According to Single National Curriculum

AL-RAZI ACADEMIC Notes

Biology

Grade 9

Promising:

- Topical MCQs
- Topical Short Questions
- Solved Exercises

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- Topical MCQs
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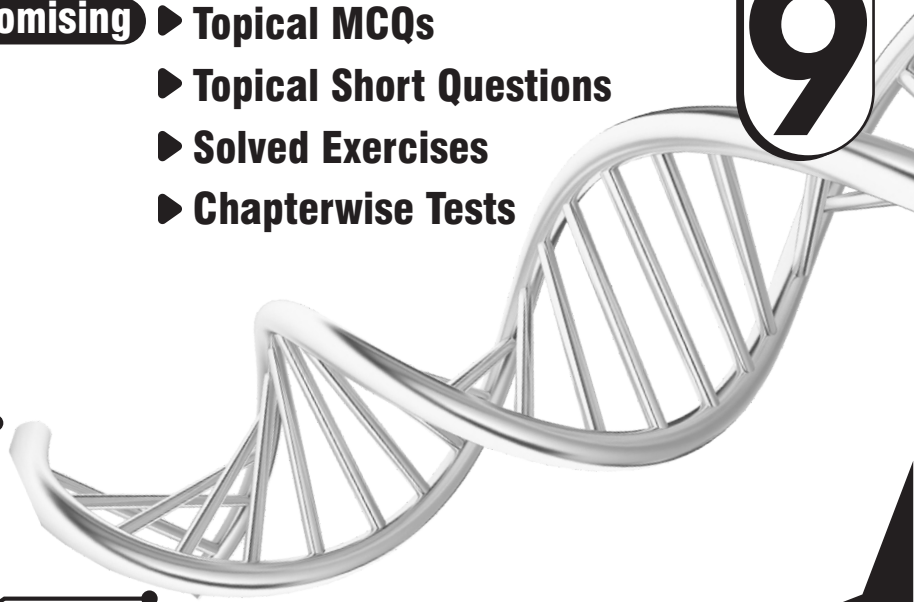
- Chapterwise Tests



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Preface

Welcome to the world of biology! This course invites you to explore the science of life, from the smallest cells to complex ecosystems. Biology helps us understand the natural world, the organisms that inhabit it, and the processes that sustain life.

In Grade 9, you'll dive into essential concepts that form the backbone of biology, including cell structure, enzymes, biomolecules, plant philosophy, the biostatistics, etc. You'll explore how living organisms grow, interact, and evolve, unlocking the mysteries of life that are all around us.

Biology is not just about memorizing facts – it's about asking questions, seeking answers, and discovering the beauty and complexity of the natural world.

Get ready to embark on an exciting journey through the wonders of biology! Your curiosity and imagination will lead the way as we explore life at its most fascinating level.

Contents

Chapter 1 The Science of Biology

1.1 Biology and its Branches

Multiple Choice Questions (MCQs)

1. Biology is the study of:
A Chemical reactions B Geological formations
C Living organisms D Non-living matter

2. The word "Biology" is derived from:
A Sanskrit words B Arabic words
C Latin words D Greek words

3. The field of Biology that deals with the study of animals is called:
A Microbiology B Botany C Zoology D Ecology

4. The study of plants, including their growth and reproduction, is known as:
A Genetics B Botany C Zoology D Microbiology

5. Microbiology focuses on the study of:
A Microorganisms B Animals C Plants D Ecosystems

6. Microorganisms studied in Microbiology include:
A Amphibians and reptiles B Mammals and birds
C Trees and shrubs D Bacteria and microscopic fungi

7. The term "bios" in the word Biology means:
A Study B Organism C Life D Nature

8. Understanding Biology helps to address issues related to:
A Health, food, and environment B Geological formations
C Space exploration D Technology and energy

9. The three major fields of Biology include:
A Genetics, Ecology, and Physiology
B Biochemistry, Physiology, and Zoology
C Botany, Microbiology, and Ecology
D Zoology, Botany, and Microbiology

10. Physiology deals with the functioning of:
A Cells B Body parts C Tissues D Organs

11. Embryology studies the development of organisms from:
A Adult organisms B Genetic material
C Environmental factors D Fertilized egg

12. Genetics focuses on the transfer of characteristics from:
A Parents to offspring B Species to species
C Organisms to environment D Cells to tissues

13. Molecular Biology studies:
A Fossils B Organ systems
C Biological molecules D Genetic traits

14. Histology is the study of:
A Cells B Organs C Tissues D Blood samples

15. In Palaeontology, we study:
A Organism classification B Body functions
C Animal behavior D Fossils

16. Fossils are preserved remains of:
A Plants and animals B Water bodies
C Rocks D Minerals

17. The oldest known fossil is a:
A Fern B Trilobite C Cyanobacterium D Dinosaur

18. Taxonomy is the classification of organisms based on:
A Body structures B Similarities and differences
C Environmental factors D Genetic material

19. Ecology focuses on the relationship between organisms and their:
A Offspring B Internal organs C Genetic traits D Environment

20. Marine Biology studies life in:
A Soil B Freshwater ecosystems C Oceans D Forests

21. Pathology is the study of:
A Diseases, causes, and effects B Genetic traits
C Tissues D Body structures

22. Immunology is the study of the immune system and its role against:
A Organ systems B Genetic inheritance
C Diseases D Cell division

23. Pharmacology focuses on the study of:
A Tissues and organs B Drugs and their effects
C Evolutionary patterns D Body functions

24. The examination of fossils helps to understand:
A Organ functions B Disease prevention
C Evolutionary history D Genetic inheritance

MCQ's Key

1	C	2	D	3	C	4	B	5	A	6	D	7	C	8	A
9	D	10	B	11	D	12	A	13	C	14	C	15	D	16	A
17	C	18	B	19	D	20	C	21	A	22	C	23	B	24	C

Short Answered Questions

1. What is Biology? (OR)

• What is the origin of the word "Biology"? Define it.

Ans. **Biology** is the science of life. The word "Biology" comes from two Greek words i.e., "bios" (life) and "logos" (study). It explores the structures, functions, and interactions of living organisms.

2. How does understanding Biology benefit us?

Ans. Understanding Biology helps us to address issues related to health, food, and the environment. Biology offers a fascinating journey of discovery from the microscopic world of bacteria to the vast ecosystems of our planet.

3. What are the major fields of Biology?

Ans. The major fields of Biology are Zoology, Botany and Microbiology.

4. What is Zoology?

Ans. **Zoology** is the study of animals, including their structure, function, behaviour, and diversity.

5. Define Botany.

Ans. **Botany** is the study of plants, including their structure, growth, reproduction, and interactions with their environment.

6. What is Microbiology? (OR)

• What organisms are studied in Microbiology?

Ans. The study of microorganisms, such as bacteria and microscopic fungi is called **microbiology.** It includes the study of the structures, functions, habitats and reproduction of microorganisms, and their impacts on health and environment.

7. What is the main purpose of Anatomy in Biology? (OR)

• What are the practical applications of Anatomy?

Ans. **Anatomy** is the branch of Biology that explores the internal physical structure of organisms, particularly humans.

Importance: It helps in disease diagnosis, medical device development, and improving quality of life

Example: The study of the organs of the digestive system.

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:

A Species distribution B Chemical reactions in organisms
C Climate change effects D Biological processes in physics

2. Biophysics applies the principles of Physics to:

A Biological processes B Cell chemistry
C Organism distribution D Genetic modification

3. Computational Biology uses models and algorithms to:

A Analyze proteins B Diagnose diseases
C Study climate change D understand biological systems

4. Biogeography focuses on the study of:

A living organisms distribution B Cell composition
C Medical treatments D Biological molecules

5. Biostatistics involves the use of statistics to:

A Study species B Develop drugs
C Analyze biological data D Understand molecules

6. Biotechnology involves using organisms to:

A Study climate change B Produce beneficial products
C Study inheritance D Study geological history

7. Bio-economics studies organisms from an:

A Ecological perspective B Evolutionary perspective
C Environmental perspective D Economical point of view

8. An example of Biochemistry is the study of:

A Muscle function B Species distribution
C Photosynthesis reactions. D Genetic engineering

9. Biophysics helps us to understand:

A Energy transfer B Muscle and joint function
C Biochemical processes D Climate change

10. Biotechnology helps in healthcare by:

A Producing insulin B Studying environment
C Calculating costs D Analyzing cell structure

11. Biogeography helps us understand the effect of:

A Physical laws B Climate on species
C Statistical trends D Molecular interactions

MCQ's Key

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

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:

A Forensics B Biotechnology C Public Health D Pharmacology

2. Fisheries and wildlife studies are related to:

A Animal Husbandry B Agriculture
C Zoology and Aquaculture D Forestry

3. Animal Husbandry involves the breeding and caring for:

A Plants B Livestock C Microorganisms D Fish

4. The field related to cultivating fruits, vegetables, and ornamental plants is:

A Forestry B Biotechnology
C Veterinary Medicine D Horticulture

5. Forensic scientists help in criminal investigations by:

A Analyzing microorganisms B Studying the effects of drugs
C Treating animal diseases
D Analyzing physical evidence from crime scenes

6. Veterinary Medicine involves the diagnosis and treatment of diseases in:

A Animals B Humans C Plants D Microorganisms

7. Environmental Science deals with solving issues related to:

A Diseases B Pollution and natural resources
C Food production D Genetic conditions

8. A person with a BS degree in Microbiology is likely to:

A Study human behavior B Treat animal diseases
C Advise on diet and nutrition
D Conduct research on microorganisms

9. A Biomedical Engineer would be involved in:

A Designing medical equipment
B Studying environmental conservation
C Developing new drugs D Conducting genetic research

MCQ's Key

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

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:

A 50-60% water B 70-75% water
C 60-90% water D 95-100% water

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

A Zygote, embryo, and fetus
B Drop, clot, lump, bones, and flesh
C Cells, tissues, and organs D Water, clay, and air

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

A Humans and insects B Fishes and mammals
C Birds and amphibians D Snakes and reptiles

MCQ's Key

1	C	**2**	B	**3**	D

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:

A 2000 B 2015 C 2010 D 2003

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

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

3. Cancer research requires collaboration among:

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

4. Robotics and AI are interdisciplinary fields that involve:

A Biology and economics B Mathematics and neuroscience
C Sociology and geology D Atmospheric science and physics

5. Space exploration involves collaboration in fields such as:

A Astrophysics, biology and medicine
B Sociology, informatics and mathematics
C Psychology and economics D Engineering and social sciences

6. The International Space Station (ISS) is an example of collaboration in:

A Space exploration B Climate change research
C Human Genome mapping D AI and robotics

7. The Human Genome Project was focused on:

A Creating new technologies
B Mapping the entire human genome
C Solving environmental issues D Understanding social behaviors

8. The field where scientists work on autonomous vehicles and machine learning is:

A Space exploration B Climate change research
C Robotics and AI D Medical advancements

9. Interdisciplinary collaboration in medical research improves:

A Space exploration techniques
B Understanding of the cosmos C Weather forecasting
D Treatment methods for diseases like cancer

MCQ's Key

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

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?

A Hypothesis B Observation
C Recognition of a problem D Experimentation

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

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

3. What type of observations involve characteristics that can be measured with numbers?

A Quantitative B Qualitative C Descriptive D Experimental

4. Deduction in a scientific research is:

A A step to form a hypothesis

B A detailed experiment C A tested hypothesis

D A logical result from the hypothesis

5. The control group in an experiment is used for.

A Testing the hypothesis B Comparing results

C Developing new hypotheses D Making observations

6. Characteristic a good hypothesis have:

A It cannot be tested B It does not match observations

C It can be disproven D It is always correct

7. In an experiment to test the necessity of carbon dioxide for photosynthesis, the group will not receive carbon dioxide:

A Experimental group B Control group

C Both groups D 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?

A The plant will grow slower

B The plant will grow taller and healthier

C The plant will stop growing D The plant will die

9. To confirm the accuracy of a hypothesis, scientists perform.

A Observations B Data analysis

C Deductions D Experiment

MCQ's Key

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

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

EXERCISE

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

1. Which branch of Biology focuses on the study of the structure and function of cells?

A Cytology B Microbiology C Histology D Ecology

2. The study of the processes of heredity and variation in living organisms is known as:

A Ecology B Genetics C Anatomy D Embryology

3. Insulin made through bacteria is an example of the technique of:

A Parasitology B Biotechnology C Biochemistry D Histology

4. Heart pumps blood, stomach digests food, and kidneys excrete wastes. The statement comes from.

A Physiology B Morphology C Anatomy D Histology

5. Which branch of Biology involves the study of the classification of organisms?

A Taxonomy B Palaeontology C Physiology D Biogeography

6. Which step comes between making hypothesis and doing experiments?

A Making deductions B Making observations
C Summarizing results D Analysing data

7. Which of the following is NOT a characteristic of the scientific method?

A It relies on evidence
B It involves formulating hypotheses
C Hypothesis will always be correct
D It requires rigorous testing

8. Choose the correct sequence of steps of scientific method?

A Observations - hypothesis - deduction - experiments
B Observations - hypothesis - law - theory
C Hypothesis - observations - deduction - experiments
D Law - theory - deduction - observations

9. People who slept near smoky fire had less chance to suffer from malaria. Why?

A Smoke kills Plasmodium in their blood
B Fire increases temperature and Plasmodium are killed in air
C Mosquitoes cannot tolerate smoke and are repelled
D Smoke kills Plasmodium present in mosquitoes

10. Experiments are very important in scientific method because a researcher:

A Always gets correct results

B Disproves many hypotheses and gets some hypothesis proved

C Is sure that he will prove the hypotheses

D Gets a chance to work in the laboratory

MCQ's Key

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

(B) Write short answers.

1. Define the following branches of Biology.

Genetics, Anatomy, Palaeontology, Marine Biology, Pathology

Ans. • **Genetics:** 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.

- **Anatomy:** Anatomy is the branch of Biology that explores the internal physical structure of organisms, particularly humans. It helps in disease diagnosis, medical device development, and improving quality of life **Example:** The study of the organs of the digestive system.
- **Palaeontology:** 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.
- **Marine Biology:** Marine Biology is the branch of Biology that deals with the study of life in oceans. It helps to understand ocean biodiversity, discover new species, and address marine conservation issues.

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

2. Which branch of Biology involves the study of the development of organisms from fertilization to birth or hatching?

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.

3. How is the profession of medicine and surgery different from animal husbandry?

Ans. The profession of **medicine and surgery** deals with the diagnosis, treatment, and surgical repair of human diseases and body parts, requiring a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree. In contrast, **animal husbandry** focuses on breeding and caring for livestock to improve their quality and productivity, and students pursue a 4-year BS degree in Animal Husbandry.

4. Differentiate between Morphology and Physiology

Ans. **Morphology** is the study of the form and structure of organisms. Morphology studies the outward appearance (shape, colour, pattern, etc.) as well as internal structures, like organs.

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

For example, how the blood circulatory system transports vital substances throughout the body.

5. What is Computational Biology?

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 in a protein.

6. What is the role of observation and experimentation in the scientific method?

Ans. • Role of observation and experimentation in the scientific method:

Scientists make **observations** about the problem using five senses. Observations may be qualitative (not measurable with numbers) or quantitative (measurable with numbers).

- **Experiments** are the most basic step of the scientific method, where hypotheses are tested, and the correct hypothesis is accepted while incorrect ones are rejected. Scientists make new deductions from the accepted hypothesis and perform further experiments to confirm its correctness.

(C) Write answers in detail.

1. Link the study of Biology with that of Physics, Chemistry, Statistics, Geography, Economics and Computer Science.

Ans. (i) Biophysics: It 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.

(ii) Biochemistry: Biochemistry is the study of the structure and reactions of different chemical substances present in living systems. The study of the chemical reactions of photosynthesis and respiration are examples of Biochemistry.

(iii) Biostatistics: It 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.

(iv) Biogeography: It 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.

(v) Bio-economics: It 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.

(vi) Computational Biology: 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 in a protein.

2. Explain how the study of Biology can lead to different professional studies.

Ans. Introduction: The students of Biology get a comprehension of the various phenomena of life. After their FSc with Biology, they can select further studies for diverse careers, **for example:**

(i) Medicine and Surgery: The profession medicine deals with the diagnosis and treatment of diseases. 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.

(ii) Dentistry: 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.

(iii) Pharmacology: 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.

(iv) Physiotherapy: It is the therapy that is used to restore movement and physical function of body that has been impaired by disease or injury.

Work of Physiotherapists:

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.

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

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

(vii) Animal Husbandry: This field 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.

(viii) Horticulture: Horticulturists cultivate fruits, vegetables, flowers, and ornamental plants. A 4-year BS degree in Horticulture is required for it.

(ix) Forestry: Foresters manage and conserve forests and wildlife. For this profession, 4-year BS degree in Forestry is necessary.

(x) Farming: 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.

(xi) Biotechnology: 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.

(xii) Forensics: Forensic scientists analyse physical evidence from crime scenes in criminal investigations. A 4-year BS degree in Forensic Science is needed for this.

3. Science is a collaborative field in which scientists work together to share knowledge. Prove this statement by giving examples.

Ans. Introduction: 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. Let's discuss a few examples of interdisciplinary collaboration in science:

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

(ii) Climate Change Research: Climate change requires collaboration among many disciplines, such as atmospheric science, ecology, economics, and sociology.

(iii) Medical Research: Medical research often depends on interdisciplinary collaboration.

For example, cancer research involves oncologists (cancer consultants), biologists, biochemists, geneticists, pharmacologists, and statisticians.

(iv) Robotics and Artificial Intelligence (AI): 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.

(v) Space Exploration: 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.

4. How a hypothesis is converted to theory, law and principle?

Ans. (i) Formation of Theory: 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. A theory is 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.

(ii) Formation of Law and principle: 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 a law or principle. A scientific law is a uniform or constant fact of nature.

Example: Biological laws are Hardy-Weinberg law and Mendel's laws of inheritance.

5. What are the basic steps a scientist adopts in order to solve a scientific problem?

Ans. Steps a Scientist Adopts to Solve a Scientific Problem: Scientists adopt a systematic approach to solving scientific problems, referred to as the scientific method. In biological research, this method is termed the **Biological method**. The steps involved in this method are as follows:

(i) Recognition of a Problem: The first step involves identifying and defining a specific scientific problem or phenomenon that a scientist wants to investigate. Such a problem may arise from a question posed by someone or an observation made by the scientist.

Example: A biologist notices that plants in an area are growing taller than usual and formulates the scientific problem:

"What factors are responsible for the increased growth of these plants?"

This problem serves as the starting point for scientific inquiry.

(ii) Observations: Scientists make observations about the problem using their five senses and by studying previous research on similar topics. Observations are classified as:

- **Qualitative Observations:** These involve non-measurable characteristics, such as the color or texture of a flower.
- **Quantitative Observations:** These involve measurements or numerical data, such as the number of birds in a tree.

Quantitative observations are considered more accurate because they are measurable, invariable, and recordable.

(iii) Hypothesis: Scientists gather information by reading books and other sources to understand the existing knowledge about the problem. Based on this information and their observations, they propose a tentative answer to the problem called a **hypothesis**.

Characteristics of a hypothesis include:

- It is a proposed statement to answer the problem.
- It aligns with the available observations.
- It can be tested through experiments.
- There is always a way to disprove it.

Scientists often propose multiple hypotheses for a single problem.

(iv) Deduction: Scientists derive logical results from their hypotheses, known as deductions, which often take the form of "if-then" statements.

For example:

Hypothesis: "Leaf discoloration and stunted growth in a plant are caused by a deficiency of iron in the soil."

Deduction: "If iron deficiency is causing the symptoms, then adding iron to the soil will improve the colors of leaves and promote plant growth."

(v) Experiments: Experiments are conducted to test the proposed hypotheses. In a successful experiment, one hypothesis is proven correct, while alternate hypotheses are rejected. Scientists perform further experiments to confirm the accepted hypothesis.

(vi) Results: Scientists gather data from their experiments and use statistical analyses and graphs to summarize the results. They include references to acknowledge information sources and share their findings by:

- Publishing results in scientific journals and books.
- Presenting findings at national and international meetings and seminars through scientific reports.

These steps allow scientists to systematically investigate and resolve scientific problems, contributing to advancements in science.

6. Describe the work of different scientists in discovering the cause of malaria.

Ans. The Work of Different Scientists in Discovering the Cause of Malaria: The cause of malaria has been a subject of research for centuries. Through systematic observations, hypotheses, deductions, and experiments, scientists were able to determine that a microorganism called Plasmodium is responsible for malaria. The following paragraphs outline the work of different scientists in discovering the cause of malaria:

Observations: Physicians have known about malaria for over 2000 years. However, it was in the late 19th century that significant observations were made regarding the disease:

(i) Malaria and marshy areas seemed to have some relation.

(ii) Quinine was identified as an effective drug for treating malaria.

(iii) Drinking water from marshy areas did not cause malaria.

(iv) Plasmodium was observed in the blood of malarial patients.

Work of Laveran: In 1878, a French army physician, Laveran, conducted research on malaria. He collected blood samples from a malarial patient and examined them under a microscope. During his examination, he noticed microorganisms in the blood, which he named Plasmodium.

Hypothesis: Based on these observations and discoveries, biologists developed the hypothesis:

"Plasmodium is the cause of malaria."

Deduction: To test this hypothesis, biologists created a logical deduction:

"If Plasmodium is the cause of malaria, then all malarial patients should have Plasmodium in their blood."

For their experiments, malarial patients were designated as the experimental group, and healthy individuals served as the control group.

Experiment and Results: To test the deduction, biologists examined the blood samples of 100 malarial patients and 100 healthy individuals under a microscope. The results showed that most malarial patients had Plasmodium in their blood, while it was absent in healthy individuals.

This experimental evidence supported the hypothesis that Plasmodium is the cause of malaria.

7. Write a descriptive note on the experiments performed by Ross.

Ans. Experiments Performed by Ronald Ross Introduction: Ronald Ross, a British army physician working in India during the 1880s, conducted groundbreaking experiments to understand how Plasmodium enters the human bloodstream and causes malaria. His work played a crucial role in confirming the role of mosquitoes in the transmission of malaria. Below is a detailed account of his experiments:

Initial Experiment: Ronald Ross allowed a female Anopheles mosquito to bite a malarial patient. After the mosquito fed on the patient's blood, he killed it and examined its stomach under a microscope. He observed that Plasmodium was multiplying in the mosquito's stomach. This provided initial evidence of a link between mosquitoes and malaria.

Experiments on Sparrows: To further test the hypothesis in a safe and controlled way, Ross decided to experiment on sparrows instead of humans:

(i) **Infecting Mosquitoes:** Ross allowed female Culex mosquitoes to bite sparrows suffering from malaria.

(ii) **Observation of Plasmodium Development:** He studied the mosquitoes at different times after feeding. He discovered that Plasmodium multiplied in the walls of the mosquito's stomach and eventually migrated to its salivary glands.

(iii) **Infecting Healthy Sparrows:** Ross allowed the infected mosquitoes to bite healthy sparrows. He later found that these sparrows developed malaria. Upon examining their blood, Ross confirmed the presence of Plasmodium.

Result: This series of experiments confirmed that mosquitoes transmit Plasmodium from infected to healthy individuals, thereby spreading malaria.

Human Experiments: In 1898, Italian biologists conducted experiments on humans to validate Ross's findings:

(i) They allowed an Anopheles mosquito to bite a malarial patient.

(ii) The infected mosquito was then allowed to bite a healthy individual.

(iii) The healthy person subsequently developed malaria, confirming that mosquitoes were responsible for transmitting Plasmodium.

Conclusion: Ronald Ross's experiments on sparrows, coupled with later human experiments, proved that mosquitoes transmit Plasmodium and play a significant role in the spread of malaria.

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