

# THE SMART STUDY NOTES

## CLASS 9<sup>th</sup> New BIOLOGY

### Chapter 1: THE SCIENCE OF BIOLOGY

#### Additional Short Questions

##### Introduction to Biology and Its Branches

##### General Introduction

Q1. What is Biology?

Ans. Biology is the scientific study of living organisms, focusing on their structures, functions, interactions, and processes. Derived from Greek words **bios** (life) and **logos** (study), it addresses issues like health, food security, and environmental conservation. Biologists explore life from microscopic bacteria to vast ecosystems.

##### Major Fields of Biology

Q2. Name the three major fields of Biology.

Ans. The three major fields are **Zoology** (study of animals), **Botany** (study of plants), and **Microbiology** (study of microorganisms). These fields investigate animal behavior, plant growth, and microbial roles in ecosystems and health.

Q3. What is Zoology?

Ans. Zoology focuses on the study of animals, including their anatomy, behavior, diversity, and physiological functions. It helps understand animal adaptations, conservation needs, and ecological roles in nature.

Q4. Define Microbiology.

Ans. Microbiology studies microorganisms like bacteria, fungi, and viruses. It examines their structure, reproduction, habitats, and impacts on health (e.g., diseases) and the environment (e.g., decomposition).

##### Branches of Biology

Q5. What is Morphology?

Ans. Morphology analyzes the form and structure of organisms, including external features (shape, color) and internal structures (organs). It aids in species classification and understanding evolutionary relationships.

Q6. Define Anatomy.

Ans. Anatomy studies the internal physical structures of organisms, such as human organs or plant tissues. It supports medical advancements, disease diagnosis, and the development of medical devices.

Q7. Why is Biology important?

Ans. Biology helps solve global challenges like disease control, sustainable agriculture, and biodiversity conservation. It provides insights into life processes, from cellular functions to ecosystem dynamics.

Q8. How does Biology connect with other sciences?

Ans. Biology integrates principles from chemistry (biochemistry), physics (biophysics), and mathematics (biostatistics) to study life processes. This interdisciplinary approach enhances understanding of complex biological systems.

Q9. What is Physiology?

Ans. Physiology studies the functioning of body parts and systems, such as how the circulatory system transports nutrients and oxygen. It explains processes like muscle contraction and hormone regulation.

Q10. Define Histology.

Ans. Histology is the microscopic study of tissues. It helps diagnose diseases (e.g., cancer), analyze drug effects, and understand organ structure by examining cell groups with similar functions.

Q11. What does Cytology focus on?

Ans. Cytology studies cells, their organelles, and mechanisms like cell division. It explores cellular structures (e.g., mitochondria) and their roles in growth and disease.

Q12. What is Molecular Biology?

Ans. Molecular Biology examines biological molecules (DNA, proteins) and life processes. It aids in developing genetically modified organisms (GMOs) and treatments for genetic disorders.

Q13. Define Embryology.

Ans. Embryology studies the development of organisms from fertilization to birth. It identifies birth defects and guides medical treatments for prenatal conditions.

Q14. What is Genetics?

Ans. Genetics explores heredity and the transfer of traits from parents to offspring. It investigates genetic diseases (e.g., cystic fibrosis) and develops improved plant/animal varieties through selective breeding.

Q15. What is Paleontology?

Ans. Paleontology studies fossils to understand evolutionary history. For example, dinosaur fossils reveal how ancient reptiles lived and adapted over millions of years.

Q16. Define Taxonomy.

Ans. Taxonomy classifies organisms into groups (e.g., species, genus) based on similarities. It organizes biodiversity and helps identify evolutionary relationships.

Q17. What is Ecology?

Ans. Ecology examines interactions between organisms and their environment. It addresses issues like

biodiversity loss and energy flow in ecosystems (e.g., food chains).

Q18. What does Marine Biology study?

Ans. Marine Biology focuses on ocean life, including species like coral reefs. It aids in discovering new species and addressing marine conservation challenges.

Q19. Define Pathology.

Ans. Pathology investigates disease causes and effects. For example, it studies uncontrolled cell division in cancer to improve diagnosis and treatment.

Q20. What is Immunology?

Ans. Immunology studies the immune system and its defense mechanisms. It develops vaccines (e.g., COVID-19 vaccines) and treatments for autoimmune diseases.

Q21. What does Pharmacology involve?

Ans. Pharmacology studies drug effects on the body. It leads to innovations like antibiotics to treat bacterial infections and manage diseases.

## **Relationship of biology with other sciences**

Q22. What is Biochemistry?

Ans. Biochemistry studies chemical substances and reactions in living systems. Examples include photosynthesis (converting sunlight to glucose) and cellular respiration (ATP production). It bridges Biology and Chemistry to explain metabolic processes.

Q23. Define Biophysics with an example.

Ans. Biophysics applies physics principles to biological processes. For instance, it uses lever mechanics to understand muscle and joint functions or analyzes nerve impulse transmission using electrical concepts.

Q24. What does Computational Biology involve?

Ans. Computational Biology uses mathematical models and algorithms to analyze biological data (e.g., protein sequences). It aids in predicting protein structures, modeling disease spread, and simulating ecosystems.

Q25. What is Biogeography?

Ans. Biogeography studies the distribution of organisms across geographical regions. It examines how climate and environmental changes influence species spread, such as why kangaroos are native to Australia.

Q26. Define Biostatistics.

Ans. Biostatistics applies statistical methods to analyze biological data. It is crucial in healthcare research (e.g., clinical trials) and public health policies (e.g., tracking disease outbreaks).

Q27. How does Biotechnology integrate Biology with technology?

Ans. Biotechnology uses living organisms to develop products like insulin-producing bacteria or pest-resistant

GM crops. It applies to healthcare, agriculture, and environmental management.

Q28. What is Bio-economics?

Ans. Bio-economics evaluates the economic viability of biological projects. For example, calculating the cost-benefit ratio of developing drought-resistant crops to ensure sustainable and profitable agriculture.

## **Careers in Biology**

### **Medicine and Surgery**

Q29. What is the role of a medical doctor or surgeon?

Ans. Medical doctors diagnose and treat diseases, while surgeons repair or replace defective body parts through operations. To pursue this career, a 5-year MBBS (Bachelor of Medicine, Bachelor of Surgery) degree is required.

### **Dentistry**

Q30. What does a dentist do, and what education is needed?

Ans. Dentists specialize in diagnosing and treating oral health issues, such as cavities or gum diseases. They require a 4-year BDS (Bachelor of Dental Surgery) degree.

### **Pharmacology**

Q31. Define the role of a pharmacologist.

Ans. Pharmacologists study how drugs affect the human body and develop new medications. A BS or Doctor of Pharmacy (D. Pharm) degree is required for this career.

### **Physiotherapy**

Q32. What is the focus of physiotherapy?

Ans. Physiotherapists restore movement and physical function in patients affected by injury or disease using exercises and therapies. A 4-year BS degree in Physical Therapy is needed.

### **Fisheries and Wildlife**

Q33. What careers are available in fisheries and wildlife?

Ans. Graduates with a BS or MS in Zoology or Fisheries can work in wildlife conservation, aquatic resource management, or habitat preservation for endangered species.

### **Agriculture**

Q34. How do agricultural scientists contribute to farming?

Ans. Agricultural scientists improve crop yields, develop sustainable farming techniques, and address food security challenges. A 4-year BS degree in Agriculture is required.

### **Animal Husbandry**

Q35. What is animal husbandry?

Ans. This field involves breeding and caring for livestock to enhance productivity and quality. Students

pursue a 4-year BS degree in Animal Husbandry for this career.

### **Horticulture**

Q36. Define the role of a horticulturist.

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

### **Forestry**

Q37. What do foresters do?

Ans. Foresters manage forests, conserve wildlife, and promote sustainable timber production. A 4-year BS degree in Forestry is necessary for this profession.

### **Farming**

Q38. What education is needed for a career in farming?

Ans. Farmers manage crops and livestock for food production. A 4-year BS degree in Agriculture or specialized farming courses is recommended.

### **Biotechnology**

Q39. What is the role of a biotechnologist?

Ans. Biotechnologists use biological processes to develop products like medicines or GM crops. A 4-year BS degree in Biotechnology is required.

### **Forensic Science**

Q40. What does a forensic scientist do?

Ans. Forensic scientists analyze physical evidence (e.g., DNA, fingerprints) from crime scenes. A 4-year BS degree in Forensic Science is needed.

## **More Careers in Biology (Page#10)**

### **Veterinary Medicine**

Q41. What is the role of a veterinarian?

Ans. Veterinarians diagnose and treat diseases in animals, perform surgeries, and ensure animal welfare. They work in clinics, farms, or wildlife reserves, addressing health issues and preventing zoonotic diseases.

### **Environmental Science**

Q42. What does an Environmental Scientist do?

Ans. Environmental Scientists tackle pollution, manage natural resources, and develop sustainable practices. They conduct research, design conservation strategies, and advocate for policies to protect ecosystems and biodiversity.

### **Microbiology**

Q43. What is the focus of a Microbiologist?

Ans. Microbiologists study microorganisms (bacteria, viruses, fungi) to understand their roles in health, disease, and ecosystems. They develop antibiotics, vaccines, and industrial applications like bioremediation.

### **Genetic Counseling**

Q44. Define Genetic Counseling.

Ans. Genetic Counselors advise individuals on genetic conditions, inheritance risks, and testing options. They support families in making informed decisions about reproductive health and managing genetic disorders.

### **Nutrition and Dietetics**

Q45. What do Nutritionists do?

Ans. Nutritionists design dietary plans to promote health, manage diseases (e.g., diabetes), and educate communities on balanced nutrition. They work in hospitals, schools, or public health programs.

### **Public Health**

Q46. What is Public Health?

Ans. Public Health professionals improve community well-being through disease prevention, health education, and policy-making. They address epidemics, vaccination campaigns, and health inequities.

### **Biomedical Engineering**

Q47. What is Biomedical Engineering?

Ans. Biomedical Engineers design medical devices (e.g., prosthetics, MRI machines) and develop technologies to enhance diagnostics, treatment, and patient care. They bridge engineering and healthcare.

### **Bioinformatics**

Q48. What does a Bioinformatician do?

Ans. Bioinformaticians analyze biological data (e.g., DNA sequences) using computational tools. They model genetic pathways, predict protein structures, and support drug discovery and genomic research.

## **Quranic Instructions to Reveal the Study of Life**

### **Importance of Water in Life**

Q49. What does Surah Al-Anbiya, Verse 30 reveal about the origin of life?

Ans. The verse states, “We made every living thing from water,” emphasizing water as the fundamental component of all life. Modern biology confirms that organisms consist of 60-90% water, and life likely originated in aquatic environments. This Quranic insight aligns with scientific theories about life’s beginnings.

### **Human Creation and Reflection**

Q50. How does Surah Al-Rehman, Verse 14 describe human creation?

Ans. The verse compares human creation to a potter shaping clay (“He made man from clay like the potter”). This metaphor highlights the complexity and intentional design of human anatomy, encouraging reflection on biological processes like cellular differentiation and organ formation.

### **Embryological Development**

Q51. What stages of embryonic development are mentioned in Surah Al-Mominoon, Verse 14?

Ans. The verse describes: "Then fashioned We the drop a clot, then fashioned We the clot a little lump, then fashioned We the little lump bones, then clothed the bones with flesh." These stages mirror modern embryology: zygote → blastocyst → skeletal formation → muscle and tissue development.

### **Diversity of Animal Life**

Q52. How does Surah Al-Nur, Verse 45 explain animal diversity?

Ans. The verse states, "Allah hath created every animal from water. Then some of creep up over their bellies, others walk on two legs, and others on four. Allah creates what he pleases. Surely, Allah is most capable of everything." reflecting evolutionary adaptations in locomotion. This diversity, studied in comparative anatomy and biomechanics, underscores Allah's creative power and the adaptability of life forms.

### **Connection to Scientific Inquiry**

Q53. How do these Quranic verses encourage the study of Biology?

Ans. The Quran urges reflection on life's origins, development, and diversity (e.g., water's role, embryology). These teachings inspire scientists to explore biological phenomena, bridging faith and empirical inquiry to uncover the intricacies of Allah's creation.

## **Science as a Collaborative Field**

### **Human Genome Project**

Q54. Which disciplines collaborated in the Human Genome Project?

Ans. The project involved molecular biologists, geneticists, computer scientists, and informatics experts. Their collaboration mapped the entire human genome, advancing genetics and personalized medicine.

### **Climate Change Research**

Q55. Name four fields involved in climate change research.

Ans. Atmospheric science, ecology, economics, and sociology. Together, they analyze environmental impacts, economic consequences, and social policies to address global warming.

### **Medical Research (Cancer)**

Q56. What roles do interdisciplinary teams play in cancer research?

Ans. Oncologists, biologists, biochemists, geneticists, pharmacologists, and statisticians collaborate to study tumor biology, develop drugs, and analyze clinical trial data for effective treatments.

### **Robotics and AI**

Q57. How does Robotics and AI exemplify interdisciplinary collaboration?

Ans. It combines computer science, engineering, mathematics, neuroscience, and psychology. This teamwork drives advancements like autonomous vehicles, machine learning, and natural language processing.

### **Space Exploration**

Q58. Which fields contribute to space exploration at organizations like NASA?

Ans. Astrophysicists, planetary scientists, engineers, biologists, and medical researchers collaborate to study space environments, design spacecraft, and ensure astronaut health during missions.

### **General Collaboration**

Q59. Why is interdisciplinary collaboration crucial in science?

Ans. It leverages diverse expertise to solve complex problems efficiently, accelerates innovation (e.g., genome mapping), and ensures sustainable solutions (e.g., climate policies).

## **Scientific Method**

### **Steps of the Scientific Method**

Q60. List the six steps of the scientific method.

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

### **Recognition of a Problem**

Q61. What is the first step in the scientific method?

Ans. Identifying and defining a scientific problem (e.g., "Why are plants growing taller than usual?"). This step sets the foundation for inquiry and guides subsequent research.

### **Observations**

Q62. Differentiate between qualitative and quantitative observations.

Ans. Qualitative: Descriptive and non-numerical (e.g., color, texture).

Quantitative: Measurable and numerical (e.g., number of birds in a tree).

Quantitative data is more objective and precise.

### **Hypothesis**

Q63. What are the key characteristics of a hypothesis?

Ans. 1. A testable statement to answer the problem.  
2. Aligns with existing observations.  
3. Can be proven or disproven through experiments.  
4. Must be falsifiable.

### **Deduction**

Q64. How do deductions work in the scientific method?

Ans. Deductions are logical predictions based on hypotheses, often framed as "if-then" statements. For example, If iron deficiency causes leaf discoloration, then adding iron will improve plant growth.

## Experiments

Q65. What is the difference between an experimental group and a control group?

Ans. Experimental group: Exposed to the variable being tested (e.g., no carbon dioxide for photosynthesis).

Control group: Remains unchanged for comparison (e.g., receives carbon dioxide).

## Results

Q66. How do scientists communicate their findings?

Ans. They analyze data using statistics/graphs, publish results in journals, share findings at conferences, and acknowledge sources in reports.

## Theory and Law (PRINCIPLE)

### Scientific Theory

Q67. What is a scientific theory?

Ans. A scientific theory is a well-substantiated explanation based on extensive evidence and repeated validation through experiments. For example, the theory of evolution explains species change over time via natural selection.

### Hypothesis to Theory

Q68. How does a hypothesis become a theory?

Ans. When a hypothesis is repeatedly confirmed through experiments and validated by multiple researchers, it evolves into a theory. Theories are broader explanations supported by consistent evidence.

### Scientific Law

Q69. What is a scientific law?

Ans. A scientific law is a universal fact of nature derived from repeated experimental validation of a theory.

Examples include Mendel's laws of inheritance and the Hardy-Weinberg law in genetics.

### Examples of Biological Laws

Q70. Name two biological laws.

Ans. 1. Mendel's laws of inheritance: Explain how traits are passed from parents to offspring.

2. Hardy-Weinberg law: Predicts genetic equilibrium in populations under specific conditions.

### Theory vs. Law

Q71. How does a theory differ from a law in biology?

Ans. A theory explains "why" phenomena occur (e.g., evolution via natural selection), while a law describes "what" happens consistently (e.g., Mendel's inheritance patterns). Laws emerge from repeatedly validated theories.

## Malaria Case Study

### Initial Observations on Malaria

Q72. What were the four key observations about malaria in the 19th century?

Ans. 1. Malaria was linked to marshy areas.

2. Quinine effectively treated malaria.

3. Drinking marsh water did not cause malaria.

4. Plasmodium was found in patients' blood.

### Identification of the Causative Agent

Q73. Who discovered Plasmodium, and how?

Ans. French physician Charles Laveran (1878) observed Plasmodium in malarial patients' blood under a microscope, identifying it as the disease's cause.

### Hypothesis and Deduction for Problem 1

Q74. What was the hypothesis and deduction for the cause of malaria?

Ans. Hypothesis: Plasmodium causes malaria.

Deduction: All malarial patients should have Plasmodium in their blood.

Experiments confirmed this by detecting Plasmodium in 100 patients.

### Biological Problem 2: Transmission Mechanism

Q75. What observations suggested mosquitoes transmit malaria?

Ans. A. F. A. King noted (1883):

1. Higher malaria rates in people sleeping outdoors.
2. Lower rates with mosquito nets or smoky fires.
3. No link to marsh water consumption.

### Ross's Experiments

Q76. How did Ronald Ross confirm mosquitoes transmit Plasmodium?

Ans. Ross used Culex mosquitoes and sparrows:

1. Infected mosquitoes bit malaria-infected sparrows.
2. Plasmodium multiplied in mosquito stomachs and salivary glands.
3. Healthy sparrows bitten by infected mosquitoes contracted malaria.

### Human Validation

Q77. How was the mosquito hypothesis tested in humans?

Ans. Italian biologists (1898) allowed **Anopheles** mosquitoes infected with **Plasmodium** to bite a healthy man, who later developed malaria, confirming human transmission.

### Key Scientific Method Steps

Q78. Which steps of the scientific method are illustrated in this case study?

- Ans. 1. Observation: Link between mosquitoes and malaria.
2. Hypothesis: Mosquitoes transmit Plasmodium.
3. Experiments: Ross's sparrow trials and human trials.
4. Conclusion: Mosquitoes are vectors for malaria.

### Role of Control Groups

Q79. Why did Ross use sparrows instead of humans initially?

Ans. To ethically test the hypothesis without risking human lives. Sparrows served as a safe model to confirm mosquito transmission.

## Exercise Short Question

### 1. Define the following branches of Biology: (Page 7-8):

Ans. a. Genetics (Page 7)

Genetics is the study of heredity and the transfer of traits from parents to offspring. It investigates genetic diseases and develops improved plant/animal varieties.

b. Anatomy (Page 6)

Anatomy focuses on the internal physical structures of organisms, such as human organs (e.g., heart, lungs).

c. Palaeontology (Page 7)

Palaeontology studies fossils to understand evolutionary history, e.g., dinosaur fossils revealing past ecosystems.

d. Marine Biology (Page 8)

Marine Biology explores ocean life, including species like corals and whales, and addresses marine conservation challenges.

e. Pathology (Page 8)

Pathology investigates disease causes and effects, such as cancer mechanisms or infectious disease diagnostics.

### 2. Which branch of Biology involves the study of the development of organisms from fertilization to birth or hatching? (Page 7)

Ans. Embryology studies the development of organisms from a fertilized egg to birth, including tissue/organ formation and prenatal treatments.

### 3. How is the profession of medicine and surgery different from animal husbandry? (Page 10-11)

Ans. 1. Medicine/Surgery: Focuses on diagnosing and treating human diseases, requiring an MBBS degree.

2. Animal Husbandry: Involves breeding and caring for livestock to improve productivity, requiring a BS in Animal Husbandry.

### 4. Differentiate between Morphology and Physiology. (Page 6)

Ans. 1. Morphology: Studies the form and structure of organisms (e.g., leaf shapes).

2. Physiology: Explores the functioning of body parts (e.g., how the heart pumps blood).

### 5. What is Computational Biology? (Page 9)

Ans. Computational Biology uses mathematical models and algorithms to analyze biological data, such as DNA

sequences or protein structures, aiding in drug discovery and disease modeling.

### 6. What is the role of observation and experimentation in the scientific method? (Page 14-16)

Ans. 1. Observation: Gathers qualitative (e.g., color) or quantitative (e.g., measurements) data to identify patterns.

2. Experimentation: Tests hypotheses under controlled conditions to validate or refute them, e.g., testing drug efficacy.