DAY THIRTY FIVE

Organisms and Ecosystem

Learning & Revision for the Day

- Organisms and their Environment
- Adaptations
- Population
- Ecosystem
- Functions of Ecosystem
- Ecosystem Services

- The term '**ecology**' was introduced by **Reiter** in 1868 and **E Haeckel** (1869) defined it as the study of natural environment including the relations of organisms to one another and to their surroundings.
- **R Mishra** is known as **Father of Indian Ecology.** He defined ecology as the interaction of form, functions and factors.
- The branch of ecology which is concerned with the study of an individual organism (an individual species) is called **Autecology**.
- The branch of ecology which deals with the study of a group (or groups) of organisms that are associated together as a unit is called **Synecology**.

Organisms and their Environment

Ecology is basically concerned with four levels of organisation

(i) **Organisms** Living component at individual level is called organism. They form the basic unit of study of ecology.

(ii) **Population** It refers to the sum total of all organisms having similar features and potential to interbreed among themselves and produce fertile offsprings.

(iii) **Communities** Assemblage of all the populations of different species in a specific geographical area. The organisms and their environment in a particular area, constitute an ecosystem.

(iv) **Biome** It is a large unit, which consists of a major vegetation type, associated fauna in a particular climatic zone.

Major biomes of the world

Biome type	Annual temperature	Annual rainfall	Important features
Tropical forest	23-27°C, average 25°C	200-450 cm/yr	Multistoreyed vegetation (5 distinct layers of vegetation), shows maximum diversity and productivity. In India, tropical rainforest occurs in Western Ghat, Asom and Andamans.
Savannah	Average temperature 30°C	90-150 cm/yr	The vegetation of this biome supports large grazing herbivores (like buffalo, zebra, etc). Common trees and shrubs of Indian Savannahs are *Acacia*, *Butea*, *Prosopis*, *Zizyphus* and *Capparis*.
Desert	Hot (Thar and Sahara) and cold (Gobi)	Less than 25 cm/yr	It occupies 1/5 of land, Sahara of North America, Thar of West Asia, Gobi of Asia are the most important deserts. Rajasthan lies in the Thar desert.
Temperate forest/grassland	Average winter temperature is 8°C and average summer temperature is 23°C.	25-75 cm/yr	Life is fairly rich in this biome. Mostly leguminous herbs, scattered bushes, occasional trees, extensive root system. The growing season is about 150 days.
Temperate deciduous forest	6-20°C	100-250 cm	It has warm summer and moderately cold winter. Plant and animal life is rich in this biome. It is found in both Northern hemisphere and Southern hemisphere. They occur in Himalayan region at an altitude of 1500-2400 m.
Coniferous forest	6-15°C	50-170 cm	Himalayan coniferous forests occur in the Himalayan region, at the altitude of 1700-3000 m. They are evergreen because the needle-shaped leaves persist 2-7 years. Lichen, mosses, fern, herbs are also abundant.
Tundra	Long cold winter, short summers	Less than 25 cm/yr	It encircles top of the world. Scattered patches of grasses, sedges, lichens, low diversity, low productivity, amphibians and reptiles are absent, common animals are lemming, snow owl, Arctic fox, polar bear, reindeer, etc.

Habitat

- It is a place where an organism lives. It represents a particular set of environmental conditions suitable for its successful growth.
- A habitat can contain many ecological niches and support a variety of species.
  - (i) A transition zone between two biomes where two biological communities meet and integrate is called **ecotone**, which have rich species diversity as compared to adjoining communities and the phenomenon is called **edge effect**.
  - (ii) Keystone species are non-dominant species which maintain the characteristics and structure of a community and act as a component of biological control.

Niche

The ecological niche of an organism represents the range of conditions that it can tolerate, the resources it utilises, and its functional role in the ecological system. Each species occupies a distinct niche, and no two species are believed to occupy the same niche.

Ecological Factors

These are constituents of the environment which directly or indirectly influence the form and functioning of organisms in an specific way. Ecological factors may be either living or biotic (e.g. plants, animals, microbes, etc.) or non-living or abiotic (environmental).

Abiotic Factors (Environmental Factors)

These are non-living factors, substances and conditions of the environment, which may influence the physiology, survival, function, behaviour and reproduction of organisms.

The major abiotic factors are described below

(i) **Temperature** governs the functions and geographical distribution of organisms. Some organisms are eurythermal, while others are stenothermal.

(ii) **Water** is an important factor for life. Organism may be euryhaline (tolerates wide range of salinity) or stenohaline (can tolerate only a narrow range of salinity).

(iii) **Light** influences life on earth as plants prepare food and release oxygen during photosynthesis.

(iv) **Soil** sustains life on earth. The physical and chemical properties of soil, such as grain size, porosity, pH and mineral composition determine the type of plant that can grow in a particular habitat.

Responses to Abiotic Factors

- All organisms in order to sustain maximum functionality maintain a constant internal environment (homeostasis).
- An organism may adopt one of the following strategies for homeostasis

(i) **Regulate**, e.g. mammals regulate temperature by shivering in cold and sweating in heat.

(ii) **Conform**, e.g. animals and plants except mammals change their body temperature in accordance with the outside environment

(iii) **Migrate**, e.g. Keoladeo National Park birds migrate from Siberia to Rajasthan.

(iv) **Suspend**, e.g. hibernation (winter sleep) and aestivation (summer sleep).

Adaptations

Adaptation is an attribute of the organism (morphological, physiological and behavioural) that enables the organism to survive and reproduce in its habitat.

Echological Adaptations in Plants

On the basis of water availability, the plants are grouped into three types

(i) **Hydrophytes** Such plants are adapted to survive in water either completely or partially submerged or floating conditions.

Adaptations

- Roots are reduced in size with the absence of root hair and root cap.
- Absorption of water and minerals occurs by general body surface.
- Stem without mechanical tissue.
- Stomata either absent or non-functional, e.g. *Hydrilla*, *Vallisneria*, *Pistia*, *Salvinia,* etc.

(ii) **Mesophytes** Plants adapted to grow in moderate amount of water.

Adaptations

- Rigid stem, large leaves, well developed root system with well developed root hairs.
- Well developed mechanical and vascular tissues, well developed cuticle, leaves with no waxycoating, e.g. garden plants, cultivated or farm crop plants.

(iii) **Xerophytes** They are adapted to survive in dry or a xeric (scarcity of water) conditions. Drought escaping xerophytes are called ephemerals.

Adaptations

- Deep root system, bushy appearance, leaves reduced to spines.
- Stomata generally closed in day time, CAM cycle of photosynthesis is common in plants.
- Thick cuticle, deep sunken stomata, palisade layer and conducting system is well developed, e.g. *Acacia*, *Prosobis*, *Zizyphus*, etc.

Ecological Adaptations in Animals

Important ecological adaptations in animals are

(i) **Camouflage** It is the ability of animals to blend with surroundings or background, e.g. praying mantis, grasshopper, stick insect, etc.

(ii) **Mimicry** It is the resemblance of one species with another in order to obtain advantage specially against predation, e.g. monarch butterfly and queen butterfly.

(iii) **Warning Colouration** Some organisms are highly poisonous and brightly coloured to be easily noticed. Predators usually avoid them, e.g. dart frog.

(iv) **Behavioural Adaptation** Some organisms show behavioural adaptations to cope with variations in their environment, e.g.

- Desert lizard in burrow during daytime to escape from the sun's heat.
- **Kangaroo rat** seldom drinks water, 90% of its water requirement is met from metabolic water (water produced by respiratory breakdown of fat) while rest 10% is taken up from food.
- **Ice fish or Antarctic fish** remains even in extremely cold sea due to extra solutes in the body fluids. The extra solutes which prevent freezing are **glycerol** and **antifreeze proteins**.
- **Mammals** living in colder climates generally have shorter ears and limbs to minimise heat loss. This is called **Allen's rule.**

Population

Population is the total number of interbreeding individuals of a species found in a geographical area, who share and compete for similar resources.

Characteristics of Population

Some common characteristics of population are

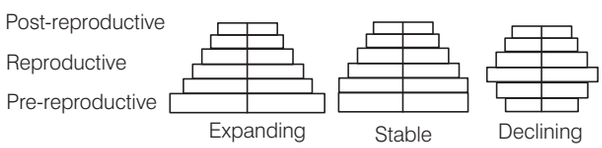
- **Natality** It may be defined as the number of organisms born per unit of population per unit time. It is also called birth rate.
- **Mortality** It may be defined as the number of organisms died per unit population per unit time. It is also called death rate.

- **Population density** Number of individuals per unit space in a given time is called population density. Number of individuals in a population is called population size. It is measured is terms of (Lm^2) for terrestrial animals and (m^3) for aquatic animals.
- **Migration** Movement of individual in or out of the population is called migration. It may be in order to get food, space, shelter, job, etc. It is of following two types:
  - **Emigration** Refers to the moving out of individuals. It results in decrease in population size.
  - **Immigration** Refers to the moving in of individuals. It results in increase in population size.

If N is the population density at time t, then its density at time $t+1$ will be $N_{t+1} = N_t + [(B+I)-(D+E)]$.

Age Pyramid

- Graphical representation of different age groups found in population with pre-reproductive group at base, reproductive ones in middle and post reproductive at top is called age pyramid.
- **Expanding population** If the number of pre-reproductive individuals are more than reproductive and post-reproductive individuals are in the least amount. The shape of pyramid is triangular in shape.
- **Stable population** If the number of individuals in pre-reproductive and reproductive group are almost same, then the future population size will remain unchanged, i.e. in zero population the shape of pyramid is bell-shaped.
- **Declining population** If the individuals of pre-reproductive groups are lesser than reproductive and post-reproductive group, then in future the population size will deplete. The pyramid is urn-shaped in this case.



Representation of age pyramids for human population

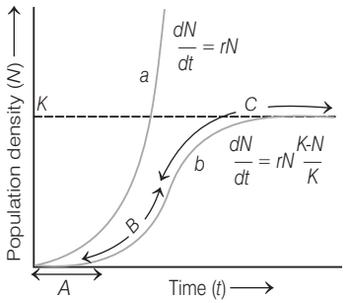
Population Growth

- Due to above described attributes of population, its size for any given species is not static rather keeps on changing with time and other factors. There are two types of model explaining population growth.

(i) **S-shaped/Sigmoid/Logistic/Growth curve** This type of growth curve has following phases

- **Lag phase** It is the initial phase of curve where organisms or population increase slowly. They tend to adapt and adjust to new environment.
- **Log phase** It is also called exponential phase in which organism multiply in geometric fashion, i.e. 2, 4, 8, 16.....
- **Equilibrium phase** It is also called stationary phase in which rate of natality is equal to rate of mortality. It is denoted by 'K' or carring capacity. Verhulst-pearl logistic growth curve shows the following equation:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right) = rN\left(1-\frac{N}{K}\right)$$



A Lag phase, *B* –Log phase, *C* – Stationary phase

Population growth curve showing

Where, N = Population density at time 't'

$\frac{dN}{dt}$ = Rate of change of population density

r = Intrinsic rate of natural increase

K = Carrying capacity

When responses are not limiting the growth, plot is **exponential**. When responses are limiting the growth, plot is **logistic**.

(ii) **J-shaped/Exponential/Growth curve** This type of growth has lag and log phases. There is no stationary or equilibrium point in this population growth curve. Suddenly, the environmental resistance becomes operative and population density shows rapid declination. Equation of exponential growth is

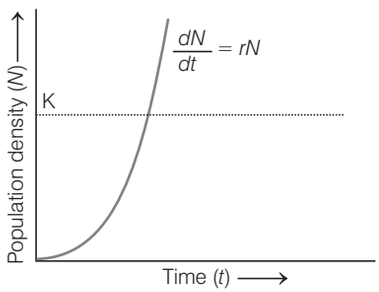
$$\frac{dN}{dt} = rN$$

Where, N = Population density

$\frac{dN}{dt}$ = Rate of change of population density

r = Intrinsic rate a natural increase

Integral form of exponential growth equation will be



Population growth curve showing exponential growth

Where,

N_t = Population density after time t

N_0 = Population density at time zero

r = Intrinsic rate of natural increase

e = The base of natural logarithms (2.71828)

Biotic Potential

It is the maximum reproductive capacity shown by an unrestricted population under optimal environmental conditions. The force acting against the achievement of maximum capacity of population growth is called **environmental resistance**. It includes factors like shortage of food, disease, predation, etc.

Population Interactions

- Living organisms cannot live in isolation and they interact in various ways to form biological communities.
- Interspecific interactions arise from the interaction of populations of two different species. They could be beneficial, detrimental or neutral.
- The organisms in a population interact in the following ways

(i) **Mutualism** is the interspecific interaction in which both the interacting species are benefitted.

(ii) **Predation** is an interspecific interaction, where one animal (predator) kills and consumes the other weaker animal (called prey).

(iii) **Parasitism** is the interspecific interaction, where one of the species depends on the other species for food and shelter. In this process, the host is damaged.

(iv) **Commensalism** is the interspecific interaction, where one species is benefitted, while the other species is neither benefitted nor harmed.

(v) **Competition** is a type of interaction either among individuals of the same species (intraspecific) or between individuals/ population of different species (interspecific competition).

(vi) **Amensalism** is the interaction between two different species, in which one species is harmed and the other is neither benefitted nor harmed.

Nature of Population Interaction

Name of interaction	Species A	Species B
Mutualism	+	+
Competition	–	–
Predation	+	–
Parasitism	+	–
Commensalism	+	0
Amensalism	–	0

Ecosystem

- An ecosystem is a basic functional unit that includes the whole community in a given area (biotic component interacting with the abiotic factors). 'Ecosystem is normally an open system because there is a continuous entry and loss of energy and materials from this system.
- The term 'ecosystem' was first used by **AG Tensley** in 1935 to describe the whole complex of living organisms living together as sociological units and their habitats.
- On the basis of origin, the ecosystem can be classified in following ways

1. Natural Ecosystem

These ecosystems are capable of operating and maintaining themselves without the interference of man. These are further classified as

(i) **Terrestrial ecosystem** These ecosystems are found in terrestrial habitat, e.g. forest, desert, etc.

(ii) **Aquatic ecosystem** These ecosystems are found in aquatic habitats. These are of two types

(a) **Freshwater ecosystem**, e.g. lake, ponds, river, etc.

(b) **Marine water ecosystem**, e.g. oceans, estuaries, etc.

2. Artificial Ecosystem

These systems are maintained, manipulated and formed by man, e.g. cropland, aquarium, artificial lake, reservoirs and township, etc.

Components of Ecosystem

EP Odum explained the components of ecosystem as follows

(i) **Abiotic Components** These constitute non-living components of ecosystem, which are divided on the basis of physical and chemical nature such as

(a) **Inorganic substances**, e.g. carbon, nitrogen, sulphur, potassium, carban dioxide and H_2O.

(b) **Organic substances**, e.g. protein, carbohydrate, lipids, etc.

(c) **Climatic regime**, e.g. temperature, humidity, wind, soil, light, etc.

(ii) **Biotic Components** These constitute living components of ecosystem, which are divided on the basis of trophic level such as:

(a) **Producers** These form autotrophic components, e.g. plants, etc.

(b) **Macroconsumers** These form the heterotrophic components of ecosystem, e.g. animals and non-green plants.

(c) **Microconsumers** These are decomposers or transformers, e.g. bacteria and fungi.

A comparative account of several ecosystems are given in the following table

Comparative summary of freshwater, marine, grassland, forest and desert ecosystems

Components	Freshwater pond ecosystem	Marine ecosystem (oceans)	Grassland ecosystem	Forest ecosystem	Desert ecosystem
Abiotic components	Water, light, pressure, pH, etc.	Temperature zones, minerals rich, salts, etc.	Nitrate, phosphate and sulphates, roughly 19% of the earth's crust.	Density depends upon rainfall	Rainfall less than 25 cm, extreme of temperature and cold
Biotic components					
(i) **Producers**	Diatoms, blue-green algae (*Oscillatoria*), green algae (*Volvox*, *Chlamydomonas*) rooted plants and floating plants.	Microscopic algae, members of Phaeophyta and Rhodophyta	*Digitaria*, *Dactyloctenium*, *Setaria*, also few shrubs.	*Quercus* in temperate forest *Pinus*, *Abies*, *Cedrus*, *Juniperus*, *Rhododendron*	Cycads, cacti, palm, etc.
(ii) **Consumers**					
• Primary	Zooplankton, *Dysticus*, *Lymnaea*	Crustaceans, molluscs and fishes	Deer, sheep, cow, buffaloes, rabbit, mouse. Also some insects, termites, millipedes.	Leafhoppers, flies, beetle, bugs, spider deer, mouse and moles.	Animals, insects, some reptiles and camel.
• Secondary	Small fish, frogs, etc.	Carnivorous fishes	Fox, jackal, snakes, frogs, lizards and birds	Lizard, fox, snake and birds.	Reptiles
• Tertiary	Large fish	Harring, shad and mackerel carnivore fishes like cod, haddock, halibut, etc.	Hawk and vulture	Lion, tiger, wild cats, etc.	Vultures
(iii) **Decomposers**	*Aspergillus* and *Saprolegnia*	Mainly bacteria and fungi	*Mucor*, *Aspergillus*, *Penicilium*, *Fusarium* *Cladosporium* and *Rhizopus*.	Mostly fungi, like *Aspergillus*, *Polyporus*, *Fusarium* and bacteria like *Bacillus*, *Clostridium*, *Streptomyces*	Fungi and bacteria, which are thermophilic

Functions of Ecosystem

Following five are the important functional aspects of the ecosystem

1. Decomposition

It is the process by which organic substances are broken down into simpler forms of matter. It takes place completely outside the body of decomposers. They digest the organic substances outside their body and then absorb it. Hence, they are also known as **osmotrophs** (absorptive).

- This process occurs in following steps; Fragmentation, leaching, humification and mineralisation.
- Major factors affecting decomposition are
  - Chemical nature of detritus.
  - Soil pH, temperature, moisture and aeration.

2. Productivity

- It refers to the rate of biomass production, i.e. the rate at which the sunlight is captured by the producers for the synthesis of energy rich organic compounds.
- Productivity is the amount of organic matter accumulated per unit area per unit time'. **Production ecology** is the branch of ecology that deals with the rate of production of organic matter in ecosystem.
- It is of following types

  (i) **Primary productivity** The rate at which radiant energy is stored by the photosynthetic and chemosynthetic activities of producers. It is of following types
  - **Gross Primary Productivity** (GPP) Rate of production of organic matter during photosynthesis. A part of it is utilised by plants in respiration.

- **Net Primary Productivity** (NPP) The amount of stored energy (left after respiration)
  or GPP – Respiratory losses (R) = NPP

(ii) **Secondary productivity** It is the rate of energy storage at consumer level, i.e. herbivore, carnivore and decomposers.

(iii) **Net productivity** It is the rate of storage of organic matter not used by the heterotrophs or consumers. It is stored and transformed to next trophic level.

3. Energy Flow

- The movement of energy in the ecosystem is termed as **energy flow**. It is unidirectional energy transformation. The flow of energy in ecosystem is controlled by two laws of thermodynamics, stated as follows:
  - **First law** Energy can neither be created, nor be destroyed, but can be transferred or transformed.
  - **Second law** In every activity involving energy transformation, dissipation of some energy takes place.
- The **incident radiation** of plant is about 1×10^6 kJ/m^2/yr and of this, less than 50% is Photosynthetic Active Radiation (PAR). Plants and photosynthetic bacteria (autotrophs) use this radiant energy to make food from simple inorganic molecules.
- Only 2-10% of PAR is captured by plants and organisms at each trophic level depends on this small amount of energy to fulfil their energy requirements.
- Each trophic level contains certain mass of living matter at a particular time called **standing crop**. The standing crop is measured as the mass of living organism (biomass).
- The number of trophic levels in the food chain is restricted due to 10% low given by **Raymond Lindeman**. According to this law, 'only 10% of energy of lower trophic level can be transferred to the organisms of next higher trophic level'.

Food Chain

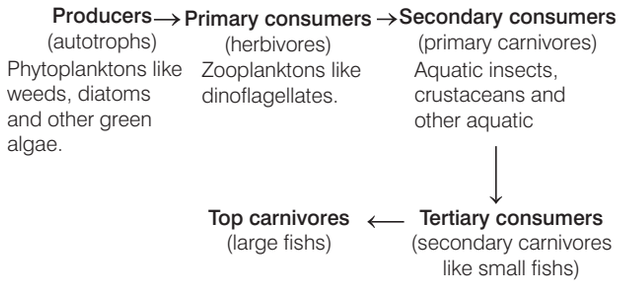
The series of organisms eating one and being eaten by the other is called the food chain. It is a process through which food energy moves. A simple food chain consists of three steps as follows:

Plant → Herbivore → Carnivore

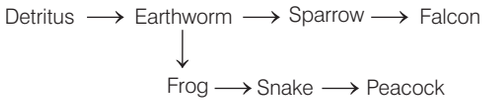
Each food chain contains many steps (levels) like producers, herbivores, primary carnivores and so on. Each step of the food chain is called **trophic level**.

On the basis of habits of organisms involved, the food chain can be categorised as

(i) **Grazing Food Chain** (GFC) The consumers who consume the living plant parts as their type of food or source constitute the grazing food chain. It is the most common type of food chain.
It is also called as predator food chain. The sequence of food chain in an aquatic ecosystem is as follows:



(ii) **Detritus Food Chain** (DFC) Animals and lower plants (bacteria and fungi) which get their energy from organic part, constitute this type of food chain. It starts from the dead organic matter and ends in inorganic compounds. A common detritus food chain with earthworm is as follows:



(iii) **Parasitic Food Chain** (PFC) It is also called auxillary food chain. This chain begin with the host and usually ends with parasites, due to which the pyramid of number gets inverted. Its food sequence is as follows:

Plant → Herbivores → Parasites → Hyperparasites

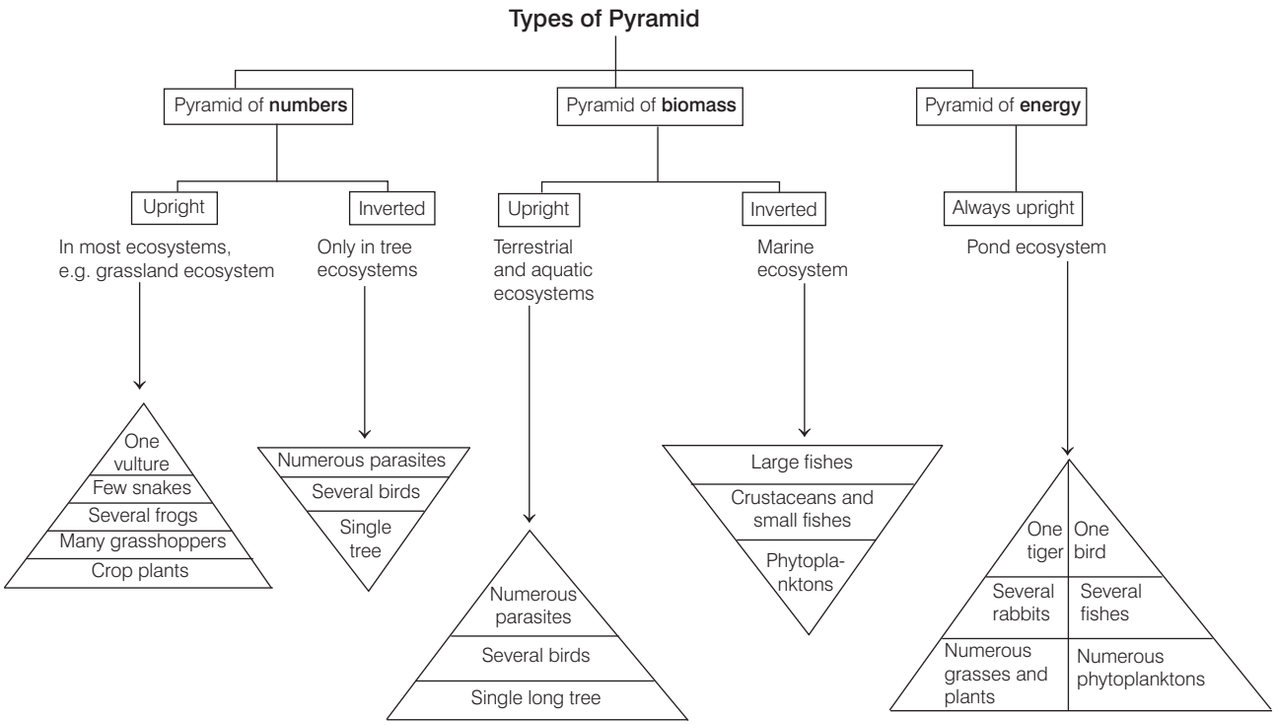
Food Web

- Food web is the network of food chains which become interconnected at various trophic levels. In any complex food web, one can recognise several different trophic levels.
- In a food web, a given species may occupy more than one trophic levels. The complexity of food web vary greatly and this can be expressed by a measure called connectance of the food web.
  Connectance of the food web

$$= \frac{\text{Actual number of interspecific interaction}}{\text{Potential number of interspecific interaction}}$$

Ecological Pyramids

- These are the graphical representations of the trophic structure and functions at successive trophic levels of an ecosystem, which may be shown in terms of their number, biomass or energy content.
- The concept of pyramid was proposed by **Charles Elton** (1927). So, they are also known as **Eltonian pyramids**.
- There are three types of pyramid shown below in figure



4. Nutrient Cycling

- The nutrients are never lost from an ecosystem but are recycled again indefinitely, this is called **nutrient cycling**.
- The amount of nutrients, i.e. carbon, nitrogen, phosphorus, calcium, etc., present in soil at any given time is called as **standing state**.
- Environmental factors like temperature, soil nature and moisture can regulate the rate of release of nutrients.
- Nutrient cycles are of two types

(i) **Gaseous Cycle** It exists in the atmosphere, e.g. carbon cycle and nitrogen cycle.

Carbon Cycle

- It occurs through atmosphere, oceans and living and dead organisms.
- About 71% of global carbon is found as dissolved form in the ocean. About 4×10^{13} kg of carbon is fixed in the biosphere through photosynthesis annually.
- Carbon dioxide is also returned to the atmosphere through burning of fossil fuels, fuel wood, organic debris, forest fires and volcanic acitivity.

(ii) **Sedimentary Cycle** It exists on the earth's crust, e.g. phosphorus cycle and sulphur cycle.

Phosphorus Cycle

- The natural reservoir of phosphorus is rock in the form of phosphates. Phosphates enter the plants through their roots and than the food chain.
- The organic wastes and dead organisms are decomposed by the phosphate-solubilising bacteria, which release phosphorus back in the soil.
- The atmospheric input of phosphorus through rainfall or gaseous exchange of phosphorus between organisms and environment is negligible

5. Ecological Succession

- It is a sequence of **seres** (developmental stage of a community) from a barren land to the climax. The climax community represents a stable end product successional sequence.
- The initial community of the area which is replaced in time by a sequence of succeeding communities until the climax

community is reached is called **pioneer stage** or **pioneer community**.

- The intermediate stages between pioneer and climax stages, i.e. final stage are called as **seral stages**.

Causes of Succession

The causes of ecological succession are as follows

- **Initial or initiating causes** These causes are both **climatic** and **biotic**. These include the factors such as erosion, wind, fire, etc. These causes heavily affect the population of that particular locality.
- **Ecesis causes** These are also called as continuing causes which modify the population to adapt several conditions of environment.
- **Stabilising causes** The climatic causes determine the nature of climatic climax, i.e. the end point of succession.

Types of Succession

On the basis of place, causes and results of succession, it is of following types

- **Allogenic succession** When the succession is caused by the factors external to the community.
- **Autogenic succession** The succession which is brought about by organisms themselves.
- **Primary succession** Clarke (1954), defined it as the succession which begins on a bare area where no life has existed, e.g. newly exposed rock, etc.
- **Secondary succession** It refers to the community development on the sites, previously occupied by well developed communities, e.g. abandoned from lands cut forests, etc.
- **Heterotrophic succession** The succession which begins predominantly on organic environment and dominance of heterotrophic organism mainly occur.
- **Autotrophic succession** Succession that begins predominantly on inorganic environment and is characterised by the dominance of autotrophic organisms.

Process of Succession

The succession is a slow and complex phenomenon, which is categorised into following stages and substages

- **Nudation** This means the development of bare areas without any form of life. It may be caused by topographic, e.g. soil erosion by various factors. Abiotic, e.g. glaciers, dry period, hailstorm, fire, etc. Biotic, e.g. human.
- **Invasion** It is the successful establishment of a species in a barren area. It is completed in following substages:
  - **Migration** The seed, spores and propagules reach to barren area.
  - **Ecesis** Adjustment of establishing species with environment prevailing there.
  - **Aggregation** Multiplication of species in numbers.
- **Competition and co-action** After aggregation the individuals of a species compete with other organisms for space, nutrition and other resources. It can be interspecific or intraspecific.
  - **Reaction** The modification of the environment through the influence of living organisms on it, is called reaction.
  - **Stabilisation** The stage at which final or climax community become more or less stabilised for a longer period of time in that particular environment.

Examples of Biological Succession

Hydrosere and xerosere are the two main biological succession. They are discussed below

- **Hydrosere/Hydrarch succession** In this succession, a pond and its community are converted into a land community.
- **Xerosere/Xerarch succession** (Lithosere) Xerosere occurs on bare rock surface where the original substratum is deficient of water and lacks organic matter.

Ecosystem Services

Healthy ecosystems are the base for a wide range of economic, environmental and aesthetic goods and services. The products of ecosystem processes are named as **ecological** or **ecosystem services**.

Ecosystem service refers to a wide range of conditions and processes through which natural ecosystems, and the species that are a part of them, help sustain and fulfil human life. Ecosystem services can be grouped into four broad categories

1. **Provisioning** Such as production of food and water.
2. **Regulating** Such as waste decomposition purification of air, control of climate and disease.
3. **Supporting** Such as nutrient cycles and crop pollination.
4. **Cultural** Such as spiritual and recreational benefits.

   Ecosystem provides following services
   - Moderate weather extremes and their impacts.
   - Disperse seeds.
   - Mitigate drought and floods.
   - Protect people from the sun's harmful ultraviolet rays cycle nutrients.
   - Detoxify and decompose wastes.
   - Protect stream and river channels and coastal shores from erosion.

DAY PRACTICE SESSION 1

FOUNDATION QUESTIONS EXERCISE

1 The term 'Ecology' was first coined in 1869 by
(a) Odum (b) Malthus
(c) Haeckal (d) Hilaire

2 Autecology is the
(a) relation of population to its environment
(b) relation of an individual to its environment
(c) relation of a community to its enviornment
(d) relation of a biome to its environment

3 Niche is ➝ NEET 2018
(a) the range of temperature that the organism needs to live
(b) the physical space where an organism lives
(c) all the biological factors in the organism's environment
(d) the functional role played by an organism where it lives

4 Niche overlap indicates
(a) active cooperation between two species
(b) two different parasites on the same host
(c) sharing of one or more resources between the two species
(d) mutualism between two species

5 Which one of the following correctly represents an organism and its ecological niche?
(a) *Vallisneria* and pond
(b) Desert locust (*Scistocerca*) and desert
(c) Plant lice (aphids) and leaf
(d) Vultures and dense forest

6 The term used for genetically similar but vegetatively different population is
(a) ecads (b) ecotype
(c) species (d) community

7 According to Allen's rule, the mammals from colder climate have
(a) shorter ears and longer limbs
(b) longer ears and shorter limbs
(c) longer ears and longer limbs
(d) shorter ears and shorter limbs

8 A population is a group of
(a) individuals in a species
(b) individuals in a family
(c) species in a community
(d) communities in an ecosyslem

9 Natality refers to ➝ NEET 2018
(a) number of individuals leaving that habitat
(b) birth rate
(c) death rate
(d) number of individuals entering habitat

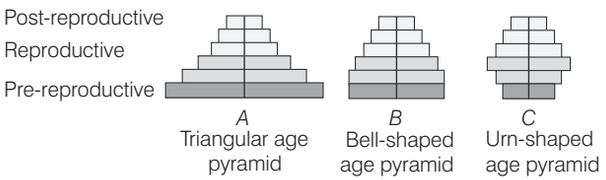
10 Two opposite forces operate in the growth and development of a population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
(a) environmental resistance (b) fecundity
(c) mortality (d) biotic control

11 The percentage ratio of natality over mortality is
(a) population dynamics (b) vital index
(c) populatin of density (d) total count

12 Geometric representation of age structure is a characteristic of
(a) biotic community (b) population
(c) landscape (d) ecosystem

13 In a growing population of a country, ➝ NEET 2018
(a) reproductive and pre-reproductive individuals are equal in number
(b) reproductive individuals are less than the post-reproductive individuals
(c) pre-reproductive individuals are more than the reproductive individuals
(d) pre-reproductive individuals are less than the reproductive individuals

14 Age pyramid *A*, *B* and *C* indicate



(a) *A*–Expanding population, *B*–Stable population, *C*–Declining population
(b) *A*–Expanding population, *B*–Declining population, *C*–Stable population
(c) *A*–Stable population, *B*–Declining population, *C*–Expanding population
(d) *A*–Declining population, *B*–Stable population, *C*–Expanding population

15 Permanent outward movement of individuals is known as
(a) natality (b) mortality (c) emigration (d) migration

16 Critical minimum and maximum values of an environmental factor is called as
(a) limiting factor (b) law of minimum
(c) limits of tolerance (d) carrying capacity

17 Population size in an area tends to increase on account of
(a) emigration (b) mortality
(c) migration (d) natality

18 Choose the correct sequence of stages of growth curve for bacteria.

(a) Lag, Log, Stationary, Decline phase
(b) Lag, Log, Stationary phase
(c) Stationary, Lag, Log, Decline phase
(d) Decline, Lag, Log, phase

19 The carrying capacity of a population is determined by its

(a) population growth rate (b) limiting resources
(c) mortality (d) natality

20 An association of individuals of different species living in the same habitat and having functional interactions is ➝ CBSE-AIPMT 2015

(a) ecological niche (b) biotic community
(c) ecosystem (d) population

21 Exponential growth occurs when there is

(a) a great environmental resistance
(b) a fixed carrying capacity
(c) no biotic potential
(d) no environmental resistance

22 The formula for exponential population growth is

(a) $\frac{dt}{dN} = rN$ (b) $\frac{dN}{rN} = dt$
(c) $\frac{rN}{dN} = dt$ (d) $\frac{dN}{dt} = rN$

23 Which of the following is a conduit for energy transfer across trohic levels?

(a) Mutualism (b) Parasitism
(c) Photocooperation (d) Predation

24 During competition,

(a) both species are benefitted
(b) both species are harmed
(c) one species is benefitted and other is harmed
(d) neither of the species is harmed or benefitted

25 A high density of elephant population in an area can result in

(a) mutualism
(b) intraspecific competition
(c) interspecific competition
(d) predation on one another

26 In commensalism,

(a) both partners are harmed
(b) weaker partner is benefitted
(c) both partners are benefitted
(d) None of the partners is benefitted

27 Mycorrhizae are the example of ➝ NEET 2017

(a) fungistasis (b) amensalism
(c) antibiosis (d) mutualism

28 Animal-plant mutualism is seen in

(a) orchid and bee (b) fig and wasp
(c) fig and bird (d) Both (a) and (b)

29 Lichens are well-known combination of an alga and a fungus, where fungus has

(a) a parasitic relationship with the alga
(b) a symbiotic relationship with the alga
(c) an epiphytic relationship with the alga
(d) a saprophytic relationship with the alga

30 If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '–' refers to ➝ NEET-II 2016

(a) mutualism (b) amensalism
(c) commensalism (d) parasitism

31 Praying mantis looks like foliage. This type of adaptation is known as

(a) camouflage (b) mimicry
(c) colouration (d) warning colouration

32 Planktons move towards surface of water during night and descend to depth during day. This is known as

(a) diurnal migration (b) periodic migration
(c) annual migration (d) None of these

33 Gause's principle of competitive exclusion states that ➝ NEET-I 2016

(a) Competition for the same resources excludes species having different food preferences
(b) No two species can occupy the same niche indefinitely for the same limiting resources
(c) Larger organisms exclude smaller ones through competition
(d) More abundant species will exclude the less abundant species through competition

34 The term ecosystem was coined by ➝ NEET-I 2016

(a) AG Tansley (b) E Haeckel
(c) E Warming (d) EP Odum

35 Ecosystem has two components

(a) plants and animals (b) biotic and abiotic
(c) weeds and trees (d) None of these

36 Which ecosystem has the maximum biomass? ➝ NEET 2017

(a) Forest ecosystem (b) Grassland ecosystem
(c) Pond ecosystem (d) Lake ecosystem

37 Which one of the following processes during decomposition is correctly described? ➝ NEET 2018

(a) Fragmentation–Carried out by organisms such as earthworm
(b) Humification–Leads to the accumulation of a dark coloured substance humus, which undergoes microbial action at a very fast rate
(c) Catabolism–Last step in the decomposition under fully anaerobic condition
(d) Leaching–Water soluble inorganic nutrients rise to the top layers of soil

38 The biomass available for consumption by the herbivores and the decomposers is called

(a) net primary productivity
(b) secondary productivity
(c) standing crops
(d) gross primary productivity

39 The correct path of energy flow in an ecosystem is

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

40 Which of the following ecosystem types has the highest annual net primary productivity?

(a) Tropical rainforest
(b) Tropical deciduous forest
(c) Temperate evergreen forest
(d) Temperate deciduous forest

41 Vertical distribution of different species occupying different levels is called

(a) fragmentation (b) stratification
(c) decomposition (d) humification

42 Secondary productivity is the rate of formation of new organic matter by ➝ NEET 2013

(a) producer (b) parasite
(c) consumer (d) decomposer

43 Energy storage at consumer level is called

(a) gross primary productivity (b) secondary productivity
(c) net primary productivity (d) net productivity

44 Which of the following ecosystems has highest gross primary productivity?

(a) Coral reefs (b) Grasslands
(c) Rainforests (d) Mangroves

45 Most animals that in deep oceanic water are ➝ CBSE-AIPMT 2015

(a) primary consumers (b) secondary consumers
(c) tertiary consumers (d) detritivores

46 Food chain is a series of population, which starts with producers. It is concerning with

(a) biotic components only
(b) energy flow and transfer of nutrients
(c) Both (a) and (b)
(d) biotic and decomposers

47 Lindeman for the first time gave energy transfer law, which states that

(a) only 20% of the energy is transferred to each trophic level
(b) only 10% of the energy is transferred to each trophic level
(c) only 30% of the energy is transferred to each trophic level
(d) only 50% of the energy is transferred to each trophic level

48 The primary producers of the deep-sea hydrothermal vent ecosystem are ➝ NEET-II 2016

(a) green algae (b) chemosynthetic bacteria
(c) blue-green algae (d) coral reefs

49 The trophic structure and function of an ecosystem can be represented as ecological pyramids. The concept of ecological pyramids was proposed by

(a) Reiter (b) Haeckel
(c) Charles Elton (d) AG Tansley

50 The pyramid of number of individuals per unit area in a grassland ecosystem will be

(a) linear (b) inverted
(c) upright (d) irregular

51 Which one of the following is not used for construction of ecological pyramids?

(a) Dry weight
(b) Number of individuals
(c) Rate of energy flow
(d) Fresh weight

52 The pyramid of biomass in a pond ecosystem is

(a) inverted
(b) always upright
(c) sometimes upright
(d) upright and sometimes inverted

53 The pyramid of energy is always

(a) inverted
(b) upright
(c) Both (a) and (b)
(d) inverted in forest ecosystem

54 Which of the following is not an upright pyramid?

(a) Pyramid of energy in all ecosystems
(b) Pyramid of biomass in grassland
(c) Pyramid of number in grassland
(d) Pyramid of number in tree ecosystem

55 What type of ecological pyramid would be obtained with the following data?
Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g ➝ NEET 2018

(a) Upright pyramid of numbers
(b) Pyramid of energy
(c) Inverted pyramid of biomass
(d) Upright pyramid of biomass

56 Natural reservoir of phosphorus is ➝ NEET 2013

(a) rock (b) fossils
(c) sea water (d) animal bones

57 Which one of the following is not a gaseous biogeochemical cycle in ecosystem?

(a) Sulphur cycle (b) Phosphorus cycle
(c) Nitrogen cycle (d) Carbon cycle

58 In which of the following both pairs have correct combination? ➝ CBSE-AIPMT 2015

(a) Gaseous nutrient cycle, Sedimentary nutrient cycle – Carbon and nitrogen, Sulphur and phosphorus
(b) Gaseous nutrient cycle, Sedimentary nutrient cycle – Carbon and sulphur, Nitrogen and phosphorus
(c) Gaseous nutrient cycle, Sedimentary nutrient cycle – Nitrogen and sulphur, Carbon and phosphorus
(d) Gaseous nutrient cycle, Sedimentary nutrient cycle – Sulphur and phosphorus, Carbon and nitrogen

59 During ecological succession, ➝ CBSE-AIPMT 2015

(a) the gradual and predictable change in species composition occurs in a given area
(b) the establishment of a new biotic community is very fast in its primary phase
(c) the numbers and types of animals remain constant
(d) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community

60 An abandoned agricultural field changing into mature forest over long span of time is an example of

(a) allogenic succession (b) autogenic succession
(c) autotrophic succession (d) heterotrophic succession

61 A community become stabilised in an area is known as

(a) pioneer community (b) climax community
(c) seres community (d) None of these

62 The second stage of hydrosere is occupied by plants like

(a) *Azolla* *(b) Typha*
(c) *Salix* (d) *Vallisneria*

63 The species that invade a bare area are called

(a) hydrophytic species (b) xerophytic species
(c) mesophytic species (d) pioneer species

64 Which of the following statements is not correct?

(a) The pyramid of biomass in sea is inverted
(b) The pyramid of energy is always inverted
(c) Hydrarch succession takes place in wetter areas and the succession serves progress from hydric to mesic conditions
(d) Xerarch seccession takes place in dry areas

65 Which of the following is a correct trend of succession in hydroseric succession?

(a) Rooted submerged → Phytoplankton → Reed swamp → Sedge meadow
(b) Phytoplankton → Reed swamp → Rooted submerged → Sedge meadow
(c) Phytoplankton → Sedge meadow → Reed swamp → Rooted submerged
(d) Phytoplankton → Rooted submerged → Reed swamp → Sedge meadow

66 Match the following columns.

	Column I		Column II
A.	Earthworm	1.	Pioneer species
B.	Succession	2.	Detritivore
C.	Ecosystem service	3.	Natality
D.	Population growth	4.	Pollination

➝ CBSE-AIPMT 2014

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	1	3	2
(c)	3	2	4	1
(d)	2	1	4	3

DAY PRACTICE SESSION 2

PROGRESSIVE QUESTIONS EXERCISE

1 A parasite which receives a part of nourishment from host is

(a) ectoparasite (b) endoparasite
(c) holoparasite (d) hemiparasite

2 Desert can be converted into grassland by

(a) psammophytes (b) oxylophytes
(c) halophytes (d) tropical forest

3 In a lake, phytoplanktons grow in abundance in the

(a) littoral zone
(b) limnetic zone
(c) profundal zone
(d) benthic zone

4 Asymptote in a logistic growth curve is obtained, when

(a) the value of '*r*' approaches zero
(b) $K = N$
(c) $K > N$
(d) $K < N$

5 Which one of the following population interactions is widely used in medical science for the production of antibiotics?

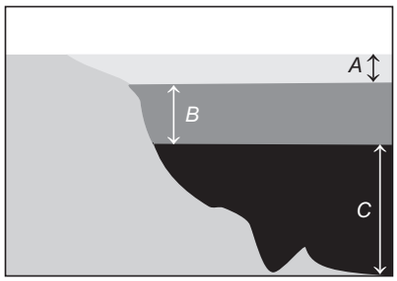
(a) Parasitism
(b) Mutualism
(c) Commensalism
(d) Amensalism

6 If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?

Plant → Mice → Snake → Peacock

(a) 0.02 J (b) 0.002 J
(c) 0.2 J (d) 0.000 2J

7 Identify *A*, *B* and *C*.



(a) *A*–Aphotic zone, *B*–Euphotic zone, *C*–Disphotic zone
(b) *A*–Euphotic zone, *B*–Disphotic zone, *C*–Aphotic zone
(c) *A*–Euphotic zone, *B*–Aphotic zone, *C*–Disphotic zone
(d) *A*–Aphotic zone, *B*–Disphotic zone, *C*–Euphotic zone

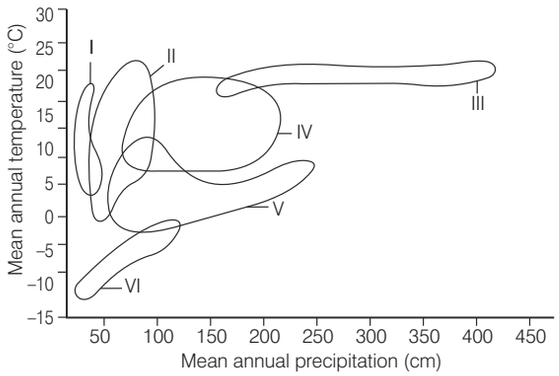
8 If a populatin of 50 paramecia present in a pool increases to 150 after an hour, what would be the growth rate of population?

(a) 50 per hour (b) 200 per hour
(c) 5 per hour (d) 100 per hour

9 Which of the following is correct for *r*-selected species?

(a) Large number of progeny with small size
(b) Large number of progeny with large size
(c) Small number of progeny with small size
(d) Small number of progeny with large size

10 In the given figure, identify coniferous forest, Arctic alpine tundra and tropical forest, respectively.



(a) I, VI and III
(b) V, VI and III
(c) IV, III and I
(d) I, II and III

11 An ecosystem, which can be easily damaged but can recover after some time if damaging effect stops, will be having

(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience

12 A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is

(a) 10 (b) 15 (c) 05 (d) zero

13 A population has more young individuals compared to the older individuals. What would be the status of the population after some years?

(a) It will decline
(b) It will stabilise
(c) It will increase
(d) It will first declined and then stabilise

14 In which one of the following pairs is the specific characteristic of soil not correctly matched?

(a) Laterite–Contains aluminium compound
(b) Terra rossa–Most suitable for roses
(c) Chemozems–Richest soil in the world
(d) Black soil–Rich in calcium carbonate

15 Which one of the following is categorised as a parasite in true sense?

(a) The female *Anopheles* bites and sucks blood from humans
(b) Human foetus developing inside the uterus draws nourishment from the mother
(c) Head louse living on the human scalp as well as laying eggs on human hair
(d) The cuckoo (koel) lays its eggs in crow's nest

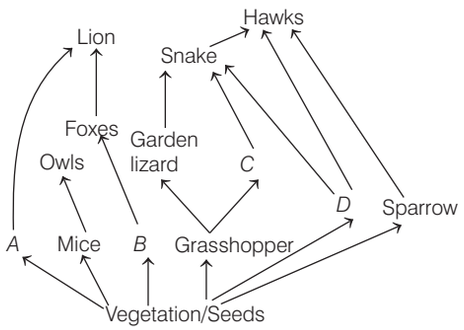
16 The population of an insect species shows and explosive increase in number during rainy season followed by its disappearance at the end of the season. What does this show?

(a) S-shaped or sigmoid growth of this insect
(b) The food plants mature and die at the end of the rainy season
(c) Its population growth curve is of J-type
(d) The population of its predators increases enormously

17 When does the growth rate of a population following the logistic model equal to zero? The logistic model is given as $\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right)$

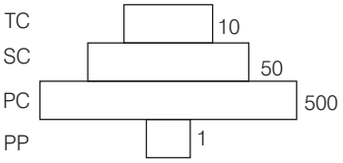
(a) when N nears the carrying capacity of the habitat
(b) when $\frac{N}{K}$ equals to zero
(c) when death rate is greater than birth rate
(d) when $\frac{N}{K}$ is exactly one

18 Indentify the likely organisms *A*, *B*, *C* and *D* in the food web shown below



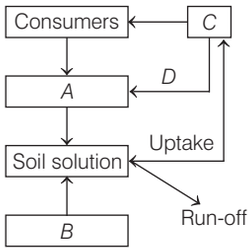
	A	*B*	*C*	*D*
(a)	Deer	Rabbit	Frog	Rat
(b)	Dog	Squirrel	Bat	Deer
(c)	Rat	Dog	Tortoise	Crow
(d)	Squirrel	Cat	Rat	Pigeon

19 Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels?



(a) Level PC is insects and level SC is small insectivorous birds
(b) Level PP is phytoplanktons in sea and whale on top level TC
(c) Level one PP is peepal trees and the level SC is sheep
(d) Level PC is bats and level SC is cats

20 Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (*A*-*D*). Identify the blanks.

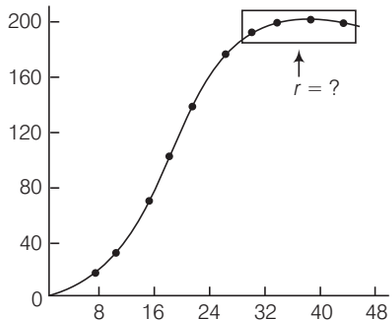


	A	*B*	*C*	*D*
(a)	Rock minerals	Detritus	Litter fall	Producers
(b)	Litter fall	Producers	Rock minerals	Litter fall
(c)	Detritus	Rock minerals	Producer	Litter fall
(d)	Producers	Litter fall	Rock minerals	Detritus

21 Given below is one of the types of ecological pyramids. This type represents

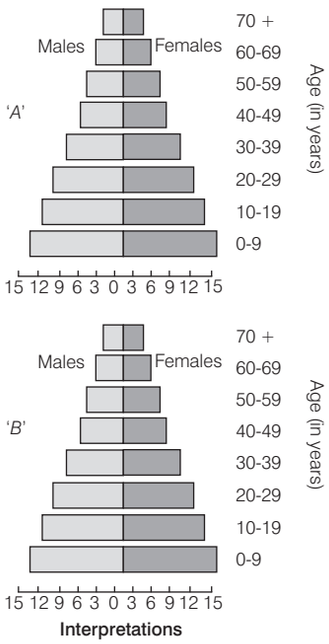
(a) pyramid of numbers in a grassland
(b) pyramid of biomass in a fallow land
(c) pyramid of biomass in a lake
(d) energy pyramid in a spring

22 From the given graph of population growth select the correct option having correct value of '*r*' from bar graph.



(a) *r* = – ve 
(b) *r* = – ve 
(c) *r* = – ve 
(d) *r* = 0 

23 A country with a high rate of population growth took measures to reduce it. The figure below shows age sex pyramids of populations *A* and *B* twenty years apart. Select the correct interpretation about them.



Interpretations

(a) '*A*' is more recent and shows slight reduction in the growth rate
(b) '*B*' is earlier pyramid and shows stabilised growth rate
(c) '*B*' is more recent showing that population is very young
(d) '*A*' is the earlier pyramid and no change has occurred in the growth rate

24 Consider the following four conditions (I-IV) and select a correct pair of them as adaptation to environment in desert lizards. Conditions are

I. Burrowing in soil to escape high temperature.
II. Losing heat rapidly from the body during high temperature.
III. Bask in sun when temperature is low.
IV. Insulating body due to thick fatty dermis.

(a) III and IV (b) I and III
(c) II and IV (d) I and II

25 Identify the incorrect statement from the following.

(a) Pyramid of energy is mostly upright, but sometimes it may be inverted
(b) Pyramid of number and biomass may be either upright or inverted
(c) Pyramid of biomass in sea is generally inverted as the biomass of fish far exceeds that of phytoplanktons
(d) Food chains are generally short and few trophic levels as only 10% of the energy is transferred to each trophic level from the lower trophic level

26 Consider the following four statements (I-IV) about certain desert animals such as kangaroo rat.

I. They have dark colour and high rate of reproduction and excrete solid urine.
II. They do not drink water, breathe at a slow rate to conserve water and have their body covered with thick hairs.
III. They feed on dry seeds and do not require drinking water.
IV. They excrete very concentrated urine and do not use water to regulate body temperature.

Which two of the above statements for such animals are true?

(a) III and I (b) I and II
(c) III and II (d) II and IV

27 Which of the following statements (I–IV) regarding energy flow are false?

I. The detritus food chain begins with dead organic matter.
II. In aquatic ecosystem, detritus food chain is the major conduit for energy flow.
III. In terrestrial ecosystem, there is a larger fraction of energy flows through grazing food chain.
IV. Producers belong to the first trophic level of the food chain.

Codes
(a) II and III (b) III and I
(c) I and IV (d) I and II

Directions (Q. Nos. 28-30) *In each of the following questions a statement of Assertion is given followed by a corresponding statement of Reason just below it. Of the statements, mark the answer as*

(a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are true, but Reason is not the correct explanation of Assertion
(c) If Assertion is true, but Reason is false
(d) If both Assertion and Reason are false

28 **Assertion** Nutrient cycle means cycling of glucose or reserved food material within the plant body.
Reason Transfer of biogenetic nutrients between living and non-living components is called biogeochemical cycle.

29 **Assertion** The rate of decomposition of detritus is reduced in the regions of high altitude.
Reason It happens due to the immobilisation of nutrients.

30 **Assertion** Animals adopt different strategies to survive in hostile environment.
Reason Praying mantis is green in colour, which merges with plant foliage.

ANSWERS

SESSION 1

1 (c)	**2** (b)	**3** (d)	**4** (b)	**5** (c)	**6** (a)	**7** (d)	**8** (c)	**9** (b)	**10** (c)
11 (b)	**12** (b)	**13** (c)	**14** (a)	**15** (c)	**16** (c)	**17** (d)	**18** (a)	**19** (b)	**20** (b)
21 (d)	**22** (d)	**23** (d)	**24** (b)	**25** (b)	**26** (c)	**27** (d)	**28** (d)	**29** (b)	**30** (d)
31 (a)	**32** (a)	**33** (b)	**34** (a)	**35** (b)	**36** (a)	**37** (a)	**38** (a)	**39** (d)	**40** (a)
41 (b)	**42** (c)	**43** (b)	**44** (b)	**45** (d)	**46** (c)	**47** (b)	**48** (b)	**49** (c)	**50** (c)
51 (d)	**52** (a)	**53** (b)	**54** (d)	**55** (c)	**56** (a)	**57** (b)	**58** (a)	**59** (a)	**60** (b)
61 (b)	**62** (d)	**63** (d)	**64** (b)	**65** (d)	**66** (d)				

SESSION 2

1 (d)	**2** (a)	**3** (b)	**4** (b)	**5** (d)	**6** (c)	**7** (b)	**8** (d)	**9** (a)	**10** (a)
11 (a)	**12** (d)	**13** (c)	**14** (d)	**15** (c)	**16** (c)	**17** (d)	**18** (a)	**19** (a)	**20** (c)
21 (c)	**22** (d)	**23** (a)	**24** (b)	**25** (a)	**26** (c)	**27** (a)	**28** (d)	**29** (a)	**30** (b)