

**SAMPLE CONTENT**



**PERFECT**  
**BIOLOGY** Vol. II

As per the new textbook prescribed  
by Maharashtra State Board

**Std. XII Sci.**

**Commensalism:**

Cattle egrets exist in a commensal relationship with foraging buffaloes. The egrets feed on insects that are dislodged during the movement of grazing livestock without either benefiting or harming the buffaloes.



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# PERFECT BIOLOGY (Vol. II) Std. XII Sci.

## Salient Features

- ☞ Written as per the new textbook
- ☞ Subtopic-wise segregation for powerful concept learning
- ☞ Complete coverage of Textual Exercise Questions and Intext Questions
- ☞ Extensive coverage of New type Questions
- ☞ 'Apply Your Knowledge' section to test application of concepts
- ☞ 'Quick Review' at the end of each chapter facilitates quick revision
- ☞ 'Competitive Corner' presents questions from prominent competitive examinations
- ☞ Reading Between the Lines, Enrich Your Knowledge, Gyan Guru, Connections, NCERT Corner are designed to impart holistic education
- ☞ Topic test at the end of each chapter for self-assessment
- ☞ Video/ PDF links provided via QR codes for boosting conceptual retention

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## PREFACE

**Perfect Biology Std. XII, Vol. II** is intended for every Maharashtra State Board aspirant of Std. XII, Science. The scope, sequence, and level of the book are designed to match the new textbook issued by the Maharashtra State board.

At this crucial juncture in their lives, when the students are grappling with the pressures of cracking a career-defining board examination, we wanted to create a book that not only develops the necessary knowledge, tools, and skills required to excel in the examination, but also enables students to appreciate the beauty of the subject and piques their curiosity.

We believe that students respond favourably to meaningful content, if it is presented in a way that is easy to read and understand, rather than being mired down with facts and information. Consequently, we have always placed the highest priority on writing clear and lucid explanations of fundamental concepts. Moreover, special care has been taken to ensure that the topics are presented in a logical order. The coherent Question/Answer approach helps students expand their horizon of understanding of the concepts.

The primary purpose of this book is to assist the students in preparing for the board examination. However, this is closely linked to other goals: to exemplify how important and how incredibly interesting Biology is, and to help the student become an expert thinker and problem solver.

The scope of the book extends beyond the State Board examination as it also offers a plethora of Multiple Choice Questions (MCQs) in order to familiarize the students with the nature of competitive examinations.

In addition, the Topic-Test has been carefully crafted to focus on concepts, thus providing the students with a quick opportunity for self-assessment and giving them an increased appreciation of chapter-preparedness.

We believe that the study of Biology helps in the understanding of many fascinating and important phenomena. In this vein, we have put an effort to relate Biology to real-world events in order to show students that Biology is a vibrant, constantly evolving science that has relevance in our modern world. We hope this book becomes a valuable tool for you and helps you to understand the concepts of Biology.

*Our **Perfect Biology Std. XII, Vol. II** adheres to our vision and achieves several goals: **building concepts, recapitulation, self-study, self-assessment and student engagement**-all while encouraging students towards cognitive thinking.*

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: [mail@targetpublications.org](mailto:mail@targetpublications.org)

*A book affects eternity; one can never tell where its influence stops.*

*Best of luck to all the aspirants!*

From,  
Publisher

**Edition:** First

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This work is purely inspired upon the course work as prescribed by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune. Every care has been taken in the publication of this reference book by the Authors while creating the contents. The Authors and the Publishers shall not be responsible for any loss or damages caused to any person on account of errors or omissions which might have crept in or disagreement of any third party on the point of view expressed in the reference book.

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## FEATURES

### 9.0 Introduction

**Q.1. Can you recall?** (Textbook page no. 182)

**i. What is the need for the control and coordination in multicellular animals?**

**Ans:** In multicellular organisms, body organs and organ systems work in an integrated manner to bring about various processes. A control over their life processes as well as a co-ordination between the various systems is needed in order to maintain homeostasis of the organism is required.

### Sub-topic wise Segregation

Every chapter is segregated sub-topic wise. A subtopic encompasses textual content in the form of aesthetic Answers, *Textual Exercises*, questions, *Intext questions*, 'Can you tell', 'Can you recall', 'Try it out', 'Use your brain power' and 'Activity' are placed aptly amongst various additional questions in accordance with the flow of subtopic. *This is our attempt to enable easy assimilation of concepts and lay strong foundation for understanding as well as writing answers in exam.*

### Reading between the lines

**Reading between the lines** provides elaboration or missing fragments of the concept which is essential for complete understanding of the concept.

*This is our attempt to help students to understand the underlying concept behind an answer.*

### Reading between the lines



The complement system comprises of group of normally inactive proteins in blood plasma and on plasma membranes.

When activated, these proteins "complement" or enhance certain immune reactions.

The complement system causes cytolysis (bursting) of microbes, promotes phagocytosis, and contributes to inflammation.

### NCERT Corner

**Graves' disease** It is an endocrine disorder that is the most common cause of hyperthyroidism. In Graves' disease, excessive secretion of thyroxine hormone is accompanied by diffused enlargement of the thyroid gland. It is an autoimmune disease where patients form antibodies that act on the thyroid glands to increase the production of hormone thyroxine hormone and thyroid gland size.

### NCERT Corner

**NCERT Corner** covers information from NCERT textbook relevant to topic. *This is our attempt to bridge the gap between NCERT curriculum and State Board textbook, thereby benefiting students in their preparation of National level competitive examinations.*

## FEATURES

### Connections

**Connections** enable students to interlink concepts covered in different chapters. *This is our attempt to encourage students to appreciate the subject as a whole.*



### Connections

In chapter 15, you will study about global warming in detail.

*[Note: Students can scan the adjacent QR code for detail information about production of recombinant proteins.]*



**QR Code** provides access to a video/PDF in order to best understanding of a concept or activity. *This is our attempt to facilitate learning through visual aids.*

### Enrich Your Knowledge

**Enrich Your Knowledge** presents fascinating information about the concept covered. *This is our attempt to create interest in the students about the concept.*

### Enrich Your Knowledge



#### Dr. Norman E. Borlaug:

An American biologist, who has been called “Father of the Green Revolution”, “Agriculture’s greatest spokesperson” and “The Man Who Saved a Billion Lives”.

Dr. Borlaug, a 1970 Nobel Laureate, was honoured for his work in the ‘Green Revolution,’ saving millions of lives from famine in India, Mexico, and the Middle East.

### GG - Gyan Guru

#### **Aerial adaptation in birds:**

*Most of the birds have only left ovary and oviduct (and rudimentary or non-functional right ovary). This is the volant /aerial adaptations shown by birds to reduce body weight for flying.*

### GG-Gyan Guru

**Gyan Guru** illustrates real life applications or examples related to the concept discussed. *This is our attempt to link learning to the life.*

## FEATURES

### Apply Your Knowledge

**Q.88. Suppose that a useful disease resistance gene has been identified by you in a bacterium. How would you transfer this gene into the plant?**

**Ans:** Steps to transfer the disease resistance gene into the plant.

Isolation of disease resistance gene using restriction endonuclease.



Creation of r-DNA molecule by inserting the disease resistance gene into a suitable vector.



Transfer of r-DNA vectors in the target cells.



Screening the cells for transformation.

### Apply Your Knowledge

**Apply Your Knowledge** includes challenging questions. This is our attempt to take students one step further and challenge their conceptual understanding.

### Quick Review

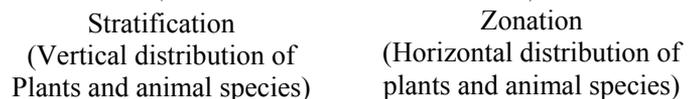
**Quick review** includes tables/flow charts to summarize the key points in a chapter.

This is our attempt to help students to reinforce key concepts.

### Quick Review



### Spatial pattern



### Exercise

#### 13.0 Introduction

1. Define population and biome.  
**Ans:** Population: Refer Q.5(i)  
Biome: Refer Q.4(vi)

#### 13.1 Organisms and the Environment Around

2. Explain the term niche.  
**Ans:** Refer Q.14
3. Elaborate on habitat.  
**Ans:** Refer Q.12

### Exercise

**Exercise** includes subtopic-wise additional questions and problems. This is our attempt to provide additional practice to students to gauge their preparation.

## FEATURES

### Multiple Choice Questions

**Multiple Choice Question** includes textual as well as additional MCQs. *This is our attempt to give students practice of MCQs and prepare them thoroughly for board examination.*

### Multiple Choice Questions

- \_\_\_\_\_ is an artificial ecosystem.  
(A) Estuary (B) Lake  
(C) Aquarium (D) Wetland
- The vertical distribution of plant species is studied in  
(A) scarification (B) stratification  
(C) zonation (D) speciation

### Competitive Corner

- Select the INCORRECT statement.  
[NEET (UG) 2011]  
(A) **Inbreeding selects harmful recessive genes that reduce fertility and productivity.**  
(B) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.  
(C) Inbreeding increases homozygosity.  
(D) Inbreeding is essential to evolve pure lines in any animal.

### Competitive Corner

**Competitive Corner** presents latest questions from prominent [NEET (UG), NEET (Odisha), MHT CET] competitive exams based entirely on the syllabus covered in the chapter. *This is our attempt to introduce students to MCQs asked in competitive exams.*

### Topic Test

**Topic Test** covers questions from the chapter for self-evaluation purpose. *This is our attempt to provide the students with revision and help them assess their knowledge of chapter.*

Time: 1 Hour 30 Min

TOPIC TEST

Total Marks: 25

### SECTION A

- Q.1. Select and write the correct answer:** [04]
- The molecular knives of DNA are  
(A) ligases (B) polymerases  
(C) endonucleases (D) transcriptase
  - \_\_\_\_\_ is a soil bacterium which causes crown gall tumours in dicotyledonous plants.  
(A) *Agrobacterium tumefaciens*  
(B) *Bacillus thuringiensis*  
(C) *Haemophilus influenza*  
(D) *Escherichia coli*

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[Reference: Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04]

- Note:**
- \* mark represents Textual question.
  - # mark represents contextual question.
  -  symbol represents contextual questions that need external reference for an answer.

## Contents and Concepts

14.0 Introduction  
 14.1 Ecosystem  
 14.2 Energy Flow  
 14.3 Ecological Pyramids

14.4 Nutrient Cycles  
 14.5 Ecological Succession  
 14.6 Ecosystem Services

## 14.0 Introduction

**Q.1. Can you recall?** (Textbook page no. 308)

- i. What is environmental biology?
- ii. Meaning of the term habitat.
- iii. Importance of ecology for humans.

**Ans:**

- i. **Environmental biology:**
  - a. Environmental biology is the study of the different habitats, evolution and adaptations of living organisms.
  - b. It is an interdisciplinary field which focuses on the relationships among animals, plants and their surroundings.
- ii. **Habitat** is a specific physical place or locally occupied by an organism, population or community which has a particular combination of biotic or environmental factors.
- iii. **Importance of ecology for humans:**
  - a. Ecology is a branch of biology which deals with the interactions among living organisms (biotic) and also with their physical (abiotic) environment.
  - b. It provides information about the benefits of ecosystems, help us to improve our environment, sustain biodiversity in a changing climate, manage our natural resources, and protect human health.
  - c. It also helps people to understand the impact of their actions on other living organisms of the planet as well as on each other.

**Q.2. Define ecosystem. Who coined the term ecosystem?**

**Ans:**

- i. An ecosystem is a self-regulatory and self-sustaining structural and functional unit of nature (biosphere) which contains both biotic and abiotic components.
- ii. The term ecosystem was coined by Tansley.

**Q.3. In how many different ways is the ecosystem is classified?**

**Ans:**

- i. The ecosystem can be classified into two basic categories:
  - a. Terrestrial ecosystem:** It consists of forest, grassland and desert.
  - b. Aquatic ecosystem:** It consists of lakes, wetlands, rivers and estuaries.
- ii. The ecosystem can also be classified as natural ecosystems and artificial ecosystems.
  - a. Natural ecosystem:** This ecosystem does not require any human inputs. It is said to be self-sustainable.
  - b. Artificial ecosystem:** This is man-engineered and maintained artificially by man. It requires constant input in terms of energy or materials. E.g. a farm land, a fish tank or a large pond for rearing fish.

**Q.4. What can be considered as one global ecosystem?**

**Ans:** Entire biosphere, made up of many local ecosystems can be considered as one global ecosystem.



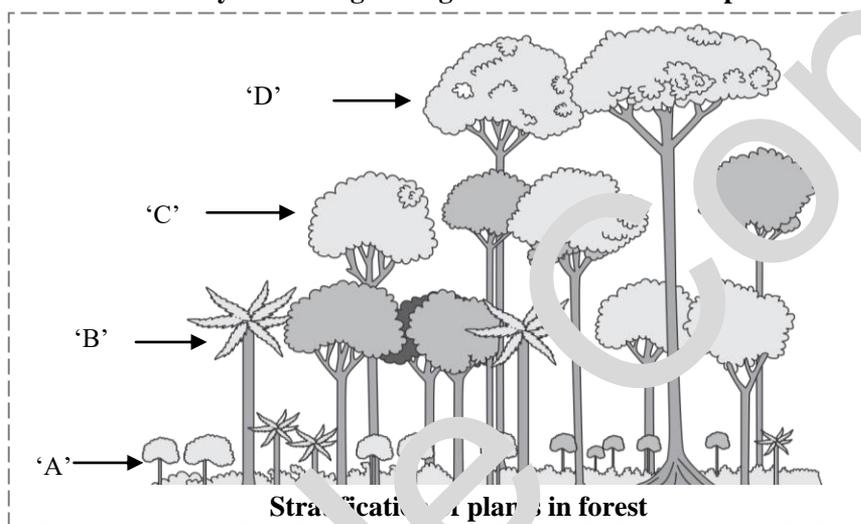
**14.1 Ecosystem**

**Q.5. What is spatial pattern? Explain its two types.**

**Ans:**

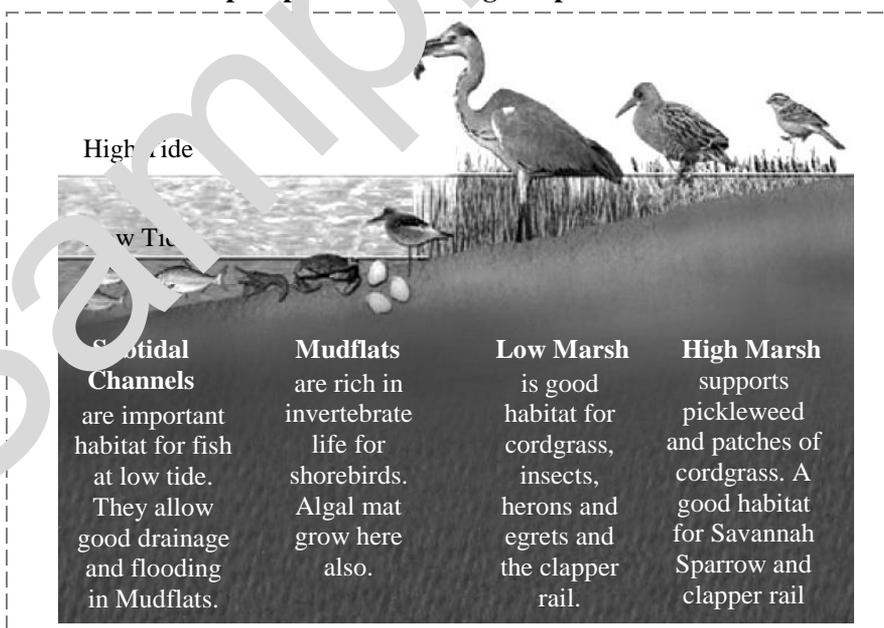
- i. The biotic and abiotic components differ as the locations vary in space and time. This variation due to space is results in **spatial pattern**.
- ii. Stratification and Zonation are the two types of spatial patterns.
- iii. **Stratification** is the vertical distribution of different species of plants and animals which occupies different levels. For e.g. trees occupy top vertical strata or layer of a forest, second is the shrubs and the bottom layer is occupied by the herbs and grasses.  
In open seas, similar stratifications are seen as epipelagic, mesopelagic, bathypelagic and benthic zones.
- iv. **Zonation** is the horizontal distribution of plants and animals on land or in water.  
It is observed in both aquatic as well as in terrestrial ecosystem, but can be easily seen at the junction of these two ecosystems.  
Edges of a large lake or beach show pronounced zonation in the form of inter-tidal, low tidal, sub-littoral zones.

**Q.6. Label the different layers in the given figure of stratification of plants in forest.**



**Ans:** A: Shrub layer      B: Understorey      C: Canopy      D: Emergent layer

**Q.7. Describe the concept represented in the given picture.**



**Ans:**

- i. The given picture represents zonation in wetland.
- ii. Refer Q.5 (iv)



**Q.8. Think about it.** (Textbook page no. 309)

Why is zonation more pronounced at the edges of habitat?

**Ans:** At the edges of habitat, we can see the transition between two significantly different ecosystems. Some organisms thrive in edges of habitat because they gain resources from both adjacent areas. Thus the zonation at the edges is more pronounced.

**Q.9. Find out.** (Textbook page no. 308)

Stratification of animals in amazon rainforest.

**Ans:**

- i. Amazon rainforest is an example of tropical rainforest found near the equatorial region. The climate here is ideal for the animals and plants.
- ii. Four layers of stratification are seen in the amazon rainforest, they are as follows:
  - a. **Emergent layer:**  
It consists of high tree tops. This layer gets most amount of sunlight and rain. This layer is home to eagles, vultures, bats, monkeys and butterflies.
  - b. **Canopy:**  
It is made up of thick leaves and branches. It is wet, sunny and breezy, but more covered than the emergent layer. Therefore, it prevents the penetration of sunlight below this layer. This layer harbours more wildlife than any other layer. Organisms like long beaked birds, guana, emerald tree boa, etc. are found in this layer. Epiphytes also grow here.
  - c. **Understorey:**  
This layer is shady, damp and warm. Shade loving plants, short trees, etc. grow in this region. Animals like frogs, jaguars, sloths, etc. are found here.
  - d. **Forest floor:**  
It is the darkest, dampest layer. Millions of insects, rodents, fungi, beetles, worms, ants, anteater etc. are found.

[Source: <https://www.dkfindout.com/us/animals-and-nature/habitats-and-ecosystems/rain-forest-layers/>]

**Q.10. Name the functional aspects of ecosystem and explain in detail.**

OR

**Explain the four processes that any ecosystem must perform to be self-sustaining.**

**Ans:** Productivity, decomposition, nutrient cycling and energy flow are the functional aspects of ecosystem.

**i. Productivity:**

It involves conversion of inorganic chemicals into organic material with the help of the radiant energy of the sun by the autotrophs and consumption of the autotrophs by heterotrophs.

**ii. Decomposition:**

It is the breakdown of the dead organic material and mineralization of the dead matter.

**iii. Nutrient cycling:**

It is the storage and transport of the nutrients. The minerals released during decomposition process are used again by autotrophs.

**iv. Energy flow:**

It is a unidirectional flow of energy from producers to consumers and finally dissipation and loss of heat.

**Q.11. Explain pond ecosystem as classical example of ecosystem.**

**Ans:**

- i. Pond ecosystem is self-sustainable unit that explains the complex interactions which exist in any aquatic ecosystem.
- ii. All the functional aspects of the ecosystem i.e. productivity, decomposition, nutrient cycling and energy flow can be observed in this ecosystem.
- iii. The abiotic components of pond are water with all the dissolved inorganic and organic substances and the rich deposit of soil at the bottom of the pond.
- iv. The rate of function of the entire pond is regulated by the solar input, the cycle of temperature, day-length and other climatic conditions.
- v. The producers of the pond are phytoplankton, algae and other aquatic plants.
- vi. Zooplankton, aquatic insects and fish are the consumers of the pond.
- vii. Fungi, bacteria present at the bottom of the pond are the decomposers.
- viii. Thus in shallow water body like pond, all the functions of an ecosystem can be observed.



**\*Q.12. What is primary productivity? Give brief description of factors that affect primary productivity.**

**Ans: Primary productivity:**

- i. Primary productivity is the rate of generation of biomass in an ecosystem which 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:
  - a. It depends on the plant species inhabiting a particular area.
  - b. It depends upon environmental factors such as light, temperature, water, precipitation, etc.
  - c. It depends upon availability of nutrients.
  - d. It also depends upon photosynthetic capacity of plants. Greater the photosynthetic activity, higher will be the primary productivity.

**Q.13. Explain in detail Gross Primary Productivity and Net Primary Productivity (NPP):**

**Ans:** Primary productivity is divided into two types i.e. Gross Primary Productivity and Net Primary Productivity.

**i. Gross Primary Productivity (GPP):**

- a. It is the rate of production of organic matter during photosynthesis.
- b. Plants use considerable amount of GPP to carry out their own respiration.

**ii. Net Primary Productivity (NPP):**

- a. It is the available biomass for the consumption to heterotrophs like herbivores, carnivores and decomposers.
- b. The gross primary productivity (GPP) minus respiratory losses (R) constitutes the net primary productivity (NPP).  
 $\text{GPP} - \text{R} = \text{NPP}$
- c. The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter.
- d. Of the 170 billion tons, the productivity of the ocean is only 55 billion tons and rest is from land ecosystem.

**Q.14. Use your brain power (Textbook page no. 310)**

What could be the reason for the low productivity of ocean?

**Ans:** Following are the reasons for low productivity of ocean:

- i. In oceans, productivity is limited by light which decreases with increasing water depth. Sunlight cannot penetrate beyond certain depth in oceans. The increasing depth causes decrease in the rate of photosynthesis. It leads to decrease in growth of aquatic plants and animals.
- ii. Oceans are not as rich as land in mineral composition.
- iii. Compared to plants in ocean, terrestrial plants are advanced in terms of their photosynthetic capacity.

**Q.15. What is secondary productivity?**

**Ans:**

- i. It is defined as the rate of formation of new organic matter by consumers.
- ii. It is the rate of assimilation of food energy at the level of consumers.
- iii. It is the amount of energy available to the consumer for transfer to the next trophic level.

**\*Q.16. Define decomposition and describe the processes and products of decomposition.**

**Ans:**

- i. **Decomposition** is the process of breakdown of complex organic matter into inorganic substances like carbon dioxide, water and nutrients by the decomposers.
- ii. Few 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 moist environment favours decomposition whereas, low temperature and anaerobic condition inhibits 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 the above steps occur simultaneously.

**d. Humification:**

It leads to accumulation of particularly decomposed, a dark coloured, amorphous, colloidal organic substance called **humus**.

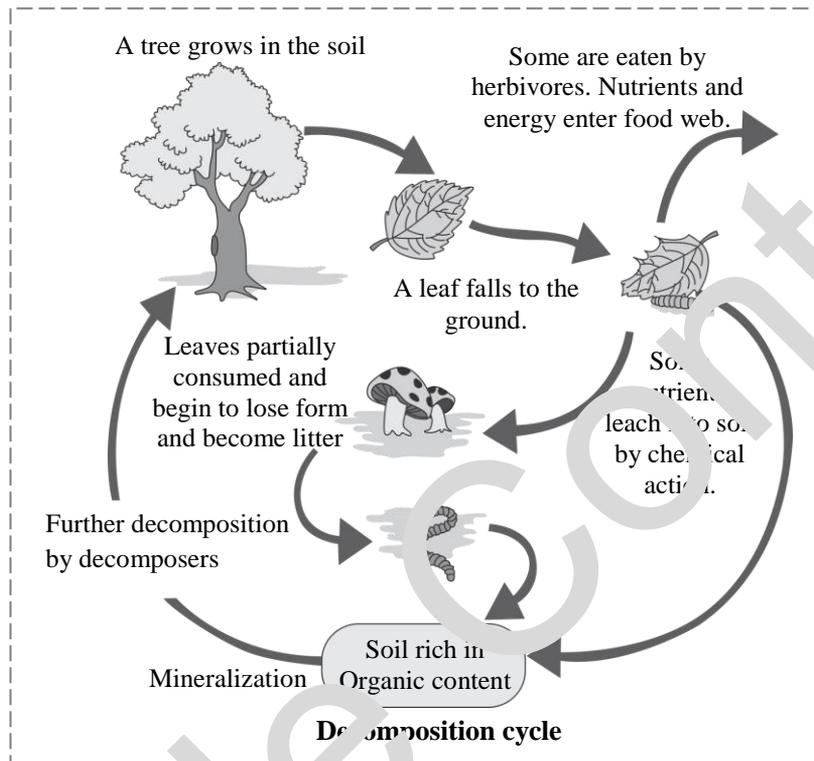
Humus serves as a reservoir of nutrients.

It is resistant to microbial action and undergoes decomposition at extremely slow rate.

Humus changes the soil texture and increases capacity of water holding in the soil.

**e. Mineralization:**

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

**NCERT Corner****Factors affecting the rate of decomposition**

The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, the rate of decomposition is slower if detritus is rich in lignin and chitin, whereas it is quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.

**14.2 Energy Flow****17. Can you read? (Textbook page no. 311)**

- What is a food chain?
- What are trophic levels in a food chain?

**Ans:**

- Food chain is a definite sequence of interaction between producers, consumers and decomposers (saprophytes).
- Trophic level is defined as the specific place organisms occupy in the food chain based on source of nutrition or food.

**Trophic levels in a food chain:**

- Producers: First trophic level.
- Herbivores (Primary consumer): Second trophic level.
- Carnivores (Secondary consumer): Third trophic level.
- Top carnivores (Tertiary consumer): Fourth trophic level.



**Q.18. Fill in the blanks:**

- i. The biotic and abiotic components of an ecosystem are all linked together to function as an \_\_\_\_\_.
- ii. \_\_\_\_\_ is the only source of energy for all ecosystems on the earth except for the deep sea ecosystems.
- iii. A constant input of \_\_\_\_\_ is the basic requirement for any ecosystem to function and sustain.
- iv. Plants capture only \_\_\_\_\_ of the PAR and this small amount of energy sustains the entire living world.
- v. There is \_\_\_\_\_ flow of energy from sun to producers and then to consumers.

**Ans:**

- i. Ecosystem unit                      ii. Sun                      iii. Solar energy
- iv. 2-10%                                  v. Unidirectional

**Q.19. Find Out** (Textbook page no. 311)

- i. Is there any presence of living organisms in the perpetual darkness of deep oceanic trenches?
- ii. In absence of solar radiation, what is their source of energy?
- iii. Which organisms do serve as producers in the food chain of deep oceans?

**Ans:**

- i. Yes, there are living organisms present in the darkness of the deep oceanic trenches. Organisms like xenophyophores, small sea cucumbers, amphipods etc. are found in such places.
- ii.
  - a. In deep oceanic trenches, photosynthesis is not possible as there is no sunlight, thus primary producers like algae or other plants are absent.
  - b. Animals in such places survive on the decaying dead organisms which sink to the bottom from upper layers of the ocean. This is generally known as marine snow.
  - c. Thus, the animals must be surviving due to detritus food chain in deep trenches.
  - d. The other way is chemosynthesis. The chemosynthetic bacteria in deep trenches can convert chemical compounds into organic nutrients. Thus, these provide energy to the animals in the absence of solar radiation. [Source: <https://www.nationalgeographic.org/encyclopedia/ocean-trench/parent/>]
- iii. Phytoplankton, marine algae, seaweeds etc., are the organisms which serve as producers in the food chain of oceans where sunlight can reach. However, chemosynthetic bacteria function as producers in deep oceanic trenches where sunlight cannot reach.

**Q.20. Define consumer in food chain. What are its three types?**

**Ans:**

- i. **Consumers:**  
Animals which are dependent directly or indirectly on plants for their food are called consumers or heterotrophs.
- ii. **Three types of consumers are:**
  - a. **Primary Consumers:**  
Animals which directly feed on plants are called primary consumers. They are also known as **herbivores**. For e.g. Insects (grasshopper, aphids, etc.), birds (parrot), mammals (sheep, cattle, goat, donkey, etc.).
  - b. **Secondary Consumers:**  
Animals which feed on other animals which eat plants are called secondary consumers. These are also known as **carnivores**.
  - c. **Tertiary Consumers:**  
Animals which feed on secondary consumers are called tertiary consumers.

**Q.21. Match the columns and rewrite the table.**

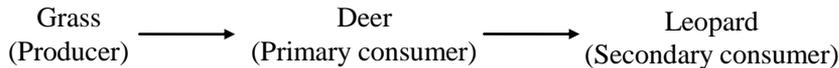
Column I		Column II		Column III	
i. Tertiary consumer	p. First trophic level (Photoautotrophs)	a. Phytoplanktons, grass, trees			
ii. Secondary consumer	q. Second trophic level (Herbivore)	b. Bird, fish and wolf			
iii. Primary consumer	r. Fourth trophic level (Top carnivore)	c. Zooplanktons, grasshopper and cow			
iv. Primary producer	s. Third trophic level (Carnivore)	d. Man, Lion			

**Ans:**

Column I		Column II		Column III	
i. Tertiary consumer	r. Fourth trophic level (Top carnivore)	d. Man, Lion			
ii. Secondary consumer	s. Third trophic level (Carnivore)	b. Bird, fish and wolf			
iii. Primary consumer	q. Second trophic level (Herbivore)	c. Zooplanktons, grasshopper and cow			
iv. Primary producer	p. First trophic level (Photoautotrophs)	a. Phytoplanktons, grass, trees			



- Q.22. i. Name the three types of food chains.**  
**ii. Identify the type of food chain depicted below:**



**Ans:**

- i. The three types of food chains are Grazing, detritus and parasitic food chain.
- ii. The given food chain represents grazing food chain.

**Q.23. What is Detritus Food Chain?**

**Ans:**

- i. Detritus food chain begins with dead organic matter.
- ii. It is composed of decomposers which are heterotrophic organisms mainly fungi and bacteria.
- iii. Their energy and nutrient requirements are fulfilled by degrading the detritus. They are known as **saprotrophs**.
- iv. The decomposers secrete enzymes which breakdown dead organic materials into simple, inorganic materials which are absorbed by them.

**Q.24. Use your brain power. (Textbook page no. 312)**

What could be the connecting points between the GFC to DFC?

**Ans:**

- i. The grazing food chain (GFC) starts from plants for e.g. grass (producers), which is eaten by animals like deer (herbivores), and these animals are in turn food for other animals like leopard (carnivores).
- ii. The detritus food chain (DFC) starts with dead organic matter. Decomposers like fungi and bacteria degrade the detritus to obtain energy.
- iii. Thus death of any organism in the grazing food chain (grass, deer, leopard, etc.) will mark beginning of the detritus food chain.

**Q.25. Can you tell? (Textbook page no. 312)**

(Refer the figure 14.5 given on page no. 312 of your textbook)

**From the given food web diagram. Give the trophic levels where the eagle is present.**

**Ans:** From the given food web diagram, the eagle is present at fourth trophic level (Top carnivore).

**\*Q.26. Distinguish between food chain and food web.**

**Ans:**

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

**Q.27. What is a trophic level? Which type of organisms occupies different trophic levels?**

**Ans:**

- i. Organism which occupies a specific place in the food chain is called its trophic level.
- ii. In ecological community, every organism occupies a place according to the source and method of obtaining food.
- iii. Producers occupy the first trophic level. Primary consumers (herbivores) are at the second trophic level, secondary consumers (carnivores) at third trophic level.

**Q.28. Use your brain power. (Textbook page no. 312)**

How will you classify man as carnivorous (primary/secondary) or omnivorous? Why?

- ii. How many trophic levels human beings function in a food chain?

**Ans:**

- i.
  - a. Humans have unique set of teeth. They have biting and tearing type of incisors and canines like those present in carnivores and also have molars for chewing. Thus, animals showing such diverse set of teeth tend to be an omnivore.
  - b. Humans lack enzyme cellulase which is present in herbivores to digest cellulose, but they have sucrase that helps in digestion of fruits, etc.



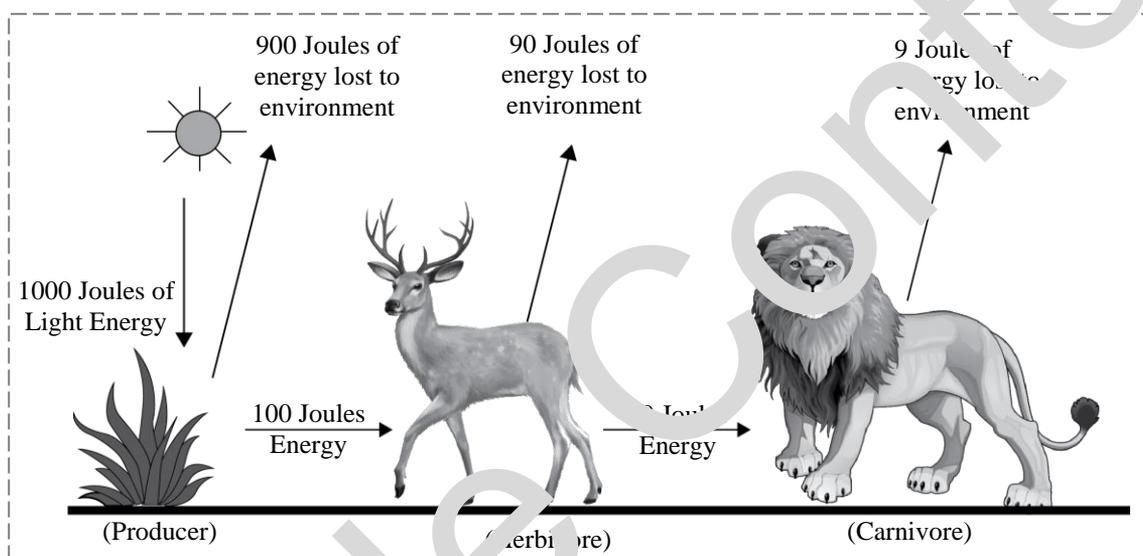
- c. For survival, humans require vitamin B<sub>12</sub> which is obtained from animal source, vitamin C obtained from *Citrus* fruit etc. Thus, a man can consume both a vegetarian diet as well as non-vegetarian diet.
  - d. Our closest evolutionary relative the chimpanzees are omnivores.
  - e. Thus, man is a classic example of omnivores.
- ii. Human beings can function in three trophic levels i.e. second trophic level (primary consumer), third trophic level (secondary consumer) or fourth trophic level (tertiary consumer).

**Q.29. Explain R. Lindeman's 10% law.**

**Ans:**

- i. In any food chain, the amount of energy available decreases at each successive trophic level.
- ii. The law given by R. Lindeman states that 'only 10% of the energy is transferred to each trophic level as useful energy, from the previous trophic level'.
- iii. The remaining 90% of energy is lost to environment in the form of heat.
- iv. The number of trophic levels in any food chain is restricted as the transfer of energy follows 10% Law.

**Q.30. What does the picture indicate?**



- Ans:** i. The given picture represents energy transfer with increasing trophic level.  
 ii. Refer Q.29.

**Q.31. Food chains do not exist in isolation but rather are always interconnected to form food web. Give reason.**

**Ans:**

- i. As we know there are different trophic levels present in the nature starting from producers followed by herbivore, primary carnivore, secondary carnivore, tertiary carnivore and lastly ultimate carnivore.
- ii. But actually beyond secondary carnivores the amount of energy available is very less. Hence, there is no tertiary carnivore that exclusively feeds on secondary carnivore.
- iii. The secondary carnivore many times feed on herbivores directly.
- iv. Thus, food chains do not exist in isolation. They are always interconnected to form food web that maintains the balance in an ecosystem.

**Q.32. Think about it. (Textbook page no. 312)**

What is the maximum number of trophic levels in a food chain?

- Ans:** There are maximum four trophic levels in a food chain, because there is loss of energy at every trophic level. Therefore, there will not be any energy left to support the trophic levels beyond fourth.

### 14.3 Ecological Pyramids

**Q.33. Define ecological pyramid. What are the three types of ecological pyramid?**

**Ans:**

- i. Ecological pyramid is graphic representation of the relationship between the organisms of various successive trophic levels with respect to energy, biomass and number.
- ii. Pyramid of biomass, pyramid of numbers and pyramid of energy are the three ecological pyramids.

**Q.34. What does the base and apex of ecological pyramid represent?**

**Ans:** The base of the pyramid represents the producers or the first trophic level and the apex represents tertiary or top level consumer.

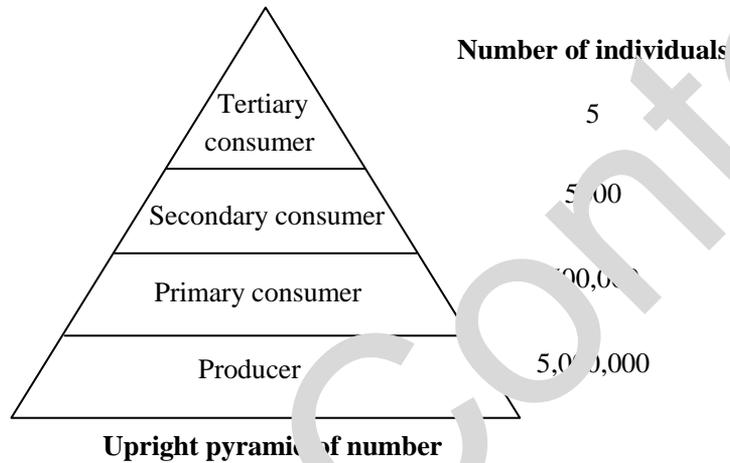
**\*Q.35. Define ecological pyramids and describe with examples, pyramids of number and biomass.**

**Ans:**

i. Refer Q.33 (i)

ii. **Pyramid of numbers:**

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

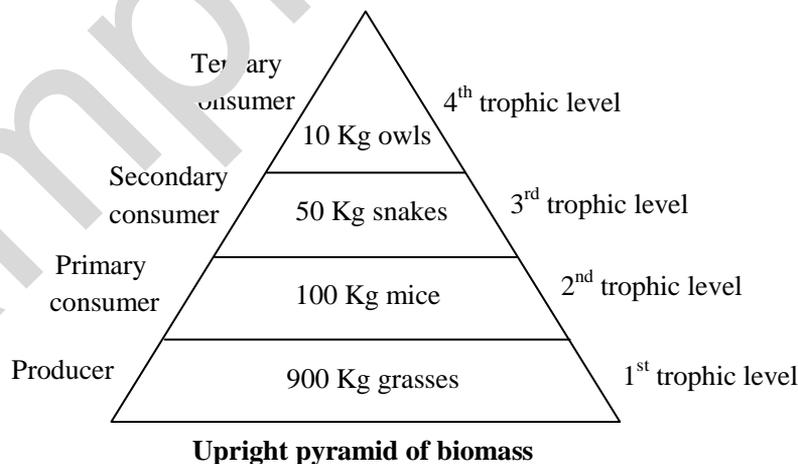


- However pyramid of number can also be inverted in some cases.

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

iii. **Pyramid of biomass:**

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



- However pyramid of biomass can also be inverted in some cases.

For e.g. Oceanic ecosystem shows inverted pyramid of biomass. In this case, biomass of phytoplanktons (producer) is less than that of zooplanktons and fishes.

**Q.36. Think about it. (Textbook page no. 313)**

How would you explain inverted pyramid of biomass in oceanic ecosystem?

**Ans:** Refer Q. 35(iii-c)



**\*Q.37. Distinguish between upright and inverted pyramid of biomass**

**Ans:**

	<b>Upright Pyramid of Biomass</b>	<b>Inverted Pyramid of Biomass</b>
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 grassland ecosystem.	Inverted pyramid of biomass in oceanic ecosystem.

**\*Q.38. Give an example of ecosystem which shows inverted pyramid of numbers.**

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

**\*Q.39. Give an example of ecosystem which shows inverted pyramid of biomass.**

**Ans:** Oceanic ecosystem is an example of inverted pyramid of biomass.

**Q.40. Use your brain power. (Textbook page no. 313)**

‘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.’

What will happen, if in the above example, we substitute larger birds of prey feeding on small insect eating birds?

**Ans:** If in the given example of inverted pyramid of tree ecosystem, a larger bird feeding on small insect eating birds is added, then pyramid become spindle shaped.

**Q.41. Explain with a neat labelled diagram why pyramid of energy is always upright?**

**Ans:**

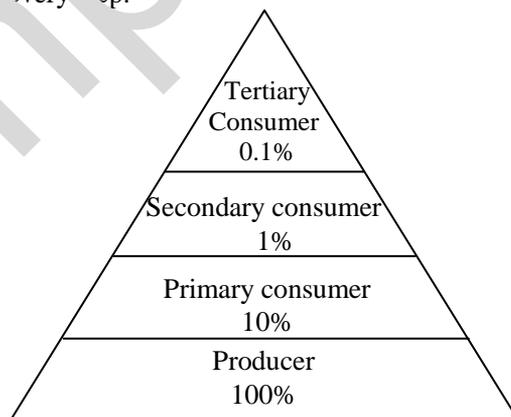
i. The relative amount of accumulated energy per unit area at different trophic levels constitutes the pyramid of energy.

**OR**

It is a graphical representation of the amount of energy trapped per unit time and area in different trophic levels of a food chain.

ii. The pyramid of energy in any ecosystem is always upright. This is because producers forming the base of the pyramid have maximum amount of energy.

iii. The energy flows from one trophic level to the next trophic level, during this energy transfer, some energy is always lost as heat at every step.



**Pyramid of Energy**

**Q.42. Which are the limitations of ecological pyramid?**

**Ans:** The limitations of ecological pyramid are as follows:

- i. It only assumes a simple food chain, something that almost never exists in nature.
- ii. Food web is not taken into consideration.

Page no. **205** to **211** are purposely left blank.

To see complete chapter buy **Target Notes** or **Target E-Notes**



Practical / Project

**Q.69. Collect the information on the various services offered by dense forest ecosystem.**

**Ans:** The various services offered by dense forest ecosystem are as follows:

- i. Ecological services:**
  - a. Forest ecosystem regulates the water regimes by catching the water obtained from rain and regulating its flow through hydrological system.
  - b. It maintains the soil quality by providing abundant organic matter through leaf and branch fall.
  - c. Prevents erosion and protects the soil from impact of rain.
  - d. Regulates the climate.
  - e. It is an important component of biodiversity.
- ii. Economic services:**
  - a. Forest ecosystem provides timber, paper, rubber and fruits.
  - b. Their products are very important for viability of agro-communities. The products include herbs, medicines, fruits, fodder, fuel, building material etc.
- iii. Scenic and landscape services:**
  - a. It provides aesthetics and beauty components of services of forests.
  - b. It provides ecotourism.

**Q.70. Collect the information of various types of pollinators and the impact of human activity on them.**

**Ans:**

- i. Various types of pollinators are birds, bats, small mammals, flies, beetles, butterflies, bees, moths etc.
- ii. Human activities which have major impact on pollinators are as follows:
  - a. Chemical pesticide and herbicide causes trouble for pollinators.
  - b. Herbicides can harm and kill the native flowers and plants that pollinators need for energy. The pesticide and herbicides can kill the pollinators.
  - c. Loss of habitat: Humans have transformed landscapes from meadows into cities, farmlands etc. This transformation has disturbed the natural habitat.
  - d. Invasive species: Non-native species being moved to new ecosystems, by accidentally and on purpose. These invasive species disrupts the ecosystem by competing with native species for natural resources and can also harm the native species.
  - e. Climate change: Climate change can affect the blooming of flowers. It can affect the life cycle and reproduction of pollinators. It can affect the migration and hibernation.

Apply Your Knowledge

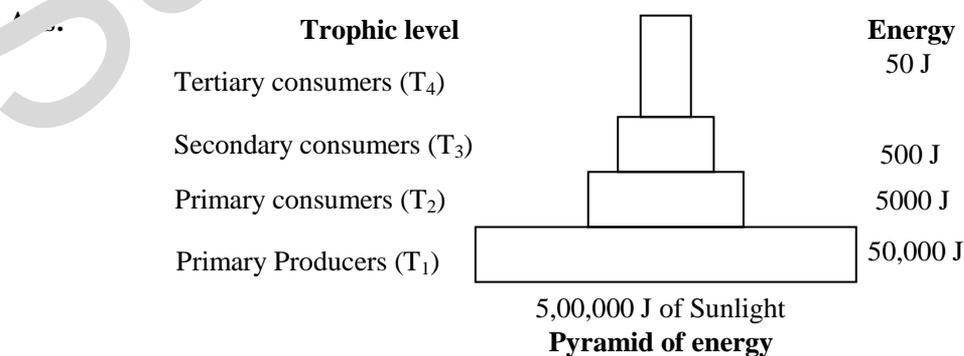
**Q.71. After a volcanic eruption has covered an area with lava, which of the following is the most likely order of succession in the recolonization of the area?**

- (A) Mosses → Herbs → Shrubs → Lichens → Trees
- (B) Shrub → Trees → Lichens → Mosses → Herbs
- (C) Lichens → Mosses → Herbs → Shrubs → Trees
- (D) Grass → Shrubs → Trees → Lichens → Herbs

**Ans:** (C)

**Hint:** Lichens are the pioneer species that initiate succession in any given region.

**Q.72. Construct an ideal pyramid of energy when 5,00,000 J of sunlight is available. Label all its trophic level.**





**Q.73. If 40 J of energy is trapped at producer level, then how much energy will be available to the peacock as food in the following food chain?**

**Plant** → **Insect** → **Frog** → **Snake** → **Peacock**

**Ans:** According to Lindeman's 10% law, only 10% of energy is transferred from one trophic level to the next.

Plant → Insect → Frog → Snake → Peacock

40 J      4 J      0.4 J      0.04 J      0.004 J

So, energy available for peacock is 0.004 J.

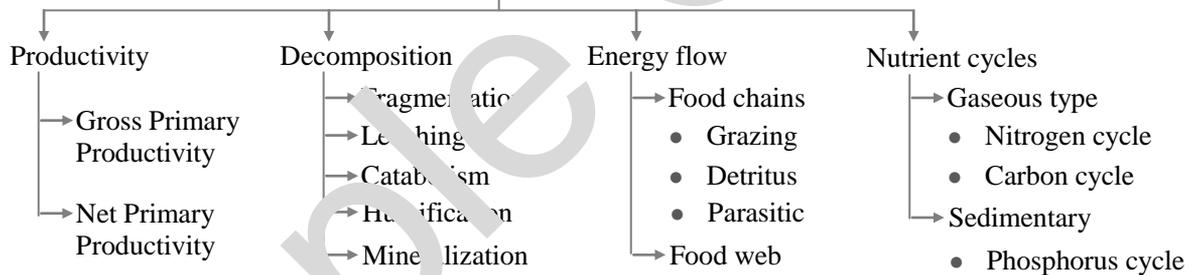
### Quick Review



### Spatial pattern



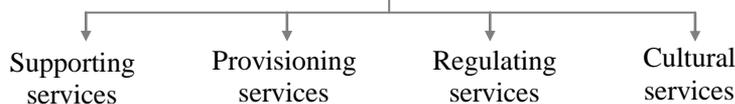
### Processes of ecosystem



### Ecological Succession



### Ecological Services



### Main ecological services

- Fixation of atmospheric CO<sub>2</sub> and release of O<sub>2</sub>
- Pollination



## Exercise

### 14.1 Ecosystem

1. Define ecosystem.

**Ans:** Refer Q.2 (i)

2. Explain the types of an ecosystem?

**Ans:** Refer Q.3

3. Define:

- i. Zonation
- ii. Stratification

**Ans:** i. Refer Q.5(iv)

ii. Refer Q.5(iii)

4. What is leaching?

**Ans:** Refer Q.16 (v-b)

5. What is Humification?

**Ans:** Refer Q.16 (v-d)

6. Define decomposition.

**Ans:** Refer Q.16 (i)

7. Explain the factors affecting primary productivity.

**Ans:** Refer Q.12 (ii)

8. What is Net primary productivity?

**Ans:** Refer Q.13 (ii)

### 14.2 Energy Flow

9. Write a short note on Detritus food chain.

**Ans:** Refer Q.23

10. Distinguish between food chain and food web.

**Ans:** Refer Q.26

11. Man is a classic example of omnivore. Give reason.

**Ans:** Refer Q.28 (i)

12. The number of trophic levels in any food chain is restricted as the transfer of energy follows '10% Law'. Give reason.

**Ans:** Refer Q.29

### 14.3 Ecological Pyramids

13. Define pyramid of numbers.

**Ans:** Refer Q.30 (ii-a)

14. Give example of inverted pyramid of biomass.

**Ans:** Refer Q.35 (iii-c)

15. Write a short note on pyramid of biomass.

**Ans:** Refer Q.35 (iii)

16. What does apex part of pyramid denotes?

**Ans:** Refer Q.34

17. Draw a neat labelled diagram of pyramid of energy?

**Ans:** Refer Q.41(diagram)

18. Pyramid of energy is always upright. Give reason.

**Ans:** Refer Q.41

### 14.4 Nutrient Cycles

19. Explain in detail the carbon cycle.

**Ans:** Refer Q.45

20. Describe the phosphorus cycle in detail.

**Ans:** Refer Q.47

21. Write a short note on Eutrophication caused by phosphorus.

**Ans:** Refer Q.49

### 14.5 Ecological Succession

22. What is ecological succession?

**Ans:** Refer Q.52

23. Explain Pioneer community and Climax community.

**Ans:** Refer Q.54

24. Explain Hydrarch and Xerarch succession.

**Ans:** Refer Q.58(ii, iii, iv)

### 14.6 Ecosystem Services

25. Explain ecological services with the help of following points:

- i. Fixation of atmospheric CO<sub>2</sub> and release of O<sub>2</sub>
- ii. Pollination

**Ans:** Refer Q.66

## Multiple Choice Questions

1. \_\_\_\_\_ is an artificial ecosystem.
 

(A) Estuary	(B) Lake
(C) Aquarium	(D) Wetland
2. The vertical distribution of plant species is studied in
 

(A) scarification	(B) stratification
(C) zonation	(D) speciation
3. Edges of a large lake or beach show pronounced \_\_\_\_\_ in the form of Inter-tidal, Littoral, Sub-littoral zones.
 

(A) zonation	(B) stratification
(C) ecological niche	(D) speciation
4. \_\_\_\_\_ is the available biomass for the consumption to heterotrophs.
 

(A) Primary productivity	(B) Net primary productivity
(C) Secondary productivity	(D) Tertiary productivity



5. Breakdown of detritus into smaller particles is called  
(A) fragmentation (B) leaching  
(C) catabolism (D) humification
6. In decomposition, bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called  
(A) fragmentation (B) leaching  
(C) catabolism (D) humification
- \*7. What is the % of photosynthetically active radiation in the incident solar radiation?  
(A) 100% (B) 50%  
(C) 1-5% (D) 2-10%
8. Energy flow in ecosystem is \_\_\_\_\_.  
(A) reverse (B) unidirectional  
(C) bidirectional (D) multidirectional
9. The energy enters the ecosystem through \_\_\_\_\_.  
(A) consumers (B) decomposers  
(C) omnivores (D) producers
- \*10. Which one of the following has the largest population in a food chain?  
(A) Producers  
(B) Primary consumers  
(C) Secondary consumers  
(D) Decomposers
11. In a food chain, the herbivores are represented by \_\_\_\_\_.  
(A) producers  
(B) primary consumers  
(C) secondary consumers  
(D) decomposers
- \*12. Secondary consumers are \_\_\_\_\_.  
(A) herbivorous (B) producers  
(C) carnivorous (D) autotrophs
13. Which of the following is NOT an omnivore?  
(A) Crow (B) Bear  
(C) Man (D) Leopard
14. Energy transfer from one trophic level to other in a food chain is \_\_\_\_\_.  
(A) 10% (B) 2%  
(C) 10% (D) 20%
- \*15. The second trophic level in a lake is \_\_\_\_\_.  
(A) phytoplankton (B) zooplankton  
(C) benthos (D) fishes
16. About 71% of total global carbon is found in \_\_\_\_\_.  
(A) oceans (B) forests  
(C) grasslands (D) agro ecosystem
- \*17. Which of the following is the most often a limiting factor of the primary productivity in any ecosystem?  
(A) Carbon (B) Nitrogen  
(C) Phosphorus (D) Sulphur
- \*18. After landslide which of the following type of succession occurs?  
(A) Primary (B) Secondary  
(C) Tertiary (D) Climax
19. The succession that starts on abandoned land is \_\_\_\_\_.  
(A) primary succession  
(B) xerarch succession  
(C) secondary succession  
(D) hydrarch succession
- \*20. Give the term used to express a community in its final stage of succession?  
(A) End community  
(B) Final community  
(C) Climax community  
(D) Dark community
21. In establishing a new ecosystem on rock, the pioneers are \_\_\_\_\_.  
(A) lichens  
(B) phytoplankton  
(C) trees  
(D) animals
22. All the successions whether taking place in water or on land, proceed to a similar climax community called \_\_\_\_\_ community.  
(A) Pioneer (B) Hydric  
(C) Mesic (D) Xeric

### Answers to Multiple Choice Questions

1. (C) 2. (B) 3. (A) 4. (B)  
5. (A) 6. (C) 7. (B) 8. (B)  
9. (D) 10. (D) 11. (B) 12. (C)  
13. (D) 14. (C) 15. (B) 16. (A)  
17. (C) 18. (B) 19. (C) 20. (C)  
21. (A) 22. (C)

[Note: 7. Of the total incident solar radiation, less than 50% of it is photosynthetically active radiation (PAR).]

### Competitive Corner

1. Which of the following ecological pyramids is generally inverted? [NEET (UG) 2019]  
(A) Pyramid of biomass in a forest  
(B) **Pyramid of biomass in a sea**  
(C) Pyramid of numbers in grassland  
(D) Pyramid of energy
2. The Xerarch succession of organisms is seen in \_\_\_\_\_. [MHT CET 2019]  
(A) River (B) Ocean  
(C) Air (D) **Desert**



3. What type of ecological pyramid would be obtained with the following data?

[NEET (UG) 2018]

Secondary consumer : 120 g

Primary consumer : 60 g

Primary producer : 10 g

- (A) Upright pyramid of numbers  
 (B) Pyramid of energy  
 (C) **Inverted pyramid of biomass**  
 (D) Upright pyramid of biomass

**Hint:** The given information represents the inverted pyramid of biomass which is generally found in aquatic ecosystem.

4. Presence of plants arranged into well define vertical layers depending on their height can be seen best in:

[NEET (UG) 2017]

- (A) Tropical Savannah  
 (B) **Tropical Rain Forest**  
 (C) Grassland  
 (D) Temperate Forest

5. Which ecosystem has the maximum biomass?

[NEET (UG) 2017]

- (A) **Forest ecosystem**  
 (B) Grassland ecosystem  
 (C) Pond ecosystem  
 (D) Lake ecosystem

6. The term ecosystem was coined by

[NEET P- I 2016]

- (A) E. Haeckel  
 (B) E. Warming  
 (C) E.P. Odum  
 (D) **A.G. Tansley**

7. Which of the following would appear as pioneer organisms on bare rocks?

[NEET P- I 2016]

- (A) Mosses (B) Green algae  
 (C) **Lichens** (D) Liverworts

8. The primary producers of the deep-sea hydrothermal vent ecosystem are

[NEET P- I 2016]

- (A) coral reefs  
 (B) green algae  
 (C) **chemosynthetic bacteria**  
 (D) blue-green algae

**Hint:** Cracks in oceans form the hydrothermal vents which emit jets of water rich in minerals and chemosynthetic bacteria. This type of bacteria utilizes energy released during chemical reaction. chemosynthetic bacteria are the primary producers of hydrothermal vent.

Time: 1 Hour 30 Min

TOPIC TEST

Total Marks: 25

## SECTION A

## Q.1 Select the correct answer

[04]

- i. \_\_\_\_\_ begins in area where natural biotic communities have been destroyed such as abandoned farm lands, burned or cut forests etc.  
 (A) Climax community (B) Secondary succession  
 (C) Seral community (D) Primary succession
- ii. In establishing a new ecosystem on rock, the pioneers are  
 (A) lichens (B) phytoplanktons (C) trees (D) animals
- iii. The relative number of individuals per unit area at different trophic levels, constitutes the  
 (A) number pyramid (B) biomass pyramid (C) energy pyramid (D) none of the above
- iv. Plants capture \_\_\_\_\_ of the PAR and this small amount of energy sustains the entire living world.  
 (A) 5-20% (B) 2-10% (C) 1-2% (D) 20-30%

## Q.2 Answer the following

[03]

- i. Give two examples of insects which are primary consumers.  
 ii. What is humus?  
 iii. Define: Secondary productivity

## SECTION B

Attempt any Four:

[08]

- Q.3. What is stratification and zonation?



Q.4. Match the columns.

	Column I		Column II
i.	Zooplanktons	a.	Tertiary consumer
ii.	Earthworm and fungi	b.	Primary consumers
iii.	Maize plants	c.	Producers
iv.	Lion	d.	Decomposers

- Q.5. What is the 10% law given by R. Lindeman?  
Q.6. Distinguish between food chain and food web.  
Q.7. Give diagrammatic representation of pyramid of biomass.  
Q.8. Write a short note pioneer community.

### SECTION C

**Attempt any Two:**

[06]

- Q.9. Explain how carbon cycle differs from phosphorus cycle.  
Q.10. Enlist any three limitations of ecological pyramid.  
Q.11. Name the mineral that acts as limiting factor for productivity in an aquatic ecosystem. Explain how this mineral causes eutrophication and write its effect on aquatic life.

### SECTION D

**Attempt any One:**

[04]

- Q.12. Define decomposition and describe the processes of decomposition.  
Q.13. What are the four categories of ecosystem services as per The Millennium Ecosystem Assessment?

*Download the answers of the Topic Test by scanning the given Q.R. Code.*

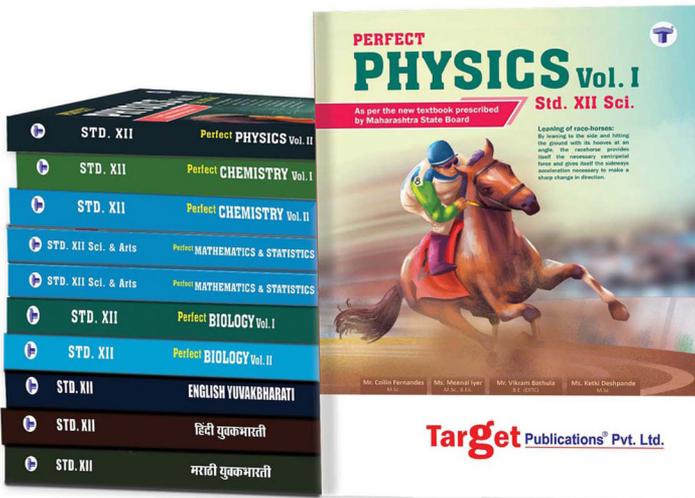




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