

Ecosystems and Energy Flow

EXERCISE [PAGE 320]

Exercise | Q 1.1 | Page 320

Multiple choice question

Which one of the following has the largest population in a food chain?

1. Producers
2. Primary consumers
3. Secondary consumers
4. **Decomposers**

Solution: Decomposers

Exercise | Q 1.2 | Page 320

Multiple choice question

The second trophic level in a lake is _____.

1. Phytoplankton
2. **Zooplankton**
3. Benthos
4. Fishes

Solution: The second trophic level in a lake is **Zooplankton.**

Exercise | Q 1.3 | Page 320

Multiple choice question

Secondary consumers are _____.

1. Herbivores
2. Producers
3. **Carnivores**
4. Autotrophs

Solution: Secondary consumers are **Carnivores.**

Exercise | Q 1.4 | Page 320

Multiple choice question

What is the % of photosynthetically active radiation in the incident solar radiation?

1. 100%
2. **50 %**
3. 1-5%
4. 2-10%

Solution: 50 %

Exercise | Q 1.5 | Page 320

Multiple choice question

Give the term used to express a community in its final stage of succession?

1. End community
2. Final community
3. **Climax community**
4. Dark community

Solution: Climax community

Exercise | Q 1.6 | Page 320

Multiple choice question

After landslide which of the following type of succession occurs?

1. Primary
2. **Secondary**
3. Tertiary
4. Climax

Solution: Secondary

Exercise | Q 1.7 | Page 320

Multiple choice question

Which of the following is most often a limiting factor of the primary productivity in any ecosystem.

1. Carbon
2. Nitrogen
3. **Phosphorus**
4. Sulphur

Solution: Phosphorus

Exercise | Q 2.1 | Page 320

Very short answer question

Give an example of an ecosystem that shows an inverted pyramid of numbers.

Solution: A tree ecosystem is an example of an inverted pyramid of numbers.

Exercise | Q 2.2 | Page 320

Very short answer question

Give an example of an ecosystem that shows an inverted pyramid of biomass.

Solution: The oceanic ecosystem is an example of an inverted pyramid of biomass.

Exercise | Q 2.3 | Page 320

Very short answer question

Which mineral acts as a limiting factor for productivity in an aquatic ecosystem.

Solution: Phosphorus.

Exercise | Q 2.4 | Page 320

Very short answer question

Name the reservoir and sink of carbon in the carbon cycle.

Solution: i. Reservoir of carbon in the carbon cycle in the atmosphere and ocean.

ii. Carbon which is present in the rock and fossil fuels like oil, coal and natural gas are the sink of the carbon cycle.

Exercise | Q 3.1 | Page 320

Short answer question

Distinguish between the upright and inverted pyramid of biomass.

Solution:

	Upright Pyramid of Biomass	Inverted Pyramid of Biomass
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i.	It is the type of ecological pyramid where the producers have maximum biomass and occupy a broad base and the consumers decrease in terms of biomass.	It is the type of ecological pyramid where the producers have less biomass and form a narrow base, while the consumers are more in terms of biomass.
E.g.	Upright pyramid of biomass in the grassland ecosystem.	The inverted pyramid of biomass in the oceanic ecosystem.

Exercise | Q 3.2 | Page 320

Short answer question

Distinguish between Food chain and Food web.

Solution:

	Food Chain	Food Web
i.	The food chain is a definite sequence of interaction between producers, consumers, and decomposers (saprophytes).	The Food web is a network of food chains that are interconnected at various levels forming an intricate web instead of a linear chain.
ii.	If any of the intermediate organisms are removed from the chain it affects the whole food chain.	In the food web, there is more than one alternative of food to most of the organisms; hence the removal of an organism does not affect the food web directly.

Exercise | Q 4.1 | Page 320

Long answer question

Define ecological pyramids and describe with examples, pyramids of number, and biomass.

Solution1:

An ecological pyramid is a graphical representation of various ecological parameters such as the number of individuals present at each trophic level, the amount of energy, or the biomass present at each trophic level. Ecological pyramids represent producers at the base, while the apex represents the top level consumers present in the ecosystem. There are three types of pyramids:

(a) Pyramid of numbers

(b) Pyramid of energy

(c) Pyramid of biomass

Pyramid of numbers: It is a graphical representation of the number of individuals present at each trophic level in a food chain of an ecosystem. The pyramid of numbers can be upright or inverted depending on the number of producers. For example, in a grassland ecosystem, the pyramid of numbers is upright. In this type of a food chain, the number of producers (plants) is followed by the number of herbivores (mice), which in turn is followed by the number of secondary consumers (snakes) and tertiary carnivores (eagles). Hence, the number of individuals at the producer level will be the maximum, while the number of individuals present at top carnivores will be least.

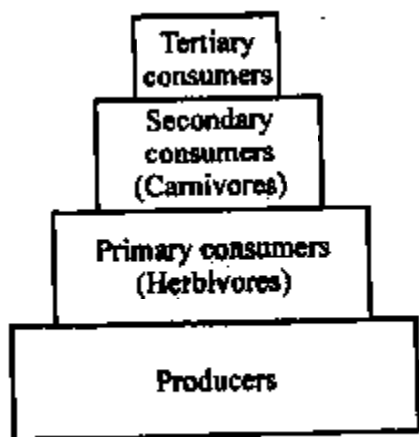


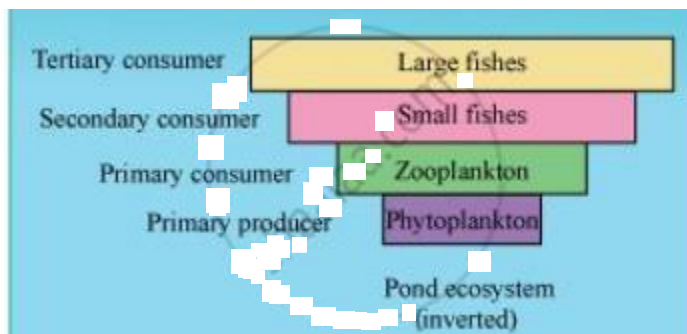
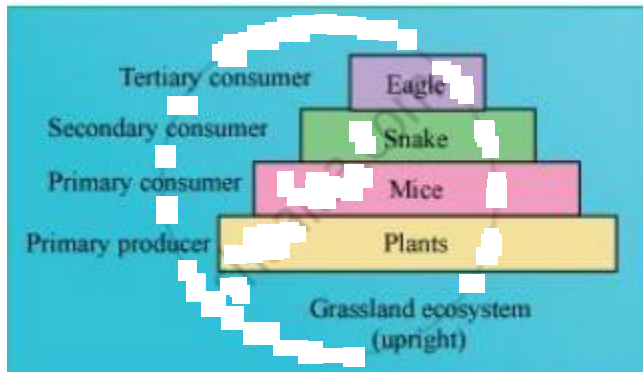
Fig. : Pyramid of number in a grassland ecosystem

On the other hand, in a parasitic food chain, the pyramid of numbers is inverted. In this type of a food chain, a single tree (producer) provides food to several fruit eating birds, which in turn support several insect species.

Pyramid of biomass

A pyramid of biomass is a graphical representation of the total amount of living matter present at each trophic level of an ecosystem. It can be upright or inverted. It is upright in grasslands and forest ecosystems as the amount of biomass present at the producer level is higher than at the top carnivore level. The pyramid of biomass is inverted in a

pond ecosystem as the biomass of fishes far exceeds the biomass of zooplankton (upon which they feed).



Solution2:

The ecological pyramid is a graphical method to show the number of organisms or biomass or amount of energy present at different trophic levels.

Pyramid of number:

The number of individuals at each trophic level is shown in the pyramid. The pyramid of number (for example of a grassland) is upright. In this, there is a decrease in the number of organisms starting from primary producers (plants) to top consumers (carnivores).

Pyramid of biomass :

The pyramid of biomass is a graphic representation of the amount of biomass per unit area sequence wise in rising trophic levels with producers at the base and top

carnivores at the apex. Pyramids of the biomass of a tree or grassland ecosystem is upright and the pyramid of a pond ecosystem is inverted.

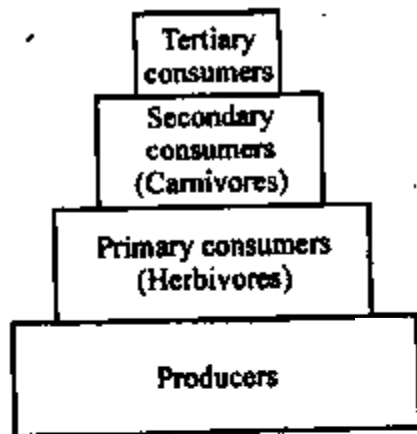


Fig. : Pyramid of number in a grassland ecosystem

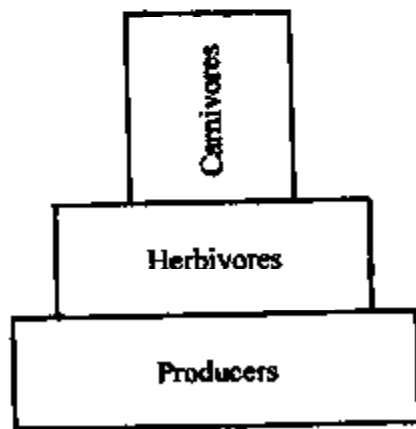


Fig. : Pyramid of biomass in a grassland ecosystem

Solution3:

i.

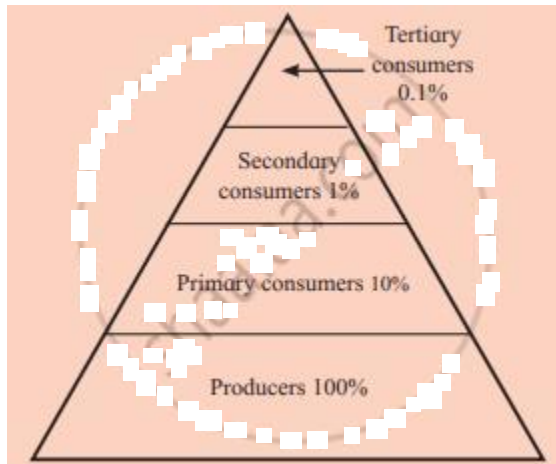
The ecological pyramid is a graphic representation of the relationship between the organisms of various successive trophic levels with respect to energy, biomass, and number.

ii.

Pyramid of numbers:

a. The relative number of individuals per unit area at different trophic levels constitutes the pyramid of number.

b. In a most well-balanced ecosystem, the pyramid of number is upright i.e. producers are more in number than herbivores, and herbivores are more in number than carnivores.



Upright pyramid of number

c. However pyramid of numbers can also be inverted in some cases.

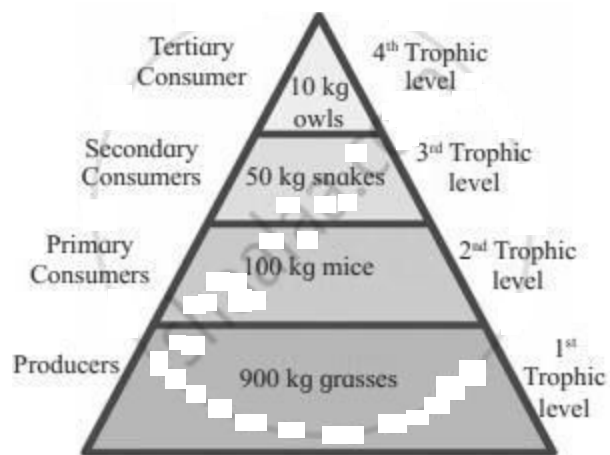
For e.g. a tree ecosystem represents an inverted pyramid of number. If we plot the number of insects on a single tree, smaller birds feeding on insects, and parasites on those birds, we get an inverted pyramid.

iii.

Pyramid of biomass:

a. The amount of biomass per unit area at different trophic levels constitutes the pyramid of biomass.

b. In a most well-balanced ecosystem, the pyramid of biomass is upright i.e. biomass of producers is more than that of herbivores, and biomass of herbivores is more than that of carnivores.



Upright pyramid of biomass

c. However pyramid of biomass can also be inverted in some cases. For e.g. Oceanic ecosystem shows an inverted pyramid of biomass. In this case, the biomass of phytoplanktons (producer) is less than that of zooplanktons and fishes.

Exercise | Q 4.2 | Page 320

Long answer question

What is primary productivity? Give a brief description of the factors that affect primary productivity.

Solution:

Primary productivity:

i.

Primary productivity is the rate of generation of biomass in an ecosystem that is expressed in units of mass per unit surface (or volume) per unit time i.e. $\text{g/m}^2/\text{day}$.

The mass unit may relate to dry matter or to the mass of carbon generated.

ii.

Factors that affect primary productivity are as follows:

- It depends on the plant species inhabiting a particular area.
- It depends upon environmental factors such as light, temperature, water, precipitation, etc.
- It depends upon the availability of nutrients.

d. It also depends upon the photosynthetic capacity of plants. The greater the photosynthetic activity, the higher will be the primary productivity.

Exercise | Q 4.3 | Page 320

Long answer question

Define decomposition and describe the processes and products of decomposition.

Solution:

- i. Decomposition is the process of breakdown of complex organic matter into inorganic substances like carbon dioxide, water, and nutrients by the decomposers.
- ii. Raw materials for decomposition are dead remains of plants and animals, fecal matter, detritus.
- iii. This process requires oxygen. Temperature and soil moisture are important factors that indirectly help soil microbes for decomposition.
- iv. Warm and the moist environment favours decomposition whereas, low temperature and anaerobic conditions inhibit the process.
- v. The steps of decomposition are fragmentation, leaching, catabolism, humification, and mineralization.

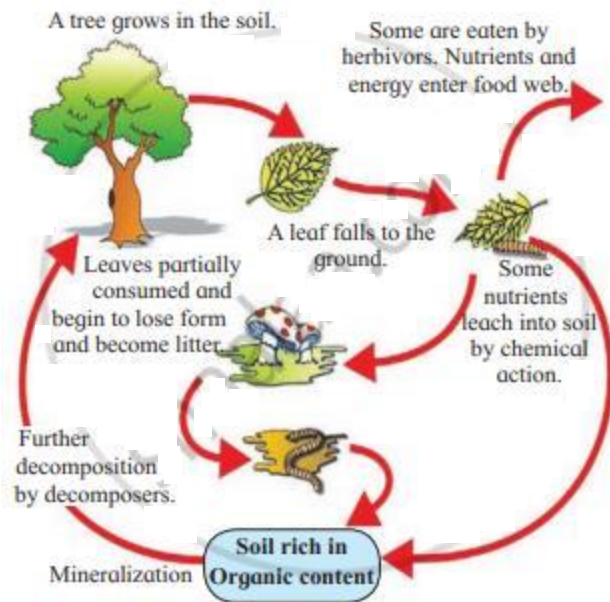
a. Fragmentation: Detritivores like earthworm breakdown detritus into smaller fragments or particles.

b. Leaching: In this process, water-soluble inorganic nutrients percolate into the soil horizon and get precipitated as unavailable salts.

c. Catabolism: The bacterial and fungal enzymes degrade detritus into simpler inorganic substances. All of the above steps occur simultaneously.

d. Humification: It leads to the accumulation of particularly decomposed, a dark coloured, amorphous, colloidal organic substance called humus. Humus serves as a reservoir of nutrients. It is resistant to microbial action and undergoes decomposition at an extremely slow rate. Humus changes the soil texture and increases the capacity of water holding in the soil.

e. Mineralization: Some microorganisms degrade humus and release inorganic nutrients by the process of mineralization.



Decomposition cycle

Exercise | Q 4.4 | Page 320

Long answer question

Write important features of a sedimentary cycle in an ecosystem.

SOLUTION 1

Sedimentary cycles have their reservoirs in the Earth's crust or rocks. Nutrient elements are found in the sediments of the Earth. Elements such as sulphur, phosphorus, potassium, and calcium have sedimentary cycles.

Sedimentary cycles are very slow. They take a long time to complete their circulation and are considered as less perfect cycles. This is because during recycling, nutrient elements may get locked in the reservoir pool, thereby taking a very long time to come out and continue circulation. Thus, it usually goes out of circulation for a long time.

SOLUTION 2

Features of a sedimentary cycle in an ecosystem are as follows:

- Earth's crust is the main reservoir of phosphorus and other minerals, such as calcium and potassium that undergo sedimentary cycles.
- The rate of release of minerals that take part in the sedimentary cycle is regulated by various environmental factors temperature, moisture, and nature of the soil.

- c. Sedimentary cycles are slower than the gaseous cycles therefore they take more time to complete.
- d. Sedimentary cycles are considered as less perfect cycles as, during recycling, nutrient elements may get locked in the reservoir pool, thereby taking a very long time to come out and continue circulation

Exercise | Q 4.5 | Page 320

Long answer question

Describe the carbon cycle and add a note on the impact of human activities on the carbon cycle.

Solution:

i. Reservoir of carbon:

- a. All life forms on earth are carbon-based because carbon is the main component of all the organic compounds of protoplasm. It constitutes 49% of the dry weight of organisms.
- b. 71% of carbon is found dissolved in oceans. The oceanic reservoir regulates the amount of carbon dioxide in the atmosphere.
- c. Carbon present in the rock and fossil fuels like oil, coal, and natural gas has been away from the rest of the carbon cycle for a long time. These long term storage places are known as the sink.
- d. The element carbon is a part of seawater, the atmosphere, rocks such as limestone and coal, soils, as well as all living things.

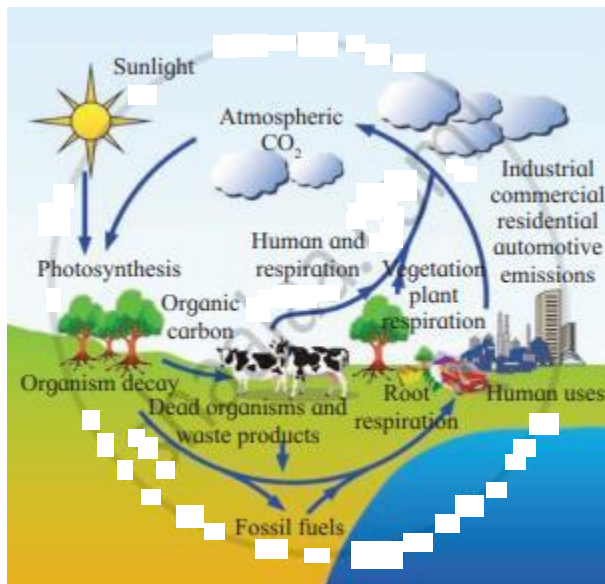
ii. Cyclic pathway of carbon:

- a. Carbon as CO_2 moves from the atmosphere to plants during the process of photosynthesis to produce food.
- b. Carbon moves from plants to animals, through food chains.
- c. At the time of exhalation, the CO_2 gas is released into the atmosphere. Thus, carbon moves from living things to the atmosphere.

- d. Decomposers also contribute substantially to CO_2 in the atmosphere, by their processing of waste materials and dead organic matter of land and oceans.
- e. When fossil fuels burn to power factories, power plants, motor vehicles, most of the carbon quickly enters the atmosphere as carbon dioxide gas.
- f. Most of the remainder is dissolved in seawater and deposited as calcium or magnesium carbonate compounds that make up shells of marine animals.
- g. The additional sources for releasing CO_2 in the atmosphere are the burning of wood, forest fire and combustion of organic matter, fossil fuel, and volcanic activity.
- h. The ocean absorbs some carbon in the form of CO_2 from the atmosphere. This carbon gets dissolved in the ocean water. Some amount of the carbon which is fixed is lost to sediments and removed from circulation.

iii. The impact of human activities on the carbon cycle

- a. Carbon cycle is significantly influenced by human activities.
- b. Rapid deforestation and the massive burning of fossil fuel for energy and transport have significantly increased the rate of release of carbon dioxide into the atmosphere.



Carbon cycle