Class 9 Biology Notes 2026

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For Pakistani Students

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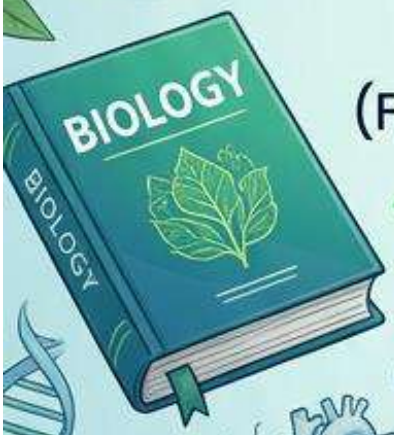


Chapter 1 The Science of Biology

1.1 Biology and its Branches

Multiple Choice Questions (MCQs)

1. **Biology is the study of:**
   Ⓐ Chemical reactions Ⓑ Geological formations
   Ⓒ Living organisms Ⓓ Non-living matter
2. **The word "Biology" is derived from:**
   Ⓐ Sanskrit words Ⓑ Arabic words
   Ⓒ Latin words Ⓓ Greek words
3. **The field of Biology that deals with the study of animals is called:**
   Ⓐ Microbiology Ⓑ Botany Ⓒ Zoology Ⓓ Ecology
4. **The study of plants, including their growth and reproduction, is known as:**
   Ⓐ Genetics Ⓑ Botany Ⓒ Zoology Ⓓ Microbiology
5. **Microbiology focuses on the study of:**
   Ⓐ Microorganisms Ⓑ Animals Ⓒ Plants Ⓓ Ecosystems
6. **Microorganisms studied in Microbiology include:**
   Ⓐ Amphibians and reptiles Ⓑ Mammals and birds
   Ⓒ Trees and shrubs Ⓓ Bacteria and microscopic fungi
7. **The term "bios" in the word Biology means:**
   Ⓐ Study Ⓑ Organism Ⓒ Life Ⓓ Nature
8. **Understanding Biology helps to address issues related to:**
   Ⓐ Health, food, and environment Ⓑ Geological formations
   Ⓒ Space exploration Ⓓ Technology and energy
9. **The three major fields of Biology include:**
   Ⓐ Genetics, Ecology, and Physiology
   Ⓑ Biochemistry, Physiology, and Zoology
   Ⓒ Botany, Microbiology, and Ecology
   Ⓓ Zoology, Botany, and Microbiology
10. **Physiology deals with the functioning of:**
    Ⓐ Cells Ⓑ Body parts Ⓒ Tissues Ⓓ Organs

8. Explain the role of Physiology in Biology. (OR)

- **How does Physiology contribute to understanding the body?**

Ans. **Physiology** is the branch of Biology that deals with the functioning of body parts.

Example: How the blood circulatory system transports vital substances throughout the body.

9. What is the focus of Embryology? (OR)

- **What is the importance of studying Embryology in Biology?**

Ans. **Embryology** is the study of the process of development of organism from fertilized egg. In this branch, scientists study tissue and organ formation, identify birth defects, and develop medical treatments.

10. Define Genetics.

Ans. **Genetics** is the branch of Biology that deals with the study of transfer of characteristics from parents to offspring. In Genetics, scientists also study the causes of genetic diseases, and develop better varieties of plants and animals.

11. What is Molecular Biology?

Ans. **Molecular Biology** deals with the study of biological molecules like carbohydrates, proteins, lipids, and nucleic acids. Molecular biologists also study fundamental life processes, develop drugs, and create genetically modified organisms.

12. How do the branches of Biology like Genetics and Molecular Biology overlap?

Ans. **Genetics** deals with the transfer of characteristics from parents to offspring, while **Molecular Biology** studies biological molecules and fundamental life processes, both contributing to understanding genetic diseases and improving living organisms varieties.

13. What is Histology and why is it important? (OR)

- **Explain the connection between Histology and disease diagnosis.**

Ans. **Histology** is the microscopic study of tissues. Tissues are groups of cells that have similar functions.

Importance: Tissue examination helps in disease diagnosis, drug studies, and understanding organ structure and function.

14. Explain the significance of Palaeontology. (OR)

- **Why is the study of fossils important in Palaeontology? (OR)**
- **Why are fossils significant in Palaeontology?**

Ans. **Palaeontology** is the branch of Biology that deals with the study of fossils. The examination of fossils helps scientists to know the evolutionary history of organisms.

Example: Dinosaur fossils provide evidence of giant reptiles that roamed the Earth millions of years ago.

15. Define Fossils.

Ans. **Fossils** are the remains of plants and animals that were preserved in rocks and other geological formations.

Example: The oldest known fossil is a cyanobacterium, estimated to be 3.4 billion years old.

16. How does Taxonomy help in the study of Biology? (OR)

- **How does Taxonomy help in understanding the diversity of life?**

Ans. **Taxonomy** is the branch of Biology that deals with the classification of organisms into groups on the basis of similarities and differences.

Importance: Classification of organisms helps to organize and understand the diversity of life, identify new species, and study evolutionary relationships.

17. What is the role of Ecology in Biology? (OR)

- **What role does Ecology play in the food chain?**

Ans. **Ecology** is the branch of Biology that deals with the relationships between organisms and their environment.

Importance: Ecology helps to conserve biodiversity and address environmental problems. The food chain, **for instance,** illustrates the interconnectedness of organisms for energy and nutrients.

18. Why is Marine Biology important?

Ans. **Marine Biology** is the branch of Biology that deals with the study of life in oceans.

Importance: It helps to understand ocean biodiversity, discover new species, and address marine conservation issues.

Example: Coral reefs support a wide variety of marine life.

19. What is the role of Pathology in understanding diseases? (OR)

- **What is the importance of studying Pathology?**

Ans. **Pathology:** Pathology is the study of diseases, their causes, and effects. Pathology helps in disease diagnosis, prevention, and treatment.

Example: Pathologist studies how the uncontrolled division and spread of cells causes cancer.

20. What does Immunology focus on?

Ans. **Immunology** is the branch in which we study the components of the immune system and their role against diseases.

Importance: Immunologists study to develop vaccines, treat, autoimmune diseases, and improve immune responses to infections.

21. Describe the field of Pharmacology and its importance. (OR)

- **How does the study of Pharmacology help in treating diseases?**

Ans. **Pharmacology** is the branch in which we study drugs and their effects on the body.

Importance: This helps in the development of new drugs.

Example: New antibiotics are developed that are used to kill bacteria and treat bacterial infections.

☆ **Similarity and Difference-Based Short Questions**

1. How are Anatomy and Histology similar?

Ans. Both Anatomy and Histology involve studying the structure of organisms, but **Anatomy** focuses on the whole body, while **Histology** studies tissues at a microscopic level.

2. What is the key difference between Physiology and Pharmacology?

Ans. **Physiology** studies the functioning of body parts, while **Pharmacology** focuses on the effects of drugs on the body.

3. How do Pathology and Immunology relate to each other?

Ans. Both study aspects of diseases, but **Pathology** focuses on causes and effects, while **Immunology** studies the immune system's role in fighting diseases.

4. How are Genetics and Pathology connected?

Ans. Both study aspects of diseases, but **Genetics** focuses on genetic causes, while **Pathology** studies diseases in general, including their physical and environmental causes.

1.2 *Relation of Biology with other Sciences*

Multiple Choice Questions (MCQs)

1. Biochemistry is concerned with the study of:

Ⓐ Species distribution Ⓑ Chemical reactions in organisms

Ⓒ Climate change effects Ⓓ Biological processes in physics

2. Biophysics applies the principles of Physics to:

Ⓐ Biological processes Ⓑ Cell chemistry

Ⓒ Organism distribution Ⓓ Genetic modification

3. **Computational Biology uses models and algorithms to:**
   Ⓐ Analyze proteins Ⓑ Diagnose diseases
   Ⓒ Study climate change Ⓓ understand biological systems
4. **Biogeography focuses on the study of:**
   Ⓐ living organisms distribution Ⓑ Cell composition
   Ⓒ Medical treatments Ⓓ Biological molecules
5. **Biostatistics involves the use of statistics to:**
   Ⓐ Study species Ⓑ Develop drugs
   Ⓒ Analyze biological data Ⓓ Understand molecules
6. **Biotechnology involves using organisms to:**
   Ⓐ Study climate change Ⓑ Produce beneficial products
   Ⓒ Study inheritance Ⓓ Study geological history
7. **Bio-economics studies organisms from an:**
   Ⓐ Ecological perspective Ⓑ Evolutionary perspective
   Ⓒ Environmental perspective Ⓓ Economical point of view
8. **An example of Biochemistry is the study of:**
   Ⓐ Muscle function Ⓑ Species distribution
   Ⓒ Photosynthesis reactions. Ⓓ Genetic engineering
9. **Biophysics helps us to understand:**
   Ⓐ Energy transfer Ⓑ Muscle and joint function
   Ⓒ Biochemical processes Ⓓ Climate change
10. **Biotechnology helps in healthcare by:**
    Ⓐ Producing insulin Ⓑ Studying environment
    Ⓒ Calculating costs Ⓓ Analyzing cell structure
11. **Biogeography helps us understand the effect of:**
    Ⓐ Physical laws Ⓑ Climate on species
    Ⓒ Statistical trends Ⓓ Molecular interactions

MCQ's Key

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

Short Answered Questions

1. **What does Biochemistry study?**

Ans. **Biochemistry** is the study of the structure and reactions of different chemical substances present in living systems.

Example: The study of the chemical reactions of photosynthesis and respiration are examples of Biochemistry.

2. Which branch of Biology applies Physics principles to biological processes? **(OR)**

- **How does Biophysics help in understanding the functions of muscles and joints?**

Ans. **Biophysics** deals with the study of the principles of Physics, which apply to biological processes.

Example: In Biophysics we study the rules of lever and motion for understanding the function of muscles, bones and joints.

3. Which branch of Biology uses computer simulations to analyze biological systems? **(OR)**

- **How does Computational Biology assist in analyzing biological data like protein sequences?**

Ans. In **Computational Biology,** scientists use Mathematical models, algorithms, and computer simulations to understand biological systems and relationships. It involves analysing biological data, such as sequence of amino acids remove in a protein.

4. What does Biogeography focus on?

Ans. **Biogeography** deals with the study of the distribution of living organisms in different geographical regions of the world. The influence of climate change on the distribution of organisms is also studied in Biogeography.

5. What is the role of Biostatistics in biological research? **(OR)**

- **Why is Biostatistics essential in biological and healthcare research?**

Ans. **Biostatistics** deals with the principles of statistics to analyse and interpret data related to living organisms. Biostatistics plays a crucial role in biological research, healthcare and public health etc.

6. How is Biotechnology beneficial in healthcare? **(OR)**

- **In what way does Biotechnology improve agricultural and medical fields?** **(OR)**
- **How can Biotechnology use bacteria to treat diabetic patients?**

Ans. **Biotechnology** deals with the use of living organisms or their components to develop beneficial products or processes for various fields, Including healthcare, agriculture, and environmental management.

Example: Biotechnologists use bacteria for the production of insulin to treat diabetic patients.

7. **What does Bio-economics study?** **(OR)**

• **What makes Bio-economics relevant to modern biological projects?**

Ans. **Bio-economics** deals with the study of organisms from economical point of view. In bio-economics, scientists calculate the cost and profit of the biological projects e.g. production of new variety of crops.

8. **How are Biochemistry and Biophysics similar?**

Ans. Both Biochemistry and Biophysics study the processes and functions occurring in living organisms, with **Biochemistry** focusing on chemical reactions and **Biophysics** applying Physics principles to biological processes.

1.3 *Careers in Biology*

Multiple Choice Questions (MCQs)

1. **The field that studies the effects of drugs on the human body is called:**
   Ⓐ Forensics Ⓑ Biotechnology Ⓒ Public Health Ⓓ Pharmacology

2. **Fisheries and wildlife studies are related to:**
   Ⓐ Animal Husbandry Ⓑ Agriculture
   Ⓒ Zoology and Aquaculture Ⓓ Forestry

3. **Animal Husbandry involves the breeding and caring for:**
   Ⓐ Plants Ⓑ Livestock Ⓒ Microorganisms Ⓓ Fish

4. **The field related to cultivating fruits, vegetables, and ornamental plants is:**
   Ⓐ Forestry Ⓑ Biotechnology
   Ⓒ Veterinary Medicine Ⓓ Horticulture

5. **Forensic scientists help in criminal investigations by:**
   Ⓐ Analyzing microorganisms Ⓑ Studying the effects of drugs
   Ⓒ Treating animal diseases
   Ⓓ Analyzing physical evidence from crime scenes

6. **Veterinary Medicine involves the diagnosis and treatment of diseases in:**
   Ⓐ Animals Ⓑ Humans Ⓒ Plants Ⓓ Microorganisms

7. **Environmental Science deals with solving issues related to:**
   Ⓐ Diseases Ⓑ Pollution and natural resources
   Ⓒ Food production Ⓓ Genetic conditions

8. **A person with a BS degree in Microbiology is likely to:**
   Ⓐ Study human behavior Ⓑ Treat animal diseases
   Ⓒ Advise on diet and nutrition
   Ⓓ Conduct research on microorganisms
9. **A Biomedical Engineer would be involved in:**
   Ⓐ Designing medical equipment
   Ⓑ Studying environmental conservation
   Ⓒ Developing new drugs Ⓓ Conducting genetic research

MCQ's Key

1	Ⓓ	2	Ⓒ	3	Ⓑ	4	Ⓓ	5	Ⓓ	6	Ⓐ	7	Ⓑ	8	Ⓓ	9	Ⓐ

Short Answered Questions

1. **What does the profession of Medicine deal with?**

Ans. The profession of **medicine** deals with the diagnosis and treatment of diseases. For this profession, students need to complete a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.

2. **What is the role of surgery in the medical field?**

Ans. In **surgery** the defective parts of the body are repaired, replaced or removed. For this profession, students need to complete a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.

3. **Write a note on Dentistry.**

Ans. **Dentists** specialize in oral health. They diagnose and treat dental diseases and perform surgeries. For this profession, students get a 4-year Bachelor of Dental Surgery (BDS) degree.

4. **What do Pharmacologists study and develop?**

Ans. **Pharmacologists** study the effects. of drugs on human body and develop new medications, For this career, a Bachelor of Studies (BS) degree in Pharmacy or Doctor of Pharmacy (D.Pharm) degree is required..

5. **What is physiotherapy?**

Ans. It is the therapy that is used to restore movement and physical function of body that has been impaired by disease or injury.

6. **How do Physiotherapists help patients to restore movement?**

Ans. **Physiotherapists** use physical exercise and physical modalities (such as massage) to improve patient's physical movement. To become a physiotherapist, a 4-year BS degree in Physical Therapy or Physiotherapy is needed.

7. What is the required degree for Fisheries and Wildlife careers?

Ans. Fisheries and wildlife departments also offer jobs to the biologists after a BS and Master of Studies (MS) degree in Zoology, Fisheries or Aquaculture.

8. What field focuses on improving farming practices and crop production?

Ans. Agricultural scientists improve farming practices, crop production, and sustainable agriculture techniques. A 4-year BS degree in Agriculture is required.

9. What is the main focus of Animal Husbandry?

Ans. The field of **Animal Husbandry** involves breeding and caring for livestock to improve their quality and productivity. For it, students can pursue a 4-year BS degree in Animal Husbandry.

10. What do Horticulturists specialize in cultivating?

Ans. **Horticulturists** cultivate fruits, vegetables, flowers, and ornamental plants. A 4-year BS degree in Horticulture is required for it.

11. What is the role of Foresters in managing natural resources?

Ans. Foresters manage and conserve forests and wildlife. A 4- year BS degree in Forestry is necessary.

12. What do Farmers grow and raise for food and other products?

Ans. The professionals of **farming** prepare farms e.g., animals farms, poultry farms, fruit farms. In such farms, they grow crops and raise animals for food and other products. A 4-year BS degree in Agriculture or specific farming courses is required for this profession.

13. What do Biotechnologists use biological processes for?

Ans. Biotechnologists use biological processes to develop products and technologies in medicine, agriculture, and more. A 4-year BS degree in Biotechnology is required for this.

14. What do Forensic scientists analyze in criminal investigations?

Ans. Forensic scientists analyse physical evidence from crime scenes in criminal investigations. A 4-year BS degree in Forensic Science is needed for this.

15. What is the focus of Veterinary Medicine?

Ans. The focus of **veterinary medicine** is diagnosis and treatment of diseases in animals and surgeries in animals.

16. What does Environmental Science aim to solve?

Ans. **Environmental Science** aims to solve issues related to pollution and natural resources.

17. What does Genetic Counseling provide support for?

Ans. **Genetic Counseling** helps in providing support to people on genetic conditions and testing.

18. What is the career choice for someone interested in promoting healthy eating habits?

Ans. Career choice for someone interested in promoting healthy eating habits is **Nutrition and Dietetics.**

19. What is the focus of Public Health?

Ans. The focus of **public health** is in improving the health of communities through education, policy-making, and research.

20. What do Biomedical Engineers design and make?

Ans. **Biomedical Engineers** work for designing and making medical equipment to improve patient care.

21. What is the main task of Bioinformatics?

Ans. The main task of **bioinformatics** is the analysis of biological data by using computational tools.

1.4 *Quranic Instructions to Reveal the Study of Life*

Multiple Choice Questions (MCQs)

1. According to the Quran, living things consist of:

Ⓐ 50-60% water Ⓑ 70-75% water

Ⓒ 60-90% water Ⓓ 95-100% water

2. The developmental stages of humans mentioned in the Quran include:

Ⓐ Zygote, embryo, and fetus

Ⓑ Drop, clot, lump, bones, and flesh

Ⓒ Cells, tissues, and organs Ⓓ Water, clay, and air

3. The Quran mentions animals creeping on their bellies as:

Ⓐ Humans and insects Ⓑ Fishes and mammals

Ⓒ Birds and amphibians Ⓓ Snakes and reptiles

MCQ's Key

1	Ⓒ	2	Ⓑ	3	Ⓓ

Short Answered Questions

1. **How much of living organisms consist of water, according to the Quranic explanation?**

Ans. According to the Quranic explanation the average water content in different organisms ranges between 60% to 90%.

2. **What are the developmental stages of humans described in Sura Al-Mominoon, Verse 14?**

Ans. According to Sura Al-Mominoon, verse 14, the stages of development of humans include a drop, a clot, a lump, bones, and flesh.

3. **How does the Quran encourage reflection on the events of human creation?**

Ans. The Quran advises humans to think about the possible ways through which human beings were created and developed.

4. **How does the Quran describe the diversity of animal life?**

Ans. The Quran describes animals as creeping on their bellies, walking on two legs, and walking on four legs.

5. **How does the description of human development in the Quran relate to embryology?**

Ans. The description of human development in the Quran relate to embryology as it aligns with the scientific stages of human embryonic development.

1.5 Science as a Collaborative Field

Multiple Choice Questions (MCQs)

1. **The Human Genome Project was completed in:**

Ⓐ 2000 Ⓑ 2015 Ⓒ 2010 Ⓓ 2003

2. **Researchers in the Human Genome Project included experts from:**

Ⓐ Moleculr biology, genetics, informatics and computer science
Ⓑ Physics, sociology, and medicine
Ⓒ Economics, engineering, and psychology
Ⓓ Atmospheric science and ecology

3. **Cancer research requires collaboration among:**

Ⓐ Geneticists, pharmacologists, and statisticians
Ⓑ Astronomers, engineers, and geologists
Ⓒ Atmospheric scientists and ecologists
Ⓓ Economists and sociologists

4. **Robotics and AI are interdisciplinary fields that involve:**
   Ⓐ Biology and economics Ⓑ Mathematics and neuroscience
   Ⓒ Sociology and geology Ⓓ Atmospheric science and physics

5. **Space exploration involves collaboration in fields such as:**
   Ⓐ Astrophysics, biology and medicine
   Ⓑ Sociology, informatics and mathematics
   Ⓒ Psychology and economics Ⓓ Engineering and social sciences

6. **The International Space Station (ISS) is an example of collaboration in:**
   Ⓐ Space exploration Ⓑ Climate change research
   Ⓒ Human Genome mapping Ⓓ AI and robotics

7. **The Human Genome Project was focused on:**
   Ⓐ Creating new technologies
   Ⓑ Mapping the entire human genome
   Ⓒ Solving environmental issues Ⓓ Understanding social behaviors

8. **The field where scientists work on autonomous vehicles and machine learning is;**
   Ⓐ Space exploration Ⓑ Climate change research
   Ⓒ Robotics and AI Ⓓ Medical advancements

9. **Interdisciplinary collaboration in medical research improves:**
   Ⓐ Space exploration techniques
   Ⓑ Understanding of the cosmos Ⓒ Weather forecasting
   Ⓓ Treatment methods for diseases like cancer

MCQ's Key

1	Ⓓ	2	Ⓐ	3	Ⓐ	4	Ⓑ	5	Ⓐ	6	Ⓐ	7	Ⓑ	8	Ⓒ	9	Ⓓ

Short Answered Questions

1. **What is the main advantage of interdisciplinary collaboration in science?**

Ans. Science is a collaborative field in which researchers from various disciplines (fields) work together to solve complex problems. Interdisciplinary teams can tackle problems more efficiently by leveraging the strengths and expertise of each discipline. It often leads to quicker and sustainable solutions.

2. **Describe the purpose and outcome of the Human Genome Project.**

Ans. The **Human Genome Project** aimed to sequence and map the entire human genome and was completed in 2003. It involved researchers from various disciplines, including molecular biology, genetics, informatics, and computer science.

3. **Why is climate change research considered an interdisciplinary field?**

Ans. **Climate change research** is interdisciplinary because it requires collaboration among many disciplines, such as atmospheric science, ecology, economics, and sociology.

4. **How does interdisciplinary collaboration contribute to advances in medical research?** **(OR)**

- **Describe the role of interdisciplinary collaboration in cancer research.**

Ans. **Medical research** often depends on interdisciplinary collaboration.
Example: Cancer research involves oncologists (cancer consultants), biologists, biochemists, geneticists, pharmacologists, and statisticians.

5. **Why is interdisciplinary collaboration essential in robotics and artificial intelligence?**

Ans. The field of **robotics and AI** is highly interdisciplinary. It involves computer science, engineering, mathematics, neuroscience, and psychology. This collaboration has led to significant advancements in robotic systems, autonomous vehicles, machine learning, and natural language processing.

6. **What is the role of collaboration between different scientific disciplines in space exploration?**

Ans. Organizations like NASA and the International Space Station (ISS) involve scientists from various fields, including astrophysics, planetary science, engineering, Biology, and medicine. These collaborations enable scientists to investigate the cosmos.

1.6 *Scientific Method*

Multiple Choice Questions (MCQs)

1. **What is the first step in the scientific method?**

Ⓐ Hypothesis Ⓑ Observation
Ⓒ Recognition of a problem Ⓓ Experimentation

2. **In scientific research, the term 'hypothesis' refers to.**

Ⓐ A proven fact Ⓑ A tentative answer to a problem
Ⓒ The results of an experiment Ⓓ The method of experimentation

3. **What type of observations involve characteristics that can be measured with numbers?**
Ⓐ Quantitative Ⓑ Qualitative Ⓒ Descriptive Ⓓ Experimental

4. **Deduction in a scientific research is:**
Ⓐ A step to form a hypothesis
Ⓑ A detailed experiment Ⓒ A tested hypothesis
Ⓓ A logical result from the hypothesis

5. **The control group in an experiment is used for.**
Ⓐ Testing the hypothesis Ⓑ Comparing results
Ⓒ Developing new hypotheses Ⓓ Making observations

6. **Characteristic a good hypothesis have:**
Ⓐ It cannot be tested Ⓑ It does not match observations
Ⓒ It can be disproven Ⓓ It is always correct

7. **In an experiment to test the necessity of carbon dioxide for photosynthesis, the group will not receive carbon dioxide:**
Ⓐ Experimental group Ⓑ Control group
Ⓒ Both groups Ⓓ Neither group

8. **In an experiment on plant growth, a scientist adds iron to the soil. If the hypothesis is true, what will happen to the plant growth?**
Ⓐ The plant will grow slower
Ⓑ The plant will grow taller and healthier
Ⓒ The plant will stop growing Ⓓ The plant will die

9. **To confirm the accuracy of a hypothesis, scientists perform.**
Ⓐ Observations Ⓑ Data analysis
Ⓒ Deductions Ⓓ Experiment

MCQ's Key

1	Ⓒ	2	Ⓑ	3	Ⓐ	4	Ⓓ	5	Ⓑ	6	Ⓒ	7	Ⓐ	8	Ⓑ	9	Ⓓ

Short Answered Questions

1. **Define scientific method.**

Ans. Scientists take specific steps for doing scientific work or research. These steps are collectively called **scientific method.**

2. **Write the steps involved in scientific method.**

Ans. The following steps are involved in scientific method:

1. Recognition of a scientific problem 2. Observation
3. Hypothesis 4. Deduction
5. Experiments 6. Results

3. What is the first step in the scientific method, and how is it initiated?

Ans. The first step involves identifying and defining a scientific problem (specific issue or phenomenon) that scientist wants to investigate. Such problem is either asked by someone or comes in biologist's mind by himself.

4. Give an example of a scientific problem and explain how it becomes a starting point for research. **(OR)**

- **How can a biologist develop a scientific problem from observations in nature?**

Ans. A biologist notices that plants in **"an"** area are growing taller than usual. He develops a scientific problem: "What factors are responsible for the increased growth of these plants?" This problem becomes the starting point for a scientific inquiry.

5. What are the two types of observations scientists make? **(OR)**

- **What is the difference between qualitative and quantitative observations?**

Ans. **(i) Nature of Data: Qualitative** observations involve characteristics that cannot be measured with numbers (e.g., colour and texture of a flower).

Quantitative observations involve measurements or numerical data that can be expressed in terms of quantity (e.g., The number of birds in a tree).

(ii) Accuracy: Qualitative observations are less accurate and cannot be recorded in terms of numbers.

Quantitative observations are considered more accurate because they are invariable, measurable, and can be recorded in terms of numbers.

6. How do scientists make observations?

Ans. Scientists make observations about the problem. They use five senses for making observation. They also read and study the previous researches on the same or related problems.

7. What is a hypothesis in scientific research? **(OR)**

- **How does a hypothesis relate to observations in the scientific method?**

Ans. On the basis of observations, scientists develop a statement that may prove the answer of the scientific problem under study. Such tentative answer of scientific problem is called **hypothesis.**

8. List the characteristics of a hypothesis.

Ans. (i) It is a proposed statement to answer the problem.
(ii) It always matches with the available observations.
(iii) It can be tested through experiments.
(iv) There is always a way to disprove the hypothesis.

9. What are deductions in scientific research? **(OR)**

- **How does a deduction help in scientific experiments?** **(OR)**
- **What is the relationship between hypothesis and deduction in scientific research?**

Ans. Scientists develop logical results from their hypotheses. Such logical results of hypotheses are called **deductions.** Usually, deductions follow the pattern of "if-then" statements. Scientists assume that. 'if' hypothesis is true 'then' what might be the results.

10. Write a deduction for the hypothesis "Leaf discoloration and stunted growth in a plant are caused by a deficiency of iron in the soil"?

Ans. The **deduction** for the given hypothesis is:
"If iron deficiency is causing the symptoms, then adding iron to the soil will lessen the leaf discoloration and promote healthier plant growth":

11. What is the most basic step of the scientific method?

Ans. **Experiment** is the most basic step of scientific method. Scientists perform experiments to test all hypotheses. In a successful experiment, one hypothesis is proved correct and the alternate hypotheses are proved incorrect. The incorrect hypotheses are rejected and the proved one is accepted.

12. What are the experimental group and control group in an experiment?

Ans. When scientists do experiments, they arrange two settings. One is called **"experimental group"** and the other is called **"control group"**. **For example,** you want to do experiment to test the necessity of carbon dioxide for photosynthesis. You will arrange two similar plants. You will not provide carbon dioxide to one plant (experimental group). While you will provide carbon dioxide to the other plant (control group). The necessity of carbon clioxide will be proved when photosynthesis does not occur in the experimental group but occurs in the control group.

13. How is the experimental group different from the control group in an experiment?

Ans. The experimental group is subjected to the condition being tested, while the control group is not. This allows scientists to measure the specific effects of the condition on the experimental group.

14. In the carbon dioxide experiment for photosynthesis, what role does the experimental group play?

Ans. In the carbon dioxide experiment, the experimental group does not receive carbon dioxide. This helps scientists observe whether the absence of carbon dioxide affects photosynthesis in comparison to the control group.

15. What do scientists do after gathering data from their experiments?

Ans. Scientists gather data from their experiments. They use statistical analyses, graphs etc. to summarize the results. Scientists also include a list of all the references in the summary to acknowledge the sources of information. Scientists publish their findings in scientific journals and books.

16. How do scientists share their research findings with other scientists?

Ans. Scientists share the findings with other scientists by creating a scientific report or presentation in talks at National and International meetings and in seminars.

1.7 *Theory and Law Principle*

Multiple Choice Questions (MCQs)

1. When experiments prove a hypothesis correct, it becomes:

Ⓐ A theory Ⓑ A law Ⓒ A principle Ⓓ A fact

2. An example of a biological theory is:

Ⓐ Mendel's laws of inheritance Ⓑ The law of gravity
Ⓒ The theory of evolution Ⓓ The Hardy-Weinberg law

3. When a theory is repeatedly validated, it becomes:

Ⓐ A hypothesis Ⓑ A fact
Ⓒ A new theory Ⓓ A law or principle

4. A scientific law is:

Ⓐ A hypothesis Ⓑ A uniform or constant fact of nature
Ⓒ A theory that explains a phenomenon
Ⓓ A concept that is yet to be tested

5. **A biological law is:**

Ⓐ The Hardy-Weinberg law Ⓑ The theory of evolution

Ⓒ Newton's laws of motion Ⓓ The law of thermodynamics

6. **The relationship between a hypothesis and a theory is that:**

Ⓐ A theory is never tested

Ⓑ A hypothesis can never lead to a theory

Ⓒ A theory is only a guess until proven correct

Ⓓ A hypothesis becomes a theory when supported by evidence

MCQ's Key

1	Ⓐ	2	Ⓒ	3	Ⓓ	4	Ⓑ	5	Ⓐ	6	Ⓓ

Short Answered Questions

1. **What is a theory in scientific terms?**

Ans. When experiments prove a hypothesis correct, scientists use such hypothesis for making further hypotheses. When new hypotheses are again proved by experiments, the original hypothesis becomes a **theory**. Theories are supported by extensive evidence and is repeatedly validated by multiple researchers.

Example: The theory of evolution explains how species change over time through natural selection.

2. **How is a scientific law formed?**

Ans. Scientists keep on testing the theories by doing experiments. They try their best to disprove the theory. If a theory is proved again and again by experiments, it becomes **'law or principle'**. A scientific law is a uniform or constant fact of nature.

The **examples** of biological laws are Hardy-Weinberg law and Mendel's laws of inheritance.

1.8 *Malaria-An example of Biological Method*

Multiple Choice Questions (MCQs)

1st problem: What is the cause of malaria?

1. **The disease malaria is most commonly linked to:**

Ⓐ Mountainous areas Ⓑ Dry deserts

Ⓒ Urban cities Ⓓ Marshy areas

2. **The microorganism identified as the cause of malaria is:**
   Ⓐ Amoeba Ⓑ Plasmodium Ⓒ Trypanosoma Ⓓ Bacterium
3. **The individual who first observed Plasmodium in the blood of malarial patients:**
   Ⓐ Robert Koch Ⓑ Charles Darwin
   Ⓒ Laveran Ⓓ Edward Jenner
4. **The only remedy for malaria between the 17th and 20th centuries was:**
   Ⓐ Quinine Ⓑ Aspirin Ⓒ Penicillin Ⓓ Chloroquine
5. **The hypothesis developed about the cause of malaria was:**
   Ⓐ Drinking marsh water causes malaria
   Ⓑ Mosquitoes are the cause of malaria
   Ⓒ Plasmodium is the cause of malaria
   Ⓓ Poor sanitation causes malaria
6. **The deduction made to test the hypothesis "Plasmodium is the cause of malaria," stated:**
   Ⓐ Healthy people should have Plasmodium in their blood
   Ⓑ All malarial patients should have Plasmodium in their blood
   Ⓒ Drinking marshy water causes malaria
   Ⓓ Plasmodium causes malaria only in animals
7. **The experimental group in the study consisted of:**
   Ⓐ Healthy individuals Ⓑ Non-malarial patients
   Ⓒ People drinking marshy water Ⓓ Malaria-infected individuals
8. **The control group in the study "Cause of Malaria" consisted of:**
   Ⓐ People drinking marshy water
   Ⓑ Healthy individuals without malaria
   Ⓒ People treated with quinine Ⓓ Malaria-infected patients

MCQ's Key

1	Ⓓ	2	Ⓑ	3	Ⓒ	4	Ⓐ	5	Ⓒ	6	Ⓑ	7	Ⓓ	8	Ⓑ

Short Answered Questions

1. **What were the main observations about malaria in the last part of 19th century?**

Ans. In the last part of 19th century, there were four major observations about malaria.

(i) Malaria and marshy areas have some relation.

(ii) Quinine is an effective drug for treating malaria.

(iii) Drinking the water of marshes does not cause malaria.
(iv) Plasmodium was seen in the blood of malarial patients.

2. How did Laveran contribute to understanding the cause of malaria?

Ans. In 1878 a French army physician Laveran did research on the "cause of malaria". He took the blood from a malarial patient and examined it under microscope. He noticed some microorganisms in the blood. The microorganism was given a name - **Plasmodium.**

3. What hypothesis did biologists form about the cause of malaria?

Ans. Biologists thought on the observations and discoveries and developed a hypothesis i.e. "Plasmodium is the cause of malaria."

4. What deduction was made to test the hypothesis "Plasmodium is the cause of malaria."?

Ans. They developed a logical result (deduction) by taking this hypothesis as true. The deduction was; "If Plasmodium is the cause of malaria, then all malarial patients should have Plasmodium in their blood."

5. How was the experiment conducted to test the deduction about the cause of malaria?

Ans. In order to test the given deduction biologists performed experiments. They examined the blood samples of 100 malarial patients and 100 healthy persons under microscope.

6. What were the results of the experiment about the cause of malaria?

Ans. The following was the result of these experiments:

- Most of the malarial patients had Plasmodium in their blood.

The result proved that the hypothesis "*plasmodium is the cause of malaria*" was true.

7. Why were healthy individuals included in the malaria experiment?

Ans. Healthy individuals were included in the malaria experiment as the control group to compare the presence of Plasmodium in malarial patients and determine if it was the cause of the disease.

Multiple Choice Questions (MCQs)

2nd problem: How plasmodium gets into the blood of man?

1. The biological problem of how Plasmodium enters the human blood was addressed by:

Ⓐ A. F. A. King Ⓑ Ronald Ross Ⓒ Laveran Ⓓ Italian biologists

2. **A. F. A. King observed that:**
   Ⓑ Smoky fires increased malaria risk
   Ⓒ Indoor sleepers had higher chances of malaria
   Ⓐ Nets were ineffective in preventing malaria
   Ⓓ Outdoor sleepers had more chances of malaria

3. **A. F. A. King suggested the hypothesis about the transmission of Malaria:**
   Ⓐ Marsh water causes malaria Ⓑ Only humans transmit malaria
   Ⓒ Mosquitoes transmit Plasmodium
   Ⓓ Quinine prevents malaria

4. **From King's hypothesis, it was deduced that:**
   Ⓐ Mosquitoes do not carry Plasmodium
   Ⓑ Plasmodium is found in mosquitoes
   Ⓒ Malaria is caused by marsh water
   Ⓓ Mosquitoes are unaffected by Plasmodium

5. **To test his hypothesis, Ronald Ross used:**
   Ⓐ Human volunteers Ⓑ Rats
   Ⓒ Infected mosquitoes and sparrows
   Ⓓ Laboratory-grown mosquitoes

6. **The presence of Plasmodium in mosquitoes proved that:**
   Ⓐ Mosquitoes carry and transmit Plasmodium
   Ⓑ Malaria is caused by the water in marshes
   Ⓒ Only sparrows can transmit malaria
   Ⓓ Malaria cannot be transmitted by mosquitoes

MCQ's Key

1	Ⓐ	2	Ⓓ	3	Ⓒ	4	Ⓑ	5	Ⓒ	6	Ⓐ

Short Answered Questions

1. **What biological problems did biologists investigate concerning malaria?**

Ans. Biologists investigated the cause of malaria and how Plasmodium, the parasite responsible for the disease, gets into the human bloodstream.

2. **What observations did A. F. A. King make regarding malaria?**

Ans. In 1883 a physician, A. F. A. King, listed 20 **observations.** Some important observations of King were:

(i) People who slept outdoors had more chances to get malaria than those who slept indoors.

(ii) People who slept under fine nets had less chances to get malaria than those who did not use such nets.

(iii) Individuals who slept near a smoky fire usually did not get malaria.

3. What hypothesis did A. F. A. King propose regarding the transmission of malaria?

Ans. On the basis of these observations King suggested a **hypothesis:** "Mosquitoes transmit Plasmodium and so are involved in the spread of malaria."

4. What deduction did biologists make based on King's hypothesis about malaria?

Ans. Following **deduction** was made from King's hypothesis.
"If mosquitoes are involved in the spread of malaria, then Plasmodium should be present in mosquitoes."

5. How did Ronald Ross test the hypothesis that mosquitoes transmit malaria?

Ans. In order to test the hypothesis, Ronald Ross performed important **experiments** in 1880s. He was a British army physician who was working in India.
He allowed a female Anopheles mosquito to bite a malarial patient. He killed this mosquito and found Plasmodium multiplying in its stomach.

6. What experiment did Ronald Ross conduct with sparrows?

Ans. Ross allowed female Culex mosquitoes to bite a malaria-infected sparrow. He observed that Plasmodium multiplied in the mosquitoes' stomach walls and moved to their salivary glands. When these infected mosquitoes bit healthy sparrows, they contracted malaria, and their blood contained Plasmodia.

7. What did Italian biologists do in 1898 to confirm malaria transmission by mosquitoes?

Ans. In 1898 Italian biologists allowed an Anopheles mosquito to bite a malarial patient. The infected mosquito was then allowed to bite a healthy man. This person later became ill with malaria. In this way, it was confirmed that mosquitoes transmit Plasmodium and so are involved in the spread of malaria.

8. What did Ronald Ross's experiments with mosquitoes and sparrows prove about malaria transmission?

Ans. Ross's experiments proved that mosquitoes carry and transmit

Chapter 2

Biodiversity

2.1 Biodiversity

Multiple Choice Questions (MCQs)

1. **Variety of organisms in a specific area is described by:**
   Ⓐ Natural resources Ⓑ Biodiversity
   Ⓒ Ecosystem stability Ⓓ Climate regulation
2. **Total number of kinds of organisms on Earth is estimated to be:**
   Ⓐ Half million Ⓑ One million
   Ⓒ Almost two million Ⓓ Less than one million
3. **Greatest biodiversity is found in:**
   Ⓐ Polar regions Ⓑ Temperate regions
   Ⓒ Desert regions Ⓓ Tropical regions
4. **International Biodiversity Day is celebrated on:**
   Ⓐ May 22nd Ⓑ April 22nd Ⓒ June 5th Ⓓ March 15th
5. **Regulation of climate by absorbing carbon dioxide is carried out by:**
   Ⓐ Animals Ⓑ Bacteria Ⓒ Plants and algae Ⓓ Fungi
6. **Factors influencing biodiversity include:**
   Ⓐ Soil type Ⓑ Altitude Ⓒ Climate Ⓓ All of the above
7. **Biodiversity provides natural resources such as:**
   Ⓐ Food and medicine Ⓑ Carbon dioxide
   Ⓒ Soil and rocks Ⓓ Air and water
8. **The balance of ecosystems is maintained by:**
   Ⓐ Climate regulation Ⓑ Biodiversity
   Ⓒ Human activities Ⓓ Water cycle
9. **Industries supported by biodiversity include:**
   Ⓐ Construction and mining Ⓑ Engineering and technology
   Ⓒ Agriculture and tourism Ⓓ Manufacturing and logistics
10. **Greater biodiversity in tropical regions is due to:**
    Ⓐ Cold climate Ⓑ High soil salinity
    Ⓒ Higher altitude Ⓓ Favorable climate

11. **International Biodiversity Day aims to:**

Ⓐ Celebrate wildlife Ⓑ Encourage reforestation

Ⓒ Promote biodiversity protection Ⓓ Reduce carbon footprint

12. **Regions with low biodiversity include:**

Ⓐ Tropical forests Ⓑ Coastal regions

Ⓒ Deserts Ⓓ Polar regions

MCQ's Key

1	Ⓑ	2	Ⓒ	3	Ⓓ	4	Ⓐ	5	Ⓒ	6	Ⓓ
7	Ⓐ	8	Ⓑ	9	Ⓒ	10	Ⓓ	11	Ⓒ	12	Ⓓ

Short Answered Questions

1. **Define biodiversity.**

Ans. **Biodiversity** means the variety of organisms in a particular area. Biodiversity of an area is measured by considering the number of different kinds of organisms and the variation within each kind.

The biodiversity in a place depends on **factors** like climate, altitude, and soil type. Tropical regions have more biodiversity than polar regions.

2. **State the purpose of International Biodiversity Day.**

Ans. The United Nations has designated May 22nd as International Biodiversity Day. It is celebrated to promote the protection of biodiversity.

3. **Write the importance of Biodiversity.**

Ans. Biodiversity ensures ecosystem stability, supports biogeochemical cycles, and regulates climate by absorbing carbon dioxide. It provides essential resources like food, medicine, and building materials, while also benefiting industries such as agriculture and tourism.

4. **What role does biodiversity play in ecosystem stability?**

Ans. Biodiversity helps to maintain the balance of ecosystems. It plays important role in biogeochemical cycles such as carbon cycle, and nitrogen cycle.

5. **How does biodiversity contribute to climate regulation?** **(OR)**

- **Explain the importance of plants and algae in ecosystems.**

Ans. Plants and algae absorb carbon dioxide. It helps to keep the climate balanced.

6. **List the natural resources provided by biodiversity.**

Ans. Biodiversity provides a vast array of resources, from food and medicine to building materials and fuel.

7. **Which industries benefit from biodiversity?**

Ans. Biodiversity supports different industries, including agriculture, tourism, and pharmaceuticals.

2.2 Classification

Multiple Choice Questions (MCQs)

1. **Classification refers to the process of:**
   Ⓐ Grouping organisms Ⓑ Evolution
   Ⓒ Biodiversity Ⓓ Speciation

2. **Classification helps in understanding:**
   Ⓐ Ecosystem behavior Ⓑ Growth patterns
   Ⓒ Photosynthesis Ⓓ Organism diversity

3. **New species are identified by:**
   Ⓐ Classification Ⓑ Soil samples
   Ⓒ Measuring features Ⓓ Disease tests

4. **The number of known species identified by biologists is:**
   Ⓐ 2 million animals, 2 million plants
   Ⓑ 2 million animals, 1 million plants
   Ⓒ 1.5 million animals, 0.5 million plants
   Ⓒ 1 million animals, 1 million plants

5. **Studying evolutionary relationships is part of:**
   Ⓐ Biodiversity Ⓑ Respiration Ⓒ Photosynthesis Ⓓ Classification

6. **Organisms are classified based on:**
   Ⓐ Physical and genetic traits Ⓑ Size only
   Ⓒ Color only Ⓓ Location

MCQ's Key

1	Ⓐ	2	Ⓓ	3	Ⓐ	4	Ⓒ	5	Ⓓ	6	Ⓐ

Short Answered Questions

1. **What is classification in biology?**

Ans. **Classification** is the process of grouping organisms into groups and subgroups based on their similarities and differences. It helps in studying organisms easily and understanding their evolutionary relationships.

2. What are the main aims of classification?

Ans. The main aims of classification are;

- To determine similarities and differences among organisms so that they can be studied easily.
- To find the evolutionary relationships among organisms.

3. How is genetics used in modern classification?

Ans. Genetics is used to identify genetic similarities and differences among organisms, helping to understand their structural and functional relationships in addition to physical characteristics.

4. How does classification aid in understanding biodiversity?

Ans. Classification allows biologists to group similar organisms together, making it easier to identify and understand their characteristics, relationships, and evolutionary history. It helps us understand the vast diversity of living organisms on Earth.

5. Why is classification important for the identification of new species?

Ans. Classification provides a framework to identify new species and understand their evolutionary relationships with other organisms, facilitating their study and classification.

6. How does classification contribute to the conservation of biological diversity?

Ans. Classification helps in managing and conserving biodiversity by grouping organisms and studying their evolutionary relationships, which informs conservation efforts.

7. What is the role of classification in communication among biologists?

Ans. Classification provides a common language for biologists around the world, enabling effective communication in the study of organisms.

2.3 *Taxonomic Ranks*

Multiple Choice Questions (MCQs)

1. The person who devised the Linnaean system of taxonomic ranks:

Ⓐ Charles Darwin Ⓑ Carl Linnaeus
Ⓒ Gregor Mendel Ⓓ Aristotle

2. The highest rank in the Linnaean system of classification:

Ⓐ Kingdom Ⓑ Phylum Ⓒ Domain Ⓓ Species

3. **The number of domains in the Linnaean system:**
Ⓐ Two Ⓑ Four Ⓒ Five Ⓓ Three

4. **The rank below kingdom in the Linnaean system:**
Ⓐ Phylum Ⓑ Class Ⓒ Order Ⓓ Genus

5. **The rank that is not one of the domains in the Linnaean system:**
Ⓐ Archaea Ⓑ Bacteria Ⓒ Eukarya Ⓓ Plantae

6. **The lowest level of classification in the Linnaean system:**
Ⓐ Kingdom Ⓑ Family Ⓒ Species Ⓓ Genus

7. **The rank that comes after family in the Linnaean system:**
Ⓐ Order Ⓑ Genus Ⓒ Class Ⓓ Phylum

8. **The kingdoms of domain Eukarya:**
Ⓐ Animalia, Plantae, Fungi, Protista
Ⓑ Animalia, Plantae, Fungi Ⓒ Animalia, Protista, Plantae
Ⓓ Fungi, Protista, Bacteria

9. **The taxonomic rank used for organisms that can interbreed and produce fertile offspring:**
Ⓐ Genus Ⓑ Species Ⓒ Family Ⓓ Order

10. **The genus of the fruit fly:**
Ⓐ Homo Ⓑ Pisum Ⓒ Drosophila Ⓓ Hominidae

11. **The rank that comes after order in the Linnaean system:**
Ⓐ Family Ⓑ Class Ⓒ Genus Ⓓ Species

12. **The scientific name of the pea plant:**
Ⓐ *Homo sapiens* Ⓑ *Pisum sativum*
Ⓒ *Drosophila melanogaster* Ⓓ *Pisum*

MCQ's Key

1	Ⓑ	2	Ⓒ	3	Ⓓ	4	Ⓐ	5	Ⓓ	6	Ⓒ
7	Ⓑ	8	Ⓐ	9	Ⓑ	10	Ⓒ	11	Ⓐ	12	Ⓑ

Short Answered Questions

1. **Define Taxon/Taxonomic rank.**

Ans. The groups into which organisms are classified are known as **taxonomic ranks or taxa** (singular "taxon").
Example: Species is the smallest taxon.

2. **Who developed the Linnaean system of classification and when?**

Ans. The Swedish botanist **Carl Linnaeus** devised the Linnaean system of taxonomic ranks in 1735. In this system, Linnaeus suggested seven taxonomic ranks i.e., kingdom; phylum (division), class, order, family, genus and species.

3. **What is the role of 'domain' in the Linnaean system? List the four kingdoms of domain Eukarya.**

Ans. The highest taxonomic rank is **domain.** All organisms are divided into three domains: Archaea, Bacteria, and Eukarya. The four **kingdoms of domain** Eukarya are Animalia, Plantae, Fungi, and Protista.

4. **Differentiate between 'kingdom' and 'phylum' in the Linnaean system.**

Ans. **Kingdom:** Domain is further divided into kingdoms.
For example, the domain Eukarya is divided into four kingdoms i.e., Animalia, Plantae, Fungi, Protista.
Phylum (Division: for plants and fungi): Each kingdom is subdivided into related phyla or divisions.

5. **What are the taxonomic ranks in the Linnaean system, from highest to lowest?**

Ans. The taxonomic ranks, from highest to lowest, are: Domain, Kingdom, Phylum (or Division), Class, Order, Family, Genus, and Species.

6. **Explain the rank of 'species' in the Linnaean system.**

Ans. **Species** is the lowest level of classification. A species is a group of similar organisms that can interbreed and produce fertile (capable of reproduction) offspring.

7. **How does the classification of a fruit fly differ from that of a human in the Linnaean system?**

Ans. The classification of a fruit fly and a human differs at the Phylum and Class levels. The **fruit fly** belongs to the Phylum Arthropoda and Class Insecta, while the **human** belongs to the Phylum Chordata and Class Mammalia.

8. **Why is 'species' considered the lowest rank in the classification system?**

Ans. Species is considered the lowest rank because it represents the most specific group of organisms, consisting of individuals that can interbreed and produce fertile offspring.

2.4 *History of Classifications*

Multiple Choice Questions (MCQs)

1. **The first person to classify organisms into two groups, plants and animals was:**

Ⓐ Carl Linnaeus Ⓑ Aristotle
Ⓒ Andrea Caesalpinia Ⓓ Ernst Hackel

2. **The person who translated Aristotle's book "de Anima" into Arabic was:**
   Ⓐ Ibn Rushd (Averroes) Ⓑ Carl Linnaeus
   Ⓒ Andrea Caesalpinia Ⓓ Abu Usman Umer Al-Jahiz
3. **The taxonomic hierarchy created by Carl Linnaeus included:**
   Ⓐ Five taxa Ⓑ Six taxa Ⓒ Seven taxa Ⓓ Eight taxa
4. **In Two kingdom classification system, Prokaryotes and fungi were classified under kingdom:**
   Ⓐ Animalia Ⓑ Monera Ⓒ Protista Ⓓ Plantae
5. **The Three-Kingdom Classification system was proposed by:**
   Ⓐ Robert Whittaker Ⓑ Carl Linnaeus
   Ⓒ Ernst Hackel Ⓓ Carl Woese
6. **In the Three-Kingdom Classification system, fungi were classified under the kingdom:**
   Ⓐ Monera Ⓑ Plantae Ⓒ Protista Ⓓ Fungi
7. **The Five-Kingdom Classification system was introduced by:**
   Ⓐ Carl Woese Ⓑ Ernst Hackel
   Ⓒ Carl Linnaeus Ⓓ Robert Whittaker
8. **The scientist introduced the terms "Prokaryotic" and "Eukaryotic" for classifying organisms:**
   Ⓐ E-Chatton Ⓑ Carl Woese
   Ⓒ Robert Whittaker Ⓓ Ernst Hackel
9. **The Three-Domain Classification system was introduced in the year:**
   Ⓐ 1866 Ⓑ 1937 Ⓒ 1977 Ⓓ 1969
10. **The kingdom added to the classification system by Ernst Hackel in 1866 was:**
    Ⓐ Plantae Ⓑ Protista Ⓒ Animalia Ⓓ Monera
11. **In the Five-Kingdom Classification system, the kingdom that includes unicellular organisms with eukaryotic cells is:**
    Ⓐ Monera Ⓒ Protista Ⓓ Fungi Ⓓ Plantae
12. **The scientist modified the Five-Kingdom Classification in 1988 based on genetics and cellular organization:**
    Ⓐ Carl Woese Ⓑ Carl Linnaeus
    Ⓒ Robert Whittaker Ⓓ Margulis and Schwartz

MCQ's Key

1	Ⓑ	2	Ⓐ	3	Ⓒ	4	Ⓓ	5	Ⓒ	6	Ⓑ
7	Ⓓ	8	Ⓐ	9	Ⓒ	10	Ⓑ	11	Ⓒ	12	Ⓓ

Short Answered Questions

1. How many species of animals did Abu Usman Umer Al-Jahiz describe?

Ans. Abu Usman Umer Al-Jahiz described the characteristics of 350 species of animals.

2. What did Andrea Caesalpinia contribute to the classification of plants?

Ans. Andrea Caesalpinia divided plants into fifteen groups and called them genera.

3. What did Carl Linnaeus contribute to classification?

Ans. Carl Linnaeus developed the Linnaean system of taxonomy, which introduced seven taxonomic ranks, including kingdom, phylum, class, order, family, genus, and species, to classify organisms based on their similarities and differences.

4. What is the Two-Kingdom Classification system?

Ans. It was the earliest classification system in which all organisms were classified into two kingdoms i.e., Plantae and Animalia.

- The organisms that can prepare their own food **(autotrophs)** were classified in the kingdom plantae.
- The organisms that cannot make their own food **(heterotrophs)** were classified in kingdom animalia. According to this system, prokaryotes (bacteria, archaea) and fungi were members of kingdom plantae.

5. What was the main issue with the Two-Kingdom Classification system?

Ans. Taxonomists found this system unworkable because many unicellular organisms like Euglena have both plant-like (presence of chlorophyll) and animal-like (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics. So, a separate kingdom was proposed for such organisms. This system also did not clear the difference between prokaryotes (bacteria and archaea) and eukaryotes.

6. Who introduced the Three-Kingdom Classification system and what was its significance?

Ans. In 1866, the German zoologist Ernst Hackel proposed a third kingdom i.e., Protista for Euglena-like organisms. He also included prokaryotes (bacteria and archaea) in the kingdom Protista. In this system, fungi were still included in the kingdom Plantae.

7. **What was the significance of adding the kingdom Protista to the classification system?**

Ans. The addition of the kingdom Protista in the Three-Kingdom classification system allowed for the classification of organisms like Euglena, which exhibit both plant-like and animal-like characteristics, addressing gaps in earlier classification systems.

8. **What are the main limitations of Three-Kingdom Classification system?**

Ans. Some taxonomists disagreed about the position of fungi in kingdom Plantae. Fungi resemble plants in many ways but are heterotrophs which get their food by absorption. They do not have cellulose in their cell walls but possess chitin.

9. **What did E-Chatton contribute to the field of classification? (OR)**

- **What was the role of E-Chatton in the history of classification?**

Ans. In 1937, French biologist E-Chatton suggested the terms, "Prokaryotic" to describe bacteria and "Eukaryotic" to describe protista, fungi, animals and plants.

10. **What were the main features of the Five-Kingdom Classification system proposed by Robert Whittaker? (OR)**

- **What does the Five-Kingdom Classification system classify organisms based on?**

Ans. In 1969, American ecologist Robert Whittaker introduced the five-kingdom classification system. This system is based on;

- The levels of cellular organization i.e. prokaryotic (bacteria, archaea), unicellular eukaryotic (Protista) and multicellular eukaryotic (fungi, plants and animals)
- The modes of nutrition i.e. photosynthesis, absorption, and ingestion.

On this basis, organisms were classified into five kingdoms: Monera, Protista, Fungi, Plantae and Animalia.

11. **How did the Five-Kingdom Classification system address different modes of nutrition?**

Ans. The system categorized organisms into kingdoms based on their mode of nutrition, including photosynthesis (Plantae), absorption (Fungi), and ingestion (Animalia), in addition to their cellular organization.

12. **How did the Five-Kingdom Classification system evolve in 1988?**

Ans. In 1988, American biologists Margulis and Schwartz modified the five-kingdom classification of Whittaker. They considered genetics along with cellular organization and mode of nutrition in classification.

They classified the organisms into the same five kingdoms as proposed by Whittaker.

13. Why was the Three-Domain Classification system introduced? (OR)

- **What significant change did the Three-Domain Classification system introduce?**

Ans. In 1977, American microbiologist Carl Woese (1928-2012) added a taxon i.e., domain above kingdom. He classified organisms into three domains i.e., Archaea, Bacteria, and Eukarya. It was actually a division of the prokaryotes in two domains i.e., Archaea and Bacteria. While all eukaryotes were placed in a single domain i.e., Eukarya. This classification is based on the differences between Archaea and Bacteria.

14. How did the classification of fungi change over time?

Ans. Initially classified with plants in the Two-Kingdom system, fungi were later separated due to their heterotrophic nature and lack of cellulose in their cell walls, being classified into their own group in the Five-Kingdom system.

15. How did the classification of bacteria change over time?

Ans. Bacteria were initially classified as part of the kingdom Plantae in the Two-Kingdom system. However, with the advent of the Three-Domain system, bacteria were divided into their own domain, Bacteria, alongside Archaea, a separate prokaryotic domain.

2.5 *Domains of Living Organisms*

Multiple Choice Questions (MCQs)

1. Domain Archaea consists of organisms that:

Ⓐ Have peptidoglycan Ⓑ Live in extreme environments
Ⓒ Have a nucleus Ⓓ Carry out photosynthesis

2. The cell wall of Archaea is made of:

Ⓐ Polypeptides Ⓑ Chitin Ⓒ Cellulose Ⓓ Peptidoglycan

3. Kingdom in domain Archaea:

Ⓐ Eubacteria Ⓑ Protista Ⓒ Archaebacteria Ⓓ Fungi

4. Bacteria in domain Bacteria have a cell wall made of:

Ⓐ Polypeptides Ⓑ Lipids Ⓒ Proteins Ⓓ Peptidoglycan

5. Domain Bacteria does not contain:

Ⓐ Archaebacteria Ⓑ Eubacteria
Ⓒ Cyanobacteria Ⓓ Prokaryotes

6. **Domain Eukarya includes organisms that:**
   Ⓐ Are unicellular Ⓑ Have eukaryotic cells
   Ⓒ Have prokaryotic cells Ⓓ Cannot photosynthesize

7. **Kingdom in domain Eukarya:**
   Ⓐ Archaebacteria Ⓑ Eubacteria Ⓒ Protista Ⓓ Monera

8. **Archaea's rRNA resembles that of:**
   Ⓐ Eukaryotes Ⓑ Bacteria Ⓒ Fungi Ⓓ Plants

9. **Domain with organisms having a nucleus:**
   Ⓐ Archaea Ⓑ Bacteria Ⓒ None Ⓓ Eukarya

10. **Thermophiles live in:**
    Ⓐ Hot springs Ⓑ Oceans Ⓒ Soil Ⓓ Salt lakes

11. **Domain that contains organisms like plants and animals:**
    Ⓐ Archaea Ⓑ Eukarya Ⓒ Bacteria Ⓓ Protista

12. **Domain Bacteria includes:**
    Ⓐ Multicellular organisms Ⓑ Eukaryotic organisms
    Ⓒ Prokaryotic organisms Ⓓ Organisms without ribosomes

13. **Domain Archaea includes:**
    Ⓐ Unicellular eukaryotes Ⓑ Multicellular plants
    Ⓒ Multicellular animals Ⓓ Unicellular prokaryotes

14. **Cyanobacteria are found in:**
    Ⓐ Eukarya Ⓑ Bacteria Ⓒ Archaea Ⓓ Protista

MCQ's Key

1	Ⓑ	2	Ⓐ	3	Ⓒ	4	Ⓓ	5	Ⓐ	6	Ⓑ	7	Ⓒ
8	Ⓐ	9	Ⓓ	10	Ⓐ	11	Ⓑ	12	Ⓒ	13	Ⓓ	14	Ⓑ

Short Answered Questions

1. **What are the main characteristics of organisms in domain Archaea?**

Ans. Archaea are primitive prokaryotes with no peptidoglycan in their cell walls.

- Their cell walls and membranes have unique polypeptides, proteins, and lipids.
- rRNA of archaea resembles eukaryotes more than bacteria.
- They survive in extreme environments like hot springs, salt lakes, and acidic/alkaline waters, as well as soil and oceans.

- Energy sources include inorganic compounds like sulfur or ammonia, or non-oxygenic photosynthesis.
- Domain Archaea contains one kingdom: Archaebacteria.
  Examples include Methanogens, Halophiles, Thermophiles, and Acidophiles.

2. How do archaebacteria survive in extreme conditions?

Ans. Archaebacteria have unique lipids in their cell membranes that enable them to withstand extreme temperatures, salinity, and acidity.

3. What distinguishes domain Bacteria from Archaea?

Ans. **Bacteria** are prokaryotic organisms with cell walls made of peptidoglycan, while **Archaea** have cell wall made up of various polypeptides and proteins and are found in more extreme environments.

4. What is the role of Methanogens in domain Archaea?

Ans. **Methanogens** are archaebacteria that produce methane as a by-product of their metabolism.

5. What is the primary characteristic of organisms in domain Eukarya?

Ans. The domain Eukarya includes all unicellular and multicellular eukaryotes. They have complex eukaryotic cells with nucleus and other membrane-bound organelles. This domain contains kingdoms protista, fungi, plantae and animalia.

2.6 *Classification of Domain Eukarya*

Multiple Choice Questions (MCQs)

1. Kingdom Protista includes eukaryotic organisms that are primarily:

Ⓐ Unicellular Ⓑ Multicellular Ⓒ Both A & B Ⓓ Neither

2. The organisms in Kingdom Protista that perform photosynthesis are known as:

Ⓐ Protozoans Ⓑ Algae Ⓒ Slime molds Ⓓ Fungi

3. Fungi obtain nutrients by:

Ⓐ Photosynthesis Ⓑ Ingestion Ⓒ Absorption Ⓓ Digestion

4. The organisms in Kingdom Plantae reproduce sexually by forming:

Ⓐ Spores Ⓑ Seeds Ⓒ Buds Ⓓ Embryos

5. **A common example of a unicellular fungus in Kingdom Fungi is:**
Ⓐ Yeast Ⓑ Mushroom Ⓒ Rust Ⓓ Mold

6. **Protists that lack a cell wall and are heterotrophic are called:**
Ⓐ Algae Ⓑ Protozoans Ⓒ Slime molds Ⓓ Diatoms

7. **Kingdom Animalia consists of organisms that develop from:**
Ⓐ Spores Ⓑ Seeds Ⓒ Embryos Ⓓ Chloroplasts

8. **The characteristic feature of fungi is that their cell walls are made of:**
Ⓐ Chitin Ⓑ Cellulose Ⓒ Proteins Ⓓ Polysaccharides

9. **In Kingdom Plantae, the process through which plants prepare their food is:**
Ⓐ Absorption Ⓑ Ingestion Ⓒ Digestion Ⓓ Photosynthesis

10. **Organisms in Kingdom Protista that are heterotrophic and lack a cell wall are called:**
Ⓐ Algae Ⓑ Slime molds Ⓒ Protozoans Ⓓ Diatoms

11. **A common example of a fungus used in food production is:**
Ⓐ Yeast Ⓑ Diatom Ⓒ Euglena Ⓓ Amoeba

12. **Kingdom Animalia includes organisms that are:**
Ⓐ Multicellular and autotrophic Ⓑ Multicellular and heterotrophic
Ⓒ Unicellular and autotrophic Ⓓ Unicellular and heterotrophic

MCQ's Key

1	Ⓒ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓐ	6	Ⓑ
7	Ⓒ	8	Ⓐ	9	Ⓓ	10	Ⓒ	11	Ⓐ	12	Ⓑ

Short Answered Questions

1. **What are the main characteristics of Kingdom Protista? (OR)**
- **What distinguishes Kingdom Protista from other kingdoms?**

Ans. Kingdom Protista consists of eukaryotic unicellular or simple multicellular organisms, which can be plant-like (algae), animal-like (protozoans), or fungus-like (slime molds). They may be autotrophic or heterotrophic.

2. **What are the three main types of protists?**

Ans. There are three types of protists.

- **Plant-like protists** (called algae) have cell walls made of cellulose. They have chlorophyll in chloroplasts and are autotrophs. Euglena and diatoms are common examples.

- **Animal-like protists** (called protozoans) are heterotrophs and ingest food. Their cells have no cell wall. Amoeba and Paramecium are common examples.
- **Fungus-like protists** absorb nutrients from decaying organic matter. Their cell walls are made of cellulose instead of chitin. Slime molds and water molds are examples.

3. What is the significance of Euglena in the study of protists?

Ans. Euglena have both **plant-like** (presence of chlorophyll) and **animal-like** (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics. It can photosynthesize like plants but can also ingest food like animals, making it an important example of a mixed-type protist.

4. How do fungi obtain nutrients?

Ans. Fungi are heterotrophic. They get nutrients in a unique way. They do not ingest food like animals and some protists. They absorb food from decaying matter present in their surroundings.

5. How do plants in Kingdom Plantae reproduce?

Ans. All plants have multicellular sex organs. During sexual reproduction, they form embryos. Asexual reproduction through vegetative parts is also common.

Examples are mosses, ferns, conifers and flowering plants.

6. How do plants in Kingdom Plantae obtain energy?

Ans. Plants in **Kingdom Plantae** are autotrophic, obtaining energy through photosynthesis, where they convert sunlight, water, and carbon dioxide into glucose and oxygen.

7. How are Kingdom Plantae and Kingdom Fungi different in terms of nutrition?

Ans. **Kingdom Plantae** includes autotrophic organisms that produce their own food through photosynthesis, while **Kingdom Fungi** consists of heterotrophic organisms that absorb nutrients from decaying matter.

8. What is a unique feature of organisms in Kingdom Animalia? (OR)

- **How do animals in Kingdom Animalia obtain food?**

Ans. Organisms in **Kingdom Animalia** are multicellular, heterotrophic, and develop from embryos. They ingest food and digest it within their bodies.

2.7 Status of Virus in Classification

Multiple Choice Questions (MCQs)

1. **Viruses are classified as acellular because they:**
   Ⓐ Lack cell wall Ⓑ Have no organelles
   Ⓒ Lack DNA/RNA Ⓓ Don't need a host
2. **The structure of a virus consists of:**
   Ⓐ Nucleus and organelles Ⓑ DNA and RNA
   Ⓒ A single cell Ⓓ Nucleic acid and protein coat
3. **Prions are made of:**
   Ⓐ Protein Ⓑ RNA Ⓒ DNA Ⓓ Protein and RNA
4. **Viroids are composed of:**
   Ⓐ Protein Ⓑ DNA Ⓒ RNA ⒹDNA and protein
5. **Which virus causes COVID-19?**
   Ⓐ Influenza Ⓑ Hepatitis Ⓒ Rhinovirus Ⓓ Coronavirus
6. **Prions and viroids are not classified as organisms because they:**
   Ⓐ Don't infect plants Ⓑ Lack cells
   Ⓒ Are multicellular Ⓓ Don't reproduce
7. **Not a feature of viruses:**
   Ⓐ Lack of organelles Ⓑ Dependence on host
   Ⓒ Ability to grow Ⓓ Protein coat

MCQ's Key

1	Ⓑ	2	Ⓓ	3	Ⓐ	4	Ⓒ	5	Ⓓ	6	Ⓑ	7	Ⓒ

Short Answered Questions

1. **Why are viruses considered borderline between living and non-living?**

Ans. Viruses are ultramicroscopic creatures that are at the borderline of living and non-living. They are acellular i.e., they are not made of cells and do not have organelles.

2. **What makes viruses different from living organisms?**

Ans. Viruses are acellular and lack the ability to metabolize or reproduce independently. They need a host cell to replicate, unlike living organisms that can carry out metabolic functions on their own.

3. Why are viruses not classified in the biological classification system?

Ans. Viruses lack any of the characteristics of the three domains or six kingdoms of life; therefore, they are not included in the classification system.

4. What are prions and viroids?

Ans. Prions and viroids are also acellular particles and are not included in classification system. **Prions** are composed of protein only and **Viroids** are composed of circular RNA only. Both these particles cause infectious diseases in certain plants. They are also a cause of cancer.

5. What are the symptoms of COVID-19?

Ans. Symptoms of COVID-19 include fever, cough, shortness of breath, fatigue, body aches, loss of taste or smell, sore throat, and headache, with potential of severe respiratory problems.

6. How does COVID-19 spread from person to person?

Ans. COVID-19 spreads primarily through respiratory droplets when an infected person coughs, sneezes, talks, or breathes. It can also spread by touching contaminated surfaces.

7. What is the role of vaccination in preventing COVID-19?

Ans. Vaccination helps the immune system to recognize and fight the virus, reducing the severity of the disease.

2.8 *Binomial Nomenclature*

Multiple Choice Questions (MCQs)

1. The founder of binomial nomenclature:

Ⓐ Aristotle Ⓑ Linnaeus Ⓒ Darwin Ⓓ Mendel

2. Parts of a scientific name:

Ⓐ One Ⓑ Three Ⓒ Two Ⓓ Four

3. The first part of a scientific name:

Ⓐ Order Ⓑ Species Ⓒ Family Ⓓ Genus

4. Language used in scientific names:

Ⓐ Latin Ⓑ English Ⓒ Greek Ⓓ French

5. Scientific name of a tiger:

Ⓐ *Panthera Tigris* Ⓑ *Panthera tigris*

Ⓒ *panthera Tigris* Ⓓ *panthera tigris*

6. **The second part of a scientific name:**
   Ⓐ Genus Ⓑ Family Ⓒ Species Ⓓ Order

7. **Handwriting a scientific name:**
   Ⓐ Underlined separately Ⓑ Italicized
   Ⓒ Bolded Ⓓ Underlined genus

8. **Scientific name of a human being:**
   Ⓐ *Homo-sapiens* Ⓑ *Homo Sapiens*
   Ⓒ *homo sapiens* Ⓓ *Homo sapiens*

9. **Scientific name of tomato:**
   Ⓐ *Solanum tuberosum* Ⓑ *Allium cepa*
   Ⓒ *Solanum esculentum* Ⓓ *Panthera tigris*

10. **Scientific name of honeybee:**
    Ⓐ *Apis cerana* Ⓑ *Apis mellifera* Ⓒ *Apis indica* Ⓓ *Apis domestica*

11. **Scientific name of onion:**
    Ⓑ *Solanum tuberosum* Ⓑ *Allium cepa*
    Ⓒ *Allium sativum* Ⓓ *Allium cepium*

12. **The system of scientific naming:**
    Ⓐ Natural classification Ⓑ Taxonomic hierarchy
    Ⓒ Phylogenetic classification Ⓓ Binomial nomenclature

13. **Common name of *Solanum tuberosum*:**
    Ⓐ Onion Ⓑ Tomato Ⓒ Potato Ⓓ Garlic

MCQ's Key

1	Ⓑ	2	Ⓒ	3	Ⓓ	4	Ⓐ	5	Ⓑ	6	Ⓒ	7	Ⓐ
8	Ⓓ	9	Ⓒ	10	Ⓐ	11	Ⓑ	12	Ⓓ	13	Ⓒ		

Short Answered Questions

1. **What is binomial nomenclature?** **(OR)**
- **Who developed the system of binomial nomenclature?** **(OR)**
- **What is the structure of a scientific name?**

Ans. The great Swedish biologist **Carl Linnaeus** was the founder of the system of giving scientific names to organisms.

The scientific name of an organism consists of two parts. The first part is the name of the **genus** to which the organism belongs. The second part is the name of the **species.** The system of scientific naming of organisms is termed as **binomial nomenclature.**

2. What is the significance of binomial nomenclature?

Ans. Binomial nomenclature provides a standard way of identifying organisms worldwide, avoiding confusion caused by local or common names.

3. Why are common names not reliable for classification?

Ans.
- Common names vary by region and language, leading to confusion (e.g., onion is called 'Piyaz,' 'ganda,' 'bassal,' or 'vassal' in Pakistan).
- Different organisms may share the same common name (e.g., 'bluebell' and 'blackbird').
- Common names lack scientific accuracy and consistency.
- Some common names, like 'silverfish' and 'starfish,' do not match the biological definition of the organism.
- They are not standardized globally, making them unreliable for scientific classification.

4. What rules govern the writing of scientific names?

Ans. The scientific naming of an organism is done in accordance with some international rules. Some important rules of binomial nomenclature are:
- For scientific naming, words are taken from Latin language.
- Every scientific name has two parts. The genus name always comes first followed by the species name.
- Every scientific name should have to be unique because the same name cannot be used for naming two different organisms.
- The first part of the name i.e. genus name should begin with a capital letter. The second part of the name i.e. species name should begin with small letter.
- At the time of printing of a scientific name, it should be typed in Italics.
- When a scientific name would be hand written, two parts of it should be separately underlined.

5. How is a handwritten scientific name formatted?

Ans. When handwritten, the genus and species names are underlined separately to distinguish them.

6. What is the scientific name of the onion?

Ans. The scientific name of the onion is *Allium cepa*.

7. What is the scientific name of the human being?

Ans. The scientific name of the human being is *Homo sapiens*.

8. What is the scientific name of the tomato?

Chapter 3 The Cell

3.1 Cell

Multiple Choice Questions (MCQs)

1. **The cell is described as the basic unit of:**
   Ⓐ Life Ⓑ Matter Ⓒ Organisms Ⓓ Energy
2. **Cells are the building blocks of:**
   Ⓐ Plants only Ⓑ Rocks
   Ⓒ Living organisms Ⓓ Non-living things
3. **Most cells cannot be seen with:**
   Ⓐ The naked eye Ⓑ A microscope
   Ⓒ Binoculars Ⓓ A magnifying glass
4. **Examples of cells that are large enough to be seen with the naked eye include:**
   Ⓐ Blood cell Ⓑ Nerve cell
   Ⓒ Muscle cell Ⓓ Egg cell of ostrich
5. **A unicellular green algae that can be seen with the naked eye is:**
   Ⓐ Acetabularia Ⓑ Euglena Ⓒ Chlorella Ⓓ Paramecium
6. **An example of a unicellular organism that can be seen with the naked eye is:**
   Ⓐ Bacterium Ⓑ Yeast Ⓒ Mushroom Ⓓ Giant Amoeba
7. **Living things, from the smallest bacterium to the largest whale, are made of:**
   Ⓐ Tissues Ⓑ Cells Ⓒ Organs Ⓓ DNA

MCQ's Key

1	Ⓐ	2	Ⓒ	3	Ⓐ	4	Ⓓ	5	Ⓐ	6	Ⓓ	7	Ⓑ

Short Answered Questions

1. **What is the cell?** **(OR)**
- **What comparison is made between cells and bricks?**

Ans. The cell is the basic unit of life. Just as bricks are the building blocks of a house, cells are the building blocks of living organisms, including plants, animals, and humans. Every living thing, from the smallest

2. **Why can most cells not be seen with the naked eye?**

Ans. Most of the cells are very small, and cannot be seen with the naked eye. Despite their size, cells are very complex and carry out many essential functions to keep living things alive and functioning.

3. **Which cells are large enough to be seen with the naked eye?**

Ans. Some cells are large enough to be seen with naked eye e.g. the egg cell of ostrich, a unicellular green algae Acetabularia, and a unicellular giant Amoeba.

3.2 *Structure of Cell*

Multiple Choice Questions (MCQs)

1. **The basic structure of a cell was discovered by:**

Ⓐ Charles Darwin Ⓑ Robert Hooke
Ⓒ Albert Einstein Ⓓ Robert Brown

2. **The discovery of the cell structure occurred in:**

Ⓐ 1665 Ⓑ 1600 Ⓒ 1800 Ⓓ 1750

3. **Robert Hooke discovered tiny, box-like structures in:**

Ⓐ Animal tissue Ⓑ Plant roots
Ⓒ Thin slice of cork Ⓓ Pond water

4. **The nucleus was observed by Robert Brown in:**

Ⓐ 1600 Ⓑ 1665 Ⓒ 1831 Ⓓ 1800

5. **Robert Brown observed the nucleus in:**

Ⓐ Animal cells Ⓑ Plant cells Ⓒ Human cells Ⓓ Bacterial cells

MCQ's Key

1	Ⓑ	2	Ⓐ	3	Ⓒ	4	Ⓒ	5	Ⓑ

Short Answered Questions

1. **Who discovered the basic structure of the cell?** **(OR)**

- **What did Robert Hooke observe in the cork?** **(OR)**
- **What was the outcome of Robert Hooke's discovery with the microscope?**

Ans. The basic structure of a cell was discovered by a curious scientist Robert Hooke. In 1665, using a simple microscope, Hooke examined a thin slice of cork and discovered tiny, box-like structures that he called "cells."

2. **What important cellular component did Robert Brown discover in 1831?** **(OR)**

- **Who observed the nucleus and in what year?**

Ans. In 1831, while studying plant cells under a microscope, Robert Brown observed the "nucleus". After that, many organelles were discovered in coming years.

3. **How did the improvements in microscope technology impact cell research?**

Ans. Improvements in microscope technology allowed scientists to observe the internal structures of cells, leading to the discovery of various organelles like the nucleus.

3.2.1 *Cell Wall*

Multiple Choice Questions (MCQs)

1. **The cell wall is found in:**
   Ⓐ Bacteria Ⓑ Fungi Ⓒ Plants Ⓓ All of the above
2. **The plant cell wall consists of how many layers?**
   Ⓐ One Ⓑ Two Ⓒ Three Ⓓ Four
3. **The primary plant cell wall is composed of:**
   Ⓐ Cellulose, hemicellulose, and pectin
   Ⓑ Lignin and cellulose Ⓒ Peptidoglycan
   Ⓓ Magnesium and calcium
4. **The role of the middle lamella is to:**
   Ⓐ Strengthen the wall Ⓑ Bind adjacent cells together
   Ⓒ Produce cellulose Ⓓ Protect protoplasm
5. **Plasmodesmata are responsible for:**
   Ⓐ Transport of water Ⓑ Protein synthesis
   Ⓒ Strengthening the wall Ⓓ Exchange of molecules
6. **The cell wall of prokaryotes is made of:**
   Ⓐ Peptidoglycan Ⓑ Cellulose Ⓒ Lignin Ⓓ Chitin
7. **The fungal cell wall is composed of:**
   Ⓐ Peptidoglycan Ⓑ Lignin Ⓒ Chitin Ⓓ Cellulose
8. **In primary wall of plants, cellulose forms:**
   Ⓐ Nucleus Ⓑ Middle lamella
   Ⓒ Outer layer of the cell membrane Ⓓ Crisscross fibers

9. **The secondary wall of plant cell wall is located:**

Ⓐ Inside the primary wall Ⓑ Outside the middle lamella

Ⓒ Between the primary wall and plasma membrane

Ⓓ Outside the cell membrane

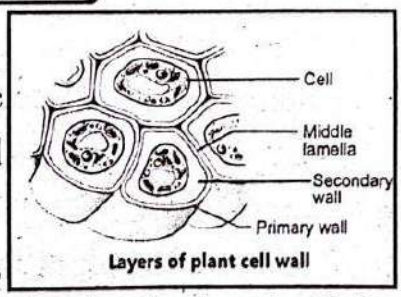
MCQ's Key

1	Ⓓ	2	Ⓒ	3	Ⓐ	4	Ⓑ	5	Ⓓ	6	Ⓐ	7	Ⓒ	8	Ⓓ	9	Ⓐ

Short Answered Questions

1. **What is cell wall?**

Ans. The cells of bacteria, fungi, plants and some protists have a rigid non-living wall around cell membrane. It is called **cell wall.**



Layers of plant cell wall

Function: It provides shape, strength, protection and support to the inner living matter (protoplasm) of the cell.

2. **How many layers make plant cell wall? Write the composition of each layer.**

Ans. The plant cell wall is made of **three layers** i.e. middle lamella, primary wall, and secondary wall.

- **Primary wall** is composed of cellulose, hemicellulose and pectin.
- **Middle lamella** is composed of magnesium, calcium and pectin.
- **Secondary wall** is composed of cellulose, lignin and other chemicals.

3. **What are the components of the primary cell wall in plants?**

Ans. The primary wall is present just above the cell membrane. It is mainly composed of cellulose, hemicellulose, and pectin. Cellulose forms fibres that crisscross over one another to form strong primary wall.

4. **What is the role of the middle lamella in plant cells?** **(OR)**

- **What is the function of the middle lamella in the plant cell wall?**

Ans. Middle lamella holds together the primary walls of adjacent cells. It contains magnesium, calcium and pectin.

5. **What makes up the secondary cell wall in plant cells?**

Ans. Some plant cells eg, xylem cells make secondary wall on the inner side of primary wall. It is mainly made of cellulose, lignin and other chemicals.

6. **What is the structure of the cell wall in prokaryotes?**

Ans. The cell wall of prokaryotes is made of peptidoglycan, (a single molecule made of amino acids and sugars).

7. **What are plasmodesmata, and what is their function? (OR)**

• **How do plasmodesmata contribute to the functioning of plant cells?**

Ans. **Plasmodesmata** (singular plasmodesma) are the channels in cell walls that allow the exchange of molecules between adjacent cells.

8. **How does the primary cell wall differ from the secondary cell wall in plants?**

Ans. The **primary wall** is present just above the cell membrane. It is mainly composed of cellulose, hemicellulose and pectin. Cellulose forms fibres that crisscross over one another to form strong primary wall.

Some plant cells eg, xylem cells make **secondary wall** on the inner side of primary wall. It is mainly made of cellulose, lignin and other chemicals.

9. **What is the significance of cellulose in plant cell walls?**

Ans. Cellulose forms fibres that crisscross over one another to form strong primary wall and secondary wall.

10. **What is the difference between plant cell walls and fungal cell walls?**

Ans. Plant cell walls are primarily made of cellulose, while fungal cell walls are made of chitin.

11. **How do the cell walls in prokaryotes and eukaryotes differ?**

Ans. In **prokaryotes,** the cell wall is made of peptidoglycan, while in **eukaryotes,** the cell wall in plants is made of cellulose, in fungi it is made of chitin and in algae, it is made of cellulose or other substances.

3.2.2 *Call Membrane*

Multiple Choice Questions (MCQs)

1. **The structure of the cell membrane is described by the:**

Ⓐ Fluid mosaic model Ⓑ Rigid mosaic model
Ⓒ Bilayer model Ⓓ Solid membrane model

2. **According to the fluid-mosaic model, the lipids form a:**

Ⓐ Solid bilayer Ⓑ Semi-permeable membrane
Ⓒ Fluid-like bilayer Ⓓ Protein bilayer

3. **In the fluid-mosaic model, the proteins:**

Ⓐ Are fixed in one position Ⓑ Move laterally
Ⓒ Do not move Ⓓ Are absent

4. **The carbohydrates in the cell membrane are joined with:**
Ⓐ Nucleic acids Ⓑ Proteins only Ⓒ Lipids only Ⓓ Proteins or lipids

5. **Cholesterol is absent in the membranes of:**
Ⓐ Most bacteria Ⓑ Eukaryotic cells Ⓒ Plant cells Ⓓ Animal cells

6. **Carbohydrates attached to lipids in the cell membrane are called:**
Ⓐ Glycoproteins Ⓑ Lipoproteins Ⓒ Glycolipids Ⓓ Proteoglycans

MCQ's Key

1	Ⓐ	2	Ⓒ	3	Ⓑ	4	Ⓓ	5	Ⓐ	6	Ⓒ

Short Answered Questions

1. **What do you know about cell membrane?**

Ans. All cells have a thin and elastic **cell membrane** around the cytoplasm. It is selectively-permeable, It allows very few molecules to pass through it while blocks many other molecules.

2. **What is selective permeability in the context of the cell membrane?**

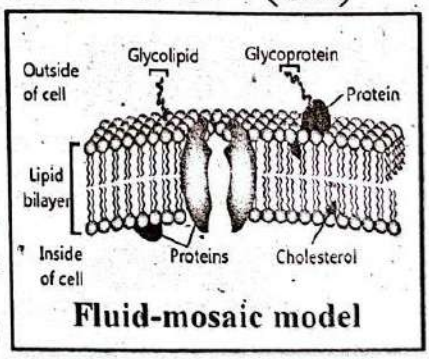
Ans. Cell membrane is selectively-permeable, It allows very few molecules to pass through it while blocks many other molecules.

3. **What are the main components of the cell membrane?**

Ans. Cell membrane is composed of proteins and lipids and small quantities of carbohydrates.

4. **What is the structure of the cell membrane described as? (OR)**

- **What is fluid-mosaic model?**



Fluid-mosaic model

Ans. The structure of cell membrane is described as **fluid-mosaic model.** According to this model the lipids make a fluid-like bilayer in which protein molecules are submerged. The lipids and proteins can move laterally. Due to these movements, the pattern or "mosaic," of lipids and proteins constantly changes. Carbohydrates are joined with proteins (in the form of glycoproteins) or with lipids (in the form of glycolipids).

5. **How are carbohydrates present in the cell membrane? (OR)**

- **What is the difference between glycoproteins and glycolipids in the cell membrane?**

Ans. According to Fluid-mosaic model, in cell membrane carbohydrates are joined to proteins as glycoproteins or to lipids as glycolipids.

6. **How do proteins behave in the fluid-mosaic model?**

Ans. In the fluid-mosaic model, proteins are embedded within the lipid bilayer and can move laterally, changing the membrane's pattern.

3.2.3 *Cytoplasm*

Multiple Choice Questions (MCQs)

1. **Glycolysis occurs in the:**
   Ⓐ Nucleus Ⓑ Mitochondria Ⓒ Cytoplasm Ⓓ Chloroplast.
2. **The liquid part of cytoplasm is called:**
   Ⓐ Cytosol Ⓑ Plasma membrane
   Ⓒ Nucleoplasm Ⓓ Mitochondria
3. **Cytosol does not contain:**
   Ⓐ Ribosomes Ⓑ Membrane-bound organelles
   Ⓒ Water Ⓓ Enzymes
4. **Cytoplasm is found in:**
   Ⓐ Animal cells only Ⓑ Plant cells only
   Ⓒ All living cells Ⓓ Only prokaryotic cells

MCQ's Key

1	Ⓒ	2	Ⓐ	3	Ⓑ	4	Ⓒ

Short Answered Questions

1. **Define cytoplasm.**

Ans. **Cytoplasm** is the jelly-like substance that fills the inside of a cell. It's a complex mixture of water, proteins, enzymes, salts, and other substances.

2. **What is the role of cytoplasm in a cell?**

Ans.
- Cytoplasm provides a medium for organelles to move and function.
- It also helps in the transport of materials throughout the cell.
- It acts as the site for various metabolic reactions e.g. Glycolysis (breakdown of glucose).
- It also stores food and wastes of the cell.

3. **What is cytosol?**

Ans. The liquid part of the cytoplasm that includes molecules and smell particles, such as ribosomes, but not membrane-bound organelles is called **cytosol.**

4. **What is the difference between cytoplasm and cytosol?**

Ans. **Cytoplasm** is the entire jelly-like substance inside the cell, including all organelles. **Cytosol** is the liquid portion of the cytoplasm that excludes membrane-bound organelles.

3.2.4 *Nucleus*

Multiple Choice Questions (MCQs)

1. **The nucleus in eukaryotic cells is surrounded by a:**
   Ⓐ Cell wall Ⓑ Plasma membrane
   Ⓒ Nuclear envelope Ⓓ Cytosol
2. **The nucleus of mature plant cells is located:**
   Ⓐ Pushed to the side Ⓑ Near the cell membrane
   Ⓒ At the center Ⓓ In the cytoplasm
3. **The main difference between prokaryotic and eukaryotic cells is that prokaryotic cells:**
   Ⓐ Have a nuclear envelope Ⓑ Do not have a nucleus
   Ⓒ Have ribosomes Ⓓ Are multicellular
4. **The jelly-like substance inside the nucleus is called:**
   Ⓐ Cytoplasm Ⓑ Mitochondria Ⓒ Riboplasm Ⓓ Nucleoplasm
5. **Nucleoli are located in the:**
   Ⓐ Nucleoplasm Ⓑ Cytoplasm Ⓒ Mitochondria Ⓓ Ribosome
6. **In Eukaryotic cells, chromatin is composed of:**
   Ⓐ RNA and ribosomes Ⓑ DNA and proteins
   Ⓒ Carbohydrates and proteins Ⓓ Water and lipids
7. **When a cell divides, chromatin condenses to form:**
   Ⓐ Mitochondria Ⓑ Golgi apparatus
   Ⓒ Chromosomes Ⓓ Ribosomes
8. **DNA contains:**
   Ⓐ Genes Ⓑ Proteins Ⓒ Water Ⓓ Carbohydrates
9. **In prokaryotic cells, the chromosome is made of:**
   Ⓐ Chromatin Ⓑ RNA and proteins
   Ⓒ DNA only Ⓓ Carbohydrates
10. **The function of nucleoli is to:**
    Ⓐ Transport materials Ⓑ Synthesize proteins
    Ⓒ Store genetic material Ⓓ Produce ribosomes

11. **The nucleus serves as the cell's:**

Ⓐ Powerhouse Ⓑ Digestive center

Ⓒ Control center Ⓓ Transport system

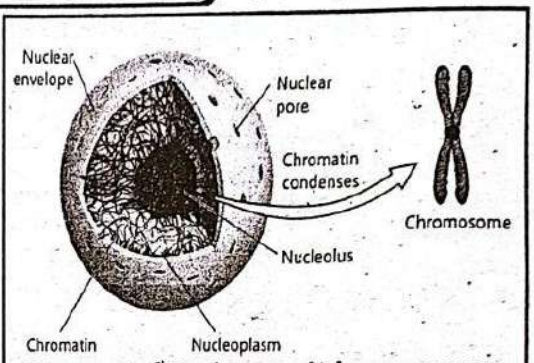
MCQ's Key

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

Short Answered Questions

1. **Where is the nucleus located in animal and mature plant cells?**

Ans. All eukaryotic cells have a prominent nucleus. In **animal cells,** it is present in the center. In **mature plant cells,** it is pushed to side due to a large central vacuole.



Structure of Nucleus and chromosome

2. **What is the nuclear envelope and its function?**

Ans. The nucleus is bounded by a double membrane known as **nuclear envelope.** It is semi-permeable and has many small pores called nuclear pores.

3. **What is nucleoplasm and what does it contain?**

Ans. The inner jelly-like material of nucleus is called **nucleoplasm.** In nucleoplasm there are one or more small bodies called **nucleoli** (singular, nucleolus). Here, ribosomes are assembled. Nucleoplasm contains fine thread-like material known as **chromatin.** It is composed of deoxyribonucleic acid (DNA) and proteins.

4. **What is the role of nucleoli in the nucleus?**

Ans. In nucleoplasm there are one or more small bodies called **nucleoli** (singular, nucleolus). Here, ribosomes are assembled.

5. **What is chromatin composed of, and what happens to it during cell division? (OR)**

What happens to chromatin when a cell is preparing for division? (OR) What are chromosomes, and when do they form?

Ans. Nucleoplasm contains fine thread-like material known as **chromatin.** It is composed of deoxyribonucleic acid (DNA) and proteins. When a cell starts dividing, its chromatin condenses and takes the shape of thick **chromosomes.**

6. **How does DNA function in the cell?** (OR)
- **Why is DNA called the hereditary material?**

Ans. DNA contains genes which control all the activities of the cell. DNA is also responsible for the transmission of characteristics to the next generation. That is why it is called the **hereditary material.**

7. **What is the primary function of the nucleus in a cell?** (OR)
- **What is the relationship between the nucleus and protein synthesis?**

Ans. The nucleus serves as the cell's "control center". It oversees cellular activities by directing the production of proteins.

8. **What is the main difference between prokaryotic and eukaryotic cells in terms of the nucleus?**

Ans. **Prokaryotic cells** do not have a true nucleus; their DNA floats freely in the cytoplasm. **Eukaryotic cells** have a well-defined nucleus enclosed by a nuclear envelope.

3.2.5 *Cytoskeleton*

Multiple Choice Questions (MCQs)

1. **Microtubules are made of:**
Ⓐ Tubulin Ⓑ Actin Ⓒ Keratin Ⓓ Myosin

2. **Microtubules help the cell in:**
Ⓐ Photosynthesis Ⓑ Shape maintenance
Ⓒ Respiration Ⓓ Cell digestion

3. **Structures formed by microtubules:**
Ⓐ Chloroplasts Ⓑ Ribosomes Ⓒ Cilia Ⓓ Vesicles

4. **Microfilaments are made of:**
Ⓐ Vimentin Ⓑ Tubulin Ⓒ Keratin Ⓓ Actin

5. **Role of microfilaments in the cell:**
Ⓐ Cell movement Ⓑ Protein synthesis
Ⓒ ATP production Ⓓ Chromosome duplication

6. **Intermediate filaments are made of:**
Ⓐ Actin Ⓑ Keratin Ⓒ Tubulin Ⓓ Myosin

7. **Intermediate filaments help in:**
Ⓐ Photosynthesis Ⓑ DNA replication
Ⓒ Protein transport Ⓓ Cell junctions

8. **Cytoskeleton is present in:**

Ⓐ Cytoplasm Ⓑ Nucleus

Ⓒ Plasma membrane Ⓓ Mitochondria

9. **Function of microtubules during cell division is to:**

Ⓐ Store genetic information Ⓑ Form the mitotic spindle

Ⓒ Build the nuclear envelope Ⓓ Transport enzymes

10. **Role of intermediate filaments in cellular structure:**

Ⓐ Facilitate photosynthesis Ⓑ Produce ribosomes

Ⓒ Anchor organelles in place Ⓓ Store waste products

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓐ	6	Ⓑ	7	Ⓓ	8	Ⓐ	9	Ⓑ	10	Ⓒ

Short Answered Questions

1. **What is the cytoskeleton, and what are its main components?**

Ans. **Cytoskeleton** is a network of thin tubes and filaments present throughout the cytoplasm. It consists of three parts i.e. microtubules, microfilaments, and intermediate filaments.

2. **What are microtubules, and what functions do they perform?**

Ans. **Microtubules** are hollow tubes made up tubulin protein.

Function: This part holds organelles in place, maintains a cell's shape, and act as tracks for organelles. Microtubules also make mitotic spindle, cilia and flagella.

3. **How do microfilaments contribute to cell movement?**

Ans. **Microfilaments** are finer than microtubules. These are made up of contractile proteins mainly actin.

Function: They help in cell movement e.g., the crawling of white blood cells and the contraction of muscle cells.

4. **What are intermediate filaments, and what roles do they play? (OR)**

- **How do intermediate filaments contribute to organelle stability?**

Ans. **Intermediate filaments** are rods made of variety of proteins, mainly keratin and vimentin.

Function: They anchor the nucleus and some other organelles in the cell They also make cell-to-cell junctions.

3.2.6 Ribosomes

Multiple Choice Questions (MCQs)

1. **Ribosomes are the sites of:**
   Ⓐ Protein synthesis Ⓑ Lipid synthesis
   Ⓒ DNA replication Ⓓ RNA transcription
2. **Ribosomes are composed of:**
   Ⓐ DNA and lipids Ⓑ Proteins and RNA
   Ⓒ Carbohydrates and RNA Ⓓ Proteins and lipids
3. **Ribosomes are found in:**
   Ⓐ Prokaryotes only Ⓑ Eukaryotes only
   Ⓒ Prokaryotes and eukaryotes Ⓓ Viruses only
4. **Eukaryotic ribosomes are:**
   Ⓐ Larger than prokaryotic ribosomes
   Ⓑ Smaller than prokaryotic ribosomes
   Ⓒ Identical to prokaryotic ribosomes
   Ⓓ Absent in prokaryotes
5. **Ribosomes float freely in:**
   Ⓐ Nucleus Ⓑ Cytoplasm
   Ⓒ Mitochondria Ⓓ Golgi apparatus
6. **Ribosomes are attached to:**
   Ⓐ Golgi apparatus Ⓑ Smooth endoplasmic reticulum
   Ⓒ Rough endoplasmic reticulum Ⓓ Lysosomes
7. **Ribosomal subunits unite during:**
   Ⓐ RNA transcription Ⓑ Lipid synthesis
   Ⓒ DNA replication Ⓓ Protein synthesis

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓐ	5	Ⓑ	6	Ⓒ	7	Ⓓ

Short Answered Questions

1. **What are ribosomes and what is their function?**

Ans. **Ribosomes** are tiny granular structures. They are the sites of protein synthesis. Ribosomes float freely in the cytoplasm and are also attached on the surface of rough endoplasmic reticulum. They are composed of almost equal amounts of proteins and ribosomal RNA (rRNA).

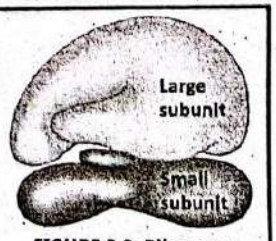


FIGURE 3.8: Ribosome

2. What are ribosomes composed of?

Ans. They are composed of almost equal amounts of proteins and ribosomal RNA (rRNA). Ribosomes are not bounded by membranes and so are also found in prokaryotes.

3. How do eukaryotic and prokaryotic ribosomes differ in size?

Ans. Ribosomes are not bounded by membranes and so are also found in prokaryotes. Eukaryotic ribosomes are slightly larger than prokaryotic ones.

4. What happens to ribosomal subunits during protein synthesis?

Ans. Each ribosome consists of two subunits. Ribosomes are the sites of protein synthesis. The two subunits of a ribosome unite during the process of protein synthesis. When a ribosome has finished its work, its subunits get separated again.

3.2.7 *Endoplasmic Reticulum*

Multiple Choice Questions (MCQs)

1. Rough Endoplasmic Reticulum (RER) is involved in:

Ⓐ Protein synthesis Ⓑ Lipid metabolism
Ⓒ Detoxification Ⓓ Contraction process

2. Smooth Endoplasmic Reticulum (SER) is responsible for:

Ⓐ Protein synthesis Ⓑ Lipid metabolism
Ⓒ DNA replication Ⓓ Ribosome production

3. The process assisted by SER in muscle cells is:

Ⓐ Contraction Ⓑ Digestion
Ⓒ Protein synthesis Ⓓ Glycolysis

4. Detoxification of harmful chemicals is performed by:

Ⓐ Rough Endoplasmic Reticulum Ⓑ Smooth Endoplasmic Reticulum
Ⓒ Ribosomes Ⓓ Mitochondria

5. The structure that lacks ribosomes on its surface is:

Ⓐ Golgi Apparatus Ⓑ Rough Endoplasmic Reticulum
Ⓒ Smooth Endoplasmic Reticulum Ⓓ Plasma Membrane

6. Channels in the cytoplasm surrounded by membranes form the:

Ⓐ Ribosomes Ⓑ Lysosomes
Ⓒ Centrioles Ⓓ Endoplasmic Reticulum

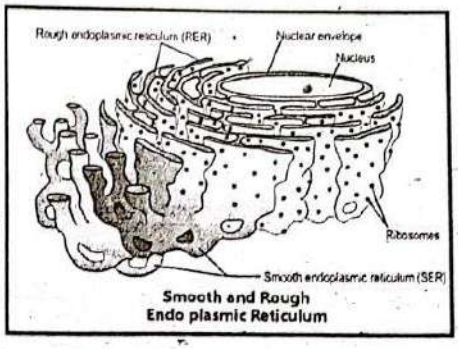
MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓐ	4	Ⓑ	5	Ⓒ	6	Ⓓ

Short Answered Questions

1. What is the Endoplasmic Reticulum (ER)?

Ans. **Endoplasmic reticulum** is a network of membrane-bounded channels present throughout the cytoplasm of eukaryotic cell. There are two types of endoplasmic reticulum.
Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER).



Smooth and Rough Endo plasmic Reticulum

2. What are the types of Endoplasmic Reticulum? (OR)

• **What distinguishes RER from SER?**

Ans. The two types of ER are **Rough Endoplasmic Reticulum (RER),** which has ribosomes and is involved in protein synthesis, and **Smooth Endoplasmic Reticulum (SER),** which lacks ribosomes and performs lipid metabolism and detoxification.

3. What is the function of Smooth Endoplasmic Reticulum (SER)?

Ans. Smooth Endoplasmic Reticulum (SER) lacks ribosomes. It is involved in lipid metabolism and in the transport of materials from one part of the cell to the other. It also detoxifies the harmful chemicals that have entered the cell. In muscle cells, the SER is also involved in contraction process.

3.2.8 Golgi Apparatus

Multiple Choice Questions (MCQs)

1. Golgi apparatus was discovered by Camillo Golgi in:
Ⓐ 1831 Ⓑ 1858 Ⓒ 1898 Ⓓ 1906

2. Golgi apparatus is made of stacked structures called:
Ⓐ Vesicles Ⓑ Tubules Ⓒ Lamellae Ⓓ Cisternae

3. Function of Golgi apparatus includes modification of molecules coming from:
Ⓐ Rough ER Ⓑ Nucleus Ⓒ Smooth ER Ⓓ Lysosomes

4. Molecules modified by Golgi apparatus are packed into:
Ⓐ Cytoplasm Ⓑ Golgi vesicles Ⓒ Nucleoplasm Ⓓ Ribosomes

5. Golgi apparatus is found in:
Ⓐ Plant cells only Ⓑ Animal cells only
Ⓒ Both plant and animal cells Ⓓ Bacteria only

6. **Golgi apparatus helps in forming:**
Ⓐ Proteins Ⓑ Secretions Ⓒ DNA Ⓓ RNA

7. **Nobel Prize for physiology and medicine was awarded to Camillo Golgi in:**
Ⓐ 1906 Ⓑ 1898 Ⓒ 1928 Ⓓ 1942

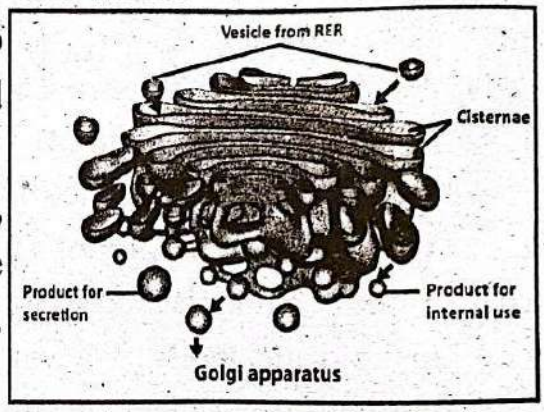
MCQ's Key

1	Ⓒ	2	Ⓓ	3	Ⓐ	4	Ⓑ	5	Ⓒ	6	Ⓑ	7	Ⓐ

Short Answered Questions

1. **What is Golgi apparatus?** **(OR)**
- **Who discovered the Golgi apparatus and when?**

Ans. In 1898, an Italian physician Camillo Golgi discovered a set of flattened sacs in the cytoplasm.
These flattened sacs, called **cisternae,** are stacked over each other and make a structure known as **Golgi apparatus.** It is found in both plant and animal cells.



2. **What is the primary function of the Golgi apparatus?** **(OR)**
- **How does the Golgi apparatus interact with rough ER?** **(OR)**
What are Golgi vesicles?

Ans. Golgi apparatus modifies molecules coming from rough ER and packs them into small membrane-bound sacs called **Golgi vesicles**. These sacs are kept in cell or are transported to exterior in the form of secretions.

3. **Why was Camillo Golgi awarded the Nobel Prize?**

Ans. In 1906 Golgi was awarded Nobel Prize for physiology and medicine.

4. **Why is the Golgi apparatus important for secretion?**

Ans. The Golgi apparatus packages and prepares molecules for secretion, ensuring they are sent to the right destination.

3.2.9 Lysosomes

Multiple Choice Questions (MCQs)

1. **Lysosomes were discovered by:**
Ⓐ Christian René de Duve Ⓑ Robert Brown
Ⓒ Camillo Golgi Ⓓ Robert Hooke

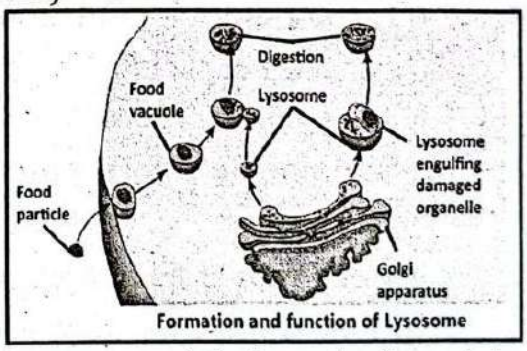
2. **Lysosomes are small vesicles containing:**
   Ⓐ Nucleic acids Ⓑ Digestive enzymes
   Ⓒ Ribosomes Ⓓ Proteins and lipids
3. **Lysosomes are predominantly found in:**
   Ⓐ Bacterial cells Ⓑ Plant cells Ⓒ Animal cells Ⓓ All cells
4. **Lysosomes bud off from:**
   Ⓐ Smooth ER Ⓑ Nucleus
   Ⓒ Rough ER Ⓓ Golgi apparatus
5. **Damaged organelles are broken down by:**
   Ⓐ Cell membrane Ⓑ Ribosomes
   Ⓒ Lysosomes Ⓓ Nucleus
6. **The scientist Christian René de Duve is associated with discovering:**
   Ⓐ Mitochondria Ⓑ Lysosomes Ⓒ Nucleus Ⓓ Golgi apparatus
7. **Cellular digestion and waste management are functions of:**
   Ⓐ Ribosomes Ⓑ Chloroplasts Ⓒ Centrioles Ⓓ Lysosomes

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓒ	6	Ⓑ	7	Ⓓ

Short Answered Questions

1. **What are lysosomes and where are they primarily found? (OR)**
- **Who discovered lysosomes? (OR)**
- **How lysosomes are formed?**



Formation and function of Lysosome

Ans. **Lysosomes** were discovered by Belgian scientist Christian René de Duve. Lysosomes bud off from Golgi apparatus. These are small membrane-bound vesicles that contain digestive enzymes. Lysosomes are predominantly found in animal cells.

2. **How are lysosomes involved in digestion within a cell?**

Ans. Cell engulfs the food material in the form of food vacuole. Lysosome fuses with food vacuole and its enzymes break down the food present in vacuole.

3. **What role do lysosomes play in waste management? (OR)**
- **How do lysosomes contribute to cellular digestion?**

Ans. Lysosomes have enzymes for breaking cellular wastes. They engulf the damaged organelles and break them.

4. **What are the functions of lysosomes?**

Ans. • Cell engulfs the food material in the form of food vacuole. Lysosome fuses with food vacuole and its enzymes break down the food present in vacuole.

- Lysosomes also have enzymes for breaking cellular wastes. They also engulf the damaged organelles and break them.
- Lysosomes can store certain molecules for later use.

3.2.10 *Mitochondria*

Multiple Choice Questions (MCQs)

1. **Mitochondria are known as the powerhouse of the cell because:**
   Ⓐ They store energy Ⓑ They produce ATP
   Ⓒ They contain enzymes Ⓓ They transport oxygen
2. **The process carried out by mitochondria to release energy is:**
   Ⓐ Anaerobic respiration Ⓑ Photosynthesis
   Ⓒ Aerobic respiration Ⓓ Protein synthesis
3. **Mitochondria are found only in:**
   Ⓐ Prokaryotic cells Ⓑ Plant cells
   Ⓒ Animal cells Ⓓ Eukaryotic cells
4. **The folds of the inner membrane of mitochondria are called:**
   Ⓐ Cristae Ⓑ Matrix Ⓒ Vesicles Ⓓ Tubules
5. **Cristae in mitochondria increase:**
   Ⓐ Storage capacity Ⓑ Surface area for respiration
   Ⓒ Oxygen transport Ⓓ ATP storage
6. **The inner fluid-like material in mitochondria is called:**
   Ⓐ Cytoplasm Ⓑ Nucleoplasm Ⓒ Matrix Ⓓ Stroma
7. **Mitochondria have their own:**
   Ⓐ Lysosomes and enzymes Ⓑ Nucleus and chromatin
   Ⓒ Cell walls and RNA Ⓓ DNA and ribosomes
8. **The ribosomes in mitochondria are similar to those of:**
   Ⓐ Prokaryotes Ⓑ Eukaryotes Ⓒ Chloroplasts Ⓓ Bacteria only
9. **Mitochondria can multiply within a cell because they:**
   Ⓐ Use cellular ATP Ⓑ Contain ribosomes
   Ⓒ Have their own DNA Ⓓ Are double-membraned

MCQ's Key

1	Ⓑ	2	Ⓒ	3	Ⓓ	4	Ⓐ	5	Ⓑ	6	Ⓒ	7	Ⓓ	8	Ⓐ	9	Ⓒ

Short Answered Questions

1. Why are mitochondria called the "powerhouse" of the cell?
(OR)
- **What reactions occur in mitochondria during aerobic respiration?**

Ans. **Mitochondria** (singular, mitochondrion) are the "powerhouse" of the cell because they produce energy. They perform the reactions of aerobic respiration in which oxygen is used to break food (glucose) to release energy (ATP-adenosine triphosphate).

2. Describe the membranes of mitochondria.

Ans. Mitochondria are double membrane-bounded organelles present only in eukaryotes. The **outer membrane** of mitochondria is smooth but the **inner membrane** forms many folds. These folds are called **cristae** (singular crista). They increase the surface area for respiration.

3. What is the function of the cristae in mitochondria? **(OR)**
- **Why is the inner membrane of mitochondria folded?**

Ans. The inner membrane of mitochondria forms many folds. These folds are called **cristae** (singular crista). They increase the surface area for respiration.

4. What is the matrix in mitochondria?

Ans. The inner fluid-like material of mitochondria is called **matrix.** Mitochondria contain their own DNA and ribosomes. They can multiply within the cell on their own. The ribosomes of mitochondria are more similar to prokaryotic ribosomes than to eukaryotic ribosomes.

5. How do mitochondria differ from other organelles in terms of DNA? **(OR)**
- **Why can mitochondria multiply independently within a cell?**

Ans. Mitochondria have their own DNA and ribosomes, allowing them to produce some of their proteins and multiply independently within the cell.

6. In what types of cells are mitochondria found?

Ans. Mitochondria are double membrane- bounded organelles present only in eukaryotes and absent in prokaryotic cells.

3.2.11 Plastids

Multiple Choice Questions (MCQs)

1. Plastids are found in the cells of:

Ⓐ Animals Ⓑ Bacteria
Ⓒ Plants and algae Ⓓ Fungi

2. **The type of plastid responsible for photosynthesis is:**
   Ⓐ Chloroplast Ⓑ Chromoplast Ⓒ Leucoplast Ⓓ Amyloplast
3. **Chloroplasts are green because they contain:**
   Ⓐ Carotenoids Ⓑ Thylakoids Ⓒ Proteins Ⓓ Chlorophyll
4. **The stacks of membranes in chloroplasts are called:**
   Ⓐ Thylakoids Ⓑ Grana Ⓒ Stroma Ⓓ Lamellae
5. **The fluid surrounding thylakoids in chloroplasts is called:**
   Ⓐ Matrix Ⓑ Cytoplasm Ⓒ Stroma Ⓓ Granum
6. **Like mitochondria, chloroplasts also contain:**
   Ⓐ Grana and ribosomes Ⓑ Stroma and lipids
   Ⓒ Thylakoids and pigments Ⓓ DNA and ribosomes
7. **Plastids that give bright colors to fruits and flowers are called:**
   Ⓐ Chromoplasts Ⓑ Leucoplasts Ⓒ Chloroplasts Ⓓ Amyloplasts
8. **The pigments in chromoplasts help in:**
   Ⓐ Photosynthesis Ⓑ Pollination and dispersal
   Ⓒ Lipid storage Ⓓ Protein synthesis
9. **The sac-like structures that form grana are called:**
   Ⓐ Thylakoids Ⓑ Chromoplasts Ⓒ Leucoplasts Ⓓ Vesicles
10. **Pigments like carotenoids are found in:**
    Ⓐ Chloroplasts Ⓑ Chromoplasts Ⓒ Leucoplasts Ⓓ Mitochondria
11. **The pigment responsible for photosynthesis is located in:**
    Ⓐ Grana Ⓑ Stroma Ⓒ Chromoplasts Ⓓ Thylakoids
12. **The type of plastid that lacks pigments:**
    Ⓐ Chromoplast Ⓑ Chloroplast Ⓒ Leucoplast Ⓓ Grana
13. **Starch storage occurs in:**
    Ⓐ Chloroplasts Ⓑ Chromoplasts Ⓒ Leucoplasts Ⓓ Grana
14. **Leucoplasts are commonly found in:**
    Ⓐ Leaves and flowers Ⓑ Roots and seeds
    Ⓒ Fruits and petals Ⓓ Algae and fungi
15. **Plastids with no pigments are involved in storing:**
    Ⓐ DNA and RNA Ⓑ Light energy
    Ⓒ Pigments for photosynthesis Ⓓ Starch, lipids, and proteins

MCQ's Key

1	Ⓒ	2	Ⓐ	3	Ⓓ	4	Ⓑ	5	Ⓒ	6	Ⓓ	7	Ⓐ	8	Ⓑ
9	Ⓐ	10	Ⓑ	11	Ⓓ	12	Ⓒ	13	Ⓒ	14	Ⓑ	15	Ⓓ		

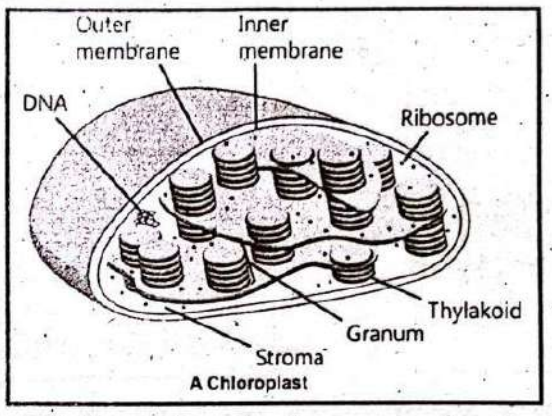
Short Answered Questions

1. Where are plastids found and what are the main types of plastids?

Ans. **Plastids** are present in the cells of plants and photosynthetic protists (algae).

There are three main types of plastids: chloroplasts, chromoplasts, and leucoplasts.

2. What is the function of chloroplasts?



Ans. **Chloroplasts** are green plastids present in the cells of green parts of plants and in algae. They contain photosynthetic pigments e.g. the green pigment chlorophyll. They carry out photosynthesis. With the help of their photosynthetic pigments, they capture light energy and convert it into chemical energy in the form of glucose.

3. What are grana and thylakoids in chloroplasts?

Ans. Like mitochondria, chloroplast is enclosed within two membranes. On the internal side of inner membrane, there are many sets of stacked membranes. These stacks are called **grana** (singular, granum) while the sac-like structures which make a granum are called **thylakoids**. Photosynthetic pigments are present on the surface of thylakoids.

4. What is the stroma in chloroplasts?

Ans. A fluid called **stroma** surrounds the thylakoids. Like mitochondria, chloroplasts also contain DNA and ribosomes.

5. What similarities do chloroplasts have with mitochondria?

Ans. Both chloroplasts and mitochondria are double membrane-bounded and contain their own DNA and ribosomes.

6. What pigments are found in chromoplasts? **(OR)**

- **What is the role of chromoplasts?** **(OR)**
- **How do chromoplasts assist plants?**

Ans. **Chromoplasts** are the plastids that contain pigments such as carotenoids. These pigments are associated with bright colours and are present in the cells of flower petals and fruits. **Chromoplasts** give colours to these parts, thus helping in pollination and dispersal of fruit and seeds.

7. **What are leucoplasts?** **(OR)**

- **Why are leucoplasts important?** **(OR)**
- **What substances are stored in leucoplasts?**

Ans. **Leucoplasts** are plastids that have no pigments. They are involved in the storage of starches, lipids, and proteins. They are present in the cells of those parts where food is stored e.g., underground stems, seeds, roots etc.

8. **What is the primary function of plastids?**

Ans. Plastids perform various functions such as photosynthesis (chloroplasts), storage (leucoplasts), and providing colors (chromoplasts).

3.2.12 *Vacuoles*

Multiple Choice Questions (MCQs)

1. **Vacuoles in animal cells are usually:**
   Ⓐ Many and small Ⓑ Single and large
   Ⓒ Membrane-less Ⓓ Filled with sap
2. **The vacuole membrane in plant cells is called:**
   Ⓐ Cell wall Ⓑ Tonoplast
   Ⓒ Plasma membrane Ⓓ Nuclear membrane
3. **The pressure exerted by a plant vacuole is called:**
   Ⓐ Hydrostatic pressure Ⓑ Osmotic pressure
   Ⓒ Turgor pressure Ⓓ Cellular pressure
4. **The cytoplasm in mature plant cells is pushed to the side due to:**
   Ⓐ Food vacuoles Ⓑ Excess water
   Ⓒ Presence of cell wall Ⓓ A large central vacuole
5. **Plant vacuoles are formed by:**
   Ⓐ Fusion of many small vacuoles Ⓑ Division of a central vacuole
   Ⓒ Contractile vacuoles combining Ⓓ Cytoplasmic division
6. **Freshwater organisms with contractile vacuoles include:**
   Ⓐ Paramecium and algae Ⓑ Amoeba and sponges
   Ⓒ Bacteria and fungi Ⓓ Plants and animals
7. **The central vacuole in plants maintains:**
   Ⓐ Cell division Ⓑ Fluid balance
   Ⓒ Turgidity Ⓓ Protein synthesis

8. **Excess water and waste removal in freshwater organisms is handled by:**

Ⓐ Contractile vacuoles Ⓑ Food vacuoles
Ⓒ Cytoplasm Ⓓ Ribosomes

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓐ	6	Ⓑ	7	Ⓒ	8	Ⓐ

Short Answered Questions

1. **What are vacuoles?**

Ans. **Vacuoles** are single membrane-bound sacs filled with fluid. **Animal cell** may have many small temporary vacuoles. They contain water and food substances.

Most **mature plant cells** have a single, large, central vacuole. It is formed by the fusion of many small vacuoles.

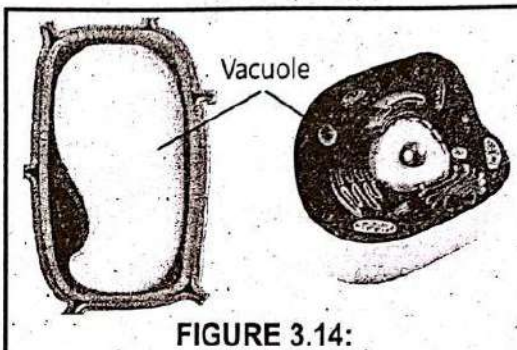


FIGURE 3.14:
Vacuole in plant and animal cell

2. **What is the function of contractile vacuoles?**

Ans. Some freshwater organisms like amoeba and sponges have **contractile vacuoles** which collect and pump out extra water and other wastes..

3. **What is the tonoplast? Also define cell sap.**

Ans. The membrane of plant vacuole is called **tonoplast** and the sap inside plant vacuole is called **cell sap**. It is a watery solution of salts.

4. **What is the role of vacuoles in plant cells?**

Ans. In plant cells, due to the large central vacuole, the cytoplasm is pushed to a side. This outward pressure of the vacuole on the cytoplasm and cell wall makes plant cells turgid. This pressure is called **turgor pressure** and the process is called **turgor**.

5. **What is the significance of turgor pressure?**

Ans. Turgor pressure is the outward pressure of the vacuole on the cytoplasm and cell wall, keeping plant cells turgid and maintaining their rigidity.

6. **What substances are stored in vacuoles?**

Ans. Vacuoles store water, salts, food substances, and sometimes wastes in both plant and animal cells.

7. **How do vacuoles differ in plant and animal cells?**

Ans. **Plant cells** usually have a single, large central vacuole, while **animal cells** have many small temporary vacuoles.

8. **Why the vacuoles called the wastebins of the cells?**

Ans. Vacuoles are called the wastebins of the cell because some, like contractile vacuoles in freshwater organisms, collect and pump out extra water and other wastes. This helps in removing harmful substances from the cell.

3.2.13 Centrioles

Multiple Choice Questions (MCQs)

1. **Centrioles are absent in:**
   Ⓐ Prokaryotes Ⓑ Higher plants Ⓒ Fungi Ⓓ All of these
2. **The structure formed by a pair of centrioles in animal cells:**
   Ⓐ Centrosome Ⓑ Basal body Ⓒ Spindle fibre Ⓓ Cilia
3. **Centrioles are made up of:**
   Ⓐ Keratin protein Ⓑ Actin protein
   Ⓒ Tubulin protein Ⓓ Vimentin protein
4. **The arrangement of microtubules in a centriole:**
   Ⓐ 9 doublets Ⓑ 9 pairs Ⓒ 3 triplets Ⓓ 9 triplets
5. **Centrioles form spindle fibres during:**
   Ⓐ Photosynthesis Ⓑ Cell division
   Ⓒ Protein synthesis Ⓓ Respiration
6. **Centrioles located near cell membranes in cells with cilia are called:**
   Ⓐ Basal bodies Ⓑ Centrosomes Ⓒ Microtubules Ⓓ Cytoskeleton
7. **The main function of basal bodies:**
   Ⓐ Formation of spindle fibres Ⓑ Formation of cilia and flagella
   Ⓒ Storage of proteins Ⓓ Transport of materials
8. **The position of the centrosome in animal cells:**
   Ⓐ In the cytosol Ⓑ At the cell membrane
   Ⓒ Near the nuclear envelope Ⓓ At the opposite poles
9. **Centrioles duplicate at the start of:**
   Ⓐ DNA replication Ⓑ Cytokinesis
   Ⓒ Protein synthesis Ⓓ Cell division

MCQ's Key

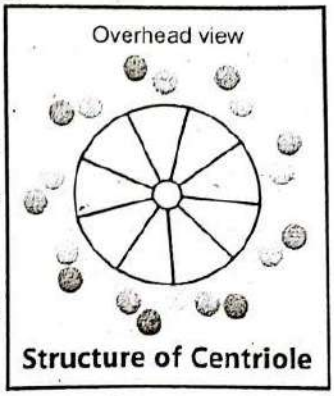
1	Ⓓ	2	Ⓐ	3	Ⓒ	4	Ⓓ	5	Ⓑ	6	Ⓐ	7	Ⓑ	8	Ⓒ	9	Ⓓ

Short Answered Questions

1. What are centrioles? (OR)

- **In which cells centrioles are found?**

Ans. **Centrioles** are barrel-shaped organelles found in the cells of animals and most protists. They are absent in prokaryotes, higher plants and fungi. There is a pair of centrioles in which both centrioles are at right angles to each other.



Structure of Centriole

2. What is a centrosome?

Ans. A **centrosome** is a pair of centrioles located near the nuclear envelope in animal cells. The two centrioles are positioned at right angles to each other.

3. How are centrioles arranged in a cell? (OR)

- **What is the structure of a centriole?**

Ans. In animal cells, the pair of centrioles is called a **centrosome** and it is located near the nuclear envelope. Each centriole is formed of 9 triplets of microtubule (made up of tubulin protein). The cells which have cilia or flagella contain centriole near cell membranes. These centrioles are called **basal bodies.**

4. Where are basal bodies located, and what is their function? (OR)

- **What are basal bodies?**

Ans. The cells which have cilia or flagella contain centriole near cell membranes. These centrioles are called **basal bodies.** Basal bodies are responsible for the formation of cilia and flagella.

5. What is the role of centrioles in cell division? (OR)

- **What happens to centrioles at the start of cell division?**

Ans. At the start of cell division, the pair of centrioles duplicates. The new pairs move to the opposite pole of the cell. There, they form spindle fibres.

3.2.14 Celia and Flagelia

Multiple Choice Questions (MCQs)

1. Projections connected to the basal body in eukaryotic cells.

Ⓐ Chromoplasts Ⓑ Cilia and flagella

Ⓒ Ribosomes Ⓓ Nucleoli

2. **The number of central microtubules in eukaryotic cilia and flagella.**
   Ⓐ Eleven pairs Ⓑ Two pairs Ⓒ Nine pairs Ⓓ One pair

3. **Protein that forms prokaryotic flagella.**
   Ⓐ Actin Ⓑ Tubulin Ⓒ Flagellin Ⓓ Keratin

4. **Primary function of cilia and flagella.**
   Ⓐ Movement Ⓑ Energy production
   Ⓒ Storing food Ⓓ Protein synthesis

5. **Structural difference between prokaryotic and eukaryotic flagella.**
   Ⓐ Number of flagella Ⓑ Composition of proteins
   Ⓒ Length of flagella Ⓓ Location in the cell

6. **Key structural feature of cilia and flagella in eukaryotic cells.**
   Ⓐ Intermediate filaments Ⓑ Endoplasmic reticulum
   Ⓒ Actin filaments Ⓓ Microtubules

MCQ's Key

1	Ⓑ	2	Ⓓ	3	Ⓒ	4	Ⓐ	5	Ⓑ	6	Ⓓ

Short Answered Questions

1. **What are cilia and flagella?**

Ans. Some cells have thin, tail-like projections called **cilia** (singular **cilium**) and **flagella** (singular flagellum). Cilia are short in length and are usually numerous in number, while flagella are longer but less in number. The function of cilia and flagella is movement.

2. **How are cilia and flagella structured in eukaryotic cells?**

Ans. Eukaryotic cilia and flagella consist of nine pairs of microtubules which surround a single central pair of microtubules. Cilia and flagella are connected to the basal body.

3. **How do prokaryotic and eukaryotic flagella differ?**

Ans. **Eukaryotic** cilia and flagella consist of nine pairs of microtubules which surround a single central pair of microtubules. Cilia and flagella are connected to the basal body. **Prokaryotic** cells also have flagella but their structure is completely different. Prokaryotic flagella are made of a protein called **flagellin**. The function of cilia and flagella is movement.

3.2.15 Comparison between Plant and Animal Cells

Multiple Choice Questions (MCQs)

1. **The boundary that regulates the movement of substances in and out of the cell is:**
   Ⓐ Cell membrane Ⓑ Chloroplast
   Ⓒ Cytoplasm Ⓓ Cell wall
2. **The tough, non-living outer layer found in plant cells is:**
   Ⓐ Cell membrane Ⓒ Large vacuole Ⓒ Cell wall Ⓓ Chloroplast
3. **The organelle that stores salts, water, and helps maintain turgidity in plant cells is:**
   Ⓐ Cell membrane Ⓑ Cytoplasm
   Ⓒ Nucleus Ⓓ Large vacuole
4. **The organelle responsible for photosynthesis in plant cells is:**
   Ⓐ Nucleus Ⓑ Chloroplast Ⓒ Cytoplasm Ⓓ Large vacuole
5. **The organelle controlling cell division and activities in cells is:**
   Ⓐ Nucleus Ⓑ Cytoplasm Ⓒ Chloroplast Ⓓ Cell wall
6. **The cellulose-based structure that provides mechanical support to plant cells is:**
   Ⓐ Cytoplasm Ⓑ Cell wall Ⓒ Nucleus Ⓓ Cell membrane

MCQ's Key

1	Ⓐ	2	Ⓒ	3	Ⓓ	4	Ⓑ	5	Ⓐ	6	Ⓑ

Short Answered Questions

1. **How is the cell wall different from the cell membrane?**

Ans. The **cell wall** is a tough, non-living outer layer found in plant cells that provides mechanical support, while the **cell membrane** is a partially permeable boundary present in all cells that controls the movement of substances in and out.

2. **Compare the location of the nucleus in animal and plant cells.**

Ans. **In animal cells,** the nucleus is located at the center, while **in plant cells,** it is pushed to the side due to the large central vacuole.

3. **What is the difference between cytoplasm and chloroplast?**

Ans. The **cytoplasm** is a jelly-like material that contains organelles and supports metabolic reactions, whereas **chloroplast** is an organelle in plant cells responsible for photosynthesis using chlorophyll.

4. **How does the large vacuole in plant cells differ from vacuoles in animal cells?**

Ans. **Plant cells** have a single, large, central vacuole that stores water and salts and maintains turgidity, whereas **animal cells** may have many small, temporary vacuoles.

3.3 *Structural Advantages of Plant and Animal Cells*

Multiple Choice Questions (MCQs)

1. **Plant cells are supported by a rigid structure made of cellulose, ensuring protection and structural stability:**
   Ⓐ Cell wall Ⓑ Cell membrane
   Ⓒ Chloroplast Ⓓ Plasmodesmata
2. **Conversion of light energy into chemical energy for food production occurs in specialized organelles found in plant cells:**
   Ⓐ Mitochondria Ⓑ Chloroplasts Ⓒ Ribosomes Ⓓ Lysosomes
3. **A structure in plant cells stores water and nutrients while maintaining cell shape through pressure:**
   Ⓐ Cytoplasm Ⓑ Cell wall
   Ⓒ Central vacuole Ⓓ Plasmodesmata
4. **Direct communication and transport of substances between plant cells occur through specialized channels:**
   Ⓐ Lysosomes Ⓑ Flagella Ⓒ Cilia Ⓓ Plasmodesmata
5. **Spindle fibers in animal cells, essential for chromosome distribution during cell division, are formed by specific structures:**
   Ⓐ Centrioles Ⓑ Cilia Ⓒ Lysosomes Ⓓ Ribosomes
6. **Enzyme-filled organelles in animal cells contribute to the breakdown and recycling of cellular waste:**
   Ⓐ Vacuoles Ⓑ Lysosomes Ⓒ Chloroplasts Ⓓ Centrioles
7. **Movement in some animal cells, such as sperm, is facilitated by a whip-like structure:**
   Ⓐ Centriole Ⓑ Cilia Ⓒ Flagellum Ⓓ Plasmodesmata
8. **Flexibility in animal cells is achieved due to the absence of a rigid external structure:**
   Ⓐ Cell membrane Ⓑ Lysosome Ⓒ Cytoplasm Ⓓ Cell wall

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓐ	6	Ⓑ	7	Ⓒ	8	Ⓓ

Short Answered Questions

Advantages of Plant Cell Structures

1. What advantage does the rigid cell wall provide to plant cells?

Ans. Plant cells have a rigid cell wall made of cellulose. It provides structural support and protection.

2. How do chloroplasts benefit plant cells?

Ans. They contain chloroplasts, which are responsible for photosynthesis. Chloroplasts convert light energy into chemical energy, allowing plants to produce food.

3. What role does the large central vacuole play in plant cells? (OR)

- **What is the significance of the central vacuole in maintaining the shape of plant cells?**

Ans. The large central vacuole stores water, nutrients, and waste products. It provides turgor pressure that maintains cell shape.

4. How do plasmodesmata benefit plant cells?

Ans. Plant cells are interconnected by plasmodesmata, channels that allow direct communication and transport of substances between cells.

Advantages of Animal Cell Structures

5. What is the role of centrioles in animal cells?

Ans. Animal cells have centrioles which make spindle fibres. This ensures the accurate distribution of chromosomes during cell division.

6. How do lysosomes benefit animal cells?

Ans. They contain lysosomes, filled with enzymes that break down waste materials. Lysosomes contribute to cellular cleanup and recycling.

7. What is the function of flagella and cilia in some animal cells?

Ans. Some animal cells have structures called flagella and cilia, which are involved in movement.

For example, sperm cells have a flagellum that propels them toward the egg for fertilization.

8. How does the lack of a rigid cell wall benefit animal cells?

Ans. They lack a rigid cell wall, allowing them to change shape easily. This flexibility is crucial for cell movements, such as white blood cells moving to sites of infection or injury.

3.4 Cell Specialization

Multiple Choice Questions (MCQs)

1. **Mesophyll cells are specialized for:**
   Ⓐ Photosynthesis Ⓑ Water absorption
   Ⓒ Nutrient storage Ⓓ Waste removal
2. **The primary function of epidermal cells is:**
   Ⓐ Water absorption Ⓑ Protection of internal tissues
   Ⓒ Photosynthesis Ⓓ Oxygen transport
3. **Skeletal muscle cells are specialized for:**
   Ⓐ Blood circulation Ⓑ Heart contraction
   Ⓒ Bone movement Ⓓ Digestion
4. **Cardiac muscle cells are specialized for:**
   Ⓐ Blood flow regulation Ⓑ Nutrient storage
   Ⓒ Bone movement Ⓓ Heart contraction
5. **Smooth muscle cells are specialized for:**
   Ⓐ Movement of skeleton Ⓑ Movement in internal organs
   Ⓒ Blood circulation Ⓓ Oxygen transport
6. **Red blood cells are specialized to:**
   Ⓐ Carry oxygen Ⓑ Break down toxins
   Ⓒ Contract muscles Ⓓ Store nutrients
7. **Liver cells are specialized for:**
   Ⓐ Producing red blood cells Ⓑ Absorbing water
   Ⓒ Detoxification Ⓓ Transmitting nerve impulses
8. **Muscle cells are specialized for:**
   Ⓐ Transmitting impulses Ⓑ Contraction
   Ⓒ Storing energy Ⓓ Absorbing nutrients
9. **Liver cells contain peroxisomes for:**
   Ⓐ Oxygen transport Ⓑ Detoxification
   Ⓒ Toxin neutralization Ⓓ Contracting muscles
10. **Mature Red blood cells lack a nucleus to:**
    Ⓐ Accommodate haemoglobin Ⓑ Store oxygen
    Ⓒ Carry nutrients Ⓓ Water absorption
11. **Smooth muscle cells are found in:**
    Ⓐ Heart walls Ⓑ Skeleton
    Ⓒ Blood vessels Ⓓ Internal organs

12. **Neurons transmit nerve impulses through:**
Ⓐ Oxygen transport Ⓑ Muscle contraction
Ⓒ Dendrites and axons Ⓓ Photosynthesis

13. **The process of detoxification in liver cells is carried out by:**
Ⓐ SER Ⓑ Peroxisomes Ⓒ Chloroplasts Ⓓ Mitochondria

14. **The liver convert toxic ammonia into:**
Ⓐ Glucose Ⓑ Urea Ⓒ Water Ⓓ Carbon dioxide

15. **The liver assists kidney function:**
Ⓐ By producing bile Ⓑ By storing iron
Ⓒ By converting ammonia into urea Ⓓ By producing hormones

16. **Division of labour in biological systems refers to:**
Ⓐ Specialization of parts Ⓑ Cell division
Ⓒ Growth of cells Ⓓ Nutrient absorption

17. **The function of the endoplasmic reticulum in a cell:**
Ⓐ Break down waste Ⓑ Generate energy
Ⓒ Synthesize lipids Ⓓ Transmit messages

18. **The role of lysosomes in a cell:**
Ⓐ Synthesize proteins Ⓑ Generate energy
Ⓒ Store genetic material Ⓓ Break down waste

MCQ's Key

1	Ⓐ	2	Ⓑ	3	Ⓒ	4	Ⓓ	5	Ⓑ	6	Ⓐ	7	Ⓒ	8	Ⓑ	9	Ⓒ
10	Ⓐ	11	Ⓓ	12	Ⓒ	13	Ⓐ	14	Ⓑ	15	Ⓒ	16	Ⓐ	17	Ⓒ	18	Ⓓ

Short Answered Questions

1. **What is the role of mesophyll cells in plants?**

Ans. **Mesophyll cells** are green cells present in leaves. They are specialized for photosynthesis. They contain large number of chloroplasts, which contain the green pigment chlorophyll necessary for capturing light energy. Their shape and arrangement in leaves is suitable for maximum absorption of light.

2. **How are epidermal cells in plants adapted for protection?**

Ans. **Epidermal cells** are flat and tightly packed cells that make the outer layer (epidermis) of plant organs. Epidermis protects the internal tissues.

3. How do root hair cells assist in plant growth? (OR)

- **What is the function of root hairs in plants?**

Ans. Epidermis of root contains root hair cells. These cells make extensions called **root hairs** to absorb water and minerals from soil.

4. What is the primary function of muscle cells?

Ans. **Muscle cells** are specialized animal cells that can contract. They are elongated cells filled with actin and other contractile proteins.

5. What are the key characteristics of skeletal muscle cells?

Ans. **Skeletal muscle cells** are long, striated. They are attached to bones. They are voluntary in action and their contractions move the skeleton for body movements and locomotion.

6. How do cardiac muscle cells function?

Ans. **Cardiac muscle cells** are branched and striated. They are found in the heart walls. They are involuntary in action and their contractions result in the pumping action of heart.

7. What is the role of smooth muscle cells?

Ans. **Smooth muscle cells** are spindle shaped and non-striated. They involuntary in action and are present in the walls of many internal organs.

For example, smooth muscles in the alimentary canal contract to move food forward, while those in blood vessels regulate blood flow.

8. How do smooth muscle cells assist in digestion and circulation?

Ans. Smooth muscle cells in the alimentary canal contract to move food forward, while those in blood vessels help regulate blood flow.

9. What is the primary function of neurons?

Ans. **Neurons** are the specialized cells of the nervous system. They are responsible for transmitting messages (nerve impulses) throughout the body.

10. What are the main components of a neuron? **(OR)**

- **What role do dendrites play in the functioning of neurons?** **(OR)**
- **How do axons contribute to nerve signal transmission?**

Ans. A neuron consists of a cell body and two types of cytoplasmic extensions. **Dendrites,** the shorter extensions, receive nerve impulses and transmit them to the cell body. **Axons,** the longer extensions, carry nerve impulses away from the cell body.

11. **What is the primary function of red blood cells? (OR)**

• **How does the shape of red blood cells help in their function?**

Ans. **Red Blood Cell (Erythrocyte)** are specialized to carry oxygen from the lungs to the body's tissues. They are biconcave disk- shaped cells. This shape provides more surface area to absorb and release oxygen. They are filled with haemoglobin that actually carries oxygen.

12. **Why do mature red blood cells lack a nucleus and other organelles in mammals?**

Ans. In mammals, the mature red blood cells do not contain nucleus, mitochondria, and endoplasmic reticulum etc. It helps to accommodate more haemoglobin.

13. **How do the structural features of red blood cells contribute to their function?**

Ans. The biconcave shape and lack of organelles in red blood cells maximize their capacity to carry and release oxygen effectively.

14. **What are the primary functions of liver cells (hepatocytes)?**

Ans. **Liver cells** are also called hepatocytes. They are specialized for a lot of important functions like storage of glycogen, iron and some vitamins; detoxification of toxic substances, production of clotting proteins of blood, recycling of old red blood cells etc.

15. **Why do liver cells have prominent nuclei?**

Ans. They have prominent nuclei for maximum activities required for making enzymes and other proteins.

16. **What role does the smooth endoplasmic reticulum (SER) play in liver cells?**

Ans. Expansive network of SER helps for extensive detoxification and lipid synthesis.

17. **What are peroxisomes in liver cells responsible for?**

Ans. There are large number of **peroxisomes** in liver cells which contain enzymes to neutralize toxic substances.

18. **How do liver cells transport their secretion?**

Ans. Small ducts are present between liver cells which collect and transport their secretion (bile) to the bile ducts.

19. **How does the liver assist in detoxifying ammonia? (OR)**

• **What role does the liver play in relation to kidney function?**

Ans. Toxic ammonia is converted into less toxic farm urea in liver; hence it assists kidney function.

20. What does the division of labour within a cell mean?

Ans. **Division of labour** refers to the specialization of different parts of a system to perform specific tasks more efficiently. It is a fundamental principle that enhances efficiency and functionality in biological systems (both within and across cells).

21. How does division of labour enhance efficiency and functionality within the cells?

Ans. Within a cell division of labour is exemplified by the various organelles that each carry out distinct functions necessary for the cell's survival,
For instance, Mitochondria generate energy, endoplasmic reticulum synthesizes proteins and lipids, and lysosomes break down waste materials. In this way, the function of each organelle contributes to the cell's overall survival, growth, and functioning.

22. What is the significance of division of labour across cells in multicellular organisms?

Ans. In multicellular organisms, the division of labour extends across cells. Each type of cell performs a specific role and contributes to the overall functions of the organism.
Example: Muscle cells are specialized for contraction and movement, nerve cells for transmitting messages, and red blood cells for carrying oxygen. This intercellular specialization allows complex organisms to perform a wide range of functions.

3.5 *Stem Cells*

Multiple Choice Questions (MCQs)

1. Stem cells are characterized as:
Ⓐ Specialized cells Ⓑ Immature cells
Ⓒ Unspecialized cells Ⓓ Differentiated cells

2. The zygote is an example of:
Ⓐ An unspecialized cell Ⓑ A mature cell
Ⓒ A specialized cell Ⓓ A differentiated cell

3. Stem cells in the bone marrow differentiate to form:
Ⓐ Nerve cells Ⓑ Blood cells and immune cells
Ⓒ Muscle cells Ⓓ Skin cells

4. Adult stem cells regularly divide in:
Ⓐ Skin only Ⓑ Liver and lungs
Ⓒ Gut and bone marrow Ⓓ Brain

5. **Stem cells in the skin assist in:**

Ⓐ Producing blood cells Ⓑ Healing wounds

Ⓒ Digestion Ⓓ Supporting nerve function

MCQ's Key

1	Ⓒ	2	Ⓐ	3	Ⓑ	4	Ⓒ	5	Ⓑ

Short Answered Questions

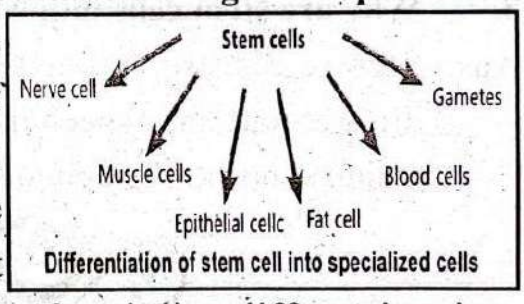
1. **How does the zygote relate to stem cells?**

Ans. In sexually reproducing organisms, all different types of cells arise from a single cell (zygote). **The zygote** is an unspecialized cell but it has the ability to make new cells which can differentiate into specialized cells.

The unspecialized cell that has the ability to differentiate into a variety of specialized cell typ is called **stem cell**.

2. **What happens when stem cells differentiate during development?**

Ans. The unspecialized cell that has the ability to differentiate into a variety of specialized cell types is called **stem cell**. During development, when the earliest stem cell (zygote) divides, it makes different cell lines. The cells of each line differentiate into specific type like skin cells, muscle cells, nerve cells, blood cells etc.



Differentiation of stem cell into specialized cells

3. **What are the functions of stem cells in the skin?**

Ans. Stem cells remain in different parts of the body throughout life. These stem cells can divide and differentiate into specific cells as the body needs them. They can also regenerate damaged tissue under the right conditions.

For example, stem cells present in skin help in wound healing.

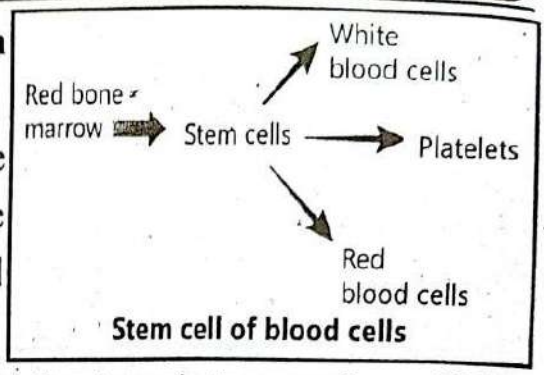
4. **How do stem cells in the liver contribute to tissue repair?**

Ans. Stem cells remain in different parts of the body throughout life. These stem cells can divide and differentiate into specific cells as the body needs them. They can also regenerate damaged tissue under the right conditions.

For example, Stem cells present in liver also help it to repair after damage.

5. **What is the significance of stem cells in the bone marrow?**

Ans. Stem cells present in the bone marrow differentiate to make different types of blood cells and immune cells.



Stem cell of blood cells

6. **How do adult stem cells contribute to tissue maintenance?** **(OR)**

• **How do stem cells assist in maintaining and repairing organs?**

Ans. In some parts of the body, such as the gut and bone marrow, adult stem cells regularly divide to produce new tissues for maintenance and repair.

7. **Where are stem cells found in the body and what do they do?**

Ans. Stem cells are found in various parts of the body, including the bone marrow, liver, and skin. They help in tissue regeneration, repair, and the production of specialized cells like blood and skin cells.

8. **Why are stem cells important for growth and repair in the body?**

Ans. Stem cells are important for growth and repair because they differentiate into specialized cells, regenerate damaged tissues, and maintain healthy cell populations in various organs.

EXERCISE

(A) Select the correct answers for the following questions.

1. **The process of cellular respiration occurs in:**

Ⓐ Nucleus Ⓑ Mitochondria
Ⓒ Nucleus Ribosomes Ⓓ Golgi apparatus

2. **The smooth endoplasmic reticulum (SER) is primarily involved in the synthesis of:**

Ⓐ Proteins Ⓑ Lipids
Ⓒ Carbohydrates Ⓓ Nucleic acids

3. **Ribosomes are composed of:**

Ⓐ RNA and protein Ⓑ DNA and protein
Ⓒ Carbohydrates and lipids Ⓓ RNA and carbohydrates

4. **What is the primary function of ribosomes?**

Ⓐ Energy production Ⓑ Protein synthesis
Ⓒ Lipid synthesis Ⓓ DNA synthesis