CHAPTER – 14

# ECOSYSTEM

**Ecosystem:** An ecosystem may be viewed as a functional unit of nature in which live species interact with one another as well as with the surrounding physical environment.

- The scale of an ecosystem varies widely, from a little pond to a large forest.
- Many ecologists believe that the entire biosphere as a large ecosystem as a composite of all local ecosystems.

For convenience let's divide this large ecosystem into two categories:

(i) Terrestrial: e.g. forest, grassland, desert
(ii) Aquatic: e.g. pond, lake, wetland, river, estuary

- Man-made ecosystem: aquarium, crop field

## Ecosystem: Structure and Function

The biotic and abiotic aspects of an ecosystem work together to ensure the flow of energy within the ecosystem's components.
The interaction of biotic and abiotic components produces a physical structure that is unique to each kind of ecosystem.

**Stratification** refers to the vertical distribution of distinct species inhabiting various strata. E.g. Trees, occupy the top vertical stratum or layer of a forest, shrubs the second, and herbs and grasses the bottom.

The functional components of an ecosystem are as follows:

- **Productivity:** In a terrestrial ecosystem, major producers are herbaceous and woody plants. **Primary production** is defined as the quantity of biomass or organic matter generated per unit area by plants during photosynthesis during a time period. It is measured in either weight ($g^{-2}$) or energy (kcal $m^{-2}$).
  **Productivity** refers to the rate at which biomass is produced. It is measured in $g^{-2}y^{-1}$ or (kcal $m^{-2}$) $yr^{-1}$.

**It is divided into two components:**

**Gross primary productivity (GPP): The GPP of an ecosystem is the rate of organic matter creation during photosynthesis**,

**Net primary productivity (NPP):** while the NPP is the leftover biomass after respiration.
**NPP = GPP -** R
NPP is the available biomass for heterotrophic consumption.

**Secondary productivity** is defined as the pace at which consumers create new organic matter.

**Note:** Primary productivity depends on the plant species inhabiting a particular area. It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants. Therefore, it varies in different types of ecosystems. The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter. Of this, despite occupying about 70 per cent of the surface, the productivity of the oceans are only 55 billion tons and the rest is of land.

## Brush Up Your Understanding

**Q1.** Primary productivity depends on.
(a) Plant species inhabiting a particular area
(b) Environmental factors
(c) Availability of nutrients
(d) All of the above

**S1.** **(d)**

**Q2.** Grassland is a.
(a) Man-made ecosystem (b) Terrestrial ecosystem
(c) Aquatic ecosystem (d) None of the above

**S2.** **(b)**

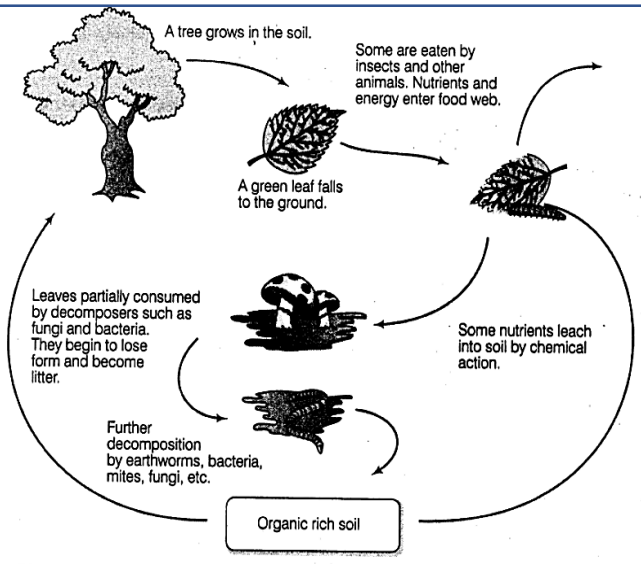
- **Decomposition:** Decomposition is the breakdown of complex organic matter into inorganic components such as carbon dioxide, water, and nutrients. Detritus is made up of dead plant remnants such as leaves, bark, flowers, and animal remains, this forms the raw material for decomposition. The following stages are involved in decomposition:

**(i)** Fragmentation: Detritivores (e.g. earthworms) feed on detritus and breakdown that increases the surface area of detritus particles for microbial action.

**(ii)** Leaching: inorganic nutrients dissolve in water and percolate through the soil and are removed due to leaching action.

**(iii)** Catabolism: Decomposers (bacteria, fungi) release enzymes that decompose detritus into simpler inorganic compounds.

**(iv)** Humification: Simplified detritus is converted to humus.



Diagrammatic representation of decomposition cycle in a terrestrial ecosystem

**Decomposition cycle in nature**

**Humus:** Humus is a Dark, amorphous substance, it is highly resistant to microbial action and undergoes decomposition very slowly, it is a reservoir of nutrients (due to its colloidal nature).

**(v)** **Mineralization:** Humus is degraded and it releases inorganic substances ( $CO_2$, $H_2O$ etc) and nutrients ($Ca^{2+}$, $Mg^{2+}$,$K^+$ etc).

## Brush Up Your Understanding

**Q1.** The process by which water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts is called.
(a) Fragmentation (b) Catabolism
(c) Leaching (d) Humification

**S1.** **(c)**

**Q2.** Decomposition is affected by.
(a) Temperature
(b) Soil moisture
(c) Chemical composition of detritus
(d) All of the above

**S2.** **(d)**

- **Energy flow:** All living species, directly or indirectly, rely on producers for sustenance. Energy flows uni-directionally from the sun to producers and ultimately to consumers. Plants use photosynthetically active radiation (PAR) to synthesise food. Plants capture only 2-10 per cent of the PAR and this small amount of energy sustains the entire living world. Because animals acquire their nourishment from plants, they are referred to as consumers.

The green plant in the ecosystem are called producers. In a terrestrial ecosystem, major producers are herbaceous and woody plants. Likewise, producers in an aquatic ecosystem are various species like phytoplankton, algae and higher plants.

**Food Chain:** The process of eating and being eaten is referred to as the **food chain,** and energy flows from producers to consumers**.**

**A GFC (Grazing Food Chain) is represented by:**

Grass ------> Goat ------> Man ------>

(Producer) (Primary Consumer) (Secondary consumer)

The **detritus food chain (DFC)** begins with decomposing organic materials. It is made up of heterotrophic organisms called decomposers (fungi and bacteria). These are also referred to as **saprotrophs** (sapro: to decompose). Decomposers release digestive enzymes that convert dead and waste materials into simple, inorganic molecules that they then absorb.

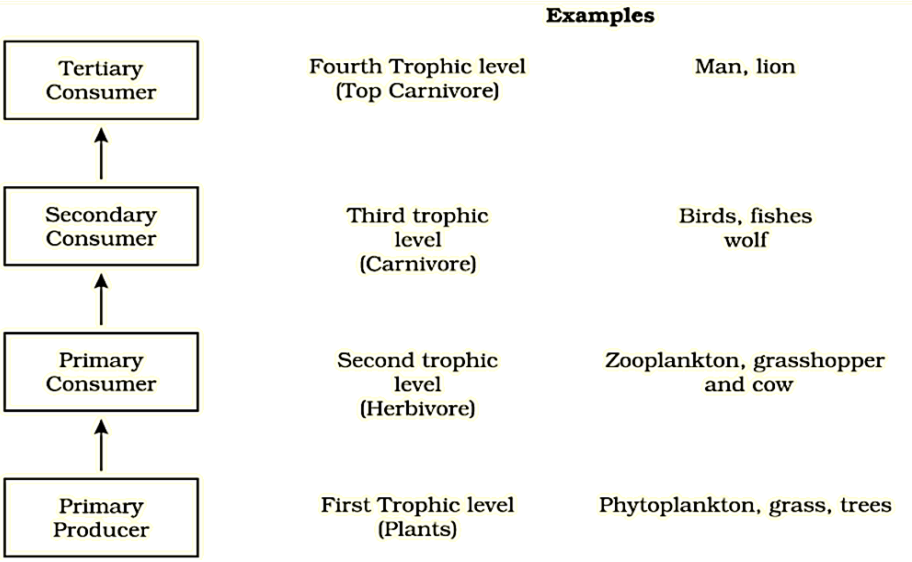
**In an aquatic ecosystem,** GFC is the major conduit for energy flow. As against this, in a terrestrial ecosystem, a much larger fraction of energy flows through the detritus food chain than through the GFC. Detritus food chain may be connected with the grazing food chain at some levels: some of the organisms of DFC are prey to the GFC animals, and in a natural ecosystem, some animals like cockroaches, crows, etc., are **omnivores**

The **food web** is formed by the natural connectivity of the food chain.

**Factors that affect Decomposition:**

- Chemical Composition: When detritus is rich in lignin and chitin, the rate of decomposition is sluggish; when detritus is rich in nitrogen and water-soluble compounds like sugars, the rate of decomposition accelerates.
- Climatic conditions: Warm and wet environments promote decomposition, whereas cold temperatures and anaerobiosis hinder it.

**Trophic Level:** An organism occupies a certain trophic level in the food chain based on its food supply. At any one moment, each tropic level contains a specific mass of living material known as the **standing crop**. Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third. The important point to note is that the amount of energy decreases at successive trophic levels. When any organism dies it is converted to detritus or dead biomass that serves as an energy source for decomposers. Organisms at each trophic level depend on those at the lower trophic level for their energy demands.

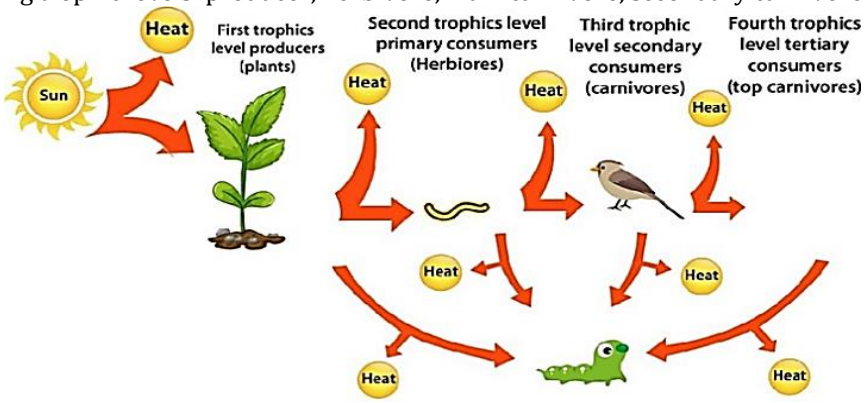



**Diagrammatic representation of trophic levels in an ecosystem**

**Standing crop:** is expressed as the biomass of living organisms or the number of living organisms per unit area.

The number of trophic levels in the grazing food chain is restricted because energy transmission follows the 10% law, which states that only 10% of energy is transmitted from the lower trophic level to the higher trophic level.

GFC allows for the following trophic levels: producer, herbivore, main carnivore, secondary carnivore.




**Energy flow through different trophic levels**

## Brush Up Your Understanding

**Q1.** In an aquatic ecosystem, which of the following is the major conduit for energy flow?
(a) Detritus food chain (b) Grazing food chain
(c) Both (a) and (b) (d) None of the above

**S1. (b)**

**Q2.** At successive trophic levels, the amount of energy.
(a) Increases (b) Decreases
(c) Remains unaffected (d) None of the above

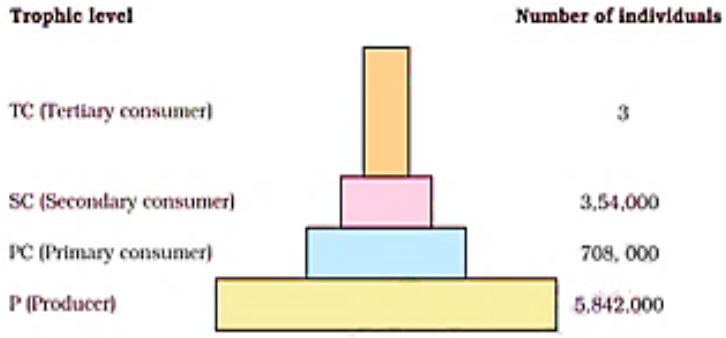
**S2. (b)**

**Ecological Pyramids:** The ecological pyramid is a graphical depiction of an ecological parameter (number, biomass, and energy) in various trophic levels of a food chain, with producers at the bottom, herbivores in the middle, and carnivores at the top. It may be upright, inverted, or spindly.

**Ecological pyramids are of following types:**

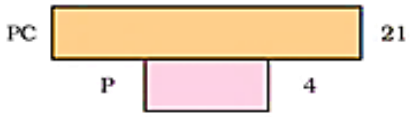
**(i)** Pyramid of Number: use the number of persons per unit area at various trophic levels, with the producer at the bottom and several consumers gradually at higher levels. It is mostly upright.

In the case of a large tree, a number pyramid is usually inverted because the number of insects feeding on that tree outnumbers the number of insects.

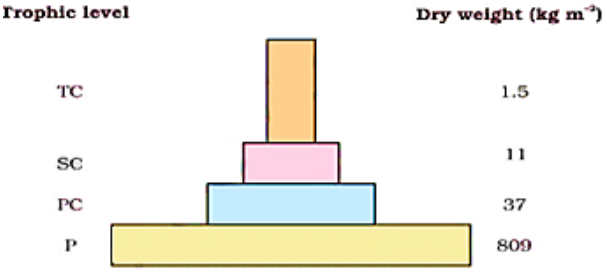



**Pyramid of Number in grassland ecosystem**

**(ii)** Pyramid of Biomass: the pyramid indicates the biomass at different trophic levels. Except in aquatic food chains with short-lived plankton, a biomass pyramid is upright. A biomass pyramid in the water is often inverted because fish biomass outnumbers phytoplankton biomass.

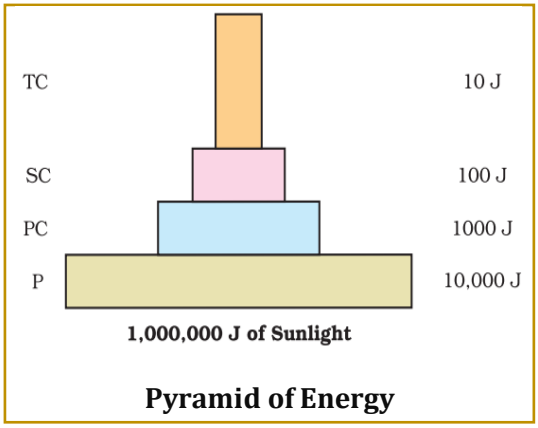



Inverted pyramid of biomass-small standing crop of phytoplankton supports large standing crop of zooplankton




Pyramid of biomass shows a sharp decrease in biomass at higher trophic levels

**(iii) Pyramid of Energy:** the pyramid provides a graphical depiction of the amount of energy trapped by various trophic levels per unit area The energy pyramid is always upright and can never be inverted because as energy travels from one trophic level to the next, some energy is always lost as heat at each stage, such as feeding, digesting, assimilation, and respiration.




**Pyramid of Energy**

### Limitations of ecological pyramid

Ecological pyramids do not take into account the same species belonging to two or more trophic levels. It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web. Moreover, saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.

## Brush Up Your Understanding

**Q1.** Which of the following pyramid is always upright?
(a) Pyramid of number (b) Pyramid of biomass
(c) Pyramid of energy (d) All of the above

**S1. (c)**

**Q2.** Which of the following is limitation of an ecological pyramid?
(a) It does not accommodate a food web
(b) It assumes a simple food chain
(c) It does not take into account the same species belonging to two or more trophic levels
(d) All of the above

**S2. (d)**

**Ecological Succession:** The steady and reasonably predictable shift in a specific area's species makeup is referred to as ecological succession.

During succession, certain species colonise a region and their population grows, while other species' populations drop and ultimately perish.

The term **climax community** refers to orderly and sequential change that leads to a community that is close to equilibrium.

**Individual transitory communities are referred to as seral stages or seral communities,** and the complete sequence of communities that changes in a specific region is referred to as **sere.**

**Primary Succession: it** begins where there are no organisms. For example, naked rocks, cooled volcanoes, and so forth.

**Secondary succession:** happens in areas where living creatures have been wiped off by natural disasters such as forest fires. Earthquake, for example.

**Plant Succession:** it can be of following types:

- Hydrach: takes place in wetter area and the successional series progress from hydric to the mesic conditions.
- Xerach: takes place in dry areas and series progress from xeric to mesic condition

**Pioneer** species are species that conquer a barren region. **Lichens are pioneer species in primary succession on rocks, secreting acids that breakdown the rock and allow weathering to generate soil.**
The little phytoplanktons that are replaced by free floating angiosperms are the pioneer species in primary succession in water.

Primary succession is a long process since soil is not accessible for pioneer species, whereas secondary succession is a faster process because soil or other nutrients are available.
In the event of secondary succession, a peak community is achieved significantly faster.

**Examples** of areas where primary succession occurs are newly cooled lava, bare rock, newly created pond or reservoir. The establishment of a new biotic community is generally slow. Before a biotic community of diverse organisms can become established, there must be soil. Depending mostly on the climate, it takes natural processes several hundred to several thousand years to produce fertile soil on bare rock.

Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests, lands that have been flooded. Since some soil or sediment is present, succession is faster than primary succession.

Description of ecological succession usually focuses on changes in vegetation. However, these vegetational changes in turn affect food and shelter for various types of animals. Thus, as succession proceeds, the numbers and types of animals and decomposers also change. At any time during primary or secondary succession, natural or human induced disturbances (fire, deforestation, etc.), can convert a particular seral stage of succession to an earlier stage.

## Brush Up Your Understanding

**Q1.** Hydrarch succession takes place in.
(a) Dry areas (b) Wet areas
(c) Both (a) and (b) (d) None of the above

**S1. (b)**

**Q2.** The species that invade a bare area are the.
(a) Climax community (b) Pioneer community
(c) Both (a) and (b) (d) None of the above

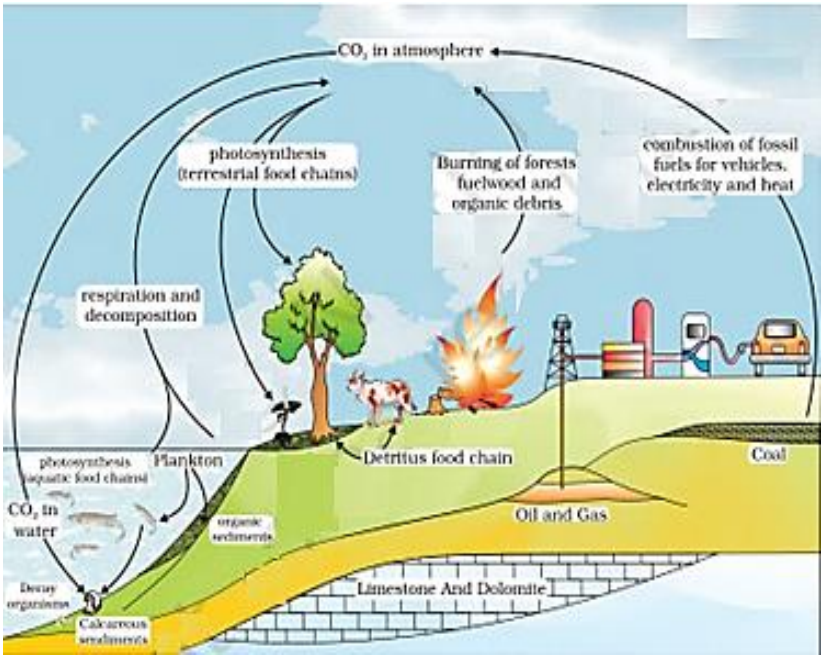
**S2. (b)**

**Nutrient Cycling:** Nutrient cycling refers to the flow of nutritional elements through the various components of an ecosystem. It is also known as the biogeochemical cycle. Nutrient cycles are classified into two types:

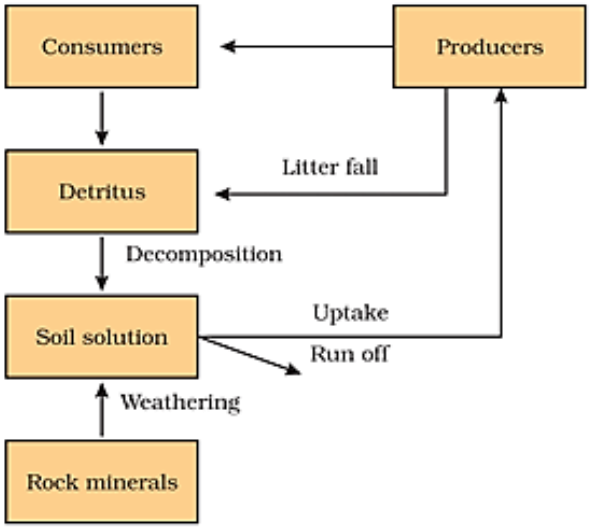
- Gaseous: the reservoir of gaseous type of nutrient cycle is the atmosphere. E.g. nitrogen and the carbon cycle
- Sedimentary: the reservoir is found in the earth's crust. E.g. sulphur and phosphorous cycle.

Environmental elements like as soil, moisture, pH, and temperature control the rate of nutrient release into the atmosphere. The reservoir's role is to compensate for the shortfall caused by an imbalance in the rates of inflow and outflow.

**Carbon Cycle:** Carbon cycling occurs in the atmosphere, the ocean, and living and dead species. The majority of carbon is fixed by plants during photosynthesis and returned to the environment as $CO_2$ during respiration. Other sources of $CO_2$ emissions in the atmosphere include wood burning, forest fires and the combustion of organic materials, fossil fuels, and volcanic activity.




**Carbon cycle in Biosphere**




**Phosphorous cycling in a terrestrial ecosystem**

**Phosphorous Cycle:** The natural phosphorus reservoir is rock, which holds phospshorus in the form of phosphates. Phosphates dissolve in soil solution as a result of weathering and are absorbed by plant roots. Bacteria breakdown the waste products of deceased organisms to release phosphorus. In comparison to carbon, gaseous exchange between organism and environment is low.

**Ecosystem Services:** Ecological services are the outcomes of ecosystem processes. It consists of-

- A healthy forest ecosystem purifies the air and water.
- Reduces floods and droughts
- Nutrient cycling
- Create fertile soil
- Make wildlife habitat available.
- Maintain biodiversity

## Brush Up Your Understanding

**Q1.** The reservoir for gaseous type of nutrient cycle exists in.

(a) Earth's crust (b) Atmosphere
(c) Both (a) and (b) (d) None of the above

**S1.** **(b)**

**Q2.** Which of the following is the major constituent of the biological membranes, nucleic acids and cellular energy transfer systems?

(a) Carbon
(b) Phosphorous
(c) Nitrogen
(d) Sulphur

**S2.** **(b)** Researchers have estimated that the value of these essential ecosystem services, which are taken for granted since they are free, is equal to twice the whole world gross national product (GNP).

## SUMMARY

Ecosystem is the functional unit of nature in which living organisms interact with each other as well as their surrounding physical environment. Biosphere is a global ecosystem consisting of all local ecosystems on earth. Aquatic and terrestrial ecosystem are natural ecosystem, ecosystems can be man-made also like aquarium and croplands. Biotic factors are the living organisms in an ecosystem and abiotic components are the non-living factors in an ecosystem like sunlight, humidity, wind, etc. Productivity, decomposition, energy flow and nutrient cycling are the major components of an ecosystem.

The function of an ecosystem is the conversion of inorganic into organic material.

Break down of complex organic matter into simpler inorganic substances like carbon dioxide, water and nutrients takes place by the action of decomposers.

Sun is the ultimate source of energy for all ecosystems on earth (except for the dep sea hydrothermal ecosystem).

Energy flow in the ecosystem occurs in the form of food chain. A food chain cannot have more than a quaternary consumer as there won't be enough energy left. Food web is a system of interlocking and interdependent food chains.

An ecological pyramid is a representation in a graphical manner of the relationship between different organisms in an ecosystem.

Ecological succession is the process of change in the species structure of an ecological community over time. The time scale can be decades, or even millions of years after a mass extinction. This change is orderly and sequential, parallel with the changes in the physical environment.

The movement of nutrients through the various components of an ecosystem is called nutrient cycling. It is also called as biogeochemical cycles (bio: living organism, geo: rocks, air, and water).

The products of ecosystem processes are called ecosystem services.

## IMPORTANT POINTERS

A constant input of solar energy is the basic requirement for any ecosystem to function and sustain.

Dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter, constitute detritus.

Humus is colloidal in nature, it serves as a reservoir of nutrients.

Decomposition is largely an oxygen-requiring process.

Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

Plants capture only 2-10 per cent of the PAR and this small amount of energy sustains the entire living world.

The detritus food chain (DFC) begins with dead organic matter.
In an aquatic ecosystem, GFC is the major conduit for energy flow.

Pyramid of energy is always upright.

Hydrarch succession takes place in wet areas, xerarch succession takes place in dry areas.

The species that invade a bare area are called pioneer species.

Healthy forest ecosystems purify air and water, mitigate droughts and floods, cycle nutrients, generate fertile soils, provide wildlife habitat, maintain biodiversity, pollinate crops, provide storage site for carbon and also provide aesthetic, cultural and spiritual values. These are some of the ecosystem services that we get from nature for free.

## MULTIPLE CHOICE QUESTIONS

**Q1.** What is stratification?
(a) it is the vertical distribution of different animals occupying different levels on earth
(b) it is the vertical distribution of different human races occupying different levels on earth
(c) it is the vertical distribution of different aquatic animals occupying different levels on earth
(d) it is the vertical distribution of different species occupying different levels on earth

**Q2.** Movement of energy in an ecosystem is.
(a) Bidirectional
(b) Unidirectional
(c) In all the directions
(d) Limited only at one place

**Q3.** Which of the following types of soil is present at bottom of rivers?
(a) Loam (b) Clay
(c) Alluvial (d) Sand

**Q4.** Which of the following is a basic requirement of an ecosystem for sustainment and functioning of an ecosystem?
(a) Constant supply of water
(b) Constant supply of solar energy
(c) Constant supply of food
(d) All of the above

**Q5.** Define productivity.
(a) It is the rate of biomass production in an ecosystem
(b) It is the rate of food production in an ecosystem
(c) It is the rate of energy production in an ecosystem
(d) All of the above

**Q6.** Which of the following in the available biomass for the consumption to heterotrophs?
(a) Primary productivity
(b) Secondary productivity
(c) Net primary productivity
(d) Gross primary productivity

**Q7.** Primary productivity depends on.
(a) Animals inhabiting the particular area
(b) Plant species inhabiting the particular area
(c) Saprophytes inhabiting the particular area
(d) Herbivores inhabiting a particular area

**Q8.** What is the primary productivity of the oceans?
(a) 75 billion tons (b) 65 billion tons
(c) 55 billion tons (d) 45 billion tons

**Q9.** Which of the following is referred to as farmer's friend?
(a) Ascaris (b) Earthworm
(c) Tapeworm (d) All of the above

**Q10.** What constitutes the detritus?
(a) Leaves, and remains of animals
(b) Leaves, remains of animals, bark of flowers and faecal matter
(c) Leaves, bark of flowers
(d) Leaves, and faecal matter

**Q11.** Which of the following are the important steps in the process of decomposition?
(a) Fragmentation
(b) Leaching, catabolism
(c) Humification, mineralisation
(d) All of the above

**Q12.** Which of the following process causes water-soluble inorganic nutrients to go down into the soil Horizon and precipitate into unavailable salts?
(a) Fragmentation (b) Catabolism
(c) Leaching (d) Humification

**Q13.** Which of the following is a dark coloured amorphous substance that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate in the soil?
(a) Minerals (b) Humus
(c) Detrius (d) Biomass

**Q14.** Which of the following controls the rate of decomposition of organic matter?
(a) Chemical composition of detritus
(b) Climatic factors
(c) Both (a) and (b)
(d) None of the above

**Q15.** What amount of photosynthetic active radiation is captured by the autotrophs due to which the entire living world survives?
(a) 1%-10%
(b) 2%-10%
(c) 3%-10%
(d) 4%-10%

**Q16.** Which among the following are the major producers in a terrestrial ecosystem?
(a) Herbaceous plants
(b) Woody plants
(c) Algae and phytoplankton
(d) None of the above

**Q17.** Which among the following are decomposers?
(a) Algae
(b) Fungi
(c) Bacteria
(d) Both (b) and (c)

**Q18.** Which among the following animals are omnivores?
(a) Crow
(b) Cockroaches
(c) Lion
(d) Both (a) and (b)

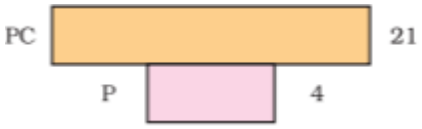
**Q19.** Primary consumers belong to which of the following trophic level in a food chain?
(a) 1 (b) 2
(c) 3 (d) 4

**Q20.** What happens to energy at successive trophic level?
(a) It decreases
(b) It increases
(c) It remains constant
(d) None of the above

**Q21.** What is standing crop?
(a) it is certain mass of energy at a tropic level at a particular time
(b) it is certain mass of living material at a tropic level at a particular time
(c) it is certain amount of food at a tropic level at a particular time
(d) None of the above

**Q22.** What is the amount of energy that gets transferred to each trophic level starting from the lower trophic level?
(a) 5%
(b) 10%
(c) 15%
(d) 20%

**Q23.** Look at the given picture and the name of the energy pyramid?




(a) Pyramid of number
(b) Pyramid of biomass
(c) Pyramid of energy
(d) None of the above

**Q24.** Among pyramid of number, pyramid of biomass and pyramid of energy, which pyramid can never be inverted?
(a) Pyramid of biomass
(b) Pyramid of number
(c) Pyramid of energy
(d) All of the above

**Q25.** What is ecological succession?
(a) it is a gradual and fairly predictable change in a population of a given area
(b) it is a gradual and fairly predictable change in the species composition of a given area
(c) it is a gradual and fairly predictable change in the energy composition of a given area
(d) None of the above

**Q26.** What changes occur in the successive seral communities?
(a) change in the diversity of species of organisms
(b) increase in the number of species and organism
(c) increase in the total biomass
(d) All of the above

**Q27.** In which of the following succession rate is faster?
(a) Primary succession
(b) Secondary succession
(c) Both (a) and (b)
(d) None of the above

**Q28.** Xerarch succession takes place in.
(a) Wet areas (b) Humid areas
(c) Dry areas (d) All of the above

**Q29.** What is standing state?
(a) it is the amount of water present in the soil at any given time
(b) it is the amount of air present in the soil at any given time
(c) it is the amount of humus present in the soil at any given time
(d) it is the amount of nutrients such as carbon, nitrogen, phosphorus, calcium etc. present in the soil at any given time

**Q30.** What is the reservoir of sedimentary cycle in nature?
(a) Water (b) Earth's crust
(c) Air (d) None of the above

**Q31.** What is the amount of carbon present in oceans?
(a) 70% (b) 71%
(c) 72% (d) 73%

**Q32.** What amount of carbon is fixed annually in the biosphere through photosynthesis?
(a) $4 \times 10^{13}$ kg
(b) $3 \times 10^{13}$ kg
(c) $2 \times 10^{13}$ kg
(d) $1 \times 10^{13}$ kg

**Q33.** Which of the following is a major constituent of biological membranes nucleic acids and cellular energy transfer systems?
(a) Sulphur
(b) Phosphorus
(c) Magnesium
(d) Iron

**Q34.** Which of the following are primary consumers in a biotic community?
(a) Saprophytes (b) Carnivores
(c) Herbivores (d) Omnivores

**Q35.** The species that invade a bare area are called.
(a) Sere species
(b) Pioneer species
(c) Climax species
(d) None of the above

**Q36.** Which of the following regulate the rate of release of nutrients into the atmosphere?
(a) Soil (b) Moisture
(c) pH (d) All of the above

**Q37.** Among the following, guess which one of the following is the most stable ecosystem?
(a) Mountain (b) Desert
(c) Forest (d) Ocean

**Q38.** Which of the following starts a food chain in pond ecosystem?
(a) Algae (b) Phytoplankton's
(c) Bacteria (d) Fungi

**Q39.** Which of the following food chain begins with dead organic matter?
(a) Grazing food chain
(b) Detritus food chain
(c) Both (a) and (b)
(d) None of the above

**Q40.** Which of the following are autotrophs?
(a) Phytoplankton (b) Algae
(c) Floating plants (d) All of the above

**Q41.** What is the annual net primary productivity of the whole biosphere?
(a) 150 billion tonnes (b) 160 billion tonnes
(c) 170 billion tonnes (d) 180 billion tonnes

**Q42.** The biomass of a species is measured in terms of.
(a) fresh weight (b) Dry weight
(c) Wet weight (d) Both (a) and (b)

**Q43.** Which of the following causes decomposition of organic matter?
(a) Humans (b) Plants
(c) Microorganisms (d) All of the above

**Q44.** Based on the source of the nutrition, an organism occupies a specific place in a food chain, this place is called as.
(a) Biomass (b) Trophic level
(c) Sere (d) Pioneer

**Q45.** Which of the following is correct about climax community?
(a) It is in a state of equilibrium
(b) It is in a state of non-equilibrium
(c) It is in a state of order
(d) It is in a state of disorder

**Q46.** Which of the following is the reservoir for gaseous type of nutrient cycle?
(a) Lithosphere (b) Stratosphere
(c) Atmosphere (d) Ionosphere

**Q47.** Which of the following is an artificial ecosystem?
(a) Pond (b) Aquarium
(c) Grassland (d) Forest

**Q48.** Where can secondary succession take place?
(a) Abandoned farm lands
(b) Burned or cut forests
(c) Flooded lands
(d) All of the above

**Q49.** What is a gradual and fairly predictable change in the species composition of a given area is called?
(a) Primary succession
(b) Secondary succession
(c) Ecological succession
(d) None of the above

**Q50.** At which of the following place, primary succession can take place?
(a) Bare rock
(b) Newly cooled lava
(c) Newly created pond
(d) All of the above

## ASSERTION AND REASON

**Direction:** in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

**Q1.** **Assertion (A):** Warm and moist environment can enhance the rate of decomposition.
**Reason (R):** Warm and moist climate leads to create anaerobic condition which promotes decomposition.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q2.** **Assertion (A):** Detritus food chain begins with detritus
**Reason (R):** Detrivores like fungi and bacteria are major decomposers in such food chains.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q3.** **Assertion (A):** Ecological pyramid cannot explain all the vital functions of an ecosystem.
**Reason (R):** Pyramids actually does not explain the role of organism working at more than one trophic level.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q4.** **Assertion (A):** Pyramid of biomass is always upright for tree ecosystem
**Reason (R):** Total biomass of a tree in a specific area is more than that of the herbivores.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

## TRUE AND FALSE

**Q1.** The species that invade a bare area are called pioneer species.

**Q2.** The detritus food chain (DFC) begins with plants, the producers.

**Q3.** Detritivores break down detritus into smaller particles. This process is called leaching.

**Q4.** Vertical distribution of different species occupying different levels is called stratification.

## PRACTICE QUESTIONS (MCQ)

**Q1.** Artificial ecosystems are characterised by.
(a) High productivity
(b) High diversity
(c) Complex food chain
(d) More cycling of nutrients

**Q2.** The ecosystem that can be included in the least productive category is the.
(a) Tropical rain forest
(b) Coral reef
(c) Desert
(d) Sugarcane field

**Q3.** The rate of organic matter stored by the producers in their body per unit time and area is called.
(a) Secondary productivity
(b) GPP
(c) NPP
(d) Ecological efficiency

**Q4.** Which of the following is the most important climatic factor that regulates the rate of decomposition?
(a) Temperature and soil moisture
(b) Soil pH and aeration
(c) Aeration and temperature
(d) Moisture and pH of the soil

**Q5.** Grazing food chain is also called as.
(a) Saprophytic food chain (b) Auxiliary food chain
(c) Predator food chain (d) None of the above

**Q6.** What percentage of incident solar radiation is captured during photosynthesis by the plants?
(a) 0.8 – 4 % (b) 0.2 – 1 %
(c) 1 – 5 % (d) 50 %

**Q7.** Which statement about grazing food chain is incorrect?
(a) Sun is the source of energy
(b) It begins with consumers
(c) Major conduit for energy flow in an ecosystem
(d) Size of organism commonly increase at higher trophic levels

**Q8.** The amount of living material present in different trophic levels at a given time is called.
(a) Standing quality (b) Standing state
(c) GPP (d) Standing crop

**Q9.** For a tree and a grassland ecosystem, the pyramid of biomass is.
(a) Upright (b) Inverted
(c) Spindle shaped (d) Urn shaped

**Q10.** Succession stages that occur on a rock is called as.
(a) Hydrarch (b) Halosere
(c) Lithosere (d) Hydrosere

**Q11.** During the process of ecological succession.
(a) Species diversity decreases
(b) Structural complexity decreases
(c) Niche become specialised
(d) Food chain relationship becomes simple

**Q12.** A largest man-made ecosystem among the following is.
(a) Garden (b) Zoo
(c) Aquarium (d) Agro-ecosystem

**Q13.** The magnitude of primary productivity is affected by.
(a) Temperature and the availability of the nutrients
(b) Solar radiations available and the availability of the nutrients
(c) Photosynthetic activity of the producers
(d) All of the above

**Q14.** Which of the following convert plant matter into animal matter?
(a) Earthworm (b) Goat
(c) Termites (d) Frog

**Q15.** Pioneer community established on a bare rock is.
(a) Mosses (b) Lichens
(c) Phytoplanktons (d) Higher plants

**Q16.** In which of the following area, succession can take several thousands of years to reach climax community is.
(a) Burnt and cut forest
(b) Sand dunes
(c) Flooded land
(d) Abandoned farm lands

**Q17.** Which of the following is not true regarding the ecosystem?
(a) Self sufficient unit
(b) Cyclic exchange of materials between living beings and environment
(c) Only requirement is input of energy
(d) Characterised by a major vegetation type

**Q18.** An ecosystem contains.
(a) Green plants and animals
(b) Green plants and decomposers
(c) Green plants, animals, decomposers and abiotic environment
(d) Producers and consumers

**Q19.** An artificial aquatic ecosystem is.
(a) Large dams and reservoirs
(b) Lakes and canals
(c) Fishery tanks and aquarium
(d) All of the above

**Q20.** Which of the following is not a structural aspect of an ecosystem?
(a) Productivity (b) Species composition
(c) Diversity (d) Life cycle

**Q21.** Functional aspect of an ecosystem is.
(a) Species composition (b) Inorganic nutrients
(c) Homeostasis (d) Topography

**Q22.** Which among the following is a least productive ecosystem?
(a) Grassland (b) Savannah
(c) Forest (d) Tundra

**Q23.** Which of the following is not true for humus?
(a) Dark coloured amorphous substance
(b) Highly resistant to microbial action
(c) Act as reservoir of nutrients and increases water holding capacity of soil
(d) They are degradation product of protein and fats and are produced by the process of mineralisation

**Q24.** A food web.
(a) Increases variety of food at each trophic level
(b) Delicately balances the inter relations amongst organism
(c) Decreases variety of food but increases quantity of food at each trophic level
(d) Increases variety as well as quantity of food at each trophic level

**Q25.** Which of the following statement is not correct about energy flow in an ecosystem?
(a) Pyramid of energy is always straight
(b) Energy flow is unidirectional
(c) Energy flow is cyclic
(d) Ecological efficiency is generally 10%

**Q26.** Climax communities.
(a) Are more diverse than the pioneer communities
(b) Are less stable than pioneer communities
(c) Have greater entropy than pioneer communities
(d) Have a large number but fewer species than pioneer communities

**Q27.** Which of the following would appear as the pioneer organism on bare rocks?
(a) Green algae (b) Lichens
(c) Liverworts (d) Mosses

**Q28.** In an ecosystem, the rate of production of organic matter during photosynthesis is termed as.
(a) Net productivity
(b) Net primary productivity
(c) Gross primary productivity
(d) Secondary productivity

**Q29.** Which of the following is not a gaseous biogeochemical cycle in ecosystem?
(a) Nitrogen cycle
(b) Carbon cycle
(c) Sulphur cycle
(d) Phosphorous cycle

**Q30.** In a biotic community, the primary consumers are.
(a) Detritivores (b) Herbivores
(c) Carnivores (d) Omnivores

## ASSERTION AND REASON

**Direction:** in the following questions, a statement of assertion (A) is followed by a statement of reason (R). Choose the correct option among a, b, c and d.

**Q1.** **Assertion (A):** In most ecosystems, all the pyramids, of number, of energy and biomass are upright.
**Reason (R):** Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q2.** **Assertion (A):** Each trophic level has a certain mass of living material at a particular time called as the standing crop.
**Reason (R):** The standing crop is measured as the weight of living organism.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q3.** **Assertion (A):** Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship with other organisms.
**Reason (R):** In an aquatic ecosystem, GFC is the major conduit for energy flow.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true

**Q4.** **Assertion (A):** The green plant in the ecosystem are called producers.
**Reason (R):** In a terrestrial ecosystem, major producers are phytoplankton, algae and higher plants.
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A)
(c) Assertion (A) is true but reason(R) is false
(d) Assertion (A) is false but reason(R) is true.

## SOLUTIONS MULTIPLE CHOICE

**S1.** **(d)** E.g. trees occupy top vertical strata of a forest, shrubs second layer and herbs and grasses occupy the bottom layers

**S2.** **(b)** the release of energy in an ecosystem is always uni-directional, that is energy synthesized by autotrophs is consumed by heterotrophs, decomposition and mineralization of dead matter is done by microorganisms and the energy is released back for refuse by the autotrophs. These events are repeated again and again.

**S3.** **(c)** Alluvial soils are rich in humus. The soil is formed by the sediments that are brought Down by the rivers from the mountains

**S4.** **(c)** solar energy is responsible for generation of new live on the earth without light life cannot sustain on Earth

**S5.** **(a)** in terms of productivity we can compare different ecosystems, by which one can know which ecosystem is functioning well.

**S6.** **(c)** net primary productivity is the available biomass for the consumption by the heterotrophs that is the herbivores and the decomposers

**S7.** **(b)** primary productivity depends on various environmental factors like availability of nutrients and photosynthetic capacity of plants

**S8.** **(c)** despite that the oceans occupy 70% of the surface of the earth their productivity is very low, it is 55 billion tons

**S9.** **(b)** earthworms are called as farmer's friend because they create holes in the soil allowing the air to pass through it that keeps the soil aerated

**S10.** **(b)** detritus in an ecosystem forms the raw material for decomposition

**S11.** **(d)** all these process lead to proper decomposition of the matter that mixes with the soil

**S12.** **(c)** leaching is an important process of decomposition

**S13.** **(c)** humus is colloidal in nature and serves as a reservoir of nutrients inside the soil, it is degraded by some microbes and release of inorganic nutrients from it occurs by the process called as mineralization.

**S14.** **(c)** in a particular climatic condition, the decomposition rate is lower if the detrius is rich in lignin and chitin and quicker if detrius is rich in nitrogen and water-soluble substances like sugars.

**S15.** **(b)** sun is the only source of energy for all the ecosystems, on earth plants and the photosynthetic bacteria fix sun's radiant energy to make food from simple inorganic material and this is only 2- 10% off of the sun's radiation.

**S16.** **(c)** in a terrestrial ecosystem the major producers are vascular plants that have no persistent woody stems above the ground.

**S17.** **(d)** fungi and bacteria that also called as decomposers are heterotrophic organisms that forms the detritus food chain

**S18.** **(d)** omnivorous are animals that eat both plants and animal's e.g chimpanzees, squirrels, dogs, crow and cockroaches.

**S19.** **(b)** organism occupied a place in the natural surrounding or in a community according to the feeding relationship with other organisms, based on the source of the nutrition of food, organism occupy a specific place in the food chain that is known as trophic level. Primary consumers of herbivores belong to the second trophic level.

**S20.** **(a)** the amount of energy decreases at successive trophic levels. When an organism dies it is converted to detritus that serves as an energy source for decomposer. Organisms at each trophic level depend on those at the lower trophic level for the energy demands.

**S21. (b)** standing crop is measured as the mass of living organisms or the number in a particular unit area.

**S22. (b)** the transfer of energy follows the 10% law, only 10% of the energy is transferred to each trophic level starting from the lower trophic level.

**S23. (b)** the picture is of pyramid of biomass in a sea, that is inverted. It is inverted because small standing crop of phytoplankton supports large standing crop of zooplankton.

**S24. (c)** pyramid of energy is always upright, it can never be inverted because when energy flows from a particular trophic level to next tropic level some energy is always lost as heat at each step.

**S25. (b)** during an ecological succession some species colonize in an area and their population becomes more numerous while populations of other species decline and even disappear.

**S26. (d)** the individual transitional communities are termed seral stages or seral communities.

**S27. (b)** secondary succession begins in areas where natural biotic communities have been destroyed in abandoned farm lands, burned or cut forest, since some soil or settlement is present succession is faster than the primary succession

**S28. (c)** xerarch succession takes place in dry areas and the series progress from xeric to mesic condition.

**S29. (d)** standing state varies in different kinds of ecosystem.

**S30. (b)** the sedimentary cycles like the sulphur and the phosphorus cycle, the reservoir of these is located in the earth's crust.

**S31. (b)** the oceanic reservoir of carbon regulates the amount of carbon dioxide in the atmosphere.

**S32. (a)** a lot amount of carbon returns to the atmosphere as carbon dioxide through respiratory activities of producers and consumers, decomposers also contribute substantially to carbon dioxide pool by the processing of waste materials and the organic matter of lands or oceans.

**S33. (b)** the natural reservoir of phosphorus is rock which contains phosphorus in the form of phosphates, it is a major constituent of the human body, the biological membranes, nucleic acid contain phosphorus as a major constituent.

**S34. (c)** Herbivores are the secondary consumers of a food chain

**S35. (b)** Pioneer species are the species that invade an area e.g lichens are able to secrete acids on rocks during primary succession and dissolve the rock and help in weathering and soil formation.

**S36. (d)** environmental factors the very important for the maintenance of nutrient cycle in the atmosphere.

**S37. (d)** Ocean is the most stable ecosystem because of dissolved oxygen, light and temperature.

**S38. (b)** in pond ecosystem, phytoplankton are at the top level in an energy pyramid.

**S39. (b)** decomposers are heterotrophic organisms that start the detritus food chain

**S40. (d)** the autotrophs forms the base of a food chain, they include the phytoplankton's the submerged and the marginal plants found at the edges of water bodies and algae.

**S41. (c)** among this the oceans contribute 55 billion tons of productivity inspite of occupying 70% of the earth's surface.

**S42. (d)** Though biomass is measured in terms of fresh or dry weight, measurement in terms of dry weight is more accurate.

**S43. (c)** microorganism mainly fungi and bacteria termed as decomposers causes the decomposition of organic matter

**S44. (b)** Producers occupy first trophic level, herbivores, second trophic level and so on.

**S45. (a)** all communities change their composition and structure constantly. In response to the changing environmental condition. The changes are orderly and sequential and are parallel with the changes in the physical environment that lead to the formation of climax community.

**S46. (c)** the function of the reservoir is to meet with the deficit which occurs due to imbalance in the rate of influx and reflex of nutrients.

**S47. (b)** Ecosystem is natural and artificial. Forest, pond are examples of natural ecosystem while aquarium is an example of artificial ecosystem

**S48. (d)** Secondary succession begins in areas where natural biotic communities have been destroyed.

**S49. (c)** during succession some species colonize an area and their population becomes more numerous whereas populations of other species decline and even disappear

**S50. (d)** the appearance of primary succession is slow process. Before a biotic community of a diverse organisms can be established at a place there must be soil present there.

## ASSERTION AND REASON

**S1. (c)** Decomposition is largely an oxygen-requiring process.

**S2. (a)**

**S3. (a)**

**S4. (a)**

## TRUE AND FALSE

**S1. (True)**

**S2. (False)** The detritus food chain (DFC) begins with dead organic matter.

**S3. (False)** Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation.

**S4. (True)**

## PRACTICE SOLUTIONS

**S1. (a)** An artificial ecosystem is a human made system of plants and animals and people living in an area together with their surroundings.

**S2. (c)** The least productive ecosystem are deserts and deep lakes.

**S3. (c)** amount of organic matter (after used up in respiration) by the producers per unit time and per unit area is called net primary productivity.

**S4. (a)** Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by the chemical composition of detritus and climatic factors. Temperature and soil moisture are the most important climatic factors the regulate decomposition through their effects on the activities of soil microbes.

**S5. (c)** Grazing food chain is also called as predator food chain, detritus food chain is also called as saprophytic food chain and parasitic food chain is also called as auxiliary food chain.

**S6. (c)** only 1 – 5 % of incident solar energy is captured during photosynthesis by the plants.

**S7. (b)** Grazing food chain starts with producer followed by herbivores followed by primary carnivore and secondary carnivore. It ends with decomposers. It is the major conduit of energy for aquatic ecosystem.

**S8. (d)** Standing crop is the total amount of living material in a specified population at a particular time, expressed as biomass (*standing biomass*) or its equivalent in terms of energy.

**S9. (a)** In grassland ecosystem, the shape of the pyramid is upright. This pyramid is called as pyramid of biomass.

**S10. (c)**

**S11. (c)** Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing. In the ecological succession the biomass overall decreases.

**S12. (d)** Man-made ecosystems are the copy of natural ecosystems created by man. The conditions of natural ecosystems are replicated in the man-made ecosystem. These are sustained by human interventions.

**S13. (d)** The primary productivity of an ecosystem is the rate at which biomass or organic matter is produced per unit area per unit time by plants(primary producers). Primary productivity depends upon plant species of the area, their photosynthetic capacity, availability of nutrients, solar radiations, precipitation, soil type and a number of other environmental factors.

**S14. (b)** Herbivorous animals are key industry animals as they convert plant matter into animal matter and all other consumers(higher animals) lives are dependent upon these primary consumers.

**S15. (b)** Lichen is the pioneer species on a bare rock. It carries out the primary succession. Lichens secrete acids over the rock that has the ability to dissolve it gradually, aiding in weathering and soil formation.

**S16. (b)** Sand dunes is an area of desert and here succession takes thousand of years to reach the climax community.

**S17. (c)** An ecosystem is a population of living species that interact as a system with the nonliving elements of their surroundings. Nutrient cycles and energy flows bind these biotic and abiotic components together.

**S18. (c)**

**S19. (d)** Artificial ecosystems are created to mimic the natural ecosystems. Different artificial ecosystems are cropland, zoo, dams and aquarium.

**S20. (a)** productivity is the rate of biomass accumulation at a specific period of time by the ecosystem. It is its functional aspect.

**S21. (c)** it is a process by which organism maintain a balance of their internal body temperature with respect to the external environment.

**S22. (d)** productivity is low in Tundra because the soil is permafrost, temperature is very low throughout the year, summer is very short.

**S23. (d)** dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate.

**S24. (d)** A network of food chains which are interconnected to each other is called a food web. In a food chain, each member is eaten by another organism in a set sequence. The producers, consumers, and decomposers are all considered as a part of the food web. The food web includes all the organisms. It helps in maintaining a balance between the interrelations of the different organisms.

**S25. (c)** the energy is not cycled in an ecosystem, flows from one level to the other and the flow is unidirectional.

**S26. (a)** The changes lead finally to a community that is in near equilibrium with the environment and that is called a climax community.

**S27. (b)** The species that invade a bare area are called pioneer species. In primary succession on rocks these are usually lichens which are able to secrete acids to dissolve rock, helping in weathering and soil formation

**S28. (c)** Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis.

**S29. (d)** the sedimentary cycle are the sulphur and phosphorus cycle, the reservoir which is located in Earth's crust.

**S30. (d)**

## ASSERTION AND REASON

**S1. (a)**

**S2. (c)** The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.

**S3. (b)**

**S4. (c)** In a terrestrial ecosystem, major producers are herbaceous and woody plant