

## Ecosystem

### Ecosystem

An ecosystem is the functional unit of nature where living organisms (biotic component) interact among themselves and also with the surrounding physical environment (Abiotic component).

### Ecosystem- Structure and Functions Ecosystem

Terrestrial ecosystem	forest, grassland, desert
Aquatic ecosystem	ponds, lakes, river estuary

### Components of ecosystem

Biotic	Non-living component	Light, Water, Soil, atmospheric gases, etc
Abiotic	Living component	Producer, consumer, decomposers

The components of the ecosystem that are seen as a functional unit are-

(i) Productivity (ii) Decomposition (iii) Energy flow (iv) Nutrient cycling

<b>Productivity</b>	The rate of biomass production is called productivity. Unit - $\text{gm}^{-2} \text{yr}^{-1}$ or $(\text{kcal m}^{-2}) \text{yr}^{-1}$ Primary production is the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. Unit - $(\text{gm}^{-2})$ or energy $(\text{kcal m}^{-2})$	<b>GPP</b> - It is the rate of production of organic matter during photosynthesis. GPP minus respiration losses (R), is the net primary productivity (NPP). <b><math>\text{NPP} = \text{GPP} - \text{R}</math></b> NPP- is the available biomass for the consumption to heterotrophs Secondary productivity is defined as the rate of formation of new organic matter by consumers.
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### Decomposition

- Breakdown of complex organic matter into inorganic substances like carbon dioxide, water and nutrients
- Detritus- Dead plant remains and dead remains of animals.

**Steps of Decomposition**- Fragmentation, leaching, catabolism, humification and mineralization

Fragmentation of Detritus	Detritivores (e.g., earthworms) break down detritus into smaller particles. This process is called fragmentation
Leaching	Water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
Catabolism	Bacterial and fungal enzymes degrade detritus into simpler inorganic substances
Humification	Accumulation of a dark coloured amorphous substance called humus
Mineralization	Degradation of humus microbes and release of inorganic nutrients in the soil

### Factors affecting rate of Decomposition

Chemical composition	The decomposition rate will be slow when detritus is rich in lignin and chitin and the rate increases when detritus is rich in nitrogen and water-soluble substances like sugars.
Climatic conditions	Warm and moist environment favour decomposition and low temperatures and anaerobiosis inhibit decomposition.

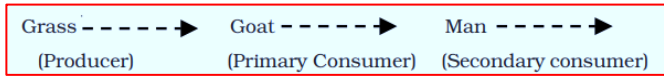
### Energy Flow

- All living organisms are dependent on their food on producers, directly or indirectly.
- There is a unidirectional flow of energy from the sun to producers and then to consumers.
- Photosynthetically active radiation (PAR) is responsible for the synthesis of food by plants.
- Transfer of energy follows the **10 percent law** that is only 10 percent of the energy is transferred to each trophic level from the lower trophic level.



## Food chain

- Consumers obtain their food from autotrophs (plants).
- Food chain is the flow of energy from one trophic level to another trophic level.
- Trophic level: Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as the trophic level. E.g. producer, herbivore, primary carnivore, secondary carnivore



- Food chains are of two types- Grazing food chain (GFC) and detritus food chain (DFC)

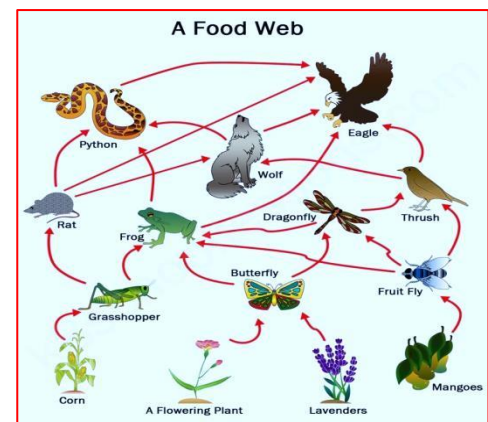
<b>GFC</b>	Energy flows from producers to consumers.
<b>DFC</b>	Begins with dead organic matter. It is made up of saprotrophs/ decomposers (heterotrophic organisms like fungi and bacteria).

## Food web

The natural interconnection of the food chain forms the food web.

### Significance of food web:

- (1) Food webs permit alternative foods.
- (2) They ensure a better chance of survival of an organism, in case any of its food sources happens to be scarce
- (3) More complex food web means a more stable ecosystem

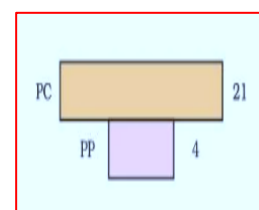
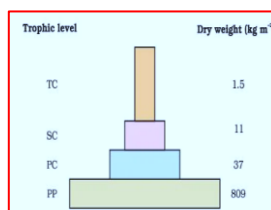
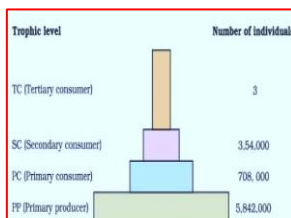


## Ecological Pyramids

- Pyramid is the graphical representation of an ecological parameter (number, biomass, energy) sequence-wise in various trophic levels of a food chain with producers at the base and herbivores in the middle and carnivores at the top tiers.
- It can be upright, inverted, or spindle-shaped.

## Three common ecological pyramids are

Pyramids of number	<ul style="list-style-type: none"> <li>Represent the number of individuals per unit area at various trophic levels with a producer at the base.</li> <li>It is generally upright.</li> <li>A pyramid of numbers in the case of a big tree is generally inverted because the number of insects feeding on that tree generally exceeds in number.</li> </ul>
Pyramids of biomass	<ul style="list-style-type: none"> <li>Represent the biomass in various trophic levels.</li> <li>The pyramid of mass is upright except in the aquatic food chain involving short-lived plankton.</li> <li>A pyramid of biomass in the sea is generally inverted.</li> </ul>
Pyramids of energy	<ul style="list-style-type: none"> <li>Gives graphic representation of the amount of energy trapped by different trophic levels per unit area.</li> <li>It is always upright, and can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step e.g in feeding, digestion, assimilation and respiration</li> </ul>



## IMPORTANT QUESTIONS

### Very Short Answer Type Questions

1- Which one is an example of a manmade ecosystem.

- a- Aquarium
- b- Crop field
- c- Aquaculture pond
- d- All of these

Ans: d

2- During ecological succession

- a. Speciation in the new area
- b. The gradual and predictable change in species composition occurs in a given area
- c. Reduction of a pioneer community
- d. Bare land with no vegetation

Ans: b

3- Energy transfer takes place from one trophic level to another –

- a- 10 %      b- 20 %      c- 50 %      d- depends on the trophic level

Ans: A

4- Which of the following is called as a detritivore?

- a. An animal feeding on an animal
- b. A plant feeding on an insect
- c. An animal feeding on insect
- d. An animal feeding on decaying organic matter

Ans: d

5- Root hairs are absent in-

- a. Xerophytes
- b. Hydrophytes
- c. Lithophytes
- d. Mesophytes

Ans: b

6- Why decomposition occurs at a faster rate in the tropics?

Ans: high humidity and temperature favour the rapid rate of decomposition

7- How do decomposers like fungi obtain their food?

Ans: Decomposers release their enzymes to decompose dead and decaying remains of plants and animals absorb the simple inorganic substances.

8- Name the trophic level occupied by secondary consumers & tertiary consumers.

Ans. Third trophic level by secondary consumer and fourth trophic level by tertiary consumer

9- What is the shape of the pyramid of biomass in the sea? Why?

Ans: Inverted, because the biomass of fishes is too much as compared to very smaller phytoplankton.

### Sort answer types questions

1- Describe stratification by citing three examples.

Ans: Vertical distribution of different species occupying different levels is called stratification. For example, trees occupy the top vertical strata of a forest, shrubs are the second and grasses occupy the bottom layers.

2- What are the four basic functional components of an ecosystem?

Ans: (i) Productivity; (ii) Decomposition; (iii) Energy flow (iv) Nutrient cycling.

3- Give two examples of autotrophic components in the food chain of the aquatic ecosystem.

Ans: phytoplankton, some algae

4- Which metabolic process causes a reduction in gross primary productivity? Explain

Ans: A considerable amount of GPP is utilized by plants in respiration.

Gross primary productivity minus respiration losses (R), is the net primary productivity (NPP).  $GPP - R = NPP$

**5- Give an account of energy flow in an ecosystem.**

Ans: The flow of energy in an ecosystem is unidirectional.

The Sun is the ultimate source of energy. It is used in the photosynthesis process to make food in autotrophs. This energy is transferred from autotrophs to the next trophic level. Only 10% of energy is transferred to next trophic level, the rest amount is lost as heat.

**Very Long Answer Type Questions**

**1- Describe steps in the process of decomposition of detritus in DFC (detritus food chain).**

Ans: Fragmentation of Detritus - Detritivores (e.g., earthworms) break down detritus into smaller particles.

Leaching- Water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.

Catabolism- Bacterial and fungal enzymes degrade detritus into simpler inorganic substances

Humification- Accumulation of a dark-coloured amorphous substance called humus

Mineralization- Degradation of humus microbes and release of inorganic nutrients in the soil.

**2- Provide a diagrammatic representation of the decomposition cycle in a terrestrial ecosystem.**

Ans: Fig. 14.1 page 244, NCERT

**3- What is meant by the ecological pyramid? Distinguish between upright & inverted pyramids. Explain with the help of a diagram.**

Ans: The graphic representation of the trophic structure of a food chain is known as the ecological pyramid.

In the upright pyramid, the number or biomass of producers is more in comparison to consumers in an ecosystem.

In an inverted pyramid, the number/biomass of producers is less as compared to consumers.

Fig. 14.4 (a, b, c) page 248 NCERT

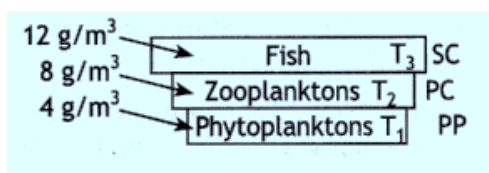
**4- (i) How does the rate of decomposition affected by abiotic factors in an ecosystem?**

**(ii) Construct a pyramid of biomass starting with phytoplankton.**

Ans: (i) Decomposition rate will be slow when detritus is rich in lignin and chitin and rate increases when detritus is rich in nitrogen and water-soluble substances like sugars.

Warm and moist environment favour decomposition and low temperature and anaerobiosis inhibit decomposition.

(ii)



**5- Describe the components of an ecosystem.**

Ans: i) Abiotic components – Inorganic substances (P, N, K, C, H etc.) b) Organic substances (Protein, carbohydrates, lipids), Climatic (water, air, soil, temperature etc.)

ii) Abiotic components-

Producers (make their own food like plants)

Consumers (Depend on producers for food. Consumers are of the following types-

i) Primary consumers - herbivores e.g. deer, cow

ii) Secondary consumers – feed on primary consumers like cats, fox

iii) Tertiary consumers- feed on secondary consumers like Lion

Decomposers: - Decompose dead and decaying objects like fungi, bacteria