

**SAMPLE CONTENT**

**PERFECT**



# BIOLOGY



## **Plank Roots/Buttress Roots**

Plank roots often develop at the base of large trees. They are woody lateral extensions around tree trunks which provide extra support to shallowly rooted trees.

**STD. XI Sci.**

**Dr. M.D. Gangakhedkar**  
M.Sc., Ph.D, DHE.

**Ms. Khushbu Bohara**  
M.Sc. (Botany)

**Dr. P. C. Thomas**  
M.Sc., M. Phil., Ph. D.

**Target** Publications<sup>®</sup> Pvt. Ltd.

# PERFECT BIOLOGY

## Std. XI Sci.

Special Inclusion

Memory Maps

### Salient Features

- ☞ Written as per the latest textbook
- ☞ Subtopic-wise segregation for powerful concept building
- ☞ Complete coverage of Textual Exercise Questions, Intext Questions and Activities
- ☞ Each chapter contains:
  - **‘Insights...’** interesting facts to instill curiosity about the concept
  - **‘Brain Teasers’** section for application of concepts learned in chapter
  - **‘Quick Review’ / ‘Memory Maps’** of the chapter for last-minute revision
  - **‘Exercise’** to provide more Theory questions and MCQs for practice
  - **‘Competitive Corner’** to give the glimpse of prominent competitive examinations [MHT-CET, NEET (UG)]
  - **‘Topic Test’** at the end of each chapter for self-assessment
- ☞ Includes important features like
  - **For your knowledge**      - **Gyan guru**      - **Connections**      - **NCERT Corner**
- ☞ **Smart Keys:** Multiple study techniques designed to impart holistic learning
  - **Reading between the lines**      - **Strategy**      - **Caution**      - **Smart Check**
- ☞ **Q.R. codes** provide:
  - The Video/pdf links boosting conceptual retention
  - Solutions of:
    - i. Competitive corner      ii. Topic test

Printed at: **Print to Print**, Mumbai

© Target Publications Pvt. Ltd.

No part of this book may be reproduced or transmitted in any form or by any means, C.D. ROM/Audio Video Cassettes or electronic, mechanical including photocopying; recording or by any information storage and retrieval system without permission in writing from the Publisher.

# PREFACE

*Everything should be made as simple as possible, but not simpler.” - Albert Einstein.*

Having this vision in mind, we have created “**Perfect Biology: Std. XI**” as per the latest textbook of Maharashtra State Board. It focuses on not just preparing students from an examination point of view but also equipping them to understand and appreciate the beauty of the concepts in Biology.

Every chapter in this book begins with a brief introduction to the chapter. Following with:

- ◆ **Insights...** provided at the start captivate readers with intriguing revelations and thought-provoking observations, setting the stage for an engaging exploration of each new chapter.
- ◆ The chapter is **segregated subtopic-wise** and encompasses all textual content in the format of Question and Answers. *Textual Exercise questions, Intext questions, ‘Can you tell’, ‘Can you recall’, ‘Try this’, and ‘Activity’* are placed aptly amongst various additional questions in accordance with the flow of subtopic.
- ◆ **Exercise** helps the students gain insight on the various levels of theory-based questions.
- ◆ **Multiple Choice Questions** and **Topic Test** (as per the latest paper pattern) assess the students on their range of preparation and the amount of knowledge of each topic.
- ◆ **Memory Map / Quick Review** summarizes the key points in the chapter for last-minute revision.
- ◆ The flow chart on the adjacent page will walk you through the **key features** of the book and elucidate how they have been carefully designed to maximize the student learning.

**Perfect Biology, Std. XI Sci.** adheres to our vision and achieves several goals: building concepts, recapitulation, self-study, self-assessment, and student engagement - all while encouraging students toward cognitive thinking.

*We hope the book benefits the learner as we have envisioned.*

Publisher

**Edition:** Fifth

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)

## Disclaimer

This reference book is transformative work based on latest Textbook of Std. XI Biology published by the Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune. We the publishers are making this reference book which constitutes as fair use of textual contents which are transformed by adding and elaborating, with a view to simplify the same to enable the students to understand, memorize and reproduce the same in examinations.

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.

© reserved with the Publisher for all the contents created by our Authors.

No copyright is claimed in the textual contents which are presented as part of fair dealing with a view to provide best supplementary study material for the benefit of students.

## KEY FEATURES

*'Insights...'* starts each chapter with engaging information and curious facts, sparking your interest right from the beginning.

Insights...

For your  
knowledge

For Your Knowledge presents fascinating information about the concept covered.

Competitive Corner includes selective questions from prominent [NEET (UG) and MHT CET] competitive exams based entirely on the syllabus covered in the chapter.

Competitive  
Corner

NCERT  
Corner

NCERT Corner covers information from NCERT textbook relevant to topic.

Connections enable students to interlink concepts covered in different chapters.

Connection

Brain  
Teasers

Brain Teasers include challenging questions.

Continued...

## KEY FEATURES

'Smart Keys' comprise a set of remarkable study techniques contrived to benefit students.

**Smart Keys**

**Reading between the lines**

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

Caution helps students to be watchful against commonly made mistakes.

**Caution**

**QR Codes**

QR codes provide:

- i. Access to a video/PDF in order to boost understanding of a concept or activity
- ii. Solutions to:  
Competitive corner and Topic test

Diagrams in Hand-drawn format are easy to memorize, save time and efforts of the students.

**Diagrams in Hand-drawn Format**


**Memory Map / Quick Review**

Memory maps / Quick Review offer easy-to-follow guides that make revising both fun and effective.

# CONTENTS

Chapter No.	Chapter Name	Marks	Marks with Option	Page No.
1	Living World	2	3	1
2	Systematics of Living Organisms	3	4	15
3	Kingdom Plantae	5	7	43
4	Kingdom Animalia	4	5	65
5	Cell Structure and Organization	4	5	92
6	Biomolecules	4	5	120
7	Cell Division	4	6	152
8	Plant Tissues and Anatomy	4	6	173
9	Morphology of Flowering Plants	7	10	199
10	Animal Tissue	4	6	232
11	Study of Animal Type – Cockroach	4	6	255
12	Photosynthesis	5	7	276
13	Respiration and Energy Transfer	5	7	306
14	Human Nutrition	5	7	331
15	Excretion and Osmoregulation	5	7	358
16	Skeleton and Movements	5	7	395

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

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





# 1 Living World

In this chapter, students would be learning about the basic principles of life and they will also get an idea about the taxonomical aids like herbarium, key, museum, zoological parks and botanical gardens that are useful for studying the variety of life forms present on the Earth. This chapter will make students aware of the need to conserve our biodiversity and introduce them with the in situ and ex situ methods of conservation. The chapter is allotted weightage of 3 marks with option and 2 marks without option.

## Contents and Concepts

- |                              |                        |
|------------------------------|------------------------|
| 1.0 Introduction             | 1.4 Museum             |
| 1.1 Basic Principles of Life | 1.5 Zoological Parks   |
| 1.2 Herbarium                | 1.6 Biodiversity Parks |
| 1.3 Botanical Gardens        | 1.7 Key                |

## Insights...

1. The world's oldest botanical garden still in existence is the Orto Botanico di Padova in Italy, founded in 1545.
2. The Chhatrapati Shivaji Maharaj Vastu Sangrahalaya in Mumbai houses a collection of taxidermy specimens.
3. The Great Banyan Tree, a massive banyan tree (*Ficus benghalensis*) with an expanded circumference of more than 330 meters, is one of Acharya Jagadish Chandra Bose Indian Botanic Garden's most renowned landmarks.
4. Maharashtra's renowned Kaas plateau, a world natural heritage site, was prominently featured in the state tableau that was the part of the Republic Day parade in the nation's capital on January 26, 2022.

## Questions and Answers

### 1.0 Introduction

**Q.1. Can you recall?** (Textbook page no. 01)

Whether all organisms are similar? Justify your answer. [3 Marks]

**Ans:** While all organisms share fundamental characteristics such as ability to reproduce, being composed of cells, requiring energy;

they also exhibit diversity with respect to their habitats, cells, genetic makeup, mode of nutrition, metabolic processes etc.

- i. Organisms are grouped as microbes, plants (autotrophs), animals (heterotrophs) and decomposers.
- ii. Different microbes and decomposers have various shapes and sizes.





- iii. Plants can be further classified on their shape, size, structure, mode of reproduction, habitats- alpine plants, xerophytes etc.
- iv. Animals show a high degree of variation. They are classified as unicellular, multicellular, invertebrates, vertebrates, etc. Also, based on their habitat, they are classified as terrestrial, aerial, aquatic and amphibians.

**Q.2. Can you tell? (Textbook page no. 01)**  
**Whether all organisms prepare their own food? [1 Mark]**

**Ans:** No, all organisms do not prepare their own food. Organisms that prepare their own food in the presence of sunlight, water and carbon dioxide are known as autotrophs (e.g. Green plants, certain microbes like cyanobacteria).

### 1.1 Basic Principles of Life

**Q.3. What are the basic principles of life? [3 Marks]**

**Ans:** The basic principles of life are as follows:

- i. **Metabolism:** Metabolism consists of catabolism (breaking of molecules) and anabolism (making of new molecules). An organism performs metabolism in order to obtain energy and various chemical molecules essential for survival.
- ii. **Growth and development:** Growth and developments in an organism occurs for a limited period of time.
- iii. **Ageing:** It is the process during which molecules, organs and systems begin to lose their effective working and become old.
- iv. **Reproduction:** Organisms reproduce asexually or sexually and give rise to young ones like themselves for the continuity of their race (species). However, sterile organisms like mules and worker bees do not reproduce, yet they are living.
- v. **Death:** As the body loses its capacity to perform metabolism, an organism dies.
- vi. **Responsiveness:** Living organisms respond to thermal, chemical or biological changes in their surroundings.

**Q.4. Can you recall? (Textbook page no. 01)**

**i. What is the difference between living and non-living things? [2 Marks]**

**Ans:**

	Parameters	Living Things	Non-living Things
a.	Growth	Living things show growth from within.	Non-living things show growth by accumulation of materials on their surface.

b.	Reproduction	They reproduce asexually or sexually, except mules, sterile worker bees, infertile organisms.	They do not reproduce.
c.	Metabolism	They perform metabolism in order to obtain energy.	No metabolic changes occur in non-living things.
d.	Irritability	They show irritability and respond to changes in their surroundings.	They do not show irritability.
e.	Ageing	They undergo ageing and eventually die.	Non-living things do not have a finite life span.

**ii. Enlist the characters of living organisms.**

**[1 Mark]**

**Ans:** Refer Q.3.

**#Q.5. Can we call reproduction as inclusive character of life? (Textbook page no. 01) [1 Mark]**

**Ans:** No, we cannot call reproduction as an inclusive character of life. Certain organisms like mules and worker bees do not reproduce and are still living. Thus, reproduction cannot be considered as an all inclusive defining characteristic of living organisms.

### NCERT CORNER

#### Reproduction In Lower Organisms:

- i. Apart from the fact that certain living organisms do not reproduce, in unicellular organisms like bacteria, unicellular algae or *Amoeba*, reproduction occurs by cell division, which is synonymous with growth (increase in number of cells).
- ii. This is also another reason why reproduction cannot be considered as an all-inclusive defining characteristic of living organisms.

**Q.6. Can you tell? (Textbook page no.01)**

**Which feature can be considered as all-inclusive characteristic of life? Why? [2 Marks]**

**Ans:**

- i. Metabolism can be considered as an all-inclusive (defining) feature of life since it is exhibited by all living organisms and does not take place in non-living things.
- ii. Responsiveness or irritability is a unique property of living beings since all living beings are conscious of their surroundings.

 CAUTION

An individual in a state of coma is alive but unable to move or respond to his or her environment.

**Q.7. Think about it.** (Textbook page no. 01)

**i. Can metabolic reactions demonstrated in a test tube (called 'in vitro' tests) be called living?** [2 Marks]

**Ans:**

- The sum of all the chemical reactions occurring in the body is known as metabolism.
- However, metabolic reactions demonstrated outside the body in a test tube in cell-free medium lack other essential characteristics of life.
- They replicate some metabolic reactions when provided with necessary substrates and enzymes but lack the highly integrated and coordinated system seen in living beings.
- Thus they cannot be called living.

**ii. Now a days patients are declared 'brain dead' and are on life support. They do not show any sign of self-consciousness. Are they living or non-living?** [2 Marks]

**Ans:** A brain-dead person is supported by life support and is biologically alive due to active metabolic functions but lacks consciousness and responsiveness.

Without life support, they would be clinically dead.

Thus, they are in a grey area – living in biological sense but not fully living as defined traditionally.

**Q.8. What are taxonomical aids? Give examples.**

[1 Mark]

**Ans:** Taxonomical aids are used to study biodiversity. e.g. Herbaria, botanical gardens, museums, biodiversity parks, zoological park, key, etc.

**Q.9. Can you tell?** (Textbook page no.01)

**How can we study large number of organisms at a glance?** [1 Mark]

**Ans:** Systematic study of organisms with the help of taxonomical aids can be used to study a large number of organisms at a glance.

## 1.2 Herbarium

**Q.10. What is a herbarium?** [1 Mark]

**Ans:** Herbarium is a dried plant specimen that is pressed, treated and mounted on a standard size sheet in order to preserve it.

[Note: Herbarium is a collection of dried, pressed and labelled plant specimens arranged by a classification system.]

**Q.11. Can you tell?** (Textbook page no. 03)

**What are the essentials of a good herbarium?**

[3 Marks]

**Ans:** The essentials of a good herbarium are as follows:

- It is essential to identify and label the collected specimen correctly.
- Specimens should be stored in a dry place as well as should be dried well before preparing a herbarium in order to prevent rotting of specimen.
- The plants are usually pressed and mounted on the sheet of paper known as herbarium sheets. Some plants are not suitable for pressing or mounting, like succulents, seeds, cones, etc. They need to be preserved in suitable liquid like formalin, acetic alcohol, etc.
- In order to preserve the specimen for longer durations, acid-free paper, special glues and inks must be used to mount the specimen so that the specimen does not deteriorate.
- This following information is given at lower right corner of sheet and is called 'label';
  - Date, place of collection along with detailed classification
  - Ecological peculiarities
  - Characters of the plant
  - Local names of plant specimens
  - Name of the collector

**Q.12. What information is mentioned in the label of a plant specimen preserved in herbarium?**

[1 Mark]

**Ans:** Refer Q.11. (v)

**Q.13. Riya found a peculiar plant on her visit to Himachal Pradesh. What are the ways she can show it to her biology teacher and get information about it?** [2 Marks]

**Ans:**

- Riya can press and mount the plant specimen on a herbarium sheet and preserve the dried plant material, until she returns back from her visit.
- She can also write any available information regarding the collected specimen on the herbarium sheet, which can be useful for further studies with her biology teacher.
- Various taxonomical aids can be useful to get information about this peculiar plant.

[Note: In order to conserve the local flora, Riya can collect photographs of plant and describe it's structure to her teacher.]



### 1.3 Botanical Gardens

#### Q.14. What are botanical gardens? [1 Mark]

**Ans:** Botanical gardens are places where living plants of different varieties collected from different parts of the world are grown *in vivo* in a scientific and systematic manner.

#### Q.15. Why do we have green house in botanical gardens? [2 Marks]

**Ans:**

- Greenhouse is a structure with suitable walls and a roof in which plants are grown under regulated climatic conditions.
- The greenhouse associated with botanical gardens are also used to grow and propagate those plants that may not survive seasonal changes.

Hence, in order to provide optimum temperature for better growth and flowering and also to protect the plants from certain diseases, there are greenhouses in botanical gardens.

#### Q.16. Write short note: Importance of botanical garden [3 Marks]

**Ans:** The importance of botanical gardens is as follows:

- They serve as a museum with collection of living plants maintained for botanical teaching and research purpose.
- Botanical gardens are important for their records of local flora.
- Botanical gardens also supply seeds and material for botanical investigations.
- Botanical gardens also supply seeds and material for botanical investigations.
- The development of botanical gardens in any country is associated with its history of civilization, culture, heritage, science, art, literature and various other social and religious expressions.
- Botanical gardens besides possessing an outdoor garden may contain herbaria, research laboratory, greenhouses and library.
- Botanical gardens are not only important for botanical studies, but also to develop tourism in the country.



#### FOR YOUR KNOWLEDGE

- The first university botanical garden (Orto Botanico di Pisa) was established (Founded in 1543) by Prof. Luca Ghini (A.D. 1490-1556) at Pisa, Italy. It is the oldest garden of the world which still exists. It houses plants from 5 continents.

- The botanical garden at Kew in England is known for its largest collection of more than 30,000 specimens (preserved plants) and more than 7 million herbaria.

[*Note: The herbarium at the Royal Botanic Gardens, Kew, houses approximately seven million plant specimens, collected from all around the world.*]

#### Q.17. Define biodiversity. [1 Mark]

**Ans:** Biodiversity is the degree of variation of life forms in an ecosystem.

#### Q.18. Define conservation. [1 Mark]

**Ans:** Conservation is the act of protecting Earth's natural resources. It involves attempts to slow down, stop or even reverse the loss in the natural habitat of an organism.

#### Q.19. Why does the loss of biodiversity matter?

(Textbook page no. 03) [2 Marks]

**Ans:**

- The loss of biodiversity is a moral and ethical issue.
- The extent of complexity and density of biodiversity can be regarded as health of an ecosystem.
- The loss of even one variety of organisms can affect the entire ecosystem.

Hence, due to all these reasons, loss of biodiversity matters.

#### Q.20. Write a short note on role of human beings in biodiversity conservation. [2 Marks]

**Ans:**

- Due to rapid increase in human population and industrialization, humans have over utilized natural resources; leading to degradation of the environment.
- In order to conserve biodiversity and its environmental resources, humans must use the resources rationally.
- Human beings are stakeholders of the environment and need to come together to overcome pollution and improve the environment quality. E.g. Ban or limit on use of harmful products (plastic, chemicals, etc.) that are toxic to various birds, animals, etc.
- Humans can further contribute by establishment of various sites for *in situ* (national parks, wildlife sanctuaries and biosphere reserves) and *ex situ* (botanical gardens, culture collections and zoological parks) conservation.



**Q.21. How can you, as an individual, prevent the loss of biodiversity? [3 Marks]**

**Ans:** As individuals, we can prevent loss of biodiversity in the following ways:

- Increasing awareness about environmental issues. Making posters that provide more information about biodiversity conservation, to raise public awareness.
- Increased support and/ or active participation in government policies and actions laid down for conservation of biodiversity.
- Protect various plant and animal species in our surrounding.
- Set up bird and bat houses wherever possible.
- Prevent felling of trees especially native plants or trees in a particular area.
- Reduce, recycle and reuse resources. Especially, reduce pollution and use of plastic bags and other materials which are potential threats for the environment.
- Use environment friendly products, segregate and dispose garbage correctly.
- Convince people about the importance of trees and the need to participate in tree plantation campaign.
- Obey the rules that fall under Biodiversity Act.

*[Students can use the given points as reference and mention additional preventive measures on their own.]*

**Q.22. Find out. (Textbook page no. 04)**

**Human being is at key position in maintaining biodiversity of earth. Find out more information about the following.**

**i. Laws to protect and conserve biodiversity in India.**

- Ans:**
- Forest (Conservation) Act, 1980
  - Biological Diversity Act, 2002
  - Wildlife (Protection) Act, 1972
  - Environment Protection Act, 1986

*[Students can find out more laws to protect and conserve Biodiversity in India.]*

**ii. Environmental effects of ambitious projects like connecting rivers or connecting cities by constructing roads.**

**Ans:** Connecting rivers or connecting cities by constructing roads have the following environmental effects:

- They form barriers to movement of animals.
- Construction of roads requires cutting down of trees and results in large scale deforestation.
- They occupy large land resources resulting in loss of habitat of various species.

d. It can alter the water flow pattern and damage many ecosystems.

e. Increase in air, water, soil and noise pollution can disturb various animals and birds, thus affecting their behavioural pattern.

**iii. Did bauxite mining in Western Ghats affect critically endangered species like – Black panther, different *Ceropegia spp.*, *Eriocaulon spp.*?**

**Ans:**

a. The Western Ghats, is one of the global biodiversity hotspots and retains more than 30% of all plant, aquatic, reptile, amphibian and mammal species found in India.

b. Recently, this ecologically sensitive region has been subjected to various developmental activities that have adversely affected the flora and fauna of the region.

c. Bauxite mining is one such activity which has had significant negative impact on the local environment. To access bauxite ore deposits, the above-ground vegetation needs to be completely removed, causing large scale deforestation. The vegetation in the adjoining area is also affected due to dumping.

d. The major threats of this activity include vegetation loss, forest fragmentation and biodiversity loss.

e. Since most mines fall in Eco-Sensitive Zones (ESZ), it has seriously affected the flora and fauna of the Western Ghats.

f. Black panthers have frequently been spotted at various locations in the Western Ghats and mining in these areas can seriously affect their health and numbers.

g. Certain species of *Ceropegia* and *Eriocaulon* that are endemic in the area have been reported to be critically endangered.

Hence it is most likely that bauxite mining in Western Ghats has adversely affected the critically endangered species like – Black panther, different *Ceropegia spp.*, *Eriocaulon spp.*

*[Source: Chandore A. (2015) Endemic and threatened flowering plants of Western Ghats with special reference to Konkan region of Maharashtra. Journal of Basic Sciences.2 (21-25)]*

**Q.23. At Andaman, authorities do not allow tourists to collect shells from beaches. Why must it be so? [2 Marks]**

**Ans:**

- Seashells are an important part of the coastal ecosystem and are crucial for the survival of various marine creatures.



- ii. They provide material for building nests of birds and also act as a substratum for attachment of algae, sea grass, sponges and various microbes.
- iii. Fishes use shells for hiding from predators, whereas hermit crabs use shells as temporary shelters.
- iv. Removal of seashells from seashores may also indirectly affect the rate of shoreline erosion.

Hence, in an attempt to protect the ecosystem, authorities in Andaman do not allow tourists to collect shells from beaches.

**Q.24. Internet my friend.** (Textbook page no.02)

**Collect information about Prof. Almeida, Prof. V. N. Naik, Dr. A. V. Sathe, Dr. P. G. Patwardhan with reference to their taxonomic work and biodiversity conservation.**

**Ans:**

- i. **Prof. Almeida:** Prof. (Dr.) Marselin R. Almeida was a renowned Plant Taxonomist and Medicinal Plant Consultant of India. He was a curator at the Blatter Herbarium (Mumbai). He discovered four new species of pteridophytes from Bombay presidency. His work includes - Pteridophytes of Maharashtra and Flora of Mahabaleshwar. He has contributed to the Flora of Maharashtra, Sawantwadi and its adjoining areas along with Dr. S. M. Almeida.
- ii. **Prof. V. N. Naik:** Prof. V. N. Naik is a renowned 'Angiosperms Taxonomist' of India. He completed the Flora of Marathwada. He has produced 15 Ph.D., 110 research articles and 6 books. His book on 'Taxonomy of Angiosperms' (Tata McGraw-Hill Education, 1984) is widely used throughout the world. He is currently a faculty of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.  
[Source: <http://www.bamu.ac.in/dept-of-botany/Achievements.aspx>]
- iii. **Dr. A. V. Sathe:** Collection and taxonomic studies of mushrooms in Maharashtra started around 1974. Prof. A.V. Sathe and his team were amongst the first to begin these studies. They recorded 75 species distributed in 43 genera. These species were collected from Maharashtra, Karnataka and Kerala. The collection of these species was documented in the form of a Monograph on Agaricales.  
[Source: Borkar P., Doshi A., Navathe D. (2015) Mushroom diversity of Konkan region of Maharashtra, India. *Journal of Threatened Taxa*. 7(10): 7625–7640]

- iv. **Dr. P. G. Patwardhan:** Dr. Patwardhan and his associates at the M.A.C.S. Research Institute, Pune-renamed as Agharkar Research Institute (ARI), Pune have performed detailed studies on lichens. His school is in possession of over 600 species of crustose lichens, obtained after intensive collection programmes. These specimens have been deposited in the Ajarekar Mycological Herbarium in the Department of Mycology and Plant Pathology at the M.A.C.S. Research Institute, Pune.

[Source:

[http://lib.unipune.ac.in:8080/xmlui/bitstream/handle/123456789/7451/07\\_introduction.pdf?sequence=7&isAllowed=y](http://lib.unipune.ac.in:8080/xmlui/bitstream/handle/123456789/7451/07_introduction.pdf?sequence=7&isAllowed=y)]

[Students are expected to find more information on their own.]

## 1.4 Museum

### Q.25. What is a museum? What are the various specimens found in a museum? [3 Marks]

**Ans:**

- i. **Museums** are the repositories where collections of preserved plant and animal specimens are kept.
- ii. The different types of specimens found in a museum include;
  - a. Plant and animal specimens preserved in formalin (10% to 40% formaldehyde) in transparent labelled jars.
  - b. Larger animals like birds and mammals, usually stuffed and preserved.
  - c. Certain specimens in dried forms are also exhibited in a museum.
  - d. Systematic collections of shells, skeletons of animals and insect boxes are also found in museums.



### READING BETWEEN THE LINES

Plants like algae, fungi, mosses and ferns are also preserved in museums since they cannot be maintained in botanical gardens.

### Q.26. What is taxidermy? [1 Mark]

**Ans:** Taxidermy is a science in which larger animals like birds and mammals are usually stuffed and preserved.

## 1.5 Zoological Parks

### Q.27. Write a note on zoological park. [2 Marks]

**Ans:**

- i. **Zoological park (zoo)** is a place where wild animals are kept in captivity.
- ii. Wild animals are kept in a protected environment and care is taken to provide conditions similar to their natural habitat.



- iii. It is a form of *ex situ* conservation of species i.e. away from their natural habitat.
- iv. A naturalist can study the food habits and behaviour of animals in a zoological park.

### GG - GYAN GURU



#### Zoo authorities in India

The Central Zoo Authority of India (CZA) is the governing authority of all zoos in India.

It enforces minimum standards and norms for the upkeep and health care of animals in Indian zoos. It also regulates the exchange of animals of endangered category (Wildlife Protection Act) among zoos. Exchange of animals between Indian and foreign zoos is also approved by the Authority.

**Q.28. Jijamata Udyan, the famous zoo in Mumbai has acclimatised the Humboldt penguins. Why should penguins be acclimatised when kept at a place away from their natural habitat? [2 Marks]**

**Ans:**

- i. Zoological park (zoo) is a type of *ex situ* conservation in which wild animals are kept in captivity.
- ii. Humboldt penguins are native to South America and the surrounding environment differs significantly at Jijamata Udyan (zoo) in Mumbai.
- iii. In order to ensure that these penguins survive longer and are healthy they need to be acclimatised (adjust) to their new environment slowly, otherwise they may develop abnormal stress and exhibit unusual behaviours.
- iv. These penguins may also be more prone to contracting certain diseases, since they are suited to living in a particular climatic condition.
- v. The enclosure of these penguins consists of water pool, air handling units and a chiller system to maintain temperatures between 12 – 14°C, where the penguins were kept for around 8 to 10 days to get acclimatised to their new environment before allowing any visitors inside the zoo.

Hence, Humboldt penguins need to be acclimatised to their new surroundings, when kept at a place away from their natural habitat.

### GG - GYAN GURU



#### Humboldt penguin

The Humboldt penguin are native to South America and live mainly in the 'Pinguino de Humboldt National Reserve' in the North of Chile. These penguins can reach the speed of 20 to 30 miles per hour, and dive to a depth of 492 feet to find food.

**Q.29. Can you tell? (Textbook page no. 03)**

**Why should we visit botanical gardens, museums and zoo? [2 Marks]**

**Ans:**

- i. Botanical gardens, museums and zoos are taxonomical aids that are used to study biodiversity.
- ii. **Botanical gardens** have a wide range of plant species that are protected and preserved which can be observed and studied.
- iii. **Museums** help gain information about various plants and animals that are preserved and may even be extinct. They act as reference hubs for biodiversity studies.
- iv. **Zoos** provide information about various animals like their food habits and behaviour. They also harbour certain endangered animals and help us understand the role of biodiversity conservation.

Hence, we should visit botanical gardens, museums and zoos.

**Q.30. Explain the different tools used for maintaining biodiversity records. [3 Marks]**

**Ans:** The different tools used for maintaining biodiversity records are as follows:

- i. **Flora:** It is the plant life occurring in a particular area at a particular time.
- ii. **Monograph:** It describes any one selected biological group.
- iii. **Manual:** It provides information and keys about identification of species found in a particular area.

## 1.6 Biodiversity Parks

**Q.31. Define biodiversity park. [1 Mark]**

**Ans:** **Biodiversity park** is an ecological assemblage of species that form self-sustaining communities on degraded/barren landscape. e.g. Uttamrao Patil Biodiversity Park, Gureghar, Mahabaleshwar.



Q.32. What do you understand from terms like *in situ* and *ex situ* conservation? [2 Marks]

Ans:

- In situ* conservation:** It includes conservation of species in their natural habitats. Grazing, cultivation and collection of products from the forests is banned in such areas. Legally protected areas include national parks, wildlife sanctuaries and biosphere reserves.
- Ex situ* conservation:** It includes conservation of species outside their natural habitats. Species are conserved in botanical gardens, culture collections and zoological parks.

Q.33. Can you tell? (Textbook page no. 03)

What is '*ex-situ*' and '*in-situ*' conservation?

[2 Marks]

Ans: Refer Q.32.



#### FOR YOUR KNOWLEDGE

Sacred groves are places where plants are conserved in the name of a holy place. These places are also considered as sacred natural sites by IUCN. Maharashtra has the highest number of documented sacred groves in India.

\*Q.34. Distinguish between botanical gardens, zoological parks and biodiversity parks with reference to their characteristics. [3 Marks]

Ans:

	Botanical Gardens	Zoological Parks	Biodiversity Parks
i.	Plants of different varieties collected from different parts of the world are grown <i>in vivo</i> in a scientific and systematic manner in a botanical garden.	Zoological parks are places where wild animals are kept in captivity.	It is an assemblage of species that form self-sustaining communities on degraded/barren landscape.
ii.	It is a type of <i>ex situ</i> conservation.	It is a type of <i>ex situ</i> conservation.	It is a type of <i>in situ</i> conservation.
iii.	It is related to conservation of various flora.	It is related to conservation of various fauna.	It is related to conservation of all biodiversity.



#### FOR YOUR KNOWLEDGE

(Textbook page no. 4)

- Dr. S. P. Agharkar is one the leading botanists of India. He was born in November 1884 in Malvan, Maharashtra. He discovered a species of freshwater jellyfish in the Western Ghats, which was previously found only in Africa and published his findings in the journal Nature in 1912.
- Dr. Agharkar collected, preserved and conducted microscopic examinations of animals and plants with the help of Dr. Annadale, the Superintendent of the Indian Museum in Kolkata.
- Agharkar also studied the flora of Nepal and the Western Ghats and was a scholar on gymnosperms and angiosperms.
- Agharkar played an important role in laying the foundations for premier Indian scientific institutions like the Indian National Science Academy, Indian Science Congress the Maharashtra Association for Cultivation of Sciences (MACS) in Pune. MACS has been renamed as ARI (Agharkar Research Institute) after Dr. S. P. Agarhkar.

## 1.7 Key

Q.35. Write a note on 'key' used as a taxonomical aid. [2 Marks]

[2 Marks]

Ans:

- Key is a taxonomical aid used in the classification of plants and animals.
- Keys are based on contrasting characters. One of the contrasting characters gets accepted and the other gets rejected.
- The statement in a key is called a lead.
- Normally keys are analytical in nature.

Scan the given Q. R. Code in Quill - The Padhai App for additional information on the topic.



**Q.36. Name the following.****[1 Mark Each]**

- A collection of dried plant specimen that are pressed, treated and mounted on a standard size sheet in order to preserve it.
- Places where collections of preserved plant and animal specimens are kept.
- Taxonomical aid used for classification of plants and animals which is based on contrasting characters.

**Ans:**

- Herbarium
- Museum
- Key

**Q.37. Answer the following.****[1 Mark Each]**

- What is the statement in a key called?
- Which chemical is used to preserve the plant and animal specimens, typically in transparent jars?

**Ans:**

- Lead
- Formalin

**Q.38. Internet my friend. (Textbook page no. 04)**

- Collect information about botanical gardens, zoological parks and biodiversity hotspots in India.

**Ans:****a. Botanical gardens in India:**

No.	Botanical Gardens of India	Location
1.	Acharya Jagadish Chandra Bose Indian Botanic Garden	Kolkata
2.	Lloyd Botanical Garden	Darjeeling
3.	National Botanical Research Institute	Lucknow
4.	Botanical Garden of the Forest Research Institute	Dehradun
5.	The State Botanical Garden	Odisha
6.	Botanical Garden	Saharanpur
7.	Government Botanical Garden	Ootacamund

**b. Zoological Parks in India:**

No.	Zoological parks	Location	Type of animals
1.	Rajiv Gandhi Zoological Park	Pune [Katraj]	Reptiles, mammals, birds. They have a snake park.
2.	Jijamata Udyan	Mumbai	Endangered species of animals and birds.
3.	Nehru Zoological Park	Hyderabad	3500 species of birds, animals and reptiles.
4.	Indira Gandhi Zoological Park	Vishakhapatnam	Primates, carnivores, small mammals, reptiles and birds.
5.	Padmja Naidu Himalayan Zoological Park	Darjeeling	Endangered animals like snow leopards, red pandas, gorals (mountain goat), Siberian tigers and a variety of endangered bird species.
6.	Allen Forest Zoo	Kanpur	Hyena, Bear, Rhinoceros, Hippopotamus, Langoor, Musk deer, Ostrich, Emu, Crane etc.
7.	Lucknow Zoo	Lucknow	Royal Bengal Tiger, White Tiger, Gibbon, Black Bear, Asiatic Elephant, Great pied, Horn Bill etc.
8.	Alipore Zoological Gardens	Kolkata	Royal Bengal Tiger, African Lion, Hippopotamus, Great Indian One-horned Rhinoceros.
9.	The Madras Crocodile Bank Trust	Chennai	Crocodiles and many species of turtles, snakes and lizards.
10.	Parassinikkadavu Snake Park	Kannur	Spectacled Cobra, King Cobra, Russell's Viper, Krait and Pit Viper.

**c. Biodiversity hotspots in India:**

No.	Biodiversity Hotspots
1.	The Eastern Himalayas (Arunachal Pradesh, Bhutan, Eastern Nepal)
2.	Indo - Burma (Purvanchal Hills, Arakan Yoma, Eastern Bangladesh)
3.	The Western Ghats and Srilanka

[Students are expected to use the given table as reference and collect more information on their own.]





ii. **Collect information of endemic flora and fauna of India.**

Ans:

- a. **Endemic flora:** *Albizia sikharamensis* (Mimosaceae), *Argyrea arakuensis* (Convolvulaceae), *Arundinella setosa* (Poaceae), *Acacia diadema* (Mimosaceae), *Citrus assamensis* (Rutaceae), *Magnolia bailloni* (Magnoliaceae), etc.  
[Source: [http://www.bsienviis.nic.in/Database/E\\_3942.aspx](http://www.bsienviis.nic.in/Database/E_3942.aspx)]
- b. **Endemic fauna:** Bare Bellied Hedgehog (*Paraechinus nudiventris*), Andaman Shrew (*Crocidura andamanensis*), Aruanchal Macaque (*Macaca munzala*), Car Nicobar Rat (*Rattus palmarum*), Peter's Tubenosed Bat (*Harpiola grisea*) etc.  
[Source: <http://faunaofindia.nic.in/PDFVolumes/spb/056/index.pdf>]  
[Students are expected to use the given sources and find more information on their own.]

### Practical / Project

\*Q.39. **Make a herbarium under the guidance of your teacher.**

[Students are expected to perform the given activity by themselves under the guidance of their teacher.]

🔗Q.40. **Find out information about any one sacred grove (Devrai) in Maharashtra.**

Ans: Sacred groves in Maharashtra are located in districts like Ahmednagar, Bhandara, Chandrapur, Jalgaon, Kolhapur, Nashik, Pune, Raigad, Ratnagiri, Sangli, Satara, Sindhudurg, Thane, Yavatmal.

[Source: Data as per C.P.R. Environment Education Centre, Chennai.]

**e.g. Sacred grove of Parinche valley, Pune district of Maharashtra:**

The Parinche valley region is comprised of the inaccessible rear part of the Purandhar fort and its surrounding valley region and is situated about 63 km to the southeast of Pune city and 18 km from Saswad town. The total area of the valley region is about 132 sq. km. Parinche is the biggest village and a nodal place in the valley. The majority (12) of the documented groves are located in the Kaldari and Pangare zones. The size of the sacred groves has however reduced due to various human related activities that have taken place in recent years. The biggest sacred grove in the Parinche valley belongs to Buvasaheb of Tonapewadi and spreads over an area of 4.80 hectares. The forest types are unique to the groves. Presence of key species in the sacred groves varies from region to region. Two key tree species, i.e. *Terminalia bellerica* and *Ficus* spp., are present in these sacred groves which have almost disappeared from the surrounding areas. Large buttressed trees are another important feature of well-preserved sacred groves. The presence of these tree species indicates the vegetation of

the past and also the type of potential vegetation that can be regenerated in these regions.

[Source: Waghchaure, C. K., Tetali, P., Gunale, V. R., Antia, N. H., & Birdi, T. J. (2006). Sacred Groves of Parinche Valley of Pune District of Maharashtra, India and their Importance. *Anthropology & Medicine*, 13(1), 55–76]

[Students can refer the given answer and search for more information about other sacred groves on their own.]

Q.41. **Rakesh went for a study tour to the nearest national park. There he found some different plant species. He was not aware about their names and family. He wanted to bring that plants to his college and keep them for longer period of time, so that he can study them thoroughly. What should he do in such a situation?**

Ans:

- Rakesh can press and mount the plant specimen on the herbarium sheet and can preserve the dried plant material.
- He can also write any information he knows about the plant on herbarium sheet, which can be used for further studies.

### Brain Teasers

Q.42. **While doing his Ph.D. in Plant Taxonomy your friend has come across a plant, which he feels is a new species. How can he confirm the same?**

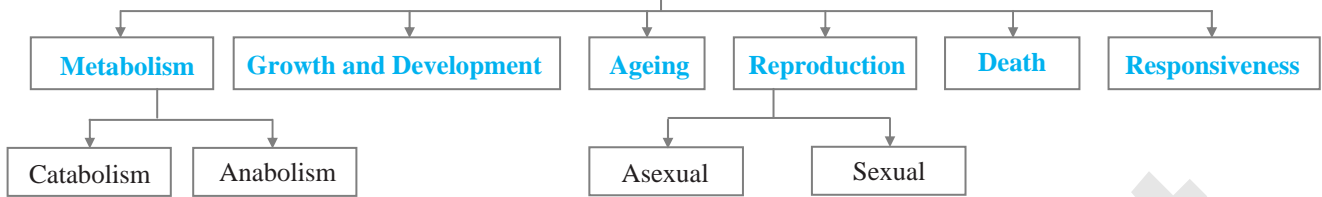
Ans:

- The newly discovered plant can be identified with the help of taxonomic keys, monographs, floras, herbaria and preserved plant specimens.
- A separate taxonomic key is available for each taxonomic category.
- The individual would have to study the morphological and anatomical features of the plant and compare it with the existing information available in the scientific literature

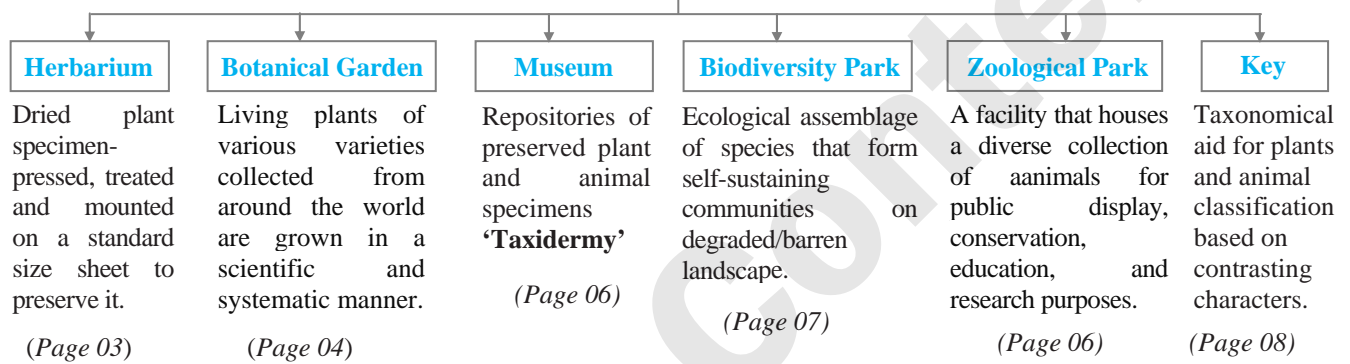


## Quick Review

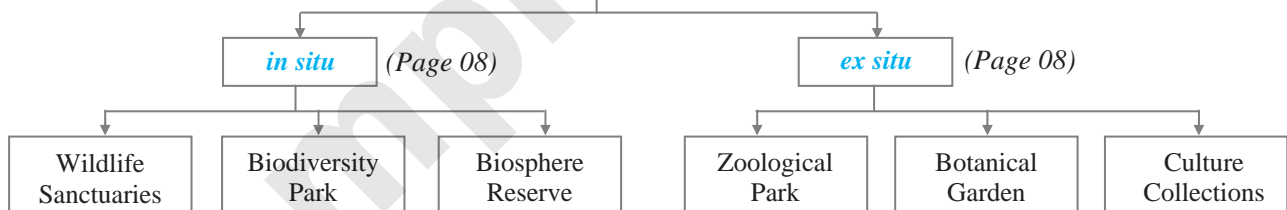
## Basic Principles of Life (Page 02)



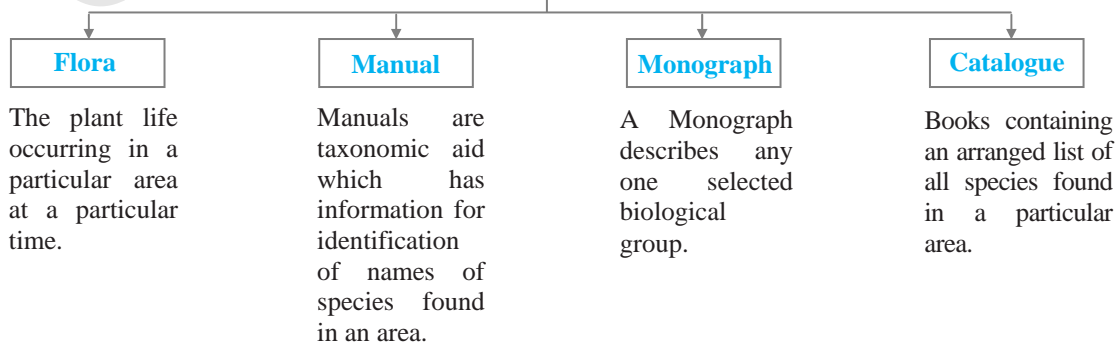
## Taxonomical Aids



## Conservation of Biodiversity



## Tools for Maintaining Biodiversity Records (Page 07)





## Exercise

### 1.1 Basic Principles of Life

1. Define metabolism. [1 Mark]

**Ans:** Refer Q.3. (i)

2. Enlist the basic principles of life. [2 Marks]

**Ans:** Refer Q.3.

3. Reproduction is not an inclusive character of life. Explain. [2 Marks]

**Ans:** Refer Q.5.

4. Define taxonomical aids and give two examples [2 Marks]

**Ans:** Refer Q.8.

### 1.2 Herbarium

5. i. Define herbarium. [1 Mark]

ii. Mention any four essentials of a good herbarium. [2 Marks]

**Ans:**

i. Refer Q.10.

ii. Refer Q.11. [Any four points]

6. Shanaya found a unfamiliar plant on her visit to Tamil Nadu. She wants to study the plant thoroughly in her laboratory? How can she do so? [2 Marks]

**Ans:** Refer Q.13.

7. Manas wants to prepare a herbarium of plants.

i. What is a herbarium?

ii. What are the essentials he should keep in mind to prepare a good herbarium?

iii. What information should be added on the label of a herbarium? [4 Marks]

**Ans:**

i. Refer Q.10. ii. Refer Q.11.

iii. Refer Q.11. (v)

### 1.3 Botanical Garden

8. Can humans help in conservation of biodiversity? Explain your answer. [2 Marks]

**Ans:** Refer Q.20.

9. Write a note on botanical gardens. [3 Marks]

**Ans:** Refer Q.14. and 16.

10. Botanical gardens are important in botanical studies. Justify. [3 Marks]

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

11. Suggest any three measures you can take to prevent loss of biodiversity. [3 Marks]

**Ans:** Refer Q.21.

12.

i. Define biodiversity.

ii. How does loss of biodiversity affect the ecosystem? [3 Marks]

**Ans:**

i. Refer Q.17.

ii. Refer Q.19.

13. Define botanical garden and write a note on importance of greenhouses in botanical gardens. [3 Marks]

**Ans:** Refer Q.14 and 15.

### 1.4 Museum

14. Which science is used to preserve larger animals at museums? [1 Mark]

**Ans:** Refer Q.26.

15. What is a museum? [1 Mark]

**Ans:** Refer Q.25. (i)

16. What chemical is used to preserve plant and animal specimens in transparent jars at museums? [1 Mark]

**Ans:** Refer Q.25. (ii-a)

### 1.5 Zoological Park

17. Define the following terms: [1 Mark Each]

i. Flora

ii. Monograph

iii. Manual

**Ans:** Refer Q.30.

### 1.6 Biodiversity Parks

18. Define the following terms: [1 Mark Each]

i. Botanical garden

ii. Zoological parks

iii. Biodiversity parks

iv. Museum

v. Herbarium

**Ans:**

i. Refer Q.14.

ii. Refer Q.27. (i)

iii. Refer Q.31.

iv. Refer Q.25. (i)

v. Refer Q.10.

### 1.7 Key

19. On what characters is the taxonomical aid 'key' based on? [1 Mark]

**Ans:** Refer Q.35.

## Multiple Choice Questions

[1 Mark Each]

\*1. Which is NOT a property of living beings?

(A) Metabolism

(B) Decay

(C) Growth

(D) Reproduction



2. Which one of the following aspects is an inclusive characteristic of living things?  
 (A) Isolated metabolic reactions occurring *in vitro*  
 (B) Reproduction  
 (C) Irritability  
 (D) Increase in mass by accumulation of material on surface
3. Which of the following property is shown by both living and non-living things?  
 (A) Growth (B) Consciousness  
 (C) Ageing (D) Metabolism
- \*4. A group of students found two cockroaches in the classroom. They had a debate whether they are alive or dead. Which life property will help them to do so?  
 (A) Metabolism (B) Growth  
 (C) Irritability (D) Reproduction
- \*5. A particular plant is strictly a seasonal plant. Which one of the following is best suited if it is to be studied in the laboratory?  
 (A) Herbarium (B) Museum  
 (C) Botanical garden (D) Flower exhibition
6. Herbarium is  
 (A) a collection of living plants which are medicinally important  
 (B) a place where plants collected from different parts of the world are grown  
 (C) a garden where herbs are cultivated  
 (D) a collection of dried and preserved plants
7. A zoological park does not  
 (A) have wild animals in captivity under human care.  
 (B) provide conditions similar to their natural habitat of animals.  
 (C) have a systematic collection of shells and skeletons of animals  
 (D) enable naturalists to study the food habits and behaviour of wild animals.
8. A naturalist can study food habits and behaviour of animals in a  
 (A) museum (B) zoological park  
 (C) botanical garden (D) herbarium
9. Which of the following is NOT a tool of maintaining biodiversity records?  
 (A) Flora (B) Monograph  
 (C) Fauna (D) Manual
10. Which of the following tools provides information for identification of names of species found in a particular area?  
 (A) Catalogues (B) Manuals  
 (C) Flora (D) Monographs
11. Keys are taxonomical aids that  
 (A) are used to identify plants and animals based on similarities and dissimilarities.  
 (B) contains the account of habitat and distribution of plants in a given area.  
 (C) provides an index to the plant species found in a particular area.  
 (D) provide information for identification of species found in an area.

### Answers to Multiple Choice Questions:

1. (B) 2. (C) 3. (A) 4. (C)  
 5. (A) 6. (D) 7. (C) 8. (B)  
 9. (C) 10. (B) 11. (A)

### Competitive Corner

1. Which one of the following is NOT a correct statement? [NEET 2013]  
 (A) Herbarium houses dried, pressed and preserved plant specimens.  
 (B) Botanical gardens have collection of living plants for reference.  
 (C) A museum has collection of photographs of plants and animals.  
 (D) Key is a taxonomic aid for identification of specimens.
2. The label of a herbarium sheet does not carry information on [NEET P-II 2016]  
 (A) height of the plant (B) date of collection  
 (C) name of collector (D) local names
3. Match the items given in Column I with those in Column II and select the correct option given below: [NEET (UG) 2018]

Column I		Column II	
i.	Herbarium	a.	It is a place having a collection of preserved plants and animals
ii.	Key	b.	A list that enumerates methodically all the species found in an area with brief description aiding identification
iii.	Museum	c.	It is a place where dried and pressed plant specimens mounted on sheets are kept
iv.	Catalogue	d.	A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

- (A) i-b, ii-d, iii-c, iv-a  
 (B) i-c, ii-b, iii-a, iv-d  
 (C) i-a, ii-d, iii-c, iv-b  
 (D) i-c, ii-d, iii-a, iv-b

### Answers to Competitive Corner:

1. (C) 2. (A) 3. (D)

**Topic Test****Time: 1 Hour 30 Min****Total Marks: 25****SECTION A****Q.1. Select and write the correct answer:****[04]**

- i. The technique in which larger animals like birds and mammals are usually stuffed and preserved is known as  
(A) Monograph (B) Herbarium (C) Taxidermy (D) Manual
- ii. \_\_\_\_\_ are the places where collection of preserved plant and animal specimen are kept.  
(A) Zoological park (B) Museum (C) Botanical garden (D) Manual
- iii. Which of the following statement is INCORRECT?  
(A) Key is taxonomical aid used for classification of plants and animals.  
(B) The keys are based on contrasting characters.  
(C) The statement in key is called as monograph.  
(D) Normally keys are analytical in nature.
- iv. \_\_\_\_\_ is shown by both living and non-living things.  
(A) Ageing (B) Consciousness (C) Growth (D) Metabolism

**Q.2. Answer the following:****[03]**

- i. Define biodiversity.
- ii. What are sacred groves?
- iii. Which chemical is commonly used to preserve plant and animal specimens in museum?

**SECTION B****Attempt any Four:****[08]**

- Q.3. Priya wants to prepare a herbarium of plants. Mention any four essentials of a good herbarium.
- Q.4. i. What are taxonomical aids?  
ii. Give any two examples.
- Q.5. Write a short note on zoological park.
- Q.6. What is *in-situ* and *ex-situ* conservation?
- Q.7. During a field visit to Andaman, Rahul observed that some volunteers were not allowing tourist to collect shells from the beaches. When he asked his teacher, she replied that it is an attempt to protect the ecosystem and explained the importance of seashells. What might have been her explanation?
- Q.8. The loss of biodiversity matters. Give reason.

**SECTION C****Attempt any Two:****[06]**

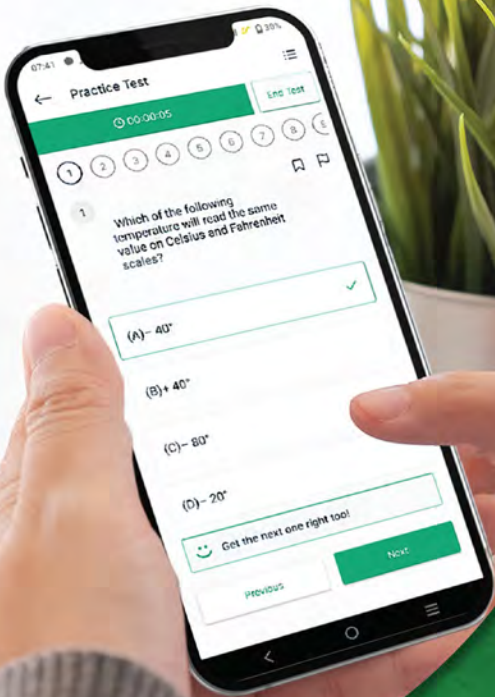
- Q.9. Describe any three basic principles of life.
- Q.10. Explain the importance of botanical garden.
- Q.11. Define the following terms.  
i. Flora                      ii. Monograph                      iii. Manual

**SECTION D****Attempt any One:****[04]**

- Q.12. Distinguish between living and non-living things based on the following parameters:  
i. Growth                      ii. Reproduction                      iii. Metabolism  
iv. Irritability                      v. Ageing
- Q.13. Jijamata Udyan, the famous zoo in Mumbai has acclimatised the Humboldt penguins. Why should penguins be acclimatised when kept at a place away from their natural habitat?

Scan the given Q. R. Code in *Quill - The Padhai App* to view solutions of Topic Test:





Give your XI<sup>th</sup> exam preparation the **TECHNOLOGY BOOST!**

Practice more than  
**4,500 MCQs**  
for just **₹499/-**

Use Coupon Code  
**QUILLPADHAI2023**



Also available for X<sup>th</sup>, XII<sup>th</sup>, MHT-CET, NEET & JEE

- Practice chapter-wise & full syllabus MCQs in test format
- Get instant verification of your answer
- Detailed analysis of every test on completion
- Option to save questions for future reference



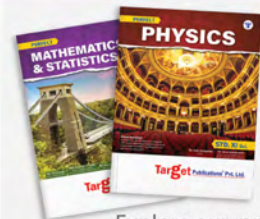
Scan QR Code to download the app

Visit our website to know more about our range of books for **X<sup>th</sup>, XII<sup>th</sup>, MHT-CET, NEET & JEE**

**Visit Our Website**

Published by:

**Target Publications<sup>®</sup> Pvt. Ltd.**  
Transforming lives through learning



Explore our range of **STD. XI Sci. Books**

📍 B2, 9<sup>th</sup> Floor, Ashar, Road No. 16/Z, Wagle Industrial Estate, Thane (W)-400604 | 📞 88799 39712 / 14 | 📱 88799 39713 / 15

🌐 [www.targetpublications.org](http://www.targetpublications.org) ✉ [mail@targetpublications.org](mailto:mail@targetpublications.org)