

EXAM
DRILL

Ecosystem

ANSWERS

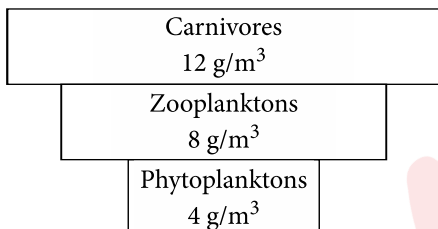
1. (d) : Four important functional aspects of the ecosystem are productivity, decomposition, energy flow and nutrient cycling.
2. (b) : Primary productivity is the rate of biomass production per unit area over a time period by plants during photosynthesis and is expressed as weight ($\text{g/m}^2/\text{yr}$) or energy ($\text{Kcal m}^{-2}\text{yr}^{-1}$). It depends on the photosynthetic efficiency of the plants grown in an area and thus on the plant species.
3. (a) : Climax community is the final community that develops in an area during ecological succession. In the climax community, productivity and respiration are equal $P = R$ or $P/R = 1$.
4. (c) : Decomposition is the process in which decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation. Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation. By the process of leaching, water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism. Humification and mineralisation occur during decomposition in the soil. Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.
5. (a) : $\text{NPP} = \text{GPP} - R$
 $\text{GPP} = 170$ tons, $R = 50$ tons
 $\text{NPP} = 170 - 50 = 120$ tons.
6. Dead plant remains such as leaves, bark, flowers and dead remains of animals including fecal matter constitute detritus. These are the raw materials for decomposition.
7. Primary consumers of the aquatic ecosystem are mostly zooplanktons.
8. The annual net primary productivity of the whole biosphere is approximately 170 billion tons of organic matter.
9. Food web is a network of food chains which become interconnected at various levels so as to form a number of feeding connections amongst the different organisms of a biotic community.
10. (a)
11. (c) : Detritivores and decomposers play vital role in the ecosystem as they remove or degrade dead bodies of organisms.
12. (b)
13. (i) (d)
 (ii) (d) : Primary consumer (earthworm) is detritivore which feed upon the dead and decaying organic matter and will convert it into inorganic substances used by the another plant. This will allow nutrient cycling.
 (iii) (b) : X is grazing food chain
 Y is detritus food chain
- (iv) (a)
 (v) (d) : Food chain X will form upright pyramid of energy. Falcon can be considered as top carnivore.
- 14 (i) (a) (ii) (c)
 (iii) (c) : E - Mineralisation
 In mineralisation, the organic matter humus will decompose and results in release of inorganic substances nitrogen and phosphorus.
 (iv) (c) : Termites and earthworm are involved in fragmentation of detritus - (cow dung)
 (v) (b) : Decomposition process is related to the breakdown of complex organic matter by decomposers to inorganic raw materials like carbon dioxide, water and various nutrients. Oxygen is required by aerobic bacteria for decomposition.
15. In an ecosystem like tropical rainforests, there is vertical distribution of different species occupying different levels. It is called stratification. E.g., The tall tree canopy occupies the highest level, followed by smaller trees, shrubs, herbs and grasses at lower levels. There are 5 to 7 strata in tropical rainforests.
16. In ecological context, herbivores are considered similar to predators because they feed on plants and their products for their food requirements just like predators feed on prey for their food needs.
17. The rate at which solar radiation, i.e., sunlight is captured by producers in the process of photosynthesis to synthesise energy rich organic compounds or the rate of total production of biomass by producers is called gross primary productivity. It is measured as weight ($\text{g/m}^2/\text{yr}$) or energy ($\text{Kcal/m}^2/\text{yr}$).

18. Earthworms are called farmer's friend because they help in fragmentation of detritus, *i.e.*, breakdown of complex organic matter and loosening of the soil. Humification and mineralisation occur during decomposition in the soil. Humification is the process of formation of highly resistant, dark coloured amorphous substance called humus from detritus or organic remains. Mineralisation is the release of inorganic substances, both non-mineral and minerals from organic matter.

19. In an ecosystem, organism may occupy more than one trophic level simultaneously. One must remember that the trophic level represents a functional level, not a species as such. A species may occupy more than one trophic level in the same ecosystem at the same time; for example, a sparrow is a primary consumer when it eats seeds, fruits, etc., and a secondary consumer when it eats insects and worms.

20. Standing crop refers to mass of living material at a particular trophic level at a particular time. It is measured as biomass or the number in a unit area.

Pyramid of biomass in sea is inverted as shown below:



21. In a food chain, each trophic level represents a functional level not a species because:

(i) At a particular time, a trophic level is never occupied by a single species.

(ii) At a particular time, all organisms of a trophic level are considered together for calculating biomass, number and energy

(iii) A particular species may occupy more than one trophic level, *e.g.*, omnivorous species may occupy more than one trophic level in the same ecosystem at the same time.

(iv) If we consider few species then no generalisation can be made for studying ecosystem.

22. Productivity is the rate of biomass production per unit area in unit time at any trophic level.

Gross productivity is the total organic matter synthesised by producers in the process of photosynthesis per unit time and area. It is also called gross primary productivity (GPP).

Net primary productivity is the weight of the organic matter stored by the producers in a unit area/volume per unit time. It is equal to the rate of organic matter synthesised during photosynthesis, *i.e.*, gross primary productivity minus the rate of respiration and other losses, *i.e.*, $NPP = GPP - R$.

Secondary productivity is the rate of resynthesis of organic matter by consumers. It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation.

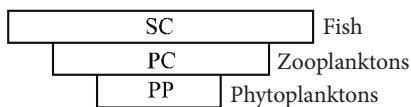
OR

An ecological pyramid is a graphic representation of an ecological parameter, like biomass, energy or number of individuals present in various trophic levels of a food chain with producers forming the base and top carnivores the tip. Each trophic level represents a functional level. Therefore, it includes all the members of all the species operating at that level.

The comparison among the three pyramids of energy, biomass and number are given below:

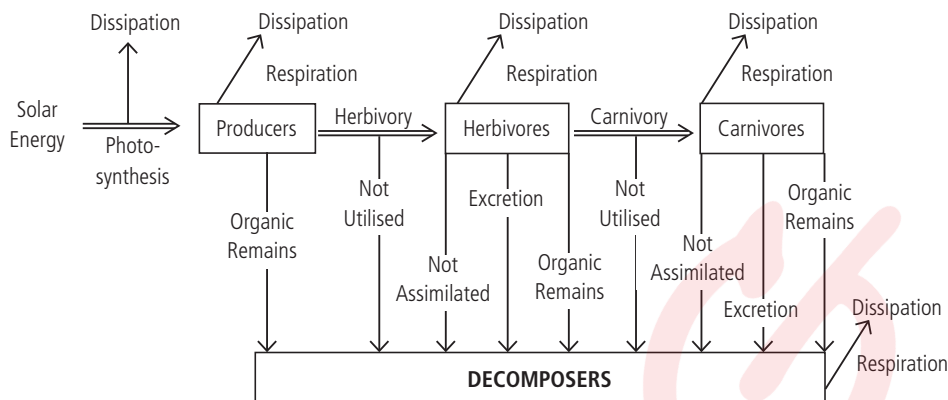
S.No.	Pyramid of Energy	Pyramid of Biomass	Pyramid of Number										
(i)	Pyramid of energy is the graphic representation of amount of energy trapped per unit time and area in different trophic levels of the food chain with producers forming the base and top carnivores at the apex.	Pyramid of biomass is the graphic representation of biomass present in per unit area of different trophic levels with producers at the base and top carnivores at the apex.	Pyramid of numbers is a graphic representation of number of individual per unit area of different trophic levels with producers forming the base and top carnivores at the apex.										
(ii)	It is always upright.	It is inverted or upright.	It is inverted, spindle-shaped or upright.										
(iii)	<p><i>E.g.</i>, pond ecosystem.</p>	<p><i>E.g.</i>, grassland and forest ecosystem.</p>	<p><i>E.g.</i>, grassland ecosystem.</p> <table border="1"> <tr> <td>Trophic levels</td> <td>Number of individuals</td> </tr> <tr> <td>TC (Tertiary consumer)</td> <td>3</td> </tr> <tr> <td>SC (Secondary consumer)</td> <td>3,54,000</td> </tr> <tr> <td>PC (Primary consumer)</td> <td>708,000</td> </tr> <tr> <td>PP (Primary producer)</td> <td>5,842,000</td> </tr> </table>	Trophic levels	Number of individuals	TC (Tertiary consumer)	3	SC (Secondary consumer)	3,54,000	PC (Primary consumer)	708,000	PP (Primary producer)	5,842,000
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23. Pyramid of biomass starting with phytoplanktons can be drawn as follows:



The pyramid of biomass in aquatic ecosystems is generally inverted because the biomass of fish far exceeds that of phytoplanktons.

24. (a) A generalised energy flow model of ecosystem is as follows :



(b) Only 10% of the energy available at one trophic level passes to the next trophic level. Therefore, organisms occupying the highest position in food chain have minimum energy.

OR

A small pond is a simple and fairly self-sustainable unit. Abiotic components include water, dissolved inorganic and organic substances and soil deposits at the bottom. Biotic components are producers, consumers and decomposers. Producers are autotrophs which include phytoplanktons, algae, submerged and floating plants. Consumers are differentiated into herbivores (zooplanktons, larvae, tadpole and some fish), primary carnivores (water scorpions, water beetle, dragon fly larvae, *Hydra* and some fish), secondary carnivores (large fish, water birds, etc.). Decomposers include fungi, bacteria and flagellates.

With the help of radiant energy of the sun, autotrophs convert the inorganic materials into organic matter. Autotrophs are consumed by heterotrophs which build up their own organic matter. Organic wastes and dead organisms are acted upon by decomposers. Minerals are released in this process. The minerals become available to autotrophs for reuse. There is cycling and recycling of matter. However, energy flow is unidirectional *i.e.*, from autotrophs towards the higher trophic levels and there is dissipation of energy at each trophic level which is lost as heat to the environment.

25. Detritus (dead remains of plants and animals) gets decomposed and is made available as nutrients to plants by the process of decomposition. The steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.

(i) Fragmentation of detritus : Detritivores (*e.g.*, earthworm)

breakdown detritus into small particles.

(ii) Catabolism : Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.

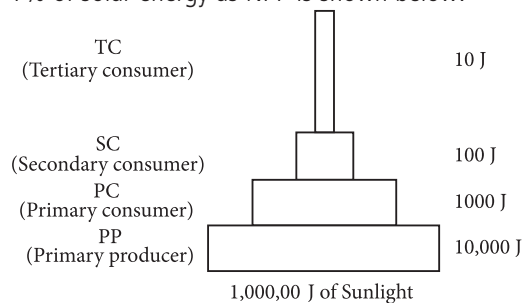
(iii) Leaching : Water soluble inorganic nutrients go down into the deeper layers of soil and get precipitated as unavailable salts.

(iv) Humification : It is the formation of humus from detritus or organic remains. Humus is dark coloured amorphous substance rich in lignin and cellulose. It is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. It is colloidal in nature, a reservoir of nutrients and helpful in maintenance of soil moisture as well as aeration.

(v) Mineralisation : It is the release of inorganic substances by the degradation of humus with the help of microbes.

OR

(a) An ideal pyramid of energy with primary producers storing only 1% of solar energy as NPP is shown below:



(b) The pyramid of energy is always upright in shape as there is always a gradual decrease in the energy content at successive trophic levels from producers to various consumers. This is because some energy is used at each trophic level for

various metabolic activities and some energy is lost as heat, so only 10% of the energy is available to the next trophic level (Lindeman's 10% law).

(c) The limitations of ecological pyramids are :

(i) Ecological pyramids assume that food chains are simple. Simple food chains do not occur in nature, instead, food webs

are present.

(ii) A single species may operate at two or more trophic levels. Ecological pyramids have no method of accommodating such cases.

(iii) Ecological pyramids have no place for detritivores and decomposers, though they play a vital role in ecosystem.

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