Sphagnum* inhibit full decay of organic matter, due to which thick layers of semidecayed organic material called peat is formed, which acts as energy source.

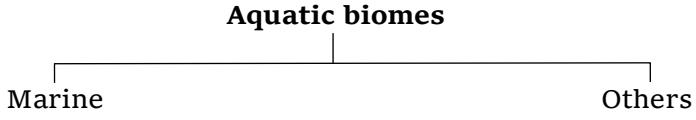
(vii) **Tundra :** The tundra encircles the top of the world. This biome is characterised by desert like levels of precipitation (less than 25 *cm* annually), extremely long and cold winters and short warmer summers.

(a) Tundra is uniform in appearance and is dominated by scattered patches of grasses, sedges and lichens. Some small trees do grow but are confined to margins of streams and lakes (In general treeless).

(b) Tundra is a biome of low diversity and low productivity.

(c) The precipitation that falls remains unavailable to plants for most of the year because it freezes. During the brief arctic summer, some of the ice melts and permafrost (or permanent ice) found about a meter down from the surface, never melts and is impenetrable to both water and roots. However, the alpine tundra found at high elevation in temperate or tropical regions does not have this layer of permafrost.

(3) **Indian biomes :** Indian forests are classified into three major types based on temperature are tropical, temperate, alpine.



(i) **The marine environment :** It is characterized by its high concentration of salt (about 3.5 percent in open sea) and mineral ions (mostly sodium and chloride followed by sulphur, magnesium and calcium).

(a) The vertical zones of the ocean are determined on the basis of availability of light for photosynthesis. The lighted upper 200 metres form the photic or euphotic zone. The next zone upto the depth 200–2000 metres gets less light which is insufficient for photosynthesis form the aphotic zone. Below 2000 metre is the area of perpetual darkness, the abyssal zone.

(b) Three major environments may be recognized in the ocean basin :

- **The littoral zone :** The sea floor from the shore to the edge or the continental shelf.
- **The benthonic zone :** The sea floor along the continental slope and the aphotic and abyssal zone.
- **The pelagic zone :** Constituting the water of the ocean basin.

❑ **Marine life : It can be grouped into three main categories :**

- **Plankton :** These are passively drifting or floating organisms. Most of these minute organisms, plankton includes photosynthesizing organisms like diatoms (phytoplankton) as well as heterotrophic organisms like small crustaceans (zooplanktons).
- **Nektons :** These consist of actively moving organisms with well developed locomotory organs.
- **Benthonic organisms :** These are found along the floor of the sea bed and include creeping, crawling or sessile organisms.

(ii) **Other (Lakes and Ponds) :** Lakes and ponds are stagnant fresh water bodies and are found practically in every biome. Many lakes are direct or indirect result of glaciation. Others are natural or man made depression filled with water. The relatively shallow lakes, called eutrophic lakes, have a rich accumulation of organic products e.g., Dal lake of Kashmir. Generally deep lakes, often with the steep and rocky sides, are poor in circulating nutrients like phosphates. These are called oligotrophic lakes. Some of the lakes contain a saline or brackish water (Sambar lake of Rajasthan).

Biosphere

All the thousands of ecosystems together constitute the biosphere, which exists as a thin envelope around the earth's surface. The global environment consists of three main sub division :

(1) **Hydrosphere :** All the water (liquid) component of the oceans, seas, rivers and other island water bodies.

(2) **Lithosphere :** The solid components of the earth crust, rocks, soil and minerals.

(3) **Atmosphere :** The gaseous cover which envelops the hydrosphere and the lithosphere and the atmosphere. The entire inhabited part of the earth and its atmosphere (including the living and the non-living components) forms the biosphere.

As a result of manipulation by man, the biosphere has become transformed into a human dominated environment of noosphere (*noo* = mind).

(4) **The concept of biosphere :** It has been evolved by the man and biosphere programme (MAB) of the UNESCO. India has identified 14 areas as biosphere reserves. Of these, the Nilgiri biosphere reserve, including parts of Karnataka, Kerala and Tamil Nadu, was declared in 1986 (first one) and the Nanda Devi biosphere reserve in 1988.

Important Tips

- The word 'ecosystem' was coined by A.G. Tansley in 1935.
- Energy is the ability of do work. The flow of energy is unidirectional in the ecosystem.
- The main source of energy for an ecosystem is the radiant energy derived from the sun.
- The energy trapped by the producers is utilized by the consumers.
- Every food chain contains levels like producers, herbivores, primary carnivores and soon. Each level is termed as "Trophic–level".
- The number of trophic levels in a food chain cannot be more than 5 or 6.
- The pyramid of energy is always upright.
- Upright pyramid occurs in energy number and biomass.
- **Flora :** A list of all different types of plants exist in an area. Biosphere whole of the environment (including atmosphere, Lithosphere and hydrosphere) where life exists.
- **Biome:** large ecosystem which are always characterised by certain specific geographic features are called biomes.
- Tundra biome is called treeless biome.
- Tropical deciduous forest extends in largest area in M.P.
- **In Detritus :** ecosystem, producers are absent.
- **Ecotone :** The zone of transition between two nearby ecosystems is called an ecotone.
- Stability of an ecosystem depends upon diversity. Croplands are mostly monocultures and lack diversity.
- The scientific study of lakes is known as limnology.
- Ecotone is the transitional zone between two vegetation regions.
- There is the highest species diversity in tropical rain forest ecosystem.
- Forest occupy 40% of land is world. In India forests occupy only 22.8% of land area.
- Energy content are determined by igniting the plant contents in O_2 bomb calorimeter.
- Lindemann gave the low of 10% for energy flow (10% energy transfer law).
- The species which are restricted to small areas are called endemic.

1.7 Environmental pollution

According to **Odum** pollution is an undesirable change in the physical, chemical or biological characteristics of our air, land and water that will harmfully affect the human life and the desirable species so that may waste or deteriorate our raw material resources. Pollution is the deliberate or accidental contamination of the environment with man's waste. Pollution is defined as matter in the

wrong place. Pollution produces bad effects on ecological (environmental) balance substances which cause pollution are called pollutants there are two categories :

❑ **Biodegrodable Pollutant :** These pollutant can be decompose by micro–organisms. However if they are released in large amount then they begin to accumulate in environment. When their concentration crosses a critical limit then they become toxic and start acting as pollutants.

❑ **Non–biodegradable pollutant :** These pollutant can not be decomposed by micro–organism. e.g., DDT, BHC, Aldrin, Plastics, *Hg*, Salfs Polythene. These pollutants are continiously accumulating in our environment.

Types of pollution : Pollution is classified into the following types :

(1) Air pollution (2) Water pollution (3) Land pollution (4) Noise pollution (5) Thermal pollution.

(1) **Air Pollution :** Air pollution refers to the undesirable change occurring in air causing harmful effects on man and domesticated species.

(i) **Air Pollutants :** The common air pollutants are : Dust, Smoke, Carbon monoxide (CO), Ammonia (NH_3), Sulphur dioxide (SO_2), Hydrogen sulphide (H_2S), Nitrogen dioxide (NO_2), Hydrogen cyanide, Hydrogen fluorides, Chlorines, Phosgenes, Arsines, Aldehydes, Ozone, Ionising and radiations. CO_2 is not a normal air pollutant. There is 0.03% CO_2 in the air its higher percentage is the cause of green house effect.

Types of air pollutants : It is two types :

(a) **Primary air pollutants :** Air is polluted by poisonous gases and undesirable substances. They are released by burning fossil fuels. These substances are called primary air pollutants. The primary air pollutants are the following :

- Soot released from unburned fuel.
- Sulphur dioxide (SO_2).
- Benzopyrene (hydrocarbon) released from cigarette smoke.
- Ammonia (NH_3).
- Oxides of nitrogen.
- Carbon monoxide (CO).
- Lead (Pb).

(b) **Secondary air pollutants :** Secondary air pollutants are poisonous substance formed from primary air pollutants. In bright sun light nitrogen, nitrogen oxides, hydrocarbons and O_2 interact to produce more powerful photochemical oxidants like ozone (O_3), peroxyacetyl nitrate (PAN), aldehydes, sulphuric acid, peroxides, etc. All these constitute photochemical smog, which retard photosynthesis in plants.

(ii) **Causes of air pollution**

(a) **Agriculture :** Hydrocarbons released by plants, pollen grains, insectisides etc. cause air pollution.

(b) **Dust :** Dust in the air is increased by dust storms wind, volcanoes, automobiles, etc.

(c) **Industries :** Combustion of fossil fuels like coal, petroleum, etc. Industrial smoke is the main source of pollution.

(d) **Automobiles :** The combustion of petrol and diesel in automobiles releases harmful gases into the air. They also produce dust.

(e) **Ionising radiations :** Ionizing radiations include alpha particles, beta particles and gamma rays. They are released into the air on testing atomic weapons.

(f) **Freons :** Use of freons and other chloro-fluoro-carbon compounds in refrigerants, coolants and as filling agents in aerosol also cause pollution.

(g) **Aerosols :** Aerosols are small particles of all sorts of solid or liquid substances suspended in the air. They block the stomata of plants and prevent the gaseous exchanges between plants and atmosphere. They may also change the climate of an area.

Biological Indicators : Some plants are sensitive to certain air pollutants. These plants are used to indicate the presence of these substances. These plants are called biological indicators. e.g.,

- The tissues present in the tip of dusheri mango turns black when they are exposed to sulphur dioxide (SO_2) fumes.
- Pinto beans and *Petunias* are used to indicate the presence of peroxy acetyl nitrate (PAN).
- Tobacco and annual blue–grass plants are used to show the presence of ozone (O_3). Lichens are biological indicaters of air pollution caused by SO_2.

(iii) **Ecological effects of air pollution**

(a) **Death :** When air is polluted with poisonous gases, death comes as a result immediately. Bhopal episode is a good example. Bhopal episode – On 2nd December 1984 about 3000 human beings died, about 5000 paralysed and thousands of cattles, birds, dogs and cats died in one night at Bhopal. This mass death is due to the leakage of methyl isocyanate (toxic gas) into the air from an insecticide plant managed by Union Carbide Corporation.

(b) **Chlorosis :** The disappearance of chlorophyll is called chlorosis. It is caused by SO_2, nitrogen dioxide, ozone and fluorides.

(c) **Necrosis :** The breakdown of cells is called necrosis. It is caused by SO_2, nitrogen dioxide, ozone and fluorides.

(d) **Green house effect :** CO_2 is released into the air by the combustion of fuels. It is estimated that CO_2 content of the air is increasing at the rate of 0.4% per annum. This will result in an appreciable warming up of the earth. This is called green house effect. It is very likely that this will cause the melting of polar ice caps resulting in a rise of nearly 60 feet on the sea level. Coastal regions and low lying areas all over the world will be go under water.

- Not only CO_2 but CFC and to some extent methane and oxides of nitrogen disturb the temperature of earth hence they all are described as green houses gases.
- 3.0 *pH* has been recorded in acid rain.

(e) **Crop losses :** Heavy loss of crop is caused by smog. Smog denotes a combination of smoke and fog. The important components of smog are ozone and PAN (peroxy acetyl nitrate). They damage leafy vegetables, cereals, textile crops, ornamental plants, fruits and forest trees.

(f) **Respiratory disorders :** Excessive ethylene accelerates respiration causing premature senescence (old age) and abscission (accumulation of yellow fluid (pus) in the body). Aldehydes irritate nasal and respiratory tracts. Chlorine and phosgenes (carbonyl chloride) cause pulmonary oedema. Bronchitis is another bad effect of air pollution.

(g) **Nausea :** H_2S smells like rotten eggs and causes nausea.

(h) **Vomiting :** SO_2 causes vomiting.

(i) **Jaundice :** Arsines induce RBC breakdown and jaundice.

(j) **Oxygen carrying capacity :** CO reduces O_2 carrying capacity of RBC by its permanent combination with haemoglobin.

(k) **Coughing :** Coughing is induced by phosgenes (carbonyl chloride).

(l) **Headache :** SO_2 causes headache.

(m) **Cancer :** Cancer is caused by air pollutants like ash, soot, smoke, chromium, nickel and readioactive elements.

(n) **Mutation :** Radioactive elements produce mutation. Ozone produces chromosomal aberrations.

(o) **Cardiac diseases :** Cadmium causes high blood pressure and heart diseases.

(p) **Pneumonia :** Pneumonia is caused by breathing in too much of manganese particles.

(q) **Depletion of Ozone umbrella :** In the atmosphere, about 30 *km* above the surface of the earth, the ozone molecules (O_3) form an umbrella. It prevents the penetration of harmful ultra violet radiation from the sun and thus protects the life of the earth. It is now feared that there is danger of depletion of the ozone umbrella, which may occur by the use of freons and other CFC-compounds in refrigerants, coolants in domestric refrigenrators and cold storage facilities, and as filling agents in the form of plastics and in aerosol packages. On reaching the ozone umbrella, they destroy ozone molecules as a result of photochemical reactions. Over the past 16 years, the density of the ozone layer has been diminishing at an average rate of 3%. It is calculated that the depletion of ozone layer by 1% results in an increase in the incidence of skin cancer by 5% to 7%. A hole in O_3 layer has been discovered in Antarctica.

(r) **Acid rain :** One of the major environmental issues facing human society at the national and international level is the problem of rain water having low *pH*. The rainwater is always slightly acidic as CO_2 in the atmosphere gets dissolved in it. However during recent years, it has been noted a further lowering of *pH* of rain water often as low as 2.4. This lowering of *pH* is due to the dissolution of acids in the rain water. Precipitation of oxides of sulphur and nitrogen with rain is termed acid rain. Acid rain is caused by air pollution. When atmospheric air contains sulphur dioxide (SO_2) and oxides of nitrogen such as nitrous oxide (N_2O) and nitric oxide (NO), they dissolve in rain water forming sulphuric acid and nitric acid. The rain water falls as acid rain. The main source of releasing oxides of sulphur and nitrogen are the power plants based on coal and oil. They contribute more than 60% of all

sulphur oxides and 25 to 30% of nitrogen oxides in the atmosphere. Automobiles make a substantial contribution in large cities. Ozone is now recognised as a major factor in the formation of acid rain.

Acid rain affects both materials and organisms. It attacks building materials principally sandstone, limestone, marble, steel and nickel. In plants, it leads to chlorosis (gradual yellowing in which the chlorophyll making mechanism is impeded) or depigmentation of leaves. The concentration of SO_3 in atmosphere is around 0.01 ppm.

Acid rain increases the acidity of lakes and rivers. Vast tracts of forests and lakes in Europe and North America have been destroyed by acid rain. Acidity kills fish, bacteria and algae and the aquatic ecosystem collapses into sterility leaving a crystal clear but ultimately a dead lake.

(iv) **Control of air pollution**

(a) The emission of exhaust from automobiles can be reduced by devices such as positive crankcase ventilation valve and catalytic converter.

(b) Electrostatic precipitators can reduce smoke and dust from industries.

(c) Gaseous pollutants arising from industries can be removed by differential solubility of gases in water.

(d) A finepray of water in the device called scrubber can separate many gases like NH_3, SO_2, etc. from the emitted exhaust.

(e) Certain gases can be removed by filtration or absorption through activated charcoal.

(f) Certain gases can be made chemically intert by chemical conversion.

(g) At the Government level pollution can be controlled by framing legislations.

(h) Vehicles based on compressed natural gas (CNG) should be introduced.

(2) **Water Pollution :** Water pollution refers to the undesirable change occurring in water which harmfully affect the life activities of man and domesticated species.

(i) **Water Pollutants :** The common water pollutants are : Domestic sewage, Industrial effluents, Pesticides, Herbicides, Fertilizers, Bacteria and Viruses, Plankton blooms and Heavy metals like Mercury, Temperature, Silt, Radioactivity, Oils etc.

(ii) **Causes of water pollution**

(a) **Domestic sewage :** Domestic sewage consists of human faces, urine, and the dirty used–up water in houses. It contains a large number of bacteria and virus. The sewage is released into the rivers on the banks of which most of the cities are situated.

(b) **Industrial effluents :** All industrial plants produce some organic and inorganic chemical wastes. Those nonusable chemical are dumped in water as a means of getting rid of them. The industrial wastes include heavy metals (*Hg, Cu,* lead, zinc etc), Detergents, Petroleum, Acids, Alkalies, Phenols, Carbonates, Alcoholcyanides, Arsenic, Chlorine, etc.

(c) **Thermal pollution :** Many industries use water for cooling. The resultant warm water is discharged into rivers. This brings about thermal pollution.

(d) **Agricultural pollution :** The fertilizers used for crops are washed into ponds and rivers.

(e) **Pesticides :** Pesticides are used to control pests in fields and houses. They include DDT, BHC, endrin etc.

(f) **Radioactive wastes :** Liquid radioactive wastes are released into the sea around nuclear installations. The oceanic currents carry the radioactive contaminants every where.

(g) **Oil pollution :** Oil is a source of pollution in sea-water. Oil pollution is due to ship accidents, loading and discharging of oil at the harbour, oil refineries and off-shore oil production. Degree of impurity of after due to organic matter is measured in terms of BOD (Biochemical Oxygen Demand). It is the demand for O_2 to decompose organic wastes in liter of water.

(h) **Eutrophication :** Rich growth of micro-organisms consumes most of the dissolved oxygen, so as to depreve other organisms. It generally occurs at the bottom layers of deep lakes. Addition of excessive plant nutrients intensifies eutrophication. It harmful to fish and other aquatic life.

(iii) **Control of water pollution :** Pollution control by sewage treatment includes the following steps :

(a) **Sedimentation :** When sewage is allowed to stand, the suspended particles settle to the bottom. So by sedimentation the suspended particles are removed from sewage.

(b) **Dilution :** The sewage can be diluted with water. This increases the O_2 contents and reduces BOD and CO_2.

(c) **Storage :** The diluted sewage is stored in a pond. This facilitates the growth of micro-organisms. This renders further oxidation of sewage.

(iv) **Waste stabilization pond or Oxidation pond :** The National Environmental Engineering Research Institute (NEERI) at Nagpur has devised a very economical method for the treatment of industrial and domestic effluents. Domestic and industrial wastes are stored in a dilute condition in shallow ponds called oxidation or stabilization ponds. After a few days micro-organisms and algae flourish. The micro–oranisms decompose the organic wastes by oxidation, and the water is purified. This water is rich in nitrogen, phosphorus, potassium and other nutrients. This water can be used for fish culture, agriculture etc.

(v) **Recycling :** Pollution can be prevented to a certain extent by reutilizing the wastes. This is called recycling. e.g., :

(a) The dung of cows and buffalo can be used for the production of energy (gobar gas).

(b) Sewage can be used for irrigation and fish culture after treatment in oxidation pond. Certain pollutants from industrial effluents can be removed by filtrationand selective absorption. Excessive use of pesticides and herbicides should be avoided. At the Government level, legislations should be framed to control water pollution.

(3) **Land pollution :** The undesirable change in the land that harmfully affect the life activities is called land pollution.

(i) **Land pollutants :** Manure, crop–residues, ashes, cinders (pieces of coal), garbage (waste food), paper, card board and plastics. Plastics are the most important land pollutants. Rubber, leather, cloth, rubbish, bricks, sand, metal, broken glasses, demolished building, dead animals, discarded furniture, automobiles, insecticides, herbicides and other biocides and radioactive elements are some of

the important land pollutants. The main sources of land pollution are pesticides, radioactive elements and fertilisers.

(ii) **Pesticides :** Pesticides are chemicals used to kill pests like insects, rats, snails, fungi, herbs, etc. They are collectively called biocides because they kill life. They are of the following types :

- **Insecticides :** There are chemicals used to kill insect pests.
- **Rodenticides :** These kill rats.
- **Fungicides :** These kill fungi.
- **Herbicides :** These kill weeds.
- **Helminthicides :** These kill helminth worms.

(a) **Chemistry of pesticide :** Based on chemical composition, pesticides are divided into following main groups. They are :

- **Chlorinated hydrocarbons :** DDT (Dichloro diphenyl trichloroethane), aldrin, dieldrin, endrin, benzene hexa chlorids (BHC) and their close relatives form chlorinated hydrocarbon. They are very poisonous, very persistent, highly mobile and highly capable of dissolving in fat. As they have higher affinity for fat, they tend to move out of the physical environment and enter the living organisms. They are non–degradable pollutants.
- **Organic phosphorus pesticides :** These include arsenic and sulphur compounds. These are much less in use.

(b) **Ecological effects of pesticides**

- **Mutation :** Insecticides induce gene mutation in human beings (Wurster, 1974).
- **Cancer :** DDT produces cancer in human tissues.
- **Congenital birth defects :** Certain herbicides like diozan increase birth defects in both people and livestock.
- **Sex hormones :** DDT affects sex hormones in mammals and birds.
- **Decline of reproduction :** In Bermuda petral, a sea bird, the rate of hatching of eggs is much reduced because of the accumulation of DDT. If the accumulation increases further, there will be failure of reproduction in this species in future.
- **Calcium metabolism :** DDT interferes with calcium metabolism resulting in calcium deficiency. DDT causes hormonal disturbance resulting in delayed ovulation and inhibition of gonad development.
- **Biomagnification :** The pesticides are non–degradable. They have much affinity towards fat. Hence they tend to move into the living organisms. They are concentrated as they pass up the food chains. For example, at each trophic level, the accumulation of insecticides increases by 10 times. For example if the goat gets one part per million (PPM) of DDT from the grasses, it will have 10 ppm in its tissues. The man, eating the goat will have 100 ppm. The man-eating tiger will have 1000 ppm. If the food chain is still greater, the accumulation will still be higher. This increasing accumulations of

insecticides in higher organisms is called biomagnification or biological amplification. DDT causes the pollution of air, water and soil.

(c) **Control of pesticide pollution**

- **Minimum use :** Pesticides should be used at minimum rates and that to only when required.
- **Biological control :** Pests should killed either by rearing predators or parasites.
- **Sterilization :** Juvenile hormones prevent metamorphosis and maturation in insects.
- **Decoy plants :** Pests can be minimised in high value crops by cultivating low value crops.
- **Rotation of crops :** Different types of crops should be cultivated in different seasons.

(4) **Radioactive pollution :** This pollution occurs through radiations. Radiations are of two types.

- **Non ionising radiations :** UV rays, IR rays, etc. UV rays cause skin burning, IR rays increases atmospheric temperature and leads to the green house effect.
- **Ionising radiation :** X – rays, β-rays, γ-rays, x – rays cause genetic injury on mutation.

Certain elements continuously disintegrate by emitting ionizing radiations. These elements are called radioactive isotopes. Ecologically important radioactive elements are Strontium-90, Argon-41, Iodin-131, Cobalt-60, Cesium – 137, Plutonium – 238, etc. Among these Sr-90' is the most dangerous radioactive pollutant.

(i) **Types of ionizing radiations :** Radioactive isotopes release three types of radiations :

(a) **Alpha particles :** These are large particles emitted by radioactive isotopes (as U^{238}). They travel only short distances. They cannot penetrate the organisms. They cause ionization.

(b) **Beta particles :** These are small particles emitted by radioactive isotopes. They can travel long distances. They can easily penetrate the body tissues and cause ionization.

(c) **Gamma rays :** These are short wavelength rays emitted by radioactive isotopes. They can travel long distances. They can easily penetrate the body tissues and cause ionization. On the basis of the biological effects produced, the radioactive radiations can be grouped into two types, namely internal emitters and external emitters.

- **Internal emitters :** The alpha and beta particles have low penetrating power. Hence they produce their effect in organisms only when they are ingested into the body. Hence these are called internal emitters.
- **External emitters :** The radiations with short wave length like gamma rays have high penetrating power. They can affect the internal tissues even when they remain outside by virtue of their high penetrating power. Hence they are called external emitters.

❑ **Fall outs :** Atomic blasts and nuclear explosion release radioactive isotopes into the atmosphere. These radioactive isotopes fall over the earth from the atmosphere continuously for a long time. Hence they are called fall-outs or nuclear fall-outs or radioactive fall-outs. These fall-outs contaminate the air, soil, water, vegetation and animals. The contaminants persist for several years.

(ii) **Ecological effects of radioactivity :** Radioactivity causes the following effects : Cancer, Leukaemia, Mental retardation, Congenital malformations, Retarded growth, Deleterious mutations, Infant mortality.

1.8 BIOGEOCHEMICAL CYCLE

Organisms are built up on chemical substances. They require certain chemicals like N_2, O_2, H_2, P, C, etc. continuously for their survival. These chemicals enter the organisms from the environment and come out after undergoing changes or without changes. Thus these elements tend to circulate in a characteristic path from the environment to the organism and back to the environment. This cyclical path of the elements from the abiotic system to the biotic system and back is called biogeochemical cycles (Bio = living organism; Geo = water, air, earth). As these chemicals form the components of food, these cycles are also called nutrient cycles.

(1) **Phases of biogeochemical cycles :** Each biogeochemical cycle has two phases, namely the biotic phase (organic phase) and the abiotic phase.

(i) **Biotic phase :** It refers to the flow of chemicals in the living organisms through food chain.

(ii) **Abiotic phase :** It refers to the distribution and flow of chemicals in the non-living environment.

(2) **Types of biogeochemical cycles :** The biogeochemical cycles are classified into two types, namely gaseous cycles and sedimentary cycles.

(i) **Gaseous cycles :** In gaseous cycles the main reservoirs of chemicals are the atmosphere and ocean. e.g. Carbon cycle, N_2 cycle, O_2 cycle etc.

(ii) **Sedimentary cycle :** In sedimentary cycles the main reservoirs are soil and rocks. e.g., Sulphur cycle, phosphorus cycle, etc.

(3) **Important biogeochemical cycles**

(i) Carbon cycle (ii) Nitrogen cycle (iii) Oxygen cycle (iv) Phosphorus cycle (v) Sulphur cycle

(i) **Carbon Cycle :** The cycling of carbon between biotic and abiotic systems is called carbon cycle. It is a gaseous cycle. The main source of carbon is the carbon dioxide (CO_2). CO_2 is present in the air and water. Air is the main reservoir. CO_2 content of air is 0.03%. Its amount remains constant.

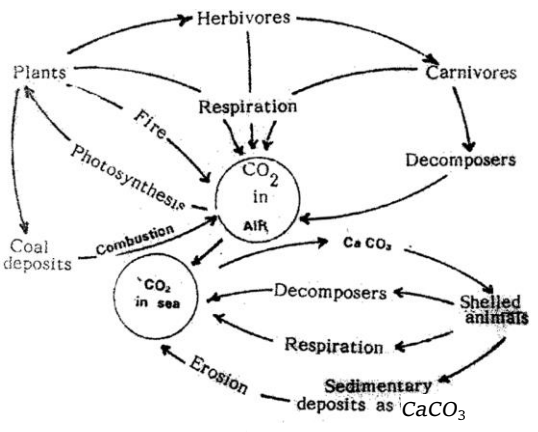


Fig: Carbon cycle

(a) **Flow of Carbon into the biotic system :** Carbon flows into the biotic system in two ways :

- **Photosynthesis :** Carbon enters the biotic system through photosynthesis. In photosynthesis green plants utilize CO_2 and incorporate the carbon of CO_2 in glucose.

Glucose is used for the synthesis of other types of carbohydrates, proteins and lipids. These compounds, containing carbon, are stored up in the plant tissues. When plants are eaten up by herbivores, the carbon flows into the body of herbivorous animals through food chain. When herbivores are eaten by carnivores, the carbon enters the body of carnivorus animals.

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2.$$

- **Formation of shell :** The CO_2 dissolved in sea water is utillized by the marine animals like protozoans, corals, molluscs, algae, etc., for the construction of shell. In these animals CO_2 is converted into calcium carbonate ($CaCO_3$) which is used for the construction of shells.

$$CO_2 + H_2O \rightarrow H_2CO_3 \text{ (Carbonic acid)}$$

$$H_2CO_3 \rightarrow H^+ + HCO_3 \text{ (Bicarbonate)}$$

$$HCO_3 + Ca^+ \rightarrow H^+ + CaCO_3 \text{ (Calcium carbonate)}$$

(b) **Flow of Carbon into the abiotic system :** The carbon of the biotic system flows into the abiotic system in five ways :

- **Respiration :** Plants and animals release CO_2 by respiration (biological oxidation).

$$C_6H_{12}O_6 \rightarrow CO_2 + H_2O + \text{Energy}$$

- **Decomposition :** When plants and animals die, the dead bodies are decomposed into CO_2 by decomposers like bacteria, algae, etc.
- **Shells :** After the death of marine animals, $CaCO_3$ stored in the shells is either deposited as sedimentary rocks or dissolved in water to release CO_2 by the reversion of the above said reactions.
- **Coal :** A certain proportion of carbon from plants is deposited as coal. Carbon from coal returns to air in the form of CO_2 through combustion and weathering.
- **Forest fire :** Combustion of wood in the forest, releases carbon from plants in the form of CO_2.

(ii) **Nitrogen cycle :** The cycling of nitrogen between abiotic and biotic systems is called nitrogen cycle. It is a gaseous cycle. The main source of N_2 is air which contains 79% N_2.

(a) **Flow of Nitrogen into the biotic system :** Nitrogen is an important nutrient of plants. But plants cannot utilize free N_2 of air. They obtain N_2 from ammonium salts, nitrites and nitrates. These compounds are formed from atmospheric N_2 by a process called nitrogen fixation.

Nitrogen fixation is a process by which atmospheric free N_2 is converted into soluble salts like nitrites and nitrates. It occurs in two ways namely electrochemical fixation and biological fixation.

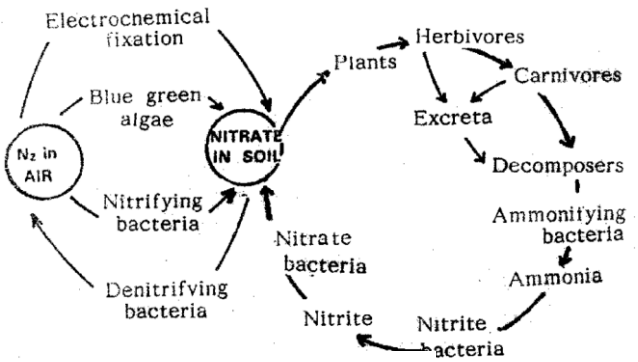


Fig : Nitrogen

- **Electrochemical fixation :** A certain amount of free N_2 is fixed by the action of lightning. The amount of nitrate formed by this method is about 35 *mg/m^2/year.*

- **Biological fixation :** It refers to the conversion of free N_2 into soluble salts by the activity of certain organisms. These organisms are called N_2 fixing organisms. The amount of nitrate formed by this method is about 140 to 700mg/m^2/year, and in a fertile area it exceeds 20000 *mg/m*. The N_2 fixing organisms are bacteria, blue green algae, fungi and other micro-organisms. *e.g. Rhizobium, Azotobacter, Closteridium, Bacillus, Nitrosomonas, Nitrococcus, Nitrobacter, Anabena, Nostoc,* etc.

The fixed N_2 is absorbed by plants through the root system and is incorporated into the proteins. When herbivores feed on these plants, the N_2 flows on the carnivores through food chain.

(b) **Flow of Nitrogen into the abiotic system :** The nitrogen of the biotic system flows into the abiotic system by four methods, namely decomposition, excretion, denitirfication and sedimentation.

- **Decomposition :** Plants and animals contain nitrogen in their body protein. After death, the proteins of dead bodies are decomposed by decomposers into amino acids and ammonia. The convertion of protein from dead bodies into ammonia by decomposition is called ammonification. This ammonia may be converted into nitrates or free nitrogen.

$$\text{Protein in dead bodies} \xrightarrow[fication]{Ammoni} NH_3 \begin{cases} N \\ NO_3 \end{cases}$$

- **Excretion :** Animals excrete nitrogenous waste products in the form of ammonia, urea and uric acid. These compounds are decomposed to release N_2.

- **Denitrification :** The conversion of nitrate into ammonia or free nitrogen is called denitrification. This is done by denitrifying bacteria. *e.g., Pseudomonas.*These bacteria utilize the O_2 present in the nitrate for the oxidation of carbohydrate.

- **Sedimentation :** Some amount of nitrate is lost from the ecosystem by sedimentation.

(iii) **Oxygen cycle :** The cycling of O_2 between biotic and abiotic systems is called O_2 cycle. It is a gaseous cycle. Air is the reservoir for O_2. O_2 enters the biosphere through respiration. The O_2 taken into the body is used for oxidation of carbohydrates, proteins and fats. Certain amount of O_2 in atmospheric air is converted into ozone (O_3) the ozone forms an umbrella-like layer in the outer atmosphere. This layer prevents the ultraviolet radiations from reaching the earth's surface.

$$C_6H_{12}O \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

$$O_2 + O \rightarrow O_3$$

Carbon monoxide is released from volcanoes. This *CO* is unstable. It combines with O_2 to form CO_2.

O_2 combines with a variety of elements to form compounds. For example, it forms CO_2 with carbon, water with hydrogen, nitrates with N_2 ferric axide with iron etc. O_2 returns to air by two main methods, namely photosynthesis and photodissociation.

$$O_2 + C \rightarrow CO_2$$

$$O_2 + 2H_2 \rightarrow 2H_2O$$

$$O_2 + N_2 \rightarrow NO_3$$

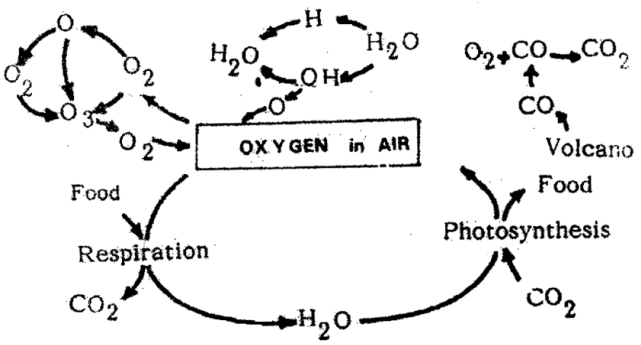


Fig : O_2 cycle

- **Photosynthesis :** Green plants synthesize carbohydrate by photosynthesis. During photosynthesis water molecules break up into hydrogen and oxygen. O_2 is released into the atmosphere and H_2 is trapped and turned into carbohydrates.

$$12H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6H_2O + 6O_2$$

- **Photodissociation :** Water vapour is dissociated to release H_2 and O_2, in presence of light.

(iv) **Phosphorus cycle :** The cycling of phosphorus between biotic and abiotic *system* is called phosphorus cycle. It is a sedimentary cycle. Phosphorus is an important mineral nutrient. The main source of phosphorus is rocks. Through erosion and weathering phosphorus is made available in the soil. Plants absorb ionic phosphate through roots. In plants it is incorporated into the protoplasmic components like DNA, RNA, AMP, ADP, ATP, GDP, GTP, NADP, phospholipids etc. from plants, it passes into herbivores and animals, the organic molecules containing phosphate are decomposed and phosphate is liberated as inorganic ion phosphate. It is again used by plants.

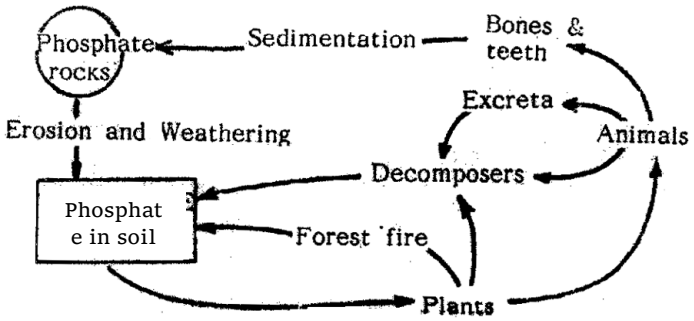


Fig : Phosphorus cycle

The excess of phosphate in the bodies of animals is excreted out through faces. The bird guano (excreta) contains a large amount of phosphate. Phosphate is also released to the soil through the combustion of forest trees and grasses. A large amount of phosphate is lost in the sea by sedimentation. A certain amount of phosphorus gets locked in bones and teeth.

(v) **Sulphur cycle :** The cycling of sulphur between biotic and abiotic systems is called sulphur cycle. It is a sedimentary cycle. Sulphur is an important component of proteins and amino acids.

Sulphur exists in a number of states. Of these, three are important. They are elemental sulphur, sulphides and sulphates. Sulphur is present in rocks.it is made available for plants in the form of inorganic sulphate by weathering and erosion. Sulphur passes into the animals through food chain. By the death of plants and animals, the decomposers again bring the sulphur to the soil for the use of plants.

Some sulphur in dead bodies is released into the air as hydrogne sulphide (H_2S) by the bacteria called *Escherichia coli* under anaerobic combustion. Similarly incomplete combustion of fossil fuel releases sulphur dioxide (SO_2) into the air.

Certain bacteria (green and purple photosynthetic bacteria) oxidise H_2S of air to sulphate which can be used by plants.

$$H_2S + 2O_2 \rightarrow SO^{-}_4 + 2H^{+}$$

Certain amount of sulphur is lost in the sediments. If iron is present in the sediments, sulphur combines with it to form iron sulphide.

$$Fe + S \rightarrow FeS$$

Important Tips

- CO_2 is not a normal air pollutant.
- There is 0.03 % CO_2 in earth's atmosphere. Rise in the amount of CO_2 causes green-house effect.
- **Primary air pollutants :** These are CO, SO_2, NH_3, Benzopyrene.
- **Secondary air pollutants :** These are poisonous substance formed from primary air pollutants. (1) Nitrogen oxide (2) O_3 (3) Sulphuric acid.
- Methyl isocynate was responsible for Bhopal tragedy on December, 1984 which was used in production of savin insecticide in union carbide.
- Hg is known to cause nervousness (reduces the nerve impulse).
- Drinking water rich in nitrates cause methane globenemia (circulatory and respiratory system are affected).
- **Ozone day :** September 16^{th}.
- Lichen and mosses are the first plants to die in SO_2 polluted environment and hence act as indicators of air pollution (especially SO_2 pollution). These are thus called indices of atmospheric purity (IAP).
- E.coli, Wolffia, Chara and Utricularia are indicators of water pollution.
- Gombusia (fish) was introduced in to several tropical regions to control malaria.

1.9 Conservation of Natural Resources

Anything which is useful to man or can be transformed into a useful product or can be used to produce a useful thing can be referred to as a **resource**. A natural resource is the resource obtained from nature. It is these natural resources which form the very basis of entire life on this planet. A natural resource can be of the following two types : living (biotic) or non-living (abiotic).

- **Biotic resources :** A resource is directly or indirectly derived from photosynthetic activity of green plants. Food, fruits, wood, fibre, milk, milk products, fish, meat and leather are termed as biotic resources. Coal, oil and natural gas are also biotic resources as they were produced by photosynthetic activity of plants which occurred millions of years ago.

- **Abiotic resources :** Mineral material, fresh water, rocks, salts and chemicals etc. are termed as abiotic resources as biological activity is not involved in their formation.

(1) **Types of natural resources :** The natural resources can be classified into three categories :

(i) **Renewable resources**

(a) Renewable resources are those resources which can be **regenerated**.

(b) These are mostly biological in nature and include forestry, agriculture, animals (biomass-based) etc.

(c) These can be reproduce itself in nature and we may harvest them continuously through a sustained proper planning and management. Solar energy, wind energy, water energy (tides) and geothermal energy belong to this category, since these are available in an inexhaustible form in nature.

(ii) **Non-renewable resources**

(a) They are physical resources like coal, oil deposits, natural gas, minerals, soil, metals etc.

(b) These are available in nature only in **limited** amounts and cannot be reproduced.

(c) Coal, petroleum and natural gas are the common sources of energy. They, being of organic origin, are also called **fossil fuels**.

(d) These account for 90% of the worlds production of commercial, energy, hydroelectric and nuclear power accounting for only 10%. The figures are :

Oil	–	39.5%
Coal	–	30.3%
Natural gas	–	19.6%
Hydro-electric	–	6.7%

(e) Their formation requires millions of years which can not occur within the human scale of time. Similarly, metals and minerals come from deposits developed by a very slow process of geo-chemical concentration which look millions of years to form.

(iii) **Inexhaustible resources**

(a) The total amount of atmosphere, water, rocks and solar energy can never get exhausted.

(b) Similarly solar energy is inexhaustible.

At present all the developing countries of the world have started to realize that there is a conflict between environment and development. The problems of human environment derive essentially from these factors :

- The first is the expansion at geometric rates of population.
- The second is a one-sided application of technology to achieve certain goals without the consideration of the effects of this technology on the human environment or on man itself.
- The third is the lack of control over the use of land.

(2) **Conservation :** It may be defined as the most efficient and most beneficial utilization of the natural resources. Conservation is also defined as the rational use of the environment to provide a high quality of living for the mankind.

(i) **Aim of conservation :** The true aim of conservation, thus, includes

(a) To insure the preservation of a quality environment that considers aesthetic, recreational as well as product needs.

(b) To insure a continuous yield of useful plants, animals and materials by establishing a balanced cycle of harvest and renewal.

(ii) **Living resource conservation has three specific objectives**

(a) **To maintain the essential ecological processes and the life support system :** This system has five elements (air, water, land, flora and fauna) which are interconnected, interrelated and interdependent; deterioration in one inevitably affects the other four elements.

(b) **To preserve the biological diversity :** It includes two related concepts **genetic diversity** and ecological diversity. The genetic diversity is the amount of the genetic variability among individuals of a single species (intraspecific genetic variability) as also between species (interspecific genetic variability). The ecological diversity means the species richness. It is the number of species of the flora and fauna found in a region (for example, India has about 45,000 species of plants and about 65,000 species of animals).

(c) **To ensure that any utilization of the species and ecosystems is sustainable :** In fact, natural resources may be conserved by efficient utilization which requires a proper balance between the supply and demand. Sustainable utilization means planned utilization so that a continuous yield of the useful plants, animals and materials may be obtained.

(iii) **The conservation of the following resources is necessary**

(a) **Minerals :** Until recently little attention was paid to the conservation of mineral resources because it was assumed that nothing could be done to save them anyway. But now these assumptions have proved wrong and it is believed that severe shortages would develop tomorrow. The conservation of minerals, therefore, has become a serious concern for conservationists all over the world.

(b) **Forests :** The need for the scientific management of forests was recognised in our country in the long past. But in our last five-year plans there has been a lack of appreciation of the potential of forestry which could play a great role in the economic growth of the country. Forests not only provide timber, pulpwood and fodder; they are also important in controlling soil erosion, floods etc.

Silviculture is the term for forest management which deals on ecological principles, with the establishment, growth and reproduction of timber trees and other organisms.

(c) **Wild life :** The terms "wild life" refers to any living organisms in its natural habitat. It includes all plants, animals and microorganisms except the cultivated plants and domesticated animals.

- **Importance of wild life :** Ecological value, Economic value**,** Scientific value, Gene banks, Sport and Enjoyment, Aesthetic value, Cultural value.
- **Causes of destruction of habitat :** Destruction of habitat, Hunting, Introduction of exotic species, Disturbance in migratory routes, Legal lapse.
- **Concept of threatened species :** The rare species of plants and animals have been categorised as under for conservation purposes by the IUCN (International Union for Conservation of Nature and

Natural Resources). Conservation means "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations." The national protection programmers must be coordinated with the international programmes, especially.

The biosphere reserve programme of the UNESCO's Man and the Biosphere project.

National parks and protected areas of International Union for Conservation of Nature and Natural resources.

The Government of India passed the Wild life (Protection) Act in 1972, under which national parks and sanctuaries were created. Creation of biosphere reserves has also been put into practice since 1986. A National park is an area, which is strictly reserved for the betterment of the wild life, and where activities like forestry, grazing or cultivation are not allowed. There are 66 national parks in India. In a sanctuary, protection is given only to the fauna and operations like harvesting of timber, collection of minor forest products and private ownership rights are permitted so long as they do not interfere with well being of animals. There are presently 368 sanctuaries in India

The union and state governments have launched several afforestation programmes. The Social Forestry Programme, started in 1976, seeks the use of public and common land to produce firewood, fodder, and small timber for the use of the rural community to reduce pressure on existing forests needed for soil and water conservation.

Some national parks and sanctuaries

Gir National Park, Junagarh (Gujrat)
Corbett National Park, Nainital (U.P.)
Ranthambore National Park, Savai Madhopur (Rajasthan)
Kanha National Park (M.P.)
Manas Sanctury, Barpeta (Assam)
Kaziranga National park , Jorhat (Assam)
Desert National Park, Jaiselmer(M.P.)
Bhitar Kanika Sanctuary, Cuttack (Orissa).

(d) **Ranges :** The conservation and management of ranges or pastures for our grazing animals is also a part of the programme for the conservation of environment. The important techniques of range management are :

- **Stock level :** The number of grazing animals has to be regulated to the rate of production *i.e.*, they could be maintained in normal productive years and could be sold out in drought years.
- **Deferred grazing :** The range may be divided into compartments where grazing is regulated in such a way that in each component grazing year is followed by a non-grazing year.
- **Fire :** The use of fires to regulate these useful grasses is a common method.

(e) **Soil erosion :** Top soil is the vital part of the soil and serves as the chief source of nutrition for plants (feeding zone). Loss or disturbance of top soil by natural agents like water, wind, gravity or ice is called soil erosion.

Soil erosion has been called **'creeping death of the soil'** by **Rama Rao**.

Soil erosion is of two types :

- **Geological or Natural erosion :** It is caused by nature.
- **Accelerated or Artificial erosion :** It is caused by man and animals.

Types of soil erosion

- **Water erosion :** It is caused by fast running water or by continuous heavy rain. It may be :

- **Sheet erosion :** Due to heavy rain, top fertile soil is removed in the form of thin sheet.
- **Rill erosion :** Fast running water cut stream or groove like structure in soil.
- **Gully erosion :** On steep slopes, fast running water cuts the soil deep and form channel like structure called gullies.
- **Rparian erosion :** During floods fast running water cut off the margins of river.

Due to heavy rains the minerals are also lost from top soil and soil becomes less fertile.

- **Wind erosion :** Soil erosion by wind is common in dry places and most servere in arid regions where soil is chiefly sandy and the vegetation is poor or even absent.

The wind throws away smallest soil particles into air where they get suspended giving a dusty appearance to the air. It is called suspension. By this method the soil particles are transported to longer distance.

- **Land slide or Slip erosion :** The hydraulic pressure caused by heavy rains and gravitational force cause the fall off the rocks in hilly areas.
- **Overfelling (Deforestation) and Overgrazing erosion :** These process reduce vegetation thus make the soil surface open for erosion (sheet erosion).

(f) **Soil conservation :** Prevention of soil erosion is called as soil conservation.

- **Methods of soil conservation**

- **Strip copping :** Crops are arranged in bands or strips to check the flow of water.
- **Crop rotation :** Crop rotation is the method of alternative sowing of leguminous and cereal crops (wheat , maize). The rotation of crops can be planned depending upon the climatic conditions, type, slope and properties of soils.

Such crops which check soil erosion should be sown during the rainy season. Legumes are useful in rotation of crops because of having nodulated roots. Soil fertility is usually maintained in the field by rotation of crops. The minerals which are consumed by cereal crop in first year are again supplied by leguminous crops in the second year.

- **Reforestation or Afforestation :** Growing of forest trees is most effective in controlling soil erosion. Afforestation also helps in prevention of floods. Indiscriminate felling of trees have resulted in

the formation of extensive ravines along Yamuna and Chambal area. The Government of India has introduced the festival of '**Van Mahotsava**'. In this festival planting of trees is done on open waste land.

- **Terracing :** Hilly slopes are divided into small flat fields called as terraces to check the flow of water.
- **Contour farming :** It is the oldest method in low rain fall area. Field is divided in furrow and ridges. Ridges at same level called as contour.
- **Green manuring :** Basically its practice is meant for increasing soil fertility but it also checks soil erosion.
- **Dry farming :** A practice for cultivation of crops in low and moderate rainfall areas.
- **Mulching :** Basal plants parts are used to make a soil cover which help in moisture conservation.

(g) **Water :** Water is one of the most important renewable resources and the conservation of our natural sources of water is very necessary. In many places water is the chief and most powerful erosive factor and floods result due to the overflow of water from the river banks. Thus, the control of floods is also a serious concern for the conservationists. It has been already pointed out that afforestation helps a lot to minimise losses caused by floods and siltation of dams.

(h) **Fisheries :** Fishes are also one of the important biotic resources and are greatly valued by man as food. Unfortunately, in the last few year fish fauna of our inland waters has greatly deplected on account of overexploitation and pollution of natural waters due to sewage and industrial wastes. It is therefore, necessary that these colourful creatures of our aquatic environment should be preserved. Fishery managers have developed many techniques to improve fish habitats. Some are :

- Large, artificial fielding reefs in the offshore waters of the oceans and freshwater lakes to provide hiding places and additional food which attracts the fish.
- Spawning channels to replace vital spawning areas destroyed or no longer accessible.
- Fix toxicants to destroy undesirable fish populations and restore the balance in favour of the game or commercial fish.
- Weed control.
- Fertilization and artificial enrichment.
- Various in-stream devices to make pools, provide cover, wash out slit, etc.
- Aeration and recirculation of lakes and reserviors.

(iv) **Conservation of biological diversity**

(a) Lately it has been felt throughout the world that the conservation of biological diversity is one of the most important challenges of the present and immediate future. Diversity characterizes most living organisms and our earth supports something like 5 to 10 million species of plants ands animals (IUCN, 1980).

(b) Two convenient approaches for conservation of biological diversity are *in-situ* conservation and *ex-situ* conservation.

- ***In-situ* conservation :** It means the conservation of living resources through their maintenance within the natural ecosystems in which they occur. It includes a comprehensive system of protected areas such as the national parks, sanctuaries, nature reserves, natural monuments, cultural landscapes, biosphere reserves and several others.
- ***Ex-situ* conservation :** It includes conservation outside the habitats by perpetuating sample populations in genetic resource centres, zoos, botanical gardens, culture collections etc., or in the form of gene pools and gamete storage for fish; germplasm banks for seeds, pollen, semen, ova, cells, etc.

Important Tips

- **Biological diversity day :** 29th December.
- **National Pollution Preservation day :** 2nd December.
- Ganga action plan for controlling pollution in Gange's started in 1985.
- Chipko movement was born in March 1973 in Gopeshwar in Chamoli when trees were not allowed to be cut by village folk. The movement has two leaders Chandi prasad Bhatt of Gopeshwar and Sunderlal Bahuguna of Silyara in Tehri. A similar appiko movement was under taken by Pondurang Hedgo in South.
- Van Mahotsav was started by K.M. Munshi in 1950.
- Richard St. Barbibaker is known as "tree saint in India".
- Wild life Institute of India is located at Dehradun (Uttaranchal).
- **Red Data Book :** It is the compilation of data on species threatened with extinction.
- **Some Abbreviations**

  CAZRI : Central Arid Zone Research Institute (Jodhpur).

  CPCB : Central Pollution Control Board.

  IBP : International Biological Programme.

  IUCN : International Union for Conservation of Nature and Natural Resources.

  MAB : Man and Biosphere Programme.

  NEERI : National Environmental Engineering Research Institute.

  WWF : World Wild life Fund (World Wide Fund for Nature).

  UNEP : United Nations Environment Programme.

  CPHERI : Central Public Health Engineering Research Institute at Nagpur.

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ASSIGNMENT

ECOLOGY AND GENERAL

Basic Level

1. Ecology takes into account only
(a) Environmental factors only (b)Plant adaptations only
(c) Effect of environment on plants (d)All of these

2. The study of inter-relationship between living organisms and their environment is called
(a) Ecosystem (b) Phytogeography (c) Ecology (d) Phytosociology

3. Study of inter-relationship between a species and its environment of a forest is called
(a) Forest ecology (b) Autoecology (c) Synecology (d) None of these

4. The branch of Botany dealing with the distribution of plants on the earth's surface is called
(a) Ecology (b) Phytology (c) Phytogeography (d) Phytosociology

5. Edephic factors are related to
(a) Soil (b) Animal (c) Man (d) Temperature

6. "*Pedology*" is the study of
(a) Soil (b) Locomotion of animals
(c) Rocks (d) Crop diseases

7. E.P. Odum is a leading
(a) Bryologist (b) Physiologist (c) Ecologist (d) Mycologist

8. Hydrophytes are characterised by
(a) Thick and large leaf (b) Delicate and mucilagenous stem
(c) Short spinous stem (d) All of these

9. Pneumatophore roots are present in
(a) Mesophytes (b) Xerophytes (c) Hydrophytes (d) Halophytes

10. Reason of fast speciation in present day crop plants are
(a) Isolation (b) Polyploidy (c) Mutation (d) Sexual reproduction

11. The term ‘niche’ of a species refers to
(a) Specific and habitual function (b) Specific place where an organism lives
(c) Competitive power of an organism (d) Specific function of organism

12. Edaphology is the relationship between
(a) Plant and biosphere (b) Animal and ecosystem
(c) Soil and living organisms (d) Soil and biosphere

13. Study of environment and animals relation
(a) Ecosystem (b) Phytosociology (c) Biotic community (d) Ecology

14. Which one of the following is a right matching pair of certain organism (s) and the kind of association

(a) Shark and sucker fish-Amensalism

(b) Algae and fungi in lichens-Mutualism

(c) Orchids growing on trees-Parasitism

(d) Cuscuta (dodder) growing in other flowering plants-epiphytism

15. Humus is found in

(a) Top portion of soil (b) Middle portion of soil (c) Deep portion of soil (d) None of these

16. Growing crops for production of alcohol and other fuels is known as

(a) Energy cropping (b) Molecular farming (c) Hydroponics (d) Dense farming

17. Which of the following statements is incorrect

(a) Lichen, an association of fungus and algae is an example of Mutualism

(b) Those epiphytes which use other plants for support only and not for water or food supply are examples of commensalism

(c) Sea-anemone on hermit-crab is an example of protocooperation

(d) Mutualism, protocooperation, commensalism cannot be included under symbiosis

18. In the mountains, there is a lot of moisture and water and still the plants are xerophytes, because

(a) Water turns into snow on mountains

(b) Water runs away due to the presence of slopes and can not be used by plant (Physiological dryness)

(c) Rocks of mountains cannot absorb water

(d) None of them is correct

19. The ecologically fixed and genetically irreversed species are called

(a) Ecotone (b) Ecological equivalents (c)Ecotype (d) None of these

20. If the strong partner is benefitted and the weak partner is damaged, it is known as

(a) Amensalism (b) Symbiosis (c) Predation (d) Allotrophy

21. A bird enters the mouth of crocodile and feed on parasitic leeches. The bird gets food and crocodile gets ribs of blood sucking leeches. Both the partners can live independently. Such an association is

(a) Mutualism (b) Amenalism (c) Commensalism (d) Protocooperation

22. Competition for food, light and space is most severe between two

(a) Closely related species growing in the same area

(b) Closely related species growing in different habitats

(c) Distantly related species growing in different habitats

(d) Distantly related species growing in the same area

23. The soil near the surface is usually darker than about one meter down. This is because the top soil

(a) Is richer in *Ca* and *Mg* (b)Contains more organic matter

(c) Is wetter than the sub soil (d) Is drier than the sub soil

24. Biotic potential refers to

(a) Increase of population under optimum conditions

(b) Increase of population under given conditions

(c) Increase of population under natural conditions

(d) Increase of population under climatic conditions

25. Ecological factors which prevent a species from producing at its maximum rate is termed as

(a) Survival curve (b) Ecological drift

(c) Environmental resistance (d) None of these

26. Extreme xerophytic condition is shown by

(a) *Brassica* (b) *Capparis* (c) *Cactus* (d) *Nerium*

27. Among the plants listed, point out one that does not fit into ecological group represented by other plants

(a) *Acacia* (b) *Rhizophora/Vallisneria*

(c) *Euphorbia* (d) *Aloe*

28. An area of soil is throughly wetted and allowed to drain until capillary movement of water stopped. The water contents of the soil will give an estimate of its

(a) Capillary water (b) Storage water (c) Field capacity (d) Gravitational water

29. When the organisms live together in such a manner that one organism is benefited, while other has no effects, it is called

(a) Commensalism (b) Parasitism (c) Mutualism (d) All of these

30. Plants growing in saline soil are called

(a) Halophytes (b) Xerophytes (c) Heliophytes (d) Oxalophytes

31. Water logging occurs in

(a) Clay soil (b) Loamy soil (c) Gravel soil (d) Sandy soil

32. Term '*ecology*' was proposed by

(a) Haeckel (b) Odum (c) Reiter (d) Daubenmier

33. Plants growing in shady regions a

(a) Sciophytes (b) Xerophytes (c) Epiphytes (d) Heliophytes

34. Development of soil from the parent rock is termed as

(a) Edaphic factor (b) Pedogenesis (c) Edaphotropism (d) Edaphic climax

35. The plants and animals living in a given area form

(a) Biological community (b)Ecotone (c) Biome (d) Consociation

36. Mycorrhiza, a relationship between fungi and roots of higher plants is

(a) Parasitic relationship (b)Saprophytic relationship

(c) Symbiotic relationship (d)Epiphytic relationship

37. *Rhizophora* is an example of

(a) Hydrophytes (b) Lithophytes (c) Mesophytes (d) Halophytes

38. Solubility and availability of plant nutrients are more related to
(a) Soil *pH* (b) Soil porosity (c) Soil temperature (d) Soil colour

39. Which of the following species are restricted to a given area
(a) Sympatric species (b) Allopatric species (c) Sibling species (d) Endemic species

40. The factor governing the structure of earth surface is
(a) Topographic (b) Edaphic (c) Biotic (d) Temperature

41. Excessive aerenchyma is characteristic of
(a) Hydrophytes (b) Xerophytes (c) Mesophytes (d) Heliophytes

42. Species are considered as
(a) Real unit of classification devised by taxonomists
(b) Real basic units of classification
(c) The lowest units of classification
(d) Artificial concept of human mind which cannot be defined in absolute terms

43. Mark the correct pair
(a) Plants growing in shady places – Heliophytes (b) Plants growing in light – Sciophytes
(c) Plants growing in saline soil – Halophytes (d) Roots are absent – Xerophytes

44. Ephemerals are xerophytes that are
(a) Draught enduring (b) Draught escaping (c) Draught resisting (d) None of these

45. The sun loving plants are referred to as
(a) Halophytes (b) Heliophytes (c) Heterotrophs (d) Sciophytes

46. Study of relationship between communities and environment is called
(a) Autoecology (b) Synecology (c) Ecology (d) Ethnology

47. *Casuarina equisetifolia* is a
(a) Mesophyte (b) Xerophyte (c) Halophyte (d) Forest epiphyte

48. The closely related morphologically similar sympatric populations, but reproductively isolated, are designated as
(a) Clines (b) Demes (c) Clones (d) Sibling species

49. Group of two or more than two plant species is called as
(a) Plant community (b) Animal ecosystem (c) Plant ecosystem (d) Ecological niche

50. The study of communities of various genera and species is called
(a) Palaecology (b) Synecology (c) Autoecology (d) Radiation ecology

51. The vegetation of Rajasthan is
(a) Arctic (b) Alpine (c) Deciduous (d) Xerophytic

52. Territoriality occurs as a result of
(a) Parasitism (b) Predation (c) Co-operation (d) Competition

53. The carrying capacity of a population is determined by its
(a) Birth rate (b) Death rate (c) Limiting resource (d) Reproductive status

54. The best soil for healthy and vigorous growth of the plant is

(a) Clay (b) Loam (c) Sandy soil (d) None of these

55. A community is defined as

(a) A group of birds (b) A collection of species

(c) Interacting populations (d) An interactive ecosystem

56. The plants in which vascular tissues are absent and well developed aerenchyma is present, are

(a) Xerophytes (b) Halophytes (c) Hydrophytes (d) Mesophytes

57. Which of the following isolation is important for speciation

(a) Seasonal (b) Tropical (c) Behavioural (d) Reproductive

58. Which of the following is not a hydrophytic angiosperm

(a) *Chara* (b) *Hydrilla* (c) Lotus (d) Water lettuce

59. Plants growing in acidic soils are known as

(a) Psammophytes (b) Oxalophytes (c) Lithophytes (d) Halophytes

60. Distribution of different plant geographically is called

(a) Allopatric (b) Sympatric (c) Geopatric (d) Sibling

61. Which of the following soil is transported by air

(a) Alluvial (b) Aerial (c) Elluvial (d) Glacial

62. The abundance of a species population within its habitat is called

(a) Niche density (b) Regional density (c) Relative density (d) Absolute density

63. When one organism is benefitted without affecting the other is called

(a) Parasitism (b) Commensalism (c) Saprophytism (d) Symbiosis

64. Plants of salty seashore wet-lands are called

(a) Halophytes (b) Heliophytes (c) Hydrophytes (d) Saprophytes

65. Which is adapted for aquatic habit

(a) *Aldrovenda* (b) *Vallisneria* (c) *Sancatia* (d) All of these

66. The lentic ecosystem includes which of following water

(a) Rain (b) Running (c) Standing (d) Gravitational

67. Succulent xerophytes are likely to be found in

(a) Tropical rain forest (b) Deciduous forest **(c)** Desert (d) Tundra

68. Plants growing in saline and marshy conditions are called

(a) Lithophytes (b) Mesophytes (c) Halophytes (d) Psammophytes

69. Deep black soil is considered to be highly productive due to high proportion of

(a) Silt and earthworm (b) Clay and Humous (c) Gravel and Ca^{++} (d) Sand and *Zn*

70. The two vegetation of ecosystem are separated by

(a) Ecotone (b) Ecoline (c) Ecosystem (d) Ecesis

71. The term ecology was coined by

(a) Linnaeus (b) William (c) Odum (d) Haeckel

72. The *pH* of a fertile soil is usually around

(a) 2 – 3 (b) 6 – 7 (c) 8 – 10 (d) 11 – 12

73. Loss of upper fertile layer of soil is known as

(a) Pedogenesis (b) Pedosolization (c) Soil erosion (d) None of these

74. *Acacia arabica* is a

(a) Mesophyte (b) Hydrophyte (c) Xerophyte (d) Halophyte

ECOSYSTEM

Basic Level

75. Term '*biosphere*' is used for the zone of earth where life exists

(a) On lithosphere (b) In the hydrosphere

(c) In the lithosphere and hydrosphere

(d) In the lithosphere, hydrosphere and atmosphere

76. When peacock eats snakes which eat insects thriving on green plants, the peacock is

(a) A primary consumer (b) A primary decomposer

(c) Final decomposer (d) The apex of food pyramid

77. In an ecosystem, the population of

(a) Primary producers are more than that of primary consumers

(b) Secondary consumers are largest because they are powerful

(c) Primary consumers out number primary producers

(d) Primary consumers are least dependent upon primary producers

78. Ecosystem is defined as

(a) Relation between plants and animals

(b) Relation between biotic and physical components

(c) Relation between producers and decomposers (d) None of these

79. The relationship in an ecosystem can be depicted in

(a) Pyramid of energy (b) Pyramid of biomass (c) Pyramid of numbers (d) All of these

80. Energy enters into the ecosystem through

(a) Herbivores (b) Carnivores (c) Producers (d) Decomposers

81. The biotic part of ecosystem includes

(a) Producers (b) Consumers (c) Decomposers (d) All of these

82. In an ecosystem bacteria are considered as

(a) Microconsumers (b) Macroconsumers

(c) Primary consumers (d) Secondary consumers

83. Main renewable source of energy is

(a) Coal (b) Forest or trees (c) Petrol (d) Fuel gas

84. The correct path of energy flow in an ecosystem is

(a) Producers → Carnivores → Herbivores → Decomposers

(b) Producers → Herbivores → Carnivores → Decomposers

(c) Herbivores → Carnivores → Producers → Decomposers

(d) Herbivores → Producers → Carnivores → Decomposers

85. When the number of organisms at successive levels are plotted, they assume the shape of a pyramid. This is called the pyramid of

(a) Energy (b) Number (c) Biomass (d) Both (a) and (c)

86. In food chain, Lion is a

(a) Primary consumer (b) Secondary producer

(c) Tertiary consumer (d) Secondary consumerFood levels in an ecosystem are called

(a) Trophic levels (b) Consumer levels (c) Producer levels (d) Herbivore levels

87. The number of individuals of a species in a particular ecosystem at a given time remains constant due to

(a) Man (b) Parasites (c) Predators (d) Available food

88. In an ecosystem `niche of species' means

(a) Its habitat (b) Competitive capacity

(c) Centre of origin (d) Its activities in habitat

89. Transfer of energy from one trophic level to other trophic level is according to the second law of thermodynamics. The efficiency of energy transfer from herbivorous to carnivorous is

(a) 25% (b) 50% (c) 10% (d) 5%

90. Ecosystem may be defined as

(a) Group of plants which act as the energy suppliers

(b) Group of organisms which form population

(c) Functional unit for ecological studies (d) None of these

91. The ecosystem consists of

(a) Producers (b) Consumers (c) Decomposers (d) All of these

92. Which of the following is an artificial ecosystem

(a) Rice-field (b) Forest (c) Grassland (d) Lake

93. Ten percent law of energy transfer, in a food chain, was enunciated by

(a) Elton (b) Heackel (c) Lindeman (d) Schimper

94. Tip of ecological pyramid is occupied by

(a) Herbivores (b) Carnivores (c) Producers (d) Decomposers

95. Source of energy in an ecosystem is

(a) Sun (b) ATP (c) Sugar made by plants (d)Green plant

96. The pyramid of energy is always
(a) Inverted (b) Upright
(c) Both upright and inverted (d) Inverted in forest ecosystem

97. Each couple should produce only two children which will help in
(a) Checking pollution (b) Stabilizing the ecosystem
(c) Fertility of soil (d) Improving food web

98. With regard to ecological food chain, man is a
(a) Producer (b) Consumer
(c) Both producer and consumer (d) Producer and decomposer

99. An ecosystem must have continuous external source of
(a) Food (b) Minerals (c) Energy (d) All of these

100. Trophic levels are formed by
(a) Organisms linked in food chain (b) Only plants
(c) Only animals (d) Only carnivores

101. The word "**ecosystem**" was first coined by
(a) Weaver and Clements (b)A.G. Tansley (c) E.P. Odum (d) By all of these

102. If phytoplankton are destroyed in the sea, then
(a) Algae will get more space to grow (b) Primary consumers will grow luxuriently
(c) It will effect the food chain (d) No effect will be seen

103. In a food chain of grassland ecosystem, the top consumers are
(a) Carnivores (b) Herbivores
(c) Either carnivores or herbivores (d) Bacteria

104. In a food chain herbivores are
(a) Primary producers (b) Primary consumers (c) Secondary consumers (d) Decomposers

105. The pyramid of number is based on
(a) Unit per area (b) Food per individual
(c) Individuals in trophic level (d) None of these

106. The total energy fixed by a gram plant (*Cicer arietinum*) in an ecosystem on the whole is called
(a) Primary production (b) Gross production (c) Secondary production (d)None of these

107. The trophic level of lion in a forest ecosystem is
(a) T_3 (b) T_4 (c) T_2 (d) T_1

108. The number of primary producer within a specified area would be maximum in
(a) Pond ecosystem (b) Grassland (c) Desert (d) Forest ecosystem

109. Carnivores are
(a) Usually primary consumers (b) Usually secondary consumers
(c) Usually secondary or tertiary consumers (d) Usually decomposers rather than consumers

110. Percentage of land covered by forests in India is
(a) 9 – 18% (b) 18 – 27% (c) 27 – 36% (d) More than 50%

111. Food chain consists of

(a) Producer, consumer and decomposer (b) Producer, carnivore and decomposer

(c) Producer and primary consumer (d) Producer, herbivore and carnivore

112. Biotic factors are

(a) Chemical factors of soil which affect life (b) Physical factors of soil which affect life

(c) All living organisms which influence other organisms

(d) Factors of atmosphere which affect life

113. A rat feeding upon potato tuber is

(a) Producer (b) Carnivore (c) Decomposer (d) Primary consumer

114. Animals which occupy the same trophic level

(a) Tiger and bear (b) Deer and bees (c) Snake and earthworm (d)Crow and cow

115. The pyramid of number in a grassland ecosystem is

(a) Always erect (b) Always inverted

(c) Either erect or inverted (d) Irregular

116. In an ecosystem energy flows in

(a) One direction (b) Two direction (c) Four direction (d) All directions

117. Aerosols reduce primary productivity by

(a) Destroying leaf tissue (b)Premature leaf fall (c) Reducing crop yields (d)All of these

118. Which of the following abundantly occurs in pond ecosystem

(a) Producer (b) Consumer (c) Top consumer (d) Decomposers

119. The rate of conservation of light energy into chemical energy of organic molecules in an ecosystem is

(a) Net primary productivity (b) Gross primary productivity

(c) Net secondary productivity (d) Gross secondary productivity

120. The phytoplankton in the ponds act as

(a) Producers (b) Decomposers (c) Consumers (d) Organic compounds

121. A food chain starts with

(a) Nitrogen fixation (b) Decay (c) Photosynthesis (d) Respiration

122. Maximum biomass and variable organism are found in

(a) River (b) Pond (c) Lake (d) Estuary

123. Which of the following food chain may not be directly dependent upon solar energy

(a) Grazing (b) Detritus (c) Soaking (d) Depleting

124. To eat and be eaten relationship is called as

(a) Food chain (b) Food web (c) Symbiosis (d) Phagocytosis

125. The sphere of living matter together with water, air and soil on the surface of earth is called

(a) Atmosphere (b) Hydrosphere (c) Lithosphere (d) Biosphere

126. Which of the following does not effect the forest ecosystem

(a) Deforestation (b) Soil erosion (c) Climatic variation (d) None of these

127. Which of the following ecosystems would be most stable

(a) Man made forest (b) Fresh water lake (c) Saline lake (d) Natural forest

128. Biosphere is

(a) Global ecosystem (b) Global community

(c) Living organism (d) Count of organism on earth

129. The living organisms of all ecosystems collectively consitute

(a) Producers (b) Decomposers (c) Consumers (d) Biosphere

130. If the plant producer dies in the ecosystem, then the system is

(a) Seriously affected (b) Cannot produce food

(c) Can have more producers (d) Hardly affected

131. Which of the following is correct sequence in food chain

(a) Fallen leaves $\rightarrow$ bacteria $\rightarrow$ insect larvae $\rightarrow$ birds

(b) Phytoplankton $\rightarrow$ zooplankton $\rightarrow$ fish

(c) Grasses $\rightarrow$ fox $\rightarrow$ rabbit

(d) Grasses $\rightarrow$ chameleon $\rightarrow$ insects $\rightarrow$ birds

132. Biomass pyramid of forest is

(a) Inverted (b) Upright (c) Infinite (d) Finite

133. Mr. X is eating curd/yoghurt. For this food intake in a food chain he should be considered as occupying

(a) First trophic level (b) Second trophic level (c) Third trophic level (d) Fourth trophic level

134. Which one of the following components of ecosystem comes from outside

(a) Oxygen (b) Temperature (c) Insects (d) Energy

135. An ecosystem resist change because it is in a state of

(a) Imbalance (b) Homeostasis

(c) Shortage of components (d) Deficiency of light

136. The sphere of living matter together with water, air and soil on the surface of earth is

(a) Lithosphere (b) Biosphere (c) Hydrosphere (d) Atmosphere

137. A plant being eaten by a herbivorous which in turn is eaten by a carnivorous makes

(a) Food chain (b) Food web (c) Omnivorous (d) Interdependent

138. The pyramid that cannot be inverted in a stable ecosystem, is pyramid of

(a) Number (b) Energy (c) Biomass (d) All of these

139. Ecosystem is

(a) A closed unit

(b) An open unit

(c) Both open and closed unit depends upon biomass present

(d) Both open and closed unit depends upon the community type

140. In an ecosystem, there is flow of energy at different trophic levels. This is as follows

(a) Primary consumers – Tertiary consumers – Secondary consumers – Decomposer – Producers

(b) Producer – Primary consumers – Secondary consumers – Tertiary consumers – Decomposers

(c) Producers – Decomposers – Primary consumers – tertiary consumers – Secondary consumers

(d) Producers – Primary consumers – Tertiary consumers – Secondary consumers – Decomposers

141. Flow of energy declines from low to higher trophic level in ecosystem, is mainly explained by

(a) First law of thermodynamic (b) Second law of thermodynamics

(c) Both of these (d) None of these

142. The pyramid of energy in a forest ecosystem is

(a) Always upright (b) Always inverted

(c) Both upright and inverted (d) None of these

143. In food chain initial organisms are

(a) Top consumers (b) Secondary consumers (c) Primary consumers (d) Photosynthates

144. Among the following, what happens in abiotic components of an ecosystem

(a) Flow of energy (b) Cycling of materials

(c) Consumer (d) Flow of energy and cycling of material

145. In an ecosystem which of the following are important components

(a) Energy flow and food chain (b) Mineral recycling and energy flow

(c) Food chain and decomposers (d) All of these

146. Energy storage at consumer level is called

(a) Gross primary productivity (b) Secondary productivity

(c) Net primary productivity (d) Net productivity

147. On the global basis the maximum productivity is shown by

(a) Aquatic ecosystem (b) Grasslands (c) Forests (d) Deserts

148. Which of the cycle is concerned with energy flow in the ecosystem

(a) Food cycle (b) O_2 cycle (c) Cl_2 cycle (d) All of these

149. If we completely remove the decomposers from an ecosystem, the ecosystem functioning will be adversely affected because

(a) Mineral movement will be blocked

(b)Herbivores will not receive solar energy

(c) Energy flow will be blocked

(d)Rate of decomposition of other components will be very high

150. An ecosystem is a complex interacting system of

(a) Individual (b) Population

(c) Communities and their physical environment (d) Communities and their soil conditions

151. Biological equilibrium is an equilibrium among the

(a) Producers (b) Producers and consumers

(c) Decomposers and producers (d) Producers, consumers and decomposers

152. Food chains are met with only in the

(a) Sea (b) Cities (c) Forests (d) In all the places

153. Constant grazing and browsing in an area may ultimately result in the formation of

(a) Dense forest (b) Grasslands (c) Desert (d) Bushy vegetation

154. Which of the following is not a biotic component

(a) Phytoplankton (b) Herbivores (c) Light (d) Bacteria

155. *Nepenthes* is a

(a) Primary producer (b) Consumer

(c) Primary producer and consumer (d) None of these

156. In a food chain, which of the following produces in the largest amount

(a) Producers (b) Decomposers (c) Tertiary consumers (d) Primary consumers

157. In a pond ecosystem, benthos means

(a) Primary consumers in the depth of a pond (b) Zooplankton on the water surface

(c) Periphyton (d) Epineuston

158. In a food chain, lion is a

(a) Secondary consumer (b)Primary consumer (c) Tertiary consumer (d) Secondary producer

159. The organisms dwelling at the bottom of a lake are called

(a) Phytoplanktons (b) Zooplanktons (c) Nektons (d) Benthos

160. The dominant second trophic level, in a lake ecosystem, is

(a) Benthos (b) Plankton (c) Zooplankton (d) Phytoplankton

161. If bamboo plant is growing in a far forest then what will be its trophic level

(a) First (b) Second (c) Third (d) Fourth

162. A lake ecosystem is

(a) Artificial (b) Abiotic (c) Natural (d) Hydrological

163. Which of the following habitats is most unsuitable for primary productivity

(a) Meadow (b) Forested river bank (c) Cave (d) Pond

164. The first link in any food chain is a green plant because

(a) They are widely distributed

(b) Firmly fixed to soil

(c) They alone have the capacity to fix the atmospheric CO_2 in the presence of sun light

(d) There are more herbivorus animals than the carnivores

165. The transfer or energy from organisms to organisms in a natural community establishes

(a) Food chains (b) Biological control (c) Natural barriers (d) All of these

166. In a tree ecosystem, the pyramid of number is
(a) Upright (b) Inverted (c) Both of the above (d) None of these

167. The zooplanktonic forms are
(a) Primary consumers (b) Secondary consumers (c) Carnivores (d) Primary producers

168. Ecological pyramids are of
(a) Two types (b) Three types (c) Four types (d) Five types

169. The driving force of the ecosystem is
(a) Carbohydrates in plants (b)Biomass (c) Producers (d) Solar energy

170. Tip of ecological pyramid is occupied by
(a) Herbivore (b) Carnivores (c) Producers (d) None of these

171. The part of earth and atmosphere supporting life is
(a) Biosphere (b) Biome (c) Ecotone (d) Biota

172. MAB stands for
(a) Man and biosphere (b)Man antibiotics and bacteria
(c) Man and biotic community (d) Mayer, Anderson and Bishby

173. The best source of energy in the environment is
(a) Water (b) Soil (c) Trees (d) Ponds

174. Decomposers are
(a) Autotrophs (b) Heterotrophs (c) Autoheterotrophs (d) Organotrophs

175. An inverted shape of pyramid is of
(a) Energy in a pond ecosystem (b) Numbers in a grasslands ecosystem
(c) Biomass in a pond ecosystem (d) Biomass in a grassland ecosystem

176. Ecosystem has two components
(a) Plants and animals (b) Weeds and trees (c) Biotic and abiotic (d) Frog and men

177. The ecosystem of a pond is referred as
(a) Lotic (b) Lentic (c) Xeric (d) Benthic

178. When spontaneous process occurs then free energy of system
(a) Decrease (b) Increase
(c) Remains same (d) Either can increase or decrease

179. A pond is a
(a) Biome (b) Natural ecosystem
(c) Artificial ecosystem (d) Community of plants and animals

180. In a biotic community, primary consumers are
(a) Omnivores (b) Carnivores (c) Detritivores (d) Herbivores

181. Ecosystem creates
(a) Food chain (b) Food web (c) Both the above (d) None of these

182. A biome consist of organisms of various trophic levels
(a) Reacting with their abiotic environment (b) Constituting a complex sociological unit
(c) Living a symbiotic life (d) Inhabiting a desert

183. Which must be preserved in an ecosystem, if the system is to be maintained

(a) Producers and carnivores (b) Producers and decomposers

(c) Carnivores and decomposers (d) Herbivores and carnivores

184. Green plants constitute

(a) First trophic level (b) Second trophic level

(c) Third trophic level (d) Complete food chain

185. In an ecosystem decomposer include

(a) Bacteria and fungi (b) Only microscopic organisms

(c) Above two (d) Above two plus macro-organisms

186. If all decomposers are removed from an ecosystem, what will happen

(a) All consumers will die (b) Energy cycle will be affected

(c) Balance of biogeochemical cycle will be disturbed

(d) Only herbivores will die

187. In a food web, each successive trophic level has

(a) Increased total energy (b) Less total energy content

(c) More total energy content (d) Non estimated energy content

188. In an aquatic environment microscopic animals and plants are collectively known as

(a) Commensals (b) Herbivores (c) Fauna and flora (d) Planktons

189. The second order consumer in a food chain is

(a) Cattle (b) Deer (c) Tiger (d) Goat

190. Which of the following is the most stable ecosystem

(a) Mountain (b) Desert (c) Forest (d) Ocean

191. Largest ecosystem of the world are

(a) Grasslands (b) Great lakes (c) Oceans (d) Forests

192. Maximum solar energy may be trapped by

(a) Growing grasses (b) Planting trees

(c) Growing algae in large water bodies (d) More cultivation of crop plants

193. In lake ecosystem, pyramid biomass is

(a) Upright (b) Inverted (c) Anything is possible (d) None is correct

194. In a food chain, the total amount of living material is depicted by

(a) Pyramid of energy (b) Pyramid of numbers (c) Pyramid of biomass (d) All of these

195. Cyberviatic is associated with

(a) Flow of energy (b) Cycle of energy (c) Energy released (d) Study of energy

196. In a terrestial ecosystem such as forest, maximum energy is in which trophic level

(a) T_1 (b) T_2 (c) T_3 (d) T_4

197. Which one of the following is a correct food chain

(a)Grasshopper → Grass → Snake → Frog → Eagle

(b) Grass → Grasshopper → Frog → Snake → Eagle

(c) Eagle → Snake → Grasshopper → Grass → Frog

(d) Frog → Snake → Eagle → Grasshopper → Grass

198. Treeless biome of cold climates is

(a) Savannah biome (b) Chapparal biome (c) Temperate biome (d) Tundra biome

199. Generally the food chain has how many trophic levels

(a) One (b) Two (c) Three or Four (d) Three

200. A wolf has just eaten a lamb when tiger saw the wolf attacked it and consumed it. The tiger is in ecological terms

(a) A producer (b) A primary consumer

(c) A secondary consumer (d) A tertiary consumer

201. In an aqueous environment, the microscopic animals are collectively called

(a) Herbivores (b) Carnivores (c) Planktons (d) Fauna and flora

202. The earth's surface capable of supporting life is called

(a) Habitate (b) Niche (c) Biosphere (d) Ecosystem

203. First link in any food chain is a green plant because

(a) Green plants can synthesize food (b) They can eat everything

(c) Fixed at one place (d) None of these

204. In forest ecosystem, pyramid of number is

(a) Upright (b) Inverted (c) Any of the two (d) None of the above

205. In forest ecosystem, fungi is grouped as

(a) Producer (b) Consumer (c) Secondary consumer (d) Decomposer

206. Forests should be conserved as they provide

(a) Food (b) Medicine (c) Wood (d) All of these

207. In an aquatic ecosystem, maximum biomagnification is seen among the

(a) Fishes (b) Phytoplanktons (c) Zooplanktons (d) Macroscopic plant

208. Why the tropical deciduous forest trees shed their leaves

(a) To save energy (b) To protect itself from heat

(c) To enhance rate of respiration (d) To prevent loss of water

209. Which part of the world has a high diversity of organisms

(a) Grasslands (b) Savannahs (c) Deciduous forests (d) Tropical rain forests

210. In India coniferous forests are found in

(a) Madhya Pradesh (b) Himalayan region (c) Satpura hills (d) Rajasthan

211. Alpine forests occur at altitude

(a) 3900 –6000 *m* (b) 1900–3000 *m* (c) 1000–1500 *m* (d) 500–1000 *m*

212. Which of the following communities is more vulnerable to invasion by outsids animals and plants

(a) Mangroves (b) Tropical evergreen forests

(c) Temperate forests (d) Oceanic island communities

213. Kaziranga biosphere is in

(a) Assam (b) Karnataka (c) West Bengal (d) Andhra Pradesh

214. The first plants to reappear in a badly burned forest area will most probably be

(a) Mosses (b) Liverworts (c) Ferns (d) Grasses

215. Moderate rainfall during summer

(a) Desert (b) Grasslands (c) Scrub forests (d) Deciduous forests

216. Tropical dense forest is due to

(a) High temperature and excess rain (b) Low temperature and excess rain

(c) High temperature and lesser rain (d) Wild animals (Tigers, lions, bears etc.)

217. Land mass occupied by forest is about

or

According to Indian forest policy what percentage of the land area should be under forest cover

(a) 11% (b) 22% (c) 30% (d) 60%

218. Rhododendron is the characteristic vegetation of

(a) Tropical zone (b) Alpine zone (c) Gangetic plains (d) Mangroove belt

219. Which ecosystem shows maximum genetic diversity

(a) Coniferous forests (b) Tropical rain forests (c) Subtropical forests (d) Temperate forests

220. Sal forests are found in India

(a) In western ghats (b) Dehradoon valley (c) Nilgiri hills (d) Satpura mountains

221. Which part of the world has a high density of organisms

(a) Grasslands (b) Savannahs (c) Deciduous forests (d) Tropical rain forests

222. Grassland with scattered trees is called

(a) Tropical rain forest (b) Evergreen forest (c) Savannah (d) Deciduous forest

223. The region consisting of long and severe winters and growing season consisting of few months of summers constitutes **[CPMT 1991]**

(a) Savannah ecosystem (b) Tiaga ecosystem (c) Tundra ecosystem (d) None of the above

224. The major man made biotic factor is

(a) Ploughing (b) Grazing (c) Fire (d) Dairying

225. Maximum productivity is found in

(a) Grass land (b) Tropical rain forest (c) Ocean (d) None of these

226. Savannahs are **[MP PMT 2002]**

(a) Tropical rain forest (b) Desert

(c) Grassland with scattered trees (d) Dense forest with close canopy

227. Temperate evergreen forests are found in **[MP PMT 1992]**

(a) Himalayan ranges (b) Western ghats (c) Aravali ranges (d) Assam

228. The treeless biomes include

(a) Tundra (b) Desert (c) Grassland (d) All of these

Pollution

Basic Level

229. A pollutant is any substance chemical or other factor that changes

(a) Natural geochemical cycles (b) Natural balance of our environment

(c) Natural flora of a place (d) The natural wild life of a region

230. Metal generally present in polluted air is **[MP PMT 1991]**

(a) Cadmium (b) Lead (c) Mercury (d) Zinc

231. Domestic waste contains

(a) Non-biodegradable pollutants (b) Biodegradable pollutants

(c) Hydrocarbons (d) None of these

232. The pollution in city like Delhi may be controlled to great extent

(a) By proper sewage and proper exit of chemicals from factories (b) By wide roads and factories away from the city

(c) By cleaning city and scanty use of pesticides (d) All of these

233. It is said, the Tajmahal may be destroyed due to **[BHU 1980]**

(a) Flood in Yamuna river (b) Decomposition of marble as a result of high temperature

(c) Air pollutants released from oil refinery of Mathura (d) All of these

234. The pollutants emitted by jet aeroplanes in outer atmosphere flourocarbons are known as

(a) Smog (b) Photochemical oxidants (c) Aerosols (d)

235. Which of the following does not occur when the sewage is discharged into water

(a) Increase in O_2 (b) Cyanophycean blooms occur

(c) Depletion of O_2 layers (d) Eutrophication

236. A process that uses micro-organisms to convert harmful industrial wastes to less toxic or non-toxic compounds is **[AIEEE 2003]**

(a) Complement fixation (b) Precipitation (c) Bioremediation (d)

237. Photochemical transformation of the automobile exhaust emission in UV wavelength of sunlight results into **[BVP 2003]**

(a) CH_4 and C_6H_6 (b) O_3 and *PAN* (c) CO_2 and NO_2 (d) *CO* and CO_2

238. Green mufler is used against which type of pollution

(a) Air (b) Water (c) Soil (d) Noise

239. B.O.D. is connected with

(a) Organic matter (b) Microbes (c) Both (a) and (b) (d) None of these

240. Biological Oxygen Demand (BOD) is a measure of

(a) Industrial wastes poured into water bodies

(b) Extent to which water is polluted with organic compounds

(c) Amount of carbon monoxide inseparably combined with haemoglobin

(d) Amount of oxygen needed by green plants during night

241. Shallow lakes with rich organic products are called

(a) Eutrophic (b) Oligotrophic (c) Saprotrophic (d) Meterotrophic

242. Which is a green house gas

(a) *CO* (b) CO_2 (c) H_2 (d) N_2

243. Maximum green house gas is released by which of the following country

(a) USA (b) India (c) France (d) Britain

244. Positive pollution of soil is due to

(a) Excessive use of fertilizers on soil (b) Addition of wastes

(c) Reduction in soil productivity (d) All of these

245. SO_2 pollution affects which part of the plant **[AFMC 2003]**

(a) Chloroplast (b) Mitochondria (c) E.R. (d) Lysosome

246. Biogas produced by anaerobic decomposition used in combustion is mainly due to presence of

(a) H_2 (b) CH_4 (c) H_2S (d) None of these

247. Humus is important for plant growth because **[BVP 2003]**

(a) It is partially decomposed

(b) It is derived from leaves

(c) It is rich in nutrients and increases the water holding capacity of soil

(d) It is made up of dead organic matter

248. CFC are not recommended to be used in refrigerators because they

(a) Increase temperature (b) Deplete ozone (c) Affect environment(d)

249. Phosphate pollution is caused by

(a) Phosphate rock only (b) Agricultural fertilizers only

(c) Sewage and phosphate rock agricultural fertilizers (d) Sewage and

250. Photochemical smog formed in congested metropolitan cities mainly consists of

(a) Ozone, peroxyacetyl nitrate and NO_x (b) Smoke, peroxyacetyl nitrate and SO_2

(c) Hydrocarbons, SO_2 and CO_2 (d) Hydrocarbons, ozone and SO_x

251. In almost all Indian metropolitan cities like Delhi, the major atmospheric pollutant(s) is/ are

(a) Suspended particulate matter (SPM) (b) Oxides of sulphur

(c) Carbon dioxide and carbon monoxide (d) Oxides of nitrogen

252. A range of loudness of sound of 70-90 decibles is rated as

(a) Very loud (b) Uncomfortable (c) Painful (d) quiet

253. The soil pollutants that affect the food chain and food web by killing micro organisms and plants are **[Kerala CET (Med.) 2003]**

(a) Pathogens (b) Chemical fertilisers (c) Agricultural wastes (d) Pesticides

254. The ultimate environmental hazard to mankind is **[BHU 2000]**

(a) Air pollution (b) Water pollution (c) Noise pollution (d) Nuclear pollution

255. The result of ozone hole is

(a) Acid rain (b) UV radiations (c) Global warming (d) Green house effect

256. Frequent occurrence of water blooms in a lake indicates

(a) Nutrient deficiency (b) Oxygen deficiency

(c) Excessive nutrient availability in the lake (d) Absence of herbivores

257. Which are sensitive to SO_2 pollution **[MP PMT 2002; BHU 2003]**

(a) Mosses (b) Algae (c) Lichen (d) Ferns

258. Ozone saves the biosphere by absorbing the high energy radiation called

(a) Infra-red (IR) (b) Ultraviolet ray (UV) (c) X-ray (d) Gama rays

259. The main cause of water pollution is

(a) Soap (b) Industrial effluents (c) Smoke (d) Ammonia

260. Which of the following is not a pollutant **[MP PMT 2003]**

(a) Hydrogen (b) Carbon dioxide (c) Sulphur dioxide (d) Carbon Monooxide

261. Water pollution is caused by

(a) Ammonia (b) Phytoplankton (c) Industrial effluents (d) Smoke

262. Ozone hole means **[AFMC 2001]**

(a) Hole in the stratosphere (b) Same concentration of ozone

(c) Decrease in concentration of ozone (d) Increase in the concentration of ozone

263. Which of the following is most poisonous **[CBSE PMT 2001]**

(a) CO (b) CO_2 (c) C (d) SO_2

264. Water pollution is caused due to

(a) Sewage and other wastes (b) Industrial effluents (c) Agricultural discharges (d) All of these

265. Increasing of temperature due to scattering of energy is determine by ozone, CO_2 and water vapour, is known as

[Pb. PMT 1999; Rajasthan PMT 1999]

(a) Radioactivity (b) Ozone effect (c) Solar reaction (d) Green house effect

266. Increase in the concentration of pollutants in higher trophic levels is called

(a) Recycling (b) Eutrophication (c) Biodegradation (d) Biomagnification

267. Which is a degradable pollutant

(a) D.D.T. (b) Aluminium foil (c) Domestic wastes (d) Mercury salts

268. Which among the following is likely to have the highest levels of D.D.T. depositions in its body

(a) Eel (b) Crab (c) Sea gull (d) Phytoplankton

269. Surface water of lake enrich in having

(a) Organic substance (b) Minerals (c) Inorganic substance (d) Pollutants

270. Effect of pollution first marked on

(a) Micro-organisms (b) Green vegetation of an area (c) Food crop (d)

271. What are the chief pollutants of the atmosphere which are most likely to deplete the ozone layer

[CPMT 1990; MP PAT 1995; CPMT 1998]

(a) Sulphur dioxide (b) Nitrogen oxide and fluorocarbons

(c) Carbon dioxide (d) Carbon monoxide

272. Acid rain is caused due to increase in concentration of (in atmosphere)

(a) SO_2 and NO_2 (b) CO and CO_2 (c) CO_2 and SO_3 (d) O_3 and dust

273. What is the intensity of sound in normal conversation

(a) 10-20 *dB* (b) 40-60 *dB* (c) 90-120 *dB* (d) 120-150 *dB*

274. Today the concentration of green house gases is very high because of

(a) Use of refrigerator (b) Increased combustion of oils and coal

(c) Deforestation (d) All of these

275. Lichens are important in the studies on atmospheric pollution because they

(a) Can grow in polluted atmosphere (b) Can readily multiply in polluted atmosphere

(c) Efficiently purify the atmosphere (d) Are very sensitive to pollutants like sulphur dioxide

276. Some effects of sulphur dioxide and its transformation products on plants include

(a) Chlorophyll destruction (b) Plasmolysis (c) Golgi body destruction (d) None of these

277. Ozone layer in upper atmosphere (stratosphere) is destroyed by **or** Which one of the chemicals is responsible for the reduction of ozone content of atmosphere **[MP PMT 1990, 2002; BHU 1989, 90; CP**

(a) Hydrochloric acid (b) Photochemical smog (c) Chlorofluoro carbon (CFC) (d)

278. Acid rain is caused by **or** Recent reports of acid rain in some industrial cities are due to the effect of atmospheric pollution by

[MP PMT 1987, 90; BHU 1989; CPMT 1989; CBSE 1988, 89; Karnataka CET 1994; EAMCET 1995]

(a) Excessive release of CO_2 by burning of fuels like wood and charcoal, cutting of forests and increased animal population

(b) Excessive release of NO_2 and SO_2 in atmosphere by burning of fossil fuel

(c) Excessive release of NH_3 by industrial plants and coal gas

(d) Excessive release of CO in atmosphere by incomplete combustion of coke, charcoal and other carbonaceous fuel in paucity of oxygen

279. Thermal pollution of water bodies is due to **[Delhi PMT 1986]**

(a) Discharge of heat (hot water) from power plants (b) Discharge of chemicals from industries

(c) Discharge of waste from mining (d) Discharges of agricultural run off

280. Photochemical smog always contains **[CPMT 1998]**

(a) O_3 (b) CH_4 (c) CO (d) None of these

281. In coming years, skin related disorders will be more common due to

(a) Pollutants in air (b) Use of detergents (c) Water pollution (d) Depletion of ozone layer

282. The maximum biomagnification would be in which of the following in case of aquatic ecosystem

(a) Fishes (b) Birds (c) Zooplanktons (d) Phytoplanktons

283. Which of the following is a water polluting factor **[CPMT 1980; MP PMT 1986; BHU 1991]**

(a) Smoke (b) Industrial waste (c) Detergent (d) Ammonia

284. Green house effect refers to

(a) Cooling of earth (b) Trapping of UV rays (c) Production of cereals (d) Warming of earth

285. Which of the following is a photochemical reaction product

(a) CO and CO_2 (b) SO_2 (c) O_3 (d) Fluorides

286. Which of the following is a renewable resource **[Bihar MDAT 1995]**

(a) Fossil fire (b) Metal (c) Water (d) All of these

287. Which of the following is the use of lichens in case of pollution

(a) They treat the polluted water (b) They act as bioindicators of pollutions

(c) They promote pollution (d) Lichens are not related with pollution

288. The presence of ozone (O_3) in the atmosphere of earth

(a) Hinders higher rate of photosynthesis

(b) Helps in checking the penetration of ultra-violet rays to earth

(c) Has been responsible for increasing the average global temperature in recent years

(d) Is advantageous since it supplies O_2 for people travelling in jets

289. Biological treatment of water pollution is done with the help of

(a) Phytoplankton (b) Lichens (c) Fungi (d) None of these

290. Green house effect is due to the presence of **[CBSE 1989, 91; CPMT 1998, 99; AIIMS 2000]**

(a) Ozone layer in the atmosphere (b) Infrared light reaching the earth

(c) Moisture layer in the atmosphere (d) CO_2 layer in the atmosphere

291. Which of the following gas causes pollution

(a) *CO* (b) SO_2 (c) Both (a) and (b) (d) None of these

292. If water pollution continues at its present rate, it will eventually

(a) Stop water cycle (b) Prevent precipitation

(c) Make oxygen molecules unavailable to water plants (d) Make nitrate molecules unavailable to water plants

293. Release of phosphates and nitrates in water bodies (*i.e.* rivers and lakes) lead to

(a) Increased algae growth (b) Increased growth of decomposers

(c) Nutrient enrichment (d) Reduced algae growth

294. Eutrophic lakes means **[Delhi PMT 1984]**

(a) Lake poor in nutrients (b) Lake rich in nutrients

(c) Lake poor in flora and fauna (d) Lake lacking in water

295. Grazing is an example of

(a) Negative pollution (b) Positive pollution (c) Sheet erosion (d) Gully erosion

296. Major pollution causing agent is

(a) Man (b) Animals (c) Hydrocarbon gases (d) None of these

297. Major pollutant present in the jet plane emission is

(a) Carbon tetrachloride (b) Sulphur dioxide (c) Carbon monoxide (d) Fluorocarbon/Aerosols

298. The stratospheric ozone depletion leads to : **[AIIMS 1994]**

(a) Global warming (b) Increase in the incidence of skin cancers

(c) Forest fires (d) All of these

299. Water pollution is caused by

(a) Growth of planktons (b) Industrial effluents

(c) Decay of bodies of aquatic animals (d) Rain

300. Photochemical smog is related to the pollution of **[MP PMT 1994]**

(a) Soil (b) Water (c) Noise (d) Air

301. Most important causative pollutant of soil may be **[MP PMT 1994]**

(a) Plastics (b) Iron junks (c) Detergents (d) Glass junks

302. Checking of reradiating heat by atmospheric dust, water vapour, ozone, CO_2 etc. is known as

(a) Green house effect (b) Radioactive effect (c) Ozone layer effect (d) Solar effect

303. DDT is a **[BHU 1982; Delhi PMT 1984; CBSE 1999]**

(a) Non-biodegradable pollutant (b) Biodegradable pollutant
(c) Antibiotics (d) None of these

304. Minamata disease is a pollution related disease results from
(a) Oil spills into sea (b) Accumulation of arsenic into atmosphere
(c) Release of industrial waste mercury into fishing water (d) Release human organic waste into drinking water

305. Which of the following is normally not an atmospheric pollutant **[CPMT 1981, 84; Delhi PMT 1982, 92; MP PMT 1984, 93; CBSE 1988, 92]**
(a) Carbon monoxide (b) Carbon dioxide (c) Sulphur dioxide (d) Hydrocarbons

306. Spraying of D.D.T. on crops produces pollution of
(a) Air only (b) Air and soil only (c) Air, soil and water (d) Air and water only

307. Generally speaking, the atmosphere in big cities is polluted most by
(a) Radioactive fall out (b) Household waste (c) Automobile exhaust (d) Pesticide residues

308. If carbon dioxide is withdrawn from the biosphere, which organism would first experience negative effects **[MP PMT 1993]**
(a) Primary producers (b) Producers (c) Secondary consumers (d)Tertiary consumers

309. One of the effects of dust is to cause
(a) Opening of stomata (b) Closure of stomata (c) Coiling of leaves (d) Yellowing of leaves

310. *Taj Mahal* is threatened due to the effect of **[CBSE 1995; BHU 1999; CPMT 2002]**
(a) Chlorine (b) Sulphur dioxide (c) Oxygen (d) Hydrogen

311. A dental disease characterised by mottling of teeth is due to presence of a certain chemical element in drinking water. Which is that element
(a) Boron (b) Chlorine (c) Fluorine (d) Mercury

312. In Minamata Bay, Japan, which of the following animals remained free from *Minamata disease*
(a) Cats (b) Rabbits (c) Dogs (d) Pigs

313. Which of the following disease is caused or aggravated by pollution
(a) Bronchitis (b) Rheumatism (c) Scurvy (d) Haemophilia

314. The excessive discharge of fertilizers into water bodies results in
(a) Growth of fish (b) Death of hydrophytes (c) Eutrophication (d) Silt

315. Acid rain is due to **[MP PMT 1996]**
(a) Sulphur dioxide pollution (b) Carbon monoxide pollution (c)

316. In 1984, Bhopal gas tragedy was caused due to leakage of
(a) Sodium monoxide (b) Sodium thiocyanate (c) Potassium isocyanate (d)Methyl isocyanate

317. Non-renewable source is
(a) Water and gas (b) Plant and coke
(c) Coke and mineral substances (d) Energy and water

318. Most hazardous metal pollutant of automobile exhaust is
(a) Mercury (b) Lead (c) Cadmium (d) Copper

319. Noise pollution is created if noise is in excess to **[Pb. PMT 1999]**

(a) 70 – 75 *dB* (b) 50 – 60 *dB* (c) 80 – 99 *dB* (d) 40 – 65 *dB*

320. Formation of ozone hole is maximum over **[CBSE PMT 1997]**

(a) India (b) Antarctica (c) Europe (d) Africa

321. The toxic effect of carbon monoxide is due to its greater affinity for haemoglobin as compared to oxygen by (approx.)

[CBSE PMT 1995]

(a) 200 times (b) 2 times (c) 1000 times (d) 20 times

322. BOD stands for **[AIIMS 1984]**

(a) Biological organism death matter decay (b) Biochemical organic

(c) Biotic oxidation demand demand (d) Biochemical oxygen

323. When huge amount of sewage is dumped into a river, the BOD will

(a) Increase (b) Remain unchanged (c) Slightly decrease (d) Decrease

324. One of the important effects of SO_2 and its transformation products on plants is

(a) Plasmolysis (b) Destruction of chlorophyll (c) Destruction of Golgi bodies (d) Destruction of cell wall

325. Measurement of the rate of O_2 consumption in unit volume of water over a period of time is done to find out **[MP PMT 1996]**

(a) Biogas generation (b) Biological oxygen demand (c) Biosynthetic pathways (d) Fermentation

326. Secondary pollutant which stops Hill reaction is **[CBSE PMT 1999; Kerala CET (Med.) 2002]**

(a) Sulphuric acid (b) Nitric acid (c) Peroxyacetyl nitrate (PAN) (d)

327. Water pollution **[MP PMT 1997; BHU 20**

(a) Increases oxygenation (b) Decreases turgidity

(c) Increases turbidity and deoxygenation (d) Increases photosynthesis

328. Air pollution effects are usually found on **[MP PMT 1997]**

(a) Leaves (b) Flowers (c) Stems (d) Roots

329. In the last decades, most serious nuclear reactor accident created MIC gas tragedy in **[CBSE PMT 1996**

(a) Russia (1990) and Bhopal (1996) (b) Ucraine (1986) and Bhopal (1984)

(c) Bhopal (1994) and Russia (1990) (d) Ucraine and USA (1984)

330. Which of the following country is responsible for releasing largest amount of green–house gases

(a) Russia (b) Germany (c) Brazil (d) America

331. In big cities, air pollution is due to

(a) Burning of fossil fuels (b) Thermal power plant (c) Sewage (d)

332. The change of the lighter coloured variety of peppered moth *Biston betularia* to its darker variety (carbonaria) is due to

[CBSE PMT 1995]

(a) Mutation of single Mendelian gene for survival in the smoke laden-industrial environment

(b) Deletion of a segment of gene due to industrial pollution

(c) Industrial carbon deposited on the wings of moth resulting in darker variety

(d) Translocation of a block of genes in chromosomes in response to heavy carbons

333. Petroleum is a **[CBSE PMT 1992]**

(a) Non-renewable source (b) Renewable source (c) A synthetic product(d)

334. Major aerosol pollutant present in the jet plane emission is

(a) Sulphur dioxide (b) Fluorocarbon (c) Carbon tetrachloride(d) Carbon monoxide

335. Which of the following pollutant is not produced by exhaust of motor vehicle in Delhi**[Delhi PMT 1982**

(a) Sulphur dioxide (b) Fly-ash (c) Hydrocarbon gases (d) Carbon monoxide

336. Which of the following does not cause pollution **[MP PMT 1988; CPMT 1993, 2002]**

(a) Hydroelectric schemes (b) Automobiles (c) Nuclear energy project (d) Thermal power project

337. Indicator plants which can be used to indicate atmospheric pollution by SO_2 are **[NCERT 1983; CPMT**

(a) Lichens like *Usnea* (b) Grassland like *Deschampsia* (c) Moss like *Sphagnum* (d) Climbers like *Cucurbita*

338. Effect of pollution is first and most marked on **[CPMT 1988]**

(a) Natural flora of a place (b) Natural geochemical cycle

(c) Natural gaseous cycle (d) Natural balance of our environment

339. One of the most dangerous radioactive pollutant to *Homo sapiens* is

(a) Strontium – 90 (b) Phosphorus – 32 (c) Sulphur – 35 (d) None of these

340. Which of the following is a rich source of energy but never cause atmospheric pollution

(a) Nuclear energy (b) Solar energy (c) Coal (d) Wood

341. Which one is not dangerous for life

(a) Biopollutants (b) Ozone layer (c) Nuclear blast (d) Deforestation

342. Pollution can be controlled by

(a) Sewage treatment (b) Manufacturing electrically operated vehicles

(c) By checking atomic blasts (d) All of these

343. Ultraviolet radiation from sunlight cause the reaction that produce

(a) Carbon monoxide (b) Sulphur dioxide (c) Ozone (d) Fluorides

344. Gases referred to as "**green house gases**" are **[BHU 2003; CPMT 2003**

(a) CO_2, O_2, NO_2, NH_3 (b) Chlorofluoro carbon, CO_2, NH_3, N_2

(c) CH_4, N_2, CO_2, NH_3 (d) Chlorofluoro carbon, CO_2, CH_4, NO_2

345. Increase in the percentage of fauna and decrease in flora may be dangerous because it enhances

(a) Percentage of CO_2 (b) Percentage of radioactive fall out

(c) Percentage of O_2 (d) Percentage of diseases

346. Air pollution causing photochemical oxidants production include

(a) Carbon monoxide, sulphur dioxide (b) Nitrous oxide, nitric acid fumes, nitric oxide

(c) Ozone, peroxyacetyl nitrate, aldehydes (d) Oxygen, chlorine, fuming nitric acid

347. Main air pollutant is **[MP PMT 2003]**

(a) CO_2 (b) CO (c) N_2 (d) Sulphur

348. Quantity of CO_2 in the atmosphere is about **[MP PMT 1991; CBSE 1997; Raj. PMT 1997]**

(a) 0.003% (b) 0.03% (c) 0.3% (d) 3.0%

349. Which of the following serves as an indicator of atmospheric pollution

(a) Ferns (b) Liverworts (c) Hornworts (d) Epiphytic lichens

350. Eutrophication results in the reduction of **[Karnataka CET 1994; CPMT 2000]**

(a) Dissolved hydrogen (b) Dissolved oxygen (c) Mineral salts (d) None of these

351. Minerals and metals are **[CBSE PMT 1992]**

(a) Renewable resources (b) Non-renewable resources

(c) Renewable and non-renewable resources (d) Biodegradable resources

352. Lichens do not like to grow in cities

(a) Because of absence of the right type of algae and fungi (b) Because of lack of moisture

(c) Because of SO_2 pollution (d) Because natural habitat is missing

353. Smog is a common pollutant in places having **[Delhi PMT 1982; CPMT 1996]**

(a) High temperature (b) Low temperature (c) Excessive SO_2 in the air (d)Excessive ammonia in t

354. The component of a living cell affected by the pollutant SO_2 is

(a) Nucleus (b) All cell membrane system (c) Cell wall (d)

355. One of the following is the chief source of water and soil pollution

(a) Agro industry (b) Mining (c) Thermal power stations (d) All of these

356. Sewage water is purified for recycling by the action of

(a) Light (b) Micro-organisms (c) Aquatic plants (d) Fishes

357. The high amount of *E. coli* in water is the indicator of

(a) Hardness of water (b) Industrial pollution (c) Sewage pollution (d) Presence of chlorine in water

358. A pollutant is an agent which causes change in **[CPMT 1989]**

(a) Balance of nature (b) Local flora (c) Geochemical cycles (d) Local fauna

359. Which of the following gas is most harmful for plants

(a) N_2 (b) SO_2 (c) CO (d) CO_2

360. Lead (*Pb*) causes **[CPMT 1992; MP PMT 200**

(a) Soil pollution (b) Air pollution (c) Radioactive pollution (d) All of these

361. Polluted water can be purified by using **[CBSE PMT 1990]**

(a) Micro-organisms (b) Algae (c) Pesticides (d) Fishes

362. Which of the following is non-renewable source **[CPMT 1995]**

(a) Forests (b) Coal (c) Sunlight (d) Water

363. Oxides of sulphur and nitrogen are important pollutants of

(a) Air and water (b) Air (c) Water (d) Soil

364. In a polluted lake, the index of pollution is **[Delhi PMT 1983]**

(a) BOD and *Daphnia* (b) *DO* and *Artemisia* (c) Presence of frogs (d) Diatoms larvae

365. Which of the following organism is likely to have more concentration of D.D.T in its body

(a) Herbivores (b) Carnivores (c) Top carnivores (d) Primary producers

366. Carbon monoxide (*CO*) is harmful to man because

(a) It forms carbolic acid (b) It generates excess CO_2

(c) It is carcinogenic (d) It competes with O_2 for haemoglobin

367. How carbon monoxide, emitted by automobiles, prevents transport of oxygen in the body tissues

(a) By changing oxygen into carbon dioxide (b) By destroying the haemoglobin

(c) By forming a stable compound with haemoglobin (d) By obstructing the reaction of oxygen with haemoglobin

368. Which of the following is not ionising radiation **[CPMT 1983]**

(a) Alpha rays (b) Beta rays (c) Infrared rays (d) Gamma rays

369. The maximum biological magnification of DDT through food web is seen in

(a) Algae (b) Bacteria (c) Higher plants (d) Man

370. Which of the following damages WBC, bonemarrows and lymph nodes

(a) I^{131} (b) Ca^{40} (c) Caesium (d) Sr^{90}

371. In a pond if there is too much wastage, then the *BOD* of pond will

(a) Increase (b) Decrease (c) Remain same (d) Both (a) and (b)

372. Fishes die by sewage because

(a) Of its bad smell (b) It replaces food material of fishes

(c) It increases oxygen competition among fishes (d) CO_2 is mixed in large amount in water

373. Leaf curling is caused by

(a) SO_2 (b) O_3 (c) H_2S (d) *CO*

374. The minamata disease in Japan was caused through the pollution of water by

(a) Lead (b) Mercury (c) Cyanide (d) Methyl isocyanate

375. U^{238} emits **[BHU 1982; BVP 2003]**

(a) γ–rays (b) β–rays (c) α–rays (d) None of these

376. Which causes water pollution

(a) 2, 4–D and pesticides (b) Smoke (c) Automobile exhaust (d)

377. 'Heat islands' are produced due to

(a) Air pollution (b) Water pollution (c) Land pollution (d) All of these

378. The supersonic jets cause pollution by the thinning of

(a) CO_2 layer (b) SO_2 layer (c) O_2 layer (d) O_3 layer

379. Which one of the following organisms is used as indicator of water quality

(a) *Biggiata* (b) *Chlorella* (c) *Azospirillum* (d) *Escherichia*

380. Carbon monoxide is a pollutant because **[CBSE PMT 1998]**

(a) It reacts with O_2 (b) It inhibits glycolysis

(c) Reacts with haemoglobin (d) Makes nervous system inactive

381. If there was no CO_2 in the earth's atmosphere, the temperature of earth's surface would be

(a) Same as present (b) Less than the present

(c) Higher than the present (d) Dependent on the amount of oxygen in the atmosphere

382. Which of the following is a secondary pollutant **[CBSE PMT 1999]**

(a) *CO* (b) CO_2 (c) *PAN* (d) Aerosol

383. Which important green-house gas, other than methane, is being produced from the agricultural fields **[CBSE PMT 1998]**

(a) Arsine (b) Sulphur dioxide (c) Ammonia (d) Nitrous oxide

384. Radioactive strontium as a result of radioactive fall out, is

(a) Sr^{80} (b) Sr^{90} (c) Sr^{85} (d) Sr^{95}

385. Most harmful pollutant is

(a) SO_2 (b) SO_3 (c) NO_2 (d) CH_4

386. Carbon monoxide is a major pollutant of **[MP PMT 1996]**

(a) Water (b) Air (c) Noise (d) Soil

387. Which of the following is pollution related disorder

(a) Fluorosis (b) Leprosis (c) Silicosis (d) Pneumonicosis

388. Which of the following is non-renewable resource

(a) Forest (b) Coal deposit (c) Water (d) Wild life

389. Sewage water can be purified for recycling with the action of

(a) Aquatic plants (b) Penicillin (c) Micro-organisms (d) Fishes

390. Biodegradable pollutant is

(a) Plastic (b) Asbestos (c) Sewage (d) All of these

391. In a polluted lake, the index of pollution is **[Delhi PMT 1983]**

(a) *Daphnia* (b) *Artemia* (c) Frog (d) None of these

Biogeochemical cycle

Basic Level

392. Which one of the following pairs is a sedimentary type of biogeochemical cycle **[CBSE PMT 1995; BH**

(a) Phosphorus and carbon dioxide (b) Oxygen and nitrogen

(c) Phosphorus and nitrogen (d) Phosphorus and sulphur

393. Biogeochemical cycling means

(a) Cycling of energy in ecosystem (b) Cycling of gases between plants and the atmosphere

(c) Cycling of nutrients in an ecosystem (d) Cycling of water

394. Which of the following cycle would be affected if decomposers of an ecosystem vanish

(a) Producer's cycle (b) Consumer's cycle (c) Decomposer's cycle (d) Biogeochemical cycle

395. Carbon cycle includes **[CPMT 1979, 81, 84; MP PMT 1984; MP PAT**

(a) Producer – consumer – decomposer (b) Decomposer – consumer – producer

(c) Producer – decomposer – consumer (d) Consumer – producer – decomposer

396. If decomposers are removed what will happen ecosystem

(a) Energy cycle is stopped (b) Mineral cycle is stopped

(c) Consumers cannot absorb solar energy (d) Rate of decomposition of mineral increases

398. The conversion of nitrate to nitrous oxide and nitrogen gas is termed as

(a) Nitrification (b) Denitrification (c) Nitrogen-fixation (d) None of these

399. In water receiving regions, water does forest regulate

(a) Hydrological cycle (b) Carbon cycle (c) Nitrogen cycle (d) Calcium cycle

400. Cycling of elements in an ecosystem is called **[MP PMT 1987, 99; BHU 2000]**

(a) Chemical cycle (b) Geochemical cycle (c) Biogeochemical cycle (d) Geological cycle

Conservation of natural resources

Basic Level

401. Soil conservation can be best achieved by having **[CPMT 1988]**

(a) Wind screens (b) Good plant covers (c) Restricted human activity (d)

402. Which of the following is an anti-forest conservation activity

(a) Economy in lumbering (b) Clear felling (c) Preservation of fires (d)

403. The country which hosted the first world earth summit on conservation of environment is

(a) Brazil (b) Spain (c) India (d) Peru

404. Chipko movement is concerned with

(a) Plant conservation (b) Project Tiger (c) Plant breeding (d) Animal breeding

405. Indian wild life conservation act came into force in the year

(a) 1972 (b) 1974 (c) 1976 (d) 1978

406. Red data book provides data on

(a) Red flowered plants (b) Red coloured fishes

(c) Endangered plants and animals (d) Red eyed birds

407. One of the following is associated with the conservation of forest

(a) Kaziranga (b) Bharatpur (c) Silent valley (d) Gir

408. Chipko Revolution is related to

(a) Soil conservation (b) Forest conservation (c) Water conservation (d) All of the above

409. Mulching helps in **[BHU 1983]**

(a) Soil fertility (b) Moisture conservation

(c) Improvement of soil structure (d) Soil sterility

410. Soil conservation is the process where **[CBSE PMT 1989, 93]**

(a) Sterile soil is converted to fertile soil (b) Soil is aerated

(c) Soil erosion is allowed (d) Soil is protected against loss

411. Number of endangered species of angiosperms in India is

(a) 487 (b) 3000 (c) 5000 (d) 15,000

412. The first biosphere reserve established in India for conserving the gene pool of flora and fauna and the life style of tribals is **[Kerala CET (Med.) 2003]**

(a) Nilgiri biosphere reserve (b) Nanda Devi biosphere reserve

(c) Uttarakhand biosphere reserve (d) Great Nicobar biosphere reserve

413. New approach to conservation is the establishment of

(a) Sancturies (b) Reserve forests (c) National parks (d) Biosphere reserves

Basic Level

414. "Exobiology" refers to the study of

(a) Exodermis (b) Terrestrial organism (c) Life in the air (d) Life on other planets

415. The possible beneficial affect of grazing animals is the

(a) Removal of wild animals (b) Eradication of weeds

(c) Removal of wild plants (d) Addition of their excrete to the soil

416. The maximum biomass of living diatoms to be found in

(a) Marine pelagic habitats (b) Moist soil and swamps (c) Deep coastmines (d)

417. World Wild life Week is

(a) First week of September (b) First week of October (c)Third week of October

418. Chernobyl tragedy occured in

(a) 26th May, 1966 (b) 26th April, 1986 (c) 6th Aug., 1947 (d) 9th May, 1945

419. In India highest amount of coal is present in **[MP PMT 2003]**

(a) West Bengal (b) Maharastra (c) Jharkhand (d) Assam

420. Which of the following statements is true regarding individuals of same species

(a) They are interbreeding (b) They live in same niche

(c) They live in different niche (d) They live in different habitate

421. On based temperature plants are classified by **[Rajasthan PMT 1999]**

(a) Warming (b) Climent (c) Haeckel (d) Rancure

422. Clay soil is obtained **[Pb. PMT 2000]**

(a) In desert (b) Around ponds (c) On seashore (d) On rocks

423. The green plants are removed from an aquarium **[Karnataka CET 1998]**

(a) The fishes will not survive (b) Fishes will increase in size (c)

424. Which of the following acts as "nature's scavengers"

(a) Man (b) Animals (c) Insects (d) Micro-organisms

425. In recent years, there has been an increasing incidence of floods in the plains of northern India because **[Delhi PMT 1982, 83]**

(a) There has been an increase in annual rainfall (b) The rate of silting of dams has gone up

(c) There has been increased deforestation in the catchment areas (d) Increased areas of land is being self cultivated

426. Plants are killed in winter by frost

(a) Because of dessication and mechanical damage to the tissue

(b) Because no photosynthesis take place at such a low temperature

(c) Because respiration ceases at such low temp

(d) Because there is no transpiration

427. Which of the following is most dangerous to wild life

(a) Over exploitation (b) Man made forest

(c) Habitat destruction (d) Introduction of foreign species

428. Which of the following changes would be likely to make terrestrial life on this planet impossible**[CPMT**

(a) A decrease in mean temperature by 10°C

(b) Change in atmosphere permitting all the solar radiation reaching the upper atmosphere to penetrate to the surface of the earth

(c) Change in the orbit of the earth from an ellipse to a circle

(d) Disappearance of the moon

429. The plant that is characteristic component of mangroove vegetation

(a) *Rhizophora mangel* (b) *Ficus religiosa* (c) *Mangifera indica* (d) *Prosopis specigera*

430. In submerged plants **[MP PAT 1996]**

(a) Anaerobic respiration is a rule

(b) Aerobic respiration occurs by utilizing dissolved oxygen of water

(c) Anaerobic and aerobic respiration take place simultaneously

(d) None of these

431. Stopage of reproduction in an organism by creating hurdle in its biology or physiology or its distruction by use of another organism is known as

(a) Predation (b) Competition (c) Biological control (d) Physiological control

432. If forest area is reduced to half, which one of the following will be a long term effect **[CBSE PMT 1996**

(a) The natives (tribals) of that area will die on account of hunger (b) Cattles of that area will die due to scarcity of fodder

(c) To diversity in germplasm will effect the crop breeding (d) It will be converted into large desert

433. The river `Sone' receives wastes from

(a) Refinery (b) Distillery (c) Textile mill (d) Paper mill

434. Soil formed by transportation of disintegrated parent material from one place to another is called **[Pune**

(a) Light soil (b) Alluvial soil (c) Heavy soil (d) Sedimentary soil

435. World environment day is celeberated on **[MP PMT 1991; CPMT 2002]**

(a) 15^{th} March (b) 15^{th} April (c) 4^{th} May (d) 5^{th} June

436. Which of the following weeds should be destroyed quickly

(a) *Eichorinia* (b) *Parthenium* (c) *Glycine max* (d) *Brassica*

437. Which one of the following factors is biotic **[CPMT 1993]**

(a) Photoperiod (b) CO_2 content to the soil (c) Texture and porosity of soil (d) Rainfall

438. *Nicotiana sylvestris* flowers only during long days and *N. tabacum* flowers only short days. It raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be cross-fertilized to produce self-fertile offspring. What is the best reason for considering *N. sylvestris* and *N. tabacum* to be separate species **[CBSE PMT 2003]**

(a) They are morphologically distinct (b) They cannot interbreed in nature

(c) They are reproductively distinct (d) They are physiologically distinct

439. Pneumatophores are helpful in

(a) Protein synthesis (b) Respiration (c) Transpiration (d) Carbohydrate metabolism

440. Which is the main causative factor of desertification

(a) Developmental activities (b) Tourism (c) Overgrazing (d)

441. Sheet erosion is caused by

(a) Fast running rivers (b) Wind (c) Heavy rains (d) Glaciers

442. The process of laterization results into

(a) Degradation of soil (b) Formation of humus (c) Mineralization of humus (d)

443. The pesticide used as preventive measure in buildings is

(a) Aldrin (b) Dieldrin (c) Endrin (d) DDT

444. Ecological factors work **[CPMT 1987]**

(a) Singly (b) Together (c) In complex combinations (d)

445. Which of the following plants are used as green manure in crop fields and in sandy soils **[CBSE PMT 2**

(a) *Dichanthium annulatum* and *Azolla ailotica* (b) *Crotalaria juncea* and *Alhagi camelorum*

(c) *Calotropis procera* and P*itylanthus niruri* (d) *Saccharum munja* and *Lantana camara*

446. Biogenetic law was putforward by

(a) E. Haeckel (b) Charles Darwins (c) Karl von Bear (d) Lamarck

447. Salinity of the soil is often caused due to **[CPMT 1989]**

(a) Accumulation of soluble minerals near or in the surface in arid region

(b) Excessive addition of water

(c) Rapid evaporation of surface water

(d) Excessive leaching

448. "National Institute of Oceanography" is situated at

(a) Bombay (b) Panaji (Goa) (c) Lucknow (d) Chennai

449. National Environmental Engineering Research Institute (**NEERI**) is situated at **[BHU 1989; Karnataka CET (Med.) 1999; Kerala CET (Med.) 2003]**

(a) New Delhi (b) Nagpur (c) Bhopal (d) Baroda

450. Foul smell in the water of tanks, ponds etc. is due to

(a) Anaerobiosis (b) Aerobiosis (c) Biological magnification (d)

451. In an aqueous environment, microscopic animals and plants are collectively known as **[CPMT 1985]**

(a) Plankton (b) Commensals (c) Herbivores (d) Fauna and flora

452. Plants grow sparsely in arid regions of the world **[CPMT 1987]**

(a) Only because of high temperature (b) Because no seeds fall on their soil

(c) Because of several factors combining together (d) Because the soil is sandy

453. The upper part of sea water mainly contains **[Delhi PMT 1985]**

(a) Nektons only (b) Planktons only (c) Nektons and planktons both (d)

454. The hypersaline waters are found in

(a) Lakes located in the alpine regions (b) Lakes located in the arid and semiarid regions

(c) Lakes located in the tropical regions (d) Estuaries

455. Which of the following functions performed by a forest helps most in controlling drought **[AIIMS 1980,**

(a) Forest act as water sheds (b) Forest prevent rainfall in monsoon

(c) Forest bring rainfall in monsoon (d) Forest have lot of water plants

456. Soil erosion can be prevented by

(a) Overgrazing (b) Removal of vegetation (c) Afforestation (d)

457. Mangroove vegetation is found in

(a) Dehradoon valley (b) Kullu valley (c) Western ghats (d) Sundervans

458. Which of the following word is related to *Homosapiens*

(a) Herbivore (b) Carnivore (c) Autotroph (d) Omnivore

459. Desert can be converted into greenland by **[MP PMT 1994; AIIMS 2001]**

(a) Oxylophytes (b) Psammophytes (c) Halophytes (d) Tropical trees

460. Good soil is **[CPMT 1972, 78; MP PMT 1988]**

(a) Which holds whole of water enters into it (b) Which allows the limited amount of water into it

(c) Which allows to percolate the water slowly from it (d) Which allows to pass water very quickly from it

461. The flora and fauna in lakes or ponds are **[AIIMS 2000]**

(a) Lentic biota (b) Lotic biota (c) Abiotic biota (d) Field layer

462. Alpine plants which are commonly found at the top of mountains show

(a) Xerophytism (b) Hydrophytism (c) Semitism (d) None of these

463. Endemic plants are those which are

(a) Cosmopolitan in distribution (b) Restricted to certain area

(c) Found in arctic region (d) Gregarious in habit

464. Which one of the following element is the critical limiting factor in the function of ecosphere because of its irretrievable loss into the ocean

(a) Phosphorus (b) Calcium (c) Magnesium (d) Iron

465. Agrostology is related with the study of **[Rajasthan PMT 1997]**

(a) Agricultural growth (b) Epiphytes (c) Grasses (d) Nematode diseases

466. In desert grasslands, which type of animals are relatively more abundant

(a) Diurnal (b) Arboreal (c) Aquatic (d) Fossorial

467. Terracing is an effective method of soil conservation in

(a) Desert areas (b) Hill areas (c) Plain areas (d) None of these

468. Deforestation may reduce the chances of **[CBSE PMT 1990]**

(a) Rainfall (b) Frequent cyclones (c) Erosion of surface soil (d)Frequent land slides

469. The salinity of the oceans is

(a) Increasing (b) Decreasing

(c) Constant (d) Decreasing now but was increasing in past

470. Soil salinity is measured by

(a) Porometer (b) Potometer (c) Conductivity meter (d) Calorimeter

471. Which is preserved in National Park

(a) Flora (b) Fauna (c) Both (a) and (b) (d) None of these

472. Loss of minerals on the hills is due to

(a) Soil erosion by water (b) Terracing (c) Contour–strip cropping (d) Strip mining

473. What is the effect of destruction of wild life **[Karnataka CET (Med.) 20**

(a) Flood (b) Soil erosion

(c) Green house effect (d) Gene for disease resistance cannot be obtained

474. Soil erosion is greater when

(a) There is no rain (b) The rainfall is low
(c) Winds do not blow (d) The rainfall is received in heavy downpour

475. Soil is a mixture of **[Pb. PMT 2000]**
(a) Sand and clay (b) Sand and humus (c) Clay and humus (d) Sand, clay and humus

476. Maximum contribution of O_2 is from
(a) Phytoplankton (b) Grasslands (c) Herbs and shrubs (d) Dense forests

477. Pneumatophores plants are found
(a) In desert (b) Near river banks (c) In grasslands (d) On mountains

478. Restoration of ecological equilibrium in mined areas can be achieved through **[Delhi PMT 1986]**
(a) Revegetation of the mined habitats (b) Conversion of mined habitats into agricultural ecosystems
(c) Prevention of soil erosion (d) Prevention of grazing

479. Abyssal zone of oceans is characterized by **[BHU 1992]**
(a) Presence of sunlight and producers
(b) Absence of sunlight and all living organisms
(c) Absence of sunlight but presence of producers
(d) Absence of sunlight and presence of consumers and decomposers

480. The vegetation of Delhi is chiefly
(a) Hydrophytic (b) Xerophytic (c) Mesophytic (d) Halophytic

481. The insectivorous plant having glandular structures on its leaf secretes sticky fluid in **[CPMT 1992]**
(a) Venusfly trap (b) Sundew plant (c) *Aldrovanda* (d) Butter wort

482. Which biological factor is responsible for poor vegetation in deserts
(a) Grazing by animals and goats (b) Low rainfall
(c) Poor fertility of soil (d) Native mankind

483. Deforestation has an alarming effect on **[Delhi PMT 1984, 86; AIIMS 2001]**
(a) Increase in grazing area (b) Sunlight
(c) Weed control (d) Soil erosion or desertification of habitat

484. Cochineal insects have proved very useful for **[BHU 1999]**
(a) Weeds control (b) *Parthenium* control (c) Cactus prevention (d) *Eicchornia* prevention

485. The spread of prickly pear (*Opuntia*) in India can be controlled by
(a) Letting loose cattles to consume them (b) Encourage the birds for seed dispersal
(c) Spraying hormones (d) Introducing cochineal insects

486. The term '*biocoenosis*' was proposed by **[MP PMT 1988, 2000; Karnataka CET (Med.)**
(a) Tansley (b) Carl Mobious (c) Warming (d) None of these

487. In which of the following energy occurs **[Delhi PMT 1992]**
(a) Leaf (b) Flower (c) Storage cells (d) Living cells

488. If all the plants of the world die all the animals will also die due to shortage of **[CPMT 1975, 78; AFMC**

(a) Cold air (b) Oxygen (c) Food (d) Timber

489. Biomass produced by plants in oceans accounts for

(a) 55% (b) 65% (c) 75% (d) 85%

490. The harmful plant of family compositae **[CPMT 1998]**

(a) *Tegetes* (b) *Helianthus* (c) *Parthenium* (d) None of these

491. Plants like Rhizophora and Avecennia grow on the sea shores under saline condition. For this they have special roots for respiration which are called

(a) Prop roots (b) Climbing roots (c) Floating roots (d) Pneumatophores

492. Forest research institute (F.R.I.) is situated in **[MP PMT 1988, 2002]**

(a) Goa (b) Pantnagar (c) Dehradun (d) Shimla

493. The American aquatic weed, which had become a trouble in India, is

(a) *Dolicus* (b) *Hibiscus* (c) *Eicchornia* (d) *Trapa bispinosa*

494. *Eicchornia crassipes* is a

(a) Desert plant (b) Parasite (c) Water plant (d) Terrestrial plant

495. Mark the national tree **[JIPMER 2002]**

(a) *Mangifera indica* (b) *Ficus benghalensis* (c) *Ficus religiosa* (d) *Azadirachta indica*

496. The character of an ecosystem is determined by the environmental factor which is shortest supply. This is the **[CBSE PMT 1994]**

(a) Law of minimum (b) Law of diminishing returns (c) Law of limiting factors (d) Law of supply and demand

497. Silent valley of Kerala is preserved because **[BHU 1981, 85]**

(a) Has many rare species (b) Many new plants (c) New hybrids (d)

498. Rotation of crops is essential for

(a) Increasing the quantity of proteins (b) Increasing the quantity of minerals

(c) Increasing fertility of the soil (d) Getting different kinds of crops

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Answer Sheet

Environmental Biology ***Assignment***

Basic Level

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
d	c	b	c	a	a	c	b	d	b	b	c	d	b	a	a	d	b	a	c
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
d	a	b	a	c	c	b	c	a	a	a	c	a	b	a	c	d	b	d	a
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
c	b	c	a	b	b	b	d	a	b	d	d	c	b	c	c	d	a	b	a
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
c	a	b	a	b	c	c	c	b	a	d	b	c	c	d	d	a	b	d	c
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
d	a	b	b	b	c	a	c	d	c	c	d	a	c	b	a	b	b	b	c

101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
a	b	c	a	b	c	b	b	a	c	b	a	c	d	b	a	a	d	a	b
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381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400

c	b	c	d	b	a	b	a	b	c	c	a	d	c	d	a	b	b	a	c
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c	a	a	c	b	a	a	b	b	a	a	d	b	b	a	c	d	d	b	c
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481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498		
b	b	d	c	d	b	d	c	c	c	d	c	c	c	b	a	a	c		

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