

1 CHAPTER

THE SCIENCE OF BIOLOGY



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1.1 BIOLOGY AND ITS BRANCHES**LONG ANSWER QUESTIONS**

Q.1 Discuss major fields of biology.

(K.B)

Ans: **FIELDS OF BIOLOGY**

Biology is a vast field that explores the incredible diversity of life on Earth. To better understand this complexity, scientists have divided Biology into three main fields:

1. Zoology

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

2. Botany

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

3. Microbiology

- 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.

Q.2 Describe different branches of Biology.

(K.B + U.B)

Ans: **BRANCHES OF BIOLOGY**

By dividing biology into a number of branches, its study becomes convenient. Some of the branches of biology are:

1. Morphology

It is the study of the **form** and **structure** of organisms.

Example:

Morphology studies the outward appearance (shape, colour, pattern, etc.) as well as internal structures, like organs.

2. 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.

3. Physiology

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.

4. Embryology

Embryology is the study of the process of **development of organism** from fertilized egg.

Applications:

In this branch, scientists study organ and tissue formation, identify birth defects, and develop medical treatments.

Example:

Development of human heart

5. Genetics

Genetics is the branch of Biology that deals with the study of **transfer of characteristics** from parents to offspring.

Applications:

In Genetics, scientists also study the causes of **genetic diseases**, and develop better varieties of plants.

6. Molecular Biology

Molecular Biology deals with the study of **biological molecules** like carbohydrates, proteins, lipids, and nucleic acids.

Applications:

Molecular biologists also study fundamental life processes, develop drugs, and create genetically modified organisms.

7. Histology

Histology is the microscopic **study of tissues**.

Tissues:

Tissues are groups of cells that have similar functions.

Applications:

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

8. Palaeontology

Palaeontology is the branch of Biology that deals with the **study of fossils**.

Fossils:

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

Applications:

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.
- The oldest known fossil is a *Cyanobacterium*, estimated to be 3.4 billion years old.

9. Taxonomy

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

Applications:

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

Example:

Humans belong to group Animalia.

10. Ecology

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

Applications:

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

11. Marine Biology

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

Applications:

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

Example:

Coral reefs support a wide variety of marine life.

12. Pathology

Pathology is the study of **diseases**, their causes, and effects.

Applications:

- Pathology helps in disease **diagnosis**, treatment development, and **disease prevention**.
- Cancer, for instance, is characterized by uncontrolled growth and spread of abnormal cells.

13. Immunology

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

Applications:

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

14. Pharmacology

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

Applications:

This helps in the development of new drugs.

Example:

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

SHORT ANSWER QUESTIONS

Q.1 Describe physiology.

(K.B)

Ans:

PHYSIOLOGY

Definition:

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.

Q.2 Distinguish between Genetics and Molecular biology.

(K.B)

Ans:

DIFFERENTIATION

Genetics	Molecular Biology
It deals with the study of transfer of characteristics from parents to offspring.	It deals with the study of biological molecules like carbohydrates, proteins, lipids, and nucleic acids:
In Genetics, scientists also study the causes of genetic diseases, and develop better varieties of plants.	Molecular biologists also study fundamental life processes, develop drugs, and create genetically modified organisms.
Examples	
• The plants having red flowers produce red flower.	• Study of structure of DNA
• Study of how parents pass on genes that determine a child's eye colour.	• Study of how DNA make proteins

Q.3 What are fossils? Write down their importance.

(K.B)

Ans:

FOSSILS

Definition:

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

Importance:

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.

Q.4 What do you know about immunology? (K.B)

Ans: IMMUNOLOGY

Definition:

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

Applications:

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

Q.5 Define pharmacology. (K.B)

Ans: PHARMACOLOGY

Definition:

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

Applications:

This helps in the development of new drugs.

Example:

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

Q.6 What is taxonomy? What does a taxonomist do? (U.B)

Ans: TAXONOMY

Definition:

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

Applications:

Taxonomists classify organisms which help them to organize and understand the diversity of life, identify new species, and study evolutionary relationships.

MULTIPLE CHOICE QUESTIONS

1. **The division of Biology that deals with study of animals is called: (K.B)**
(A) Botany (B) Microbiology
(C) Anatomy (D) Zoology
2. **The microscopic study of tissues: (K.B)**
(A) Paleontology (B) Pharmacology
(C) Entomology (D) Histology
3. **The study of the functions of different parts of living organisms is called: (A.B)**
(A) Morphology (B) Anatomy
(C) Histology (D) Physiology
4. **The study of internal physical structures of organisms is called: (A.B)**
(A) Morphology (B) Physiology
(C) Anatomy (D) Cell Biology
5. **The study of transfer of characteristics from parents to offsprings is called: (K.B)**
(A) Histology (B) Anatomy
(C) Genetics (D) Inheritance
6. **The study of remains of extinct organisms: (K.B)**

- (A) Taxonomy (B) Paleontology
(C) Biotechnology (D) Entomology
7. **Molecular biology is also known as:** (U.B)
(A) Biometry (B) Bio-economics
(C) Biochemistry (D) Biogeography
8. **The oldest known fossil is of:** (K.B)
(A) Dinosaurs (B) Cyanobacterium
(C) Moss plant (D) Eagles
9. **Studying _____ helps in the conservation of biodiversity.** (K.B)
(A) Inheritance (B) Taxonomy
(C) Ecology (D) All of these
10. **Antibiotics are used to kill:** (K.B)
(A) Fungi (B) Bacteria
(C) Bacteria and Viruses (D) Viruses

1.2 RELATION OF BIOLOGY WITH OTHER SCIENCES

LONG ANSWER QUESTIONS

- Q.1 **Link the study of biology with that of Physics, Chemistry, Statistics, Geography, Economics and Computer science.** (K.B)

Ans: **RELATION OF BIOLOGY WITH OTHER SCIENCES**

Biology is closely linked with other natural sciences such as Chemistry, Physics, and Earth Sciences. These connections help us understand life processes, environmental interactions, and the complexities of living organisms.

Here are a few examples of how Biology is connected with other natural sciences.

1. **Biochemistry**

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

Examples:

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

2. **Biophysics**

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

Examples:

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

3. **Computational Biology**

In Computational Biology, scientists use **Mathematical models**, **algorithms**, and **computer simulations** to understand biological systems and relationships.

Examples:

It involves analysing biological data, such as sequence of amino acids in a protein.

4. **Biogeography**

It deals with the study of the **distribution of living organisms** in different **geographical regions** of the world.

Examples:

The influence of **climate change** on the distribution of organisms is also studied in Biogeography.

5. Biostatistics

It deals with the principles of **statistics** to **analyse** and interpret data related to living organisms.

Applications:

Biostatistics plays a crucial role in biological research, healthcare, and public health etc.

6. Biotechnology

It 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.

Examples:

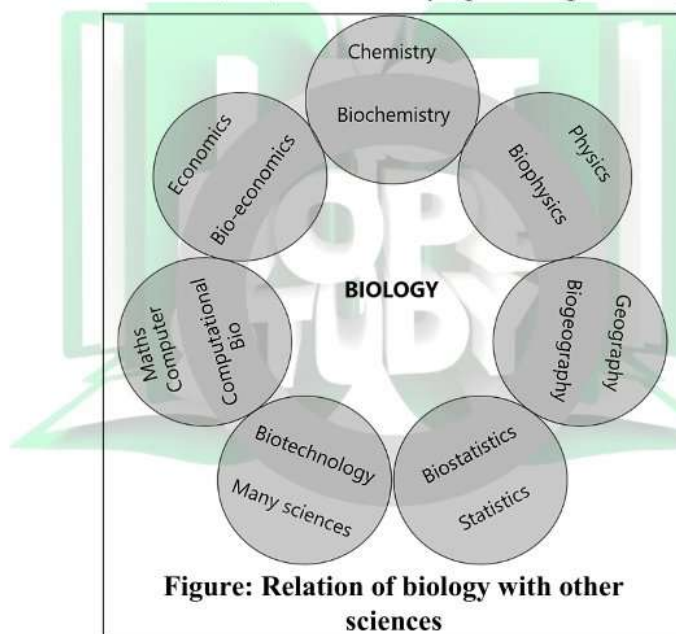
Biotechnologists use bacteria for the production of **insulin** to treat diabetic patients.

7. Bio-economics

It deals with the study of organisms from **economical point of view**. In bio- economics, scientists calculate and compare the cost and profit of the biological projects.

Examples:

- Production of new variety of crops.
- Production of wheat, fish, rice and studying their export value, etc.

**SHORT ANSWER QUESTIONS**

Q.1 How biology is related with other sciences?

(U.B)

Ans:

RELATION OF BIOLOGY WITH OTHER SCIENCES

Biology does not work alone. It works with other sciences to understand nature. These sciences utilize each other's methods and techniques that helps scientists learn more about life and how living things relate to their surroundings.

Examples:

- The animals **move, walk or run** on the principles of physics.
- There is a similarity between working principle of **lever** in physics and **human limbs**.
- The behaviour of atoms and molecules underline and explain the behaviour of living cell.

Q.2 Define biochemistry with the help of some examples. (K.B)

Ans: **BIOCHEMISTRY**

Definition:

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

Examples:

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

Q.3 What does scientists do in computational biology? (U.B)

Ans: **COMPUTATIONAL BIOLOGY**

In Computational Biology, scientists use **Mathematical models**, algorithms, and computer simulations to understand biological systems and relationships.

Examples:

It involves **analysing biological data**, such as sequence of amino acids in a protein.

Q.4 Define biotechnology. (U.B)

Ans: **BIOTECHNOLOGY**

Definition:

It 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.

Examples:

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

Q.5 Explain the relation of biology with economics.. (U.B)

Ans: **BIO-ECONOMICS**

Definition:

It deals with the study of organisms from **economical point of view**. In bio- economics, scientists calculate and compare the cost and profit of the biological projects.

Examples:

- Production of new variety of crops.
- Production of wheat, fish, rice and studying their export value, etc.

MULTIPLE CHOICE QUESTIONS

1. Study of occurrence and distribution of living organisms in different geographical regions of the world: (K.B)

- | | |
|------------------|------------------|
| (A) Biochemistry | (B) Biogeography |
| (C) Biometry | (D) Entomology |

2. The cost and profit value of yield of wheat crop can be calculated through: (A.B)

- | | |
|------------------|-------------------|
| (A) Biogeography | (B) Bio-economics |
| (C) Biophysics | (D) Biometry |

3. The process of photosynthesis is studied under: (U.B)

- | | |
|------------------|------------------|
| (A) Biogeography | (B) Biochemistry |
| (C) Biophysics | (D) Biometry |

4. If you are making human growth hormone by using *E. coli*, then it is related with: (A.B)

- | | |
|----------------------------|-------------------|
| (A) Biomedical engineering | (B) Bio-economics |
| (C) Biotechnology | (D) Biometry |

5. It helps to interpret data during biological research: (K.B)

(A) Biogeography

(B) Biostatistics

(C) Biophysics

(D) Biometry

1.3 CAREERS IN BIOLOGY**LONG ANSWER QUESTIONS**

Q.1 Explain how the study of biology can lead to different professional studies. **(K.B)**

Ans: **CAREERS IN BIOLOGY**

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

1. Medicine and Surgery

Medicine:

The profession medicine deals with the **diagnosis** and **treatment** of diseases.

Surgery:

In surgery the defective parts of the body are repaired, replaced or removed.

Higher Studies:

For this profession, students need to complete a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.

2. Dentistry

Dentists specialize in **oral health**, diagnosing and treating dental issues and performing surgeries.

Higher Studies:

For it, the students can pursue a 4-year Bachelor of Dental Surgery (BDS) degree.

3. Pharmacology

Pharmacologists study the effects of **drugs** on human body and develop **new medications**.

Higher Studies:

For this career, a Bachelor of Studies (BS) degree in Pharmacy or Doctor of Pharmacy (D. Pharm) degree is required.

4. Physiotherapy

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

Application:

Physiotherapists use **physical exercise** and **physical modalities** (such as massage) to improve patient's physical movement and function.

Higher Studies:

To become a physiotherapist, a 4-year BS degree in Physical Therapy or Physiotherapy is needed.

5. Fisheries and Wildlife

Fisheries:

The field of fisheries focuses on the **conservation** and **management of fish** and their habitat.

Wildlife:

The field of Wildlife focuses on protecting and managing undomesticated animals and other organisms that live in the wild (i.e., forests, mountains).

Higher Studies:

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

6. Agriculture

Agricultural scientists improve **farming practices**, **crop production**, and sustainable agriculture techniques.

Higher Studies:

A 4-year BS degree in Agriculture is required.

7. Animal Husbandry

This field involves **breeding** and **caring** for **livestock** to improve their quality and productivity.

Higher Studies:

For it, students can pursue a 4-year BS degree in Animal Husbandry.

8. Horticulture

Horticulturists **cultivate** fruits, vegetables, flowers, and ornamental plants.

Higher Studies:

A 4-year BS degree in Horticulture is required for it.

9. Forestry

Foresters **manage** and **conserve forests** and **wildlife**.

Higher Studies:

A 4-year BS degree in Forestry is necessary.

10. Farming

Farmers grow **crops** and **raise animals** for food and other products.

Higher Studies:

A 4-year BS degree in Agriculture or specific farming courses is required for this profession.

11. Biotechnology

Biotechnologists use biological processes to develop products and technologies in medicine, agriculture, and more.

Higher Studies:

A 4-year BS degree in Biotechnology is required for this.

12. Forensic

Forensic scientists analyse **physical evidence** from **crime scenes** to help in criminal investigations.

Higher Studies:

A 4-year BS degree in Forensic Science is needed for this.

Q.2 Enlist some careers related to biology with their major jobs in market.

(K.B)

Ans:

CAREERS IN BIOLOGY

Career	Major jobs
Veterinary Medicine	Diagnosis and treatment of diseases in animals and surgeries.
Environmental Science	Solving issues related to pollution and natural resources.
Microbiology	Research on microorganisms to understand their impact.
Genetic Counselling	Providing support to people on genetic conditions and testing.
Nutrition and Dietetics	Advising on proper dietary habits to promote health.
Public Health	Improving the health of communities through education, policy-making, and research.
Biomedical Engineering	Designing and making medical equipment to improve patient care.
Bioinformatics	Analysis of biological data by using computational tools.

SHORT ANSWER QUESTIONS

Q.1 Discuss the difference between medicine and surgery. (K.B)

Ans: **DIFFERENCE**

Medicine:

The profession medicine deals with the **diagnosis** and **treatment** of diseases.

Surgery:

In surgery the defective parts of the body are repaired, replaced or removed.

Q.2 Explain the work of a pharmacologist and a dentist. (U.B)

Ans: **DIFFERENCE**

Dentist:

Dentists specialize in oral health, diagnosing and treating dental issues and performing surgeries.

Pharmacologists:

Pharmacologists study the effects of drugs on human body and develop new medications.

Q.3 Explain physiotherapy as a profession. (K.B)

Ans: **PHYSIOTHERAPY**

Definition:

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

Application:

Physiotherapists use physical exercise and physical modalities (such as massage) to improve patient's physical movement and function.

Higher Studies:

To become a physiotherapist, a 4-year BS degree in Physical Therapy or Physiotherapy is needed.

Q.4 Define biotechnology. What do you know about Bt Cotton? (K.B)

Ans: **BIOTECHNOLOGY**

Biotechnology:

Biotechnologists use biological processes to develop products and technologies in medicine, agriculture, and more.

Bt Cotton:

- In Pakistan, scientists have used biotechnology to create a special kind of cotton plant called Bt cotton.
- This new type of cotton can protect itself from certain pests without needing many chemical pesticides, which is better for the environment and could help farmers in the future.

Q.5 Write down the job areas/roles of microbiology, genetic counselling, public health and bioinformatics? (K.B)

Ans: **JOB AREAS**

Career	Major jobs
Microbiology	Research on microorganisms to understand their impact.
Genetic Counselling	Providing support to people on genetic conditions and testing.
Public Health	Improving the health of communities through education, policy-making, and research.
Bioinformatics	Analysis of biological data by using computational tools.

Q.6 What is horticulture?

(K.B)

Ans:

HORTICULTURE**Definition:**

Horticulturists cultivate fruits, vegetables, flowers, and ornamental plants.

Higher Studies:

A 4-year BS degree in Horticulture is required for it.

MULTIPLE CHOICE QUESTIONS

- The art of gardening:** (K.B)
(A) Agriculture (B) Forestry
(C) Horticulture (D) Animal Husbandry
- Profession dealing with production of useful products through micro-organisms:** (A.B)
(A) Microbiology (B) Animal Husbandry
(C) Biotechnology (D) Biochemistry
- To treat diseases by the removal or replacement of defective parts/organs is:** (U.B)
(A) Medicine (B) Engineering
(C) Surgery (D) Biotechnology
- Farming is the growth of:** (K.B)
(A) Crops (B) Animals
(C) Both A and B (D) Land
- This profession is concerned with data analysis of biological research:** (K.B)
(A) Biomedical engineering (B) Biotechnology
(C) Bioinformatics (D) Dentistry
- This profession is concerned with improving the health of communities:** (K.B)
(A) Biomedical engineering (B) Public health
(C) Bioinformatics (D) M.B.B.S.
- A _____ scientist analyse physical evidence from crime scenes.** (K.B)
(A) Biotechnology (B) Forensic
(C) Microbiology (D) M.B.B.S.

1.4 QURANIC INSTRUCTIONS TO REVEAL THE STUDY OF LIFE**LONG ANSWER QUESTIONS**

Q.1 Write Quranic Verses and their translation about the study of life.

(K.B + U.B)

Ans:

QURAN AND BIOLOGY

In the Holy Quran, there are several verses that highlight the study of life. Here are a few Quranic guidelines that encourage exploring and reflecting on the study of life.

Verse:**Origin of life in water**

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ

Translation:

“We made every living thing from water.”

(Sura: Ambia, Verse: 30)

Explanation:

- The Quran mentions in multiple verses that all living things were created from water.
- Water is described as a divine blessing from God.
- Living things consist of **85 to 90 percent of water**, and the above Verse hints at the common origin of all living things in the water.

Verse:**Creation of Human beings**

خَلَقَ الْإِنْسَانَ مِنْ صَلْصَالٍ كَالْفَخَّارِ

Translation:

“He made man from clay like the potter.”

(Sura: Rehman, Verse: 14)

Explanation:

- By the hints given in both these Verses, we can find the events that occurred in the **creation of human beings**.
- We are advised to think over the possible ways through which such events might have occurred.

Verse:

Development

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظْمًا فَكَسَوْنَا الْعِظْمَ لَحْمًا

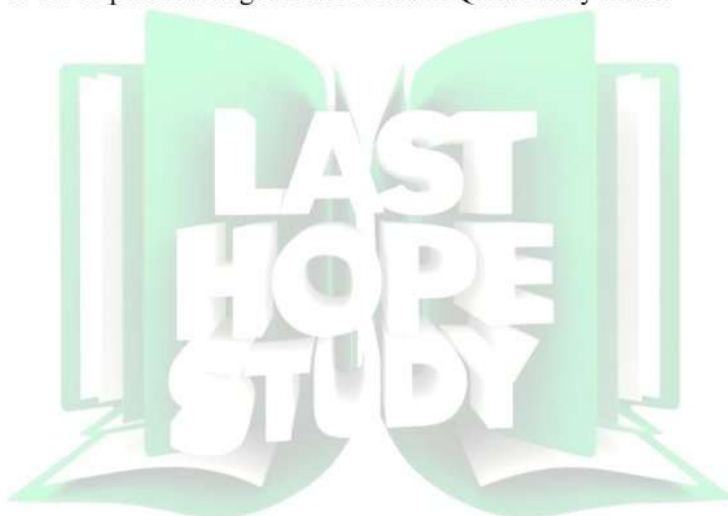
Translation:

“Then fashioned We the drop a clot, then fashioned We the clot a little lump, then fashioned We the little lump bones, then clotted the bones with flesh.”

(Sura: Al-Mominoon, Verse: 14)

Explanation:

God also hints at the method of the **development** of animals including human beings. The sequence of developmental stages is described in Quran many times.



Verse:**Evolution**

وَاللَّهُ خَلَقَ كُلَّ دَابَّةٍ مِنْ مَّاءٍ فَمِنْهُمْ مَنْ يَمْشِي عَلَى بَطْنِهِ وَمِنْهُمْ مَنْ يَمْشِي عَلَى رِجْلَيْنِ وَمِنْهُمْ مَنْ يَمْشِي عَلَى أَرْبَعٍ يَخْلُقُ اللَّهُ مَا يَشَاءُ ۚ إِنَّ اللَّهَ عَلَى كُلِّ شَيْءٍ قَدِيرٌ

Translation:

“Allah hath created every animal from water. Then some of them creep over their bellies, others walk on two legs, and the others on four. Allah creates what He pleases. Surely, Allah is most capable of everything”

(Sura: Al-Nur, Verse: 45)

Explanation:

- This verse explains that God created early **life in water** (fishes) and then **animals with limbs** were evolved.
- Among, such animals some were created who creep over their bellies and then some were created who walked on 2 and some on 4 legs.

SHORT ANSWER QUESTIONS

Q.1 Define science. What it helps us?

(U.B)

Ans:

SCIENCE

Science is a process of **collecting information** about the world around us.

Steps in Doing Science:

Much of the time, the first step in collecting information is asking a question. Why do I feel pain when I touch a hot object? Making observations, asking questions and trying to find the answers is what science all about.

Importance of Science:

The study of science helps us to answer the how, what, where and why of our surroundings.

Q.2 Define the term Biology.

(K.B)

Ans:

BIOLOGY

The word biology consists of two Greek words

- **bios** meaning life
- **logos** meaning thought, reasoning and study

Biology is the study of living organisms. It helps us to explain how living things relate to one another and to their surroundings.

Q.3 How origin of life is related to water according to the Holy Quran?

(K.B)

Ans:

ORIGIN OF LIFE IN WATER

In Sura Ambia (Ayat 30), the Quran says: “We made every living thing from water.”

Living things consists of 85 to 90 percent of water. So, all living things have come out of water and thus have a common origin.

Q.4 How human was created? Explain in the light of the Holy Quran.

(K.B)

Ans:

CREATION OF MAN

The Holy Quran says that “He made man from clay like the potter” (Sura: Rehman, Verse: 14).

Explanation:

This Ayat explains that creation of man consisted of two steps.

- The first step was the creation from water.
- The second step was to mix clay with water to create man.

It can be said for all animals as man shares all characteristics of life with other animals.

Q.5 State the Ayat that explains the development process of living organisms.

(K.B)

Ans:

DEVELOPMENT**Verse:**

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا الْمُضْغَةَ عِظْمًا فَكَسَوْنَا الْعِظْمَ لَحْمًا

Translation:

“Then fashioned We the drop a clot, then fashioned We the clot a little lump, then fashioned We the little lump bones, then clotted the bones with flesh.”

(Sura: Al-Mominoon, Verse: 14)

The sequence of developmental stages is described in Quran many times.

MULTIPLE CHOICE QUESTIONS

1. The most intelligent beings among all living organisms are: (K.B)
(A) Lions (B) Humans
(C) Octopus (D) Gorilla
2. Science is the study that includes: (K.B)
(A) Observation (B) Experiments
(C) Both A and B (D) None of these
3. Scientific study of living organisms is called: (K.B)
(A) Biotechnology (B) Chemistry
(C) Biology (D) Geology
4. The word “bios” mean: (K.B)
(A) Thought (B) Life
(C) Knowledge (D) Reasoning
5. The word “logos” mean: (K.B)
(A) Thought (B) Life
(C) Knowledge (D) Non-living
6. Word “Biology” has been derived from: (K.B)
(A) English (B) Greek
(C) Italian (D) French
7. How much percent of water is present in living organisms: (K.B)
(A) 60 (B) 85
(C) 85-90 (D) 70-80
8. Man was created by mixing clay with: (K.B)
(A) Blood (B) Water
(C) DNA (D) Minerals
9. “We made every living thing from water”. This ayat is from Sura: (K.B)
(A) Ambia (B) Mominoon
(C) Al Nasr (D) Rehman
10. Evidences of evolution are found in Sura: (K.B)
(A) Ambia (B) Mominoon
(C) Al Nasr (D) Al Nur

1.5 SCIENCE AS A COLLABORATIVE FIELD

LONG ANSWER QUESTIONS

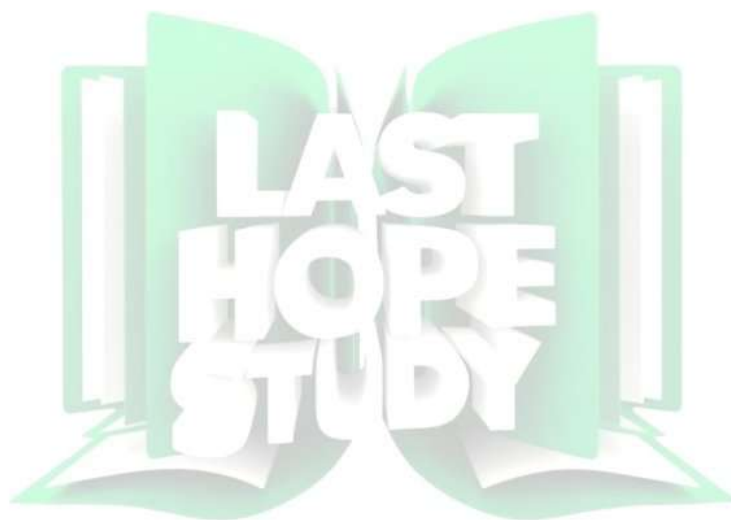
- Q.1 Science is a collaborative field in which scientists work together to share knowledge. Prove this statement by giving examples. (K.B + U.B)

Ans: SCIENCE AS A COLLABORATIVE FIELD

Explanation:

- 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 more **robust solutions**.



Examples:

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

1. Human Genome Project

The Human Genome Project aimed to sequence and **map the entire human genome**. This project was completed in 2003.

Interdisciplinary Teams:

It involved researchers from various disciplines, including biology, genetics, informatics, and computer science.

2. Climate Change Research

Climate change requires collaboration among many disciplines, such as atmospheric science, ecology, economics, and sociology.

3. Medical Research

Advances in medical research often rely on **interdisciplinary collaboration**.

Interdisciplinary Teams:

Cancer research involves **oncologists** (cancer consultants), biologists, biochemists, geneticists, pharmacologists, and statisticians.

4. Robotics and Artificial Intelligence (AI)

The field of robotics and AI is highly interdisciplinary.

Interdisciplinary Teams:

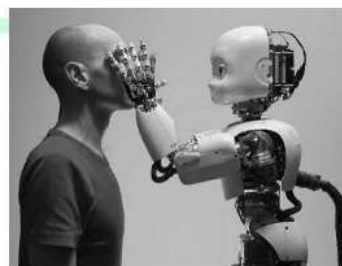
It involves computer science, engineering, mathematics, neuroscience, and psychology.

Advancements:

This collaboration has led to significant advancements in robotic systems, **autonomous vehicles**, machine learning and natural language processing.

5. 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.

**SHORT ANSWER QUESTIONS**

Q.1 Why various disciplines need collaboration in science?

(K.B)

Ans: **COLLABORATION**

Importance:

- 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 more robust solutions.

Q.2 Why is interdisciplinary collaboration essential in projects like the Human Genome Project?

(U.B)

Ans: **INTERDISCIPLINARY COLLABORATION**

- The Human Genome Project was a big effort to identify every gene in human DNA.
- Biologists looked at the DNA structure, while computer scientists handled a lot of data.
- Chemists studied how molecules interact, and physicists provided special tools for detailed observations.

- By combining different areas of study, the project gave a full understanding of human genetics.

Q.3 Which disciplines are required in climate change research? (K.B)

Ans: CLIMATE CHANGE RESEARCH

Climate change requires collaboration among many disciplines, such as atmospheric science, ecology, economics, and sociology.

Q.4 Give some example showing the research collaboration by NASA. (K.B)

Ans: INTERDISCIPLINARY COLLABORATION

- The development of the Mars Rover by NASA is a fascinating project that resulted from the collaboration between astronomers, engineers and computer scientists.
- This teamwork led to the creation of a robot that could explore the surface of Mars, sending back valuable data about the planet's environment and potential for life.

MULTIPLE CHOICE QUESTIONS

1. Bioinformatics is the combination of biology with: (K.B)

- (A) Agriculture (B) Information technology
(C) Biotechnology (D) Pharmacy

2. The term I.S.S stands for: (K.B)

- (A) Internet Service Station (B) International Space Services
(C) International Space Station (D) Both B and C

3. Human genome project was completed in: (K.B)

- (A) 1990 (B) 2003
(C) 2005 (D) 2010

4. It is the one who studies cancer: (K.B)

- (A) Oncologist (B) Economist
(C) Horticulturist (D) Pharmacologist

5. If ecologist, economist and sociologist are working together, the scientific project must be related with: (A.B)

- (A) Agriculture (B) Cancer study
(C) Climate change (D) Cosmos

1.6 SCIENTIFIC METHOD

LONG ANSWER QUESTIONS

Q.1 What are the basic steps a scientist adopts in order to solve scientific problems? (K.B)

Ans: SCIENTIFIC METHOD

Scientific Method:

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

Biological Method:

For biological research, scientific method is called biological method.

Steps of Scientific Method:

The following steps are involved in scientific method:

- Recognition of a problem
- Observation
- Hypothesis
- Deduction
- Experiments

- Results

1. Recognition of a Problem

The first step involves **identifying** and **defining a problem** (specific issue or phenomenon) that scientist wants to investigate through scientific inquiry.

Development of Problem:

A problem is either **asked by someone** or comes in biologist's mind by himself.

Example:

- A biologist notices that plants in a certain 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.

2. Observation

Observations are the **information** related to the problem which is under study. Scientists make observations about the problem.

Methods of Making Observations:

- They use **five senses** for making observations.
- They also read and study the previous researches on the same or related problems.

Types of Observations:

Observations may be qualitative or quantitative.

a) **Qualitative Observations**

Qualitative observations involve characteristics that **cannot be measured** with numbers.

Example:

Describing the **colour** and **texture** of a flower.

b) **Quantitative Observations**

Quantitative observations involve **measurements** or **numerical data** that can be expressed in terms of quantity.

Accuracy:

Quantitative observations are **more accurate** than qualitative because quantitative observations are invariable, measurable and can be recorded in terms of numbers.

Example:

Counting the number of birds in a tree (e.g., 5 birds).

3. Hypothesis

- On the basis of observations, scientists develop a statement that may prove the answer of the identified problem/question.
- Such **tentative answer** of scientific problem is called hypothesis.
- Scientists make many hypotheses for a single problem.

Example:

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

Characteristics of Hypothesis:

A hypothesis has the following characteristics:

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

4. Deduction

Scientists develop **logical results** from their hypotheses. Such logical results of hypotheses are called deductions.

Pattern of Deduction:

- Usually, deductions follow the pattern of “**if-then**” statements.
- Scientists assume that “if” hypothesis is true “then” what might be the results.

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 lessen the leaf discoloration and promote healthier plant growth”.

5. Experiments

- It 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.
- Scientists make new deductions from the accepted hypothesis.
- Then they perform further experiments and confirm the correctness of hypothesis.

Experimental Design:

When scientists do experiments, they arrange two settings. One is called “**experimental group**” and the other is called “**control group**”.

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 dioxide will be proved when photosynthesis does not occur in the experimental group but occurs in the control group.

6. Results

Scientists gather data from their experiments.

Summarization of Results:

- They use **statistical analyses, graphs**, or any other relevant information to summarize the results.
- Scientists also include a list of all the references in the summary to acknowledge the sources of information.

Reporting the Results:

- Scientists **publish** their findings in **scientific journals** and **books**.
- They also 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**LONG ANSWER QUESTIONS**

Q.1 Explain theory and law/principle. OR

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

(K.B)

Ans:

THEORY AND LAW/PRINCIPLE**Theory:**

- When experiments prove a hypothesis correct, scientists use such hypothesis for formulating further hypotheses.
- When new hypotheses are again proved by experiments, the original hypothesis becomes a theory.

Validation of Theories

Theories are supported by **extensive evidence** and have been repeatedly validated by multiple

researchers and studies.

Example:

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

Law/Principle

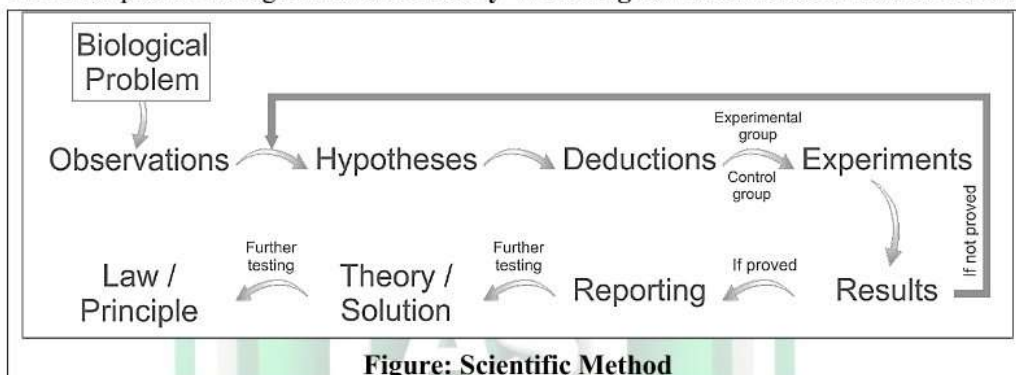
- Scientists keep on testing the theories by making new hypotheses from theories.
- They try their best to disprove the theory.
- If a theory is proved again and again by experiments, it becomes a **law** or **principle**.

Authenticity of Law/Principle:

A scientific law is a uniform or **constant fact of nature**.

Examples:

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



SHORT ANSWER QUESTIONS

Q.1 Define biological method.

Ans:

DEFINITION

Scientists take specific steps for doing scientific work or research. These steps are collectively called scientific method. For biological research, scientific method is called biological method.

Q.2 Write steps of scientific method.

(K.B)

Ans:

SCIENTIFIC METHOD

The following steps are involved in scientific method:

- Recognition of a problem
- Observation
- Hypothesis
- Deduction
- Experiments
- Results

Q.3 Define biological problem.

(K.B)

Ans:

BIOLOGICAL PROBLEM

A **question** related to living organisms that is either asked by someone or comes in mind of researcher.

Example: Disease of fever and chills (i.e., Malaria)

Q.4 Why quantitative observations are better in biological method?

(U.B)

Ans:

Quantitative observations involve **measurements** or **numerical data** that can be expressed in terms of quantity.

Accuracy:

Quantitative observations are more accurate than qualitative because quantitative observations are invariable, measurable and can be recorded in terms of numbers.

Q.5 Define hypothesis. (K.B)

Ans: **HYPOTHESIS**

Definition:

On the basis of observations, scientists develop a statement that may prove the answer of the identified problem/question. Such **tentative answer** of scientific problem is called hypothesis.

Example:

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

Q.6 What is the difference between qualitative and quantitative observations? (U.B)

Ans: **DIFFERENCE**

The difference between qualitative and quantitative observations are as follows:

Qualitative Observation	Quantitative Observation
Qualitative observations are considered less accurate.	Quantitative observations are considered more accurate.
These observations are variable and less measurable.	These observations are invariable and measurable.
These involve characteristics that cannot be measured with numbers.	These involve measurements or numerical data that can be expressed in terms of quantity.
Example	
- Describing the colour and texture of a flower. - The freezing point of water is colder than its boiling point.	- Counting the number of birds in a tree (e.g., 5 birds). - The freezing point of water is 0°C and boiling point is 100°C

Q.7 Develop a deduction from following hypothesis. (A.B)

Ans: "*Plasmodium* is the cause of malaria",

DEDUCTION

"If *Plasmodium* is the cause of malaria, then all persons ill with malaria should have *Plasmodium* in their blood".

Q.8 What are the characteristics of a hypothesis? (K.B)

Ans: **CHARACTERISTICS OF HYPOTHESIS**

A hypothesis has the following characteristics:

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

Q.9 Define deduction. How deductions are formed? (K.B)

Ans: **DEFINITION**

Scientists develop **logical results** from their hypotheses. Such logical results of hypotheses are called deductions.

Pattern of Deduction:

- Usually, deductions follow the pattern of "**if-then**" statements.
- Scientists assume that "if" hypothesis is true "then" what might be the results.

Q.10 Discuss the importance of deduction. Why they are needed? (U.B)

Ans:

DEFINITION

- In deduction-based science, deduction usually takes the form of **predictions** about what outcomes of experiments or observations we should expect if a particular hypothesis is correct.
- We then test the hypothesis by performing the experiment to see whether or not the results are predicted.

Q.11 Why does a biologist go for experimentation during solving a biological problem?

Ans: **EXPERIMENTATION DURING SOLUTION OF A BIOLOGICAL METHOD**

- Experiments are performed to prove if hypothesis is true or not.
- The deductions drawn from hypothesis are subjected to **rigorous testing**.
- Through experimentation, biologist learns which hypothesis is correct.

Q.12 What is difference between theory and law?

(U.B)

Ans: **DIFFERENTIATION**

The difference between theory and law are as follows:

THEORY	LAW
• If hypothesis is found to be correct then it becomes theory.	• If a theory is proved again and again by experiments, it becomes a law or principle.
• A theory can be challenged	• A law cannot be challenged
• A theory can be altered in case of new evidence.	• A law is already an established and definite entity. It cannot be altered.
Example	
Theory of evolution	Mendel's laws of inheritance

MULTIPLE CHOICE QUESTIONS

- The scientific method in which biological problems are solved is called:** (K.B)
 (A) Geological method (B) Biological method
 (C) Non-biological method (D) All of these
- The problem related to living organisms:** (K.B)
 (A) Chemical (B) Geological
 (C) Biological (D) Physical
- Quantitative observations are considered:** (K.B)
 (A) Less accurate (B) Invariable
 (C) More accurate (D) Both B and C
- A tentative answer of the scientific problem is:** (K.B)
 (A) Deduction (B) Hypothesis
 (C) Law (D) Theory
- Logical result of the hypothesis is:** (K.B)
 (A) Experimentation (B) Deduction
 (C) Observation (D) Results
- "Plants need sunlight for photosynthesis". It is a/an:** (A.B)
 (A) Experimentation (B) Deduction
 (C) Hypothesis (D) Results

7. Which of the following is not a good characteristic of hypothesis? (K.B)
(A) Must be a general statement (B) Must be correct
(C) Must have prediction (D) Must be testable
8. _____ is the most basic and important step of biological method. (K.B)
(A) Observations (B) Deductions
(C) Experimentation (D) Hypothesis
9. A hypothesis that is often tested and never rejected is called: (K.B)
(A) Principle (B) Theory
(C) Deduction (D) Law
10. A verified theory becomes a: (K.B)
(A) Law (B) Principle
(C) Hypothesis (D) Both A and B

1.8 MALARIA – AN EXAMPLE OF BIOLOGICAL METHOD

LONG ANSWER QUESTIONS

- Q.1 Write a note on the cause of malaria. OR
Describe the work of different scientists in discovering the cause of malaria. (K.B)

Ans: **CAUSE OF MALARIA**

Malaria – A Biological Problem:

Malaria is a common disease in many countries including Pakistan. In human history, malaria has killed more people than any other disease. Let's see how this problem was resolved by biologists.

1. Recognition

This disease was known to physicians of the **ancient times** (more than 2000 years ago) as a **disease of fever** and **chills** with recurring attacks.

2. Observations

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

- **Malaria** and **marshy areas** have some relation.
- Drinking the water of marshes does not cause malaria.
- **Quinine** is an effective drug for treating malaria.
- **Plasmodium** was seen in the blood of malarial patients.

3. Hypothesis

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

4. Deduction

Biologists developed a logical result (**deduction**) by taking this hypothesis as true.

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

5. Experiments

- In order to test the deduction biologists performed experiments.
- They examined the blood samples of **100 malarial patients** and **100 healthy persons** under microscope.
- In these experiments, the malarial patients were the experimental group while the healthy persons were the control group.

6. Results

The following were the results of these experiments:

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

- Some healthy persons also had *Plasmodium* in their blood.
- The results proved that the hypothesis "*Plasmodium* is the cause of malaria" was true.

Q.2 Write a note on the spread of malaria. OR

Write a note on the transmission of *Plasmodium* in man.

(K.B)

Ans: TRANSMISSION OF PLASMODIUM

After finding the cause of malaria, the next biological problem was to learn about "how *Plasmodium* gets into the blood of man".

1. **Recognition of Problem**

Biologists were having following initial observations which recognized this problem:

- **Malaria is associated with marshes.**
- **Drinking water of marshes did not cause malaria.**

When biologists noted these observations, they thought that *Plasmodium* was not in the marsh water.

2. **Observation**

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

- People who slept **outdoors** had more chances to get malaria than those who slept indoors.
- People who slept under **fine nets** had less chances to get malaria than those who did not use such nets.
- Individuals who slept near a **smoky fire** usually did not get malaria.

3. **Hypothesis**

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

4. **Deduction**

Following deduction was made from this hypothesis.

"If mosquitoes are involved in the spread of malaria, then *Plasmodium* should be present in mosquitoes."

5. **Experiments and Results**

a) **Experiments of Ronald Ross**

In order to test the above deduction, **Ronald Ross** performed important experiments in 1880s. He was a **British army physician** who was working in India.

Experiment 1:

- He allowed a **female *Anopheles* mosquito** to bite a **malarial patient**.
- He killed this mosquito and found *Plasmodium* multiplying in its **stomach**.
- As the next experiment, he thought to allow an infected mosquito (having *Plasmodium*) to bite a healthy person.
- If the hypothesis was true, the healthy person would have got malaria.
- But he did not use human beings for such risky experiment.

Experiment 2:

- Ross performed his experiment again but used sparrows instead of man.
- He allowed a **female *Culex* mosquito** to bite a **sparrow** suffering from malaria.
- He studied some mosquitoes at various times.
- He found that *Plasmodium* multiplied in the walls of the **mosquito's stomach** and then moved into its **salivary glands**.
- He allowed some infected mosquitoes to bite healthy sparrows.
- Ross found that these healthy sparrows got malaria.
- When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

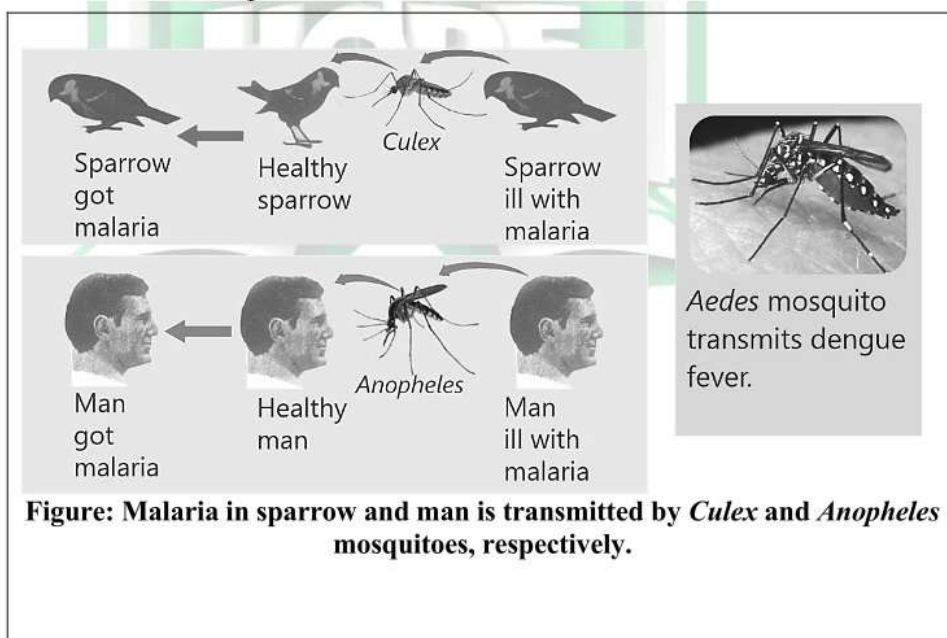
- So, it proved the hypothesis; “Mosquitoes transmit *Plasmodium* and so mosquitoes are involved in the spread of malaria”.



Figure: Ronald Ross with his experimental set-up

Experiments of Human Beings:

- In the end, the hypothesis was tested by experiments on human beings.
- 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.



SHORT ANSWER QUESTIONS

Q.1 How did physicians describe malaria in early days?

(K.B)

Ans: DESCRIPTION OF MALARIA IN EARLY DAYS

The physicians described malaria in early days as:

- A **disease of chills and fever** with recurring attacks.
- The disease more common among people living in low measuring area.

Q.2 What is the treatment of malaria? (K.B)

Ans: For the treatment of malaria quinine extracted from bark of **cinchona plant** is used. A part from **quinine** certain other antimalarial drugs are also used for the treatment of malaria.

Q.3 Write down the work of Laveran.

Ans: **WORK OF LAVERAN**

- 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*.

Q.4 What were the observations for malaria until 19th century?

Ans: **OBSERVATIONS**

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

- **Malaria** and **marshy areas** have some relation.
- Drinking the water of marshes does not cause malaria.
- **Quinine** is an effective drug for treating malaria.
- *Plasmodium* was seen in the blood of malarial patients.

Q.5 What is incubation period? (K.B)

Ans: **DEFINITION**

The period between the **entry of parasite** in host and **appearance of symptoms** is called incubation period.

Q.6 Write down the observations of A.F.A king about malaria.

Ans:

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

- People who slept **outdoors** had more chances to get malaria than those who slept indoors.
- People who slept under **fine nets** had less chances to get malaria than those who did not use such nets.
- Individuals who slept near a **smoky fire** usually did not get malaria.

Q.7 What is required for maturation of eggs of female mosquito?

Ans: Female mosquito needs blood of mammals or birds for the maturation of their eggs.

Q.8 Why Ronald Ross used sparrows in his experiment? (U.B)

Ans: **USAGE OF SPARROW BY RONALD ROSS**

Ronald Ross used sparrows in his experiment because scientist avoid using human beings for experimentation when results could be so serious.

Q.9 How did Ross Prove that mosquito transmit *Plasmodium* and spread malaria? (K.B)

Ans: **EXPERIMENT OF RONALD ROSS**

Ronald Ross, a British army physician perform important experiment while working in India.

Experiment 2:

- When Ross performed his experiment on sparrows instead of man, he allowed a **female *Culex mosquito*** to bite a sparrow suffering from malaria.
- He studied some mosquitoes at various times.
- He found that *Plasmodium* multiplied in the walls of the **mosquito's stomach** and then moved into its **salivary glands**.
- He allowed some infected mosquitoes to bite healthy sparrows.
- Ross found that these healthy sparrows got malaria.
- When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.
- So, it proved the hypothesis; "**Mosquitoes transmit *Plasmodium* and so mosquitoes are**

involved in the spread of malaria”.

Q.10 Discuss some symptoms of malaria. (K.B)

Ans: SYMPTOMS OF MALARIA

The patients of malaria feel very chill and cold.

Symptoms:

The body temperature rises above the normal value of 98.5°F.

The patients also suffer from:

- Headache
- Feeling of nausea
- After sometimes, the person begins to sweat, feels better.
- The whole series are repeated after every 24, 48 or 72 hours depending upon the species of *Plasmodium*.

MULTIPLE CHOICE QUESTIONS

1. **Most effective remedy against malaria until 20th century:** (K.B)
 (A) Cinchona (B) Ranitidine
 (C) Amoxicillin (D) Quinine
2. **French army physician who worked on malaria in 1878?** (K.B)
 (A) Robert Brown (B) Laveran
 (C) Ross (D) Mendel
3. **Who started to know the reason of malaria?** (K.B)
 (A) Robert Brown (B) Laveran
 (C) Ronald Ross (D) Mendel
4. **Malaria is caused by:** (K.B)
 (A) *Plasmodium* (B) Virus
 (C) Mosquito (D) *E. coli*
5. **Malaria is spread by:** (K.B)
 (A) *Plasmodium* (B) Virus
 (C) Mosquito (D) *E. coli*
6. **Mark the incorrect observation about cause of malaria:** (K.B)
 (A) Malaria is associated with marshes
 (B) Quinine is an effective drug for treating malaria
 (C) Drinking water of marshes causes malaria
 (D) Individuals who slept near a smoky fire usually did not get malaria
7. **How many observations were presented by A.F.A King?** (K.B)
 (A) 04 (B) 13
 (C) 20 (D) 15
8. **Ronald Ross belonged to:** (K.B)
 (A) Holland (B) America
 (C) German (D) Britian
9. **“Mosquito transmit *Plasmodium* and so are involved in the spread of malaria”. Who suggested this hypothesis?** (K.B)
 (A) Laveran (B) Ronald Ross
 (C) Aristotle (D) A.F.A King
10. **Female mosquitoes used by Ross in his experiments:** (K.B)
 (A) *Anopheles* and *Aedes* (B) *Aedes* and *Culex*
 (C) *Culex* and *Anopheles* (D) All of these
11. **Malaria in sparrows is spread by:** (K.B)
 (A) *Anopheles* mosquito (B) *Aedes* mosquito
 (C) *Culex* mosquito (D) Mosquito
12. ***Plasmodium* is transferred by:** (K.B)

- (A) Honey bee (B) Virus
(C) House fly (D) Mosquito
13. The malaria in birds is spread by: (K.B)
(A) *Anopheles* mosquito (B) *Aedes* mosquito
(C) *Culex* mosquito (D) Mosquito
14. Female mosquitoes need the blood of _____ for the maturation of their eggs. (K.B)
(A) Insects (B) Birds
(C) Mammals (D) Reptiles
15. Ross found *Plasmodium* multiplying in: (K.B)
(A) Salivary glands (B) Stomach
(C) Blood (D) Both A and C

TEXTBOOK EXERCISE

MULTIPLE CHOICE 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) Proteomics
3. Insulin made through bacteria is an example of the technique of:
(A) Parasitology (B) Biotechnology
(C) Biochemistry (D) Histology
4. Heart pumps, the brain memorizes, kidneys excrete. The statement comes from:
(A) Physiology (B) Anatomy
(C) Morphology (D) Cardiology
5. Which branch of Biology involves the study of the classification of organisms?
(A) Taxonomy (B) Physiology
(C) Palaeontology (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

SHORT ANSWER QUESTIONS

Q.1 Define the following branches of biology.

Ans: **DEFINITIONS**

a) Genetics

Genetics is the branch of Biology that deals with the study of **transfer of characteristics** from parents to offspring.

Applications:

In Genetics, scientists also study the causes of genetic diseases, and develop better varieties of plants.

b) 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.

c) Palaeontology

Palaeontology is the branch of Biology that deals with the **study of fossils**.

Fossils:

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

d) Marine Biology

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

Applications:

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

e) Pathology

Pathology is the **study of diseases**, their causes, and effects.

Applications:

- Pathology helps in disease diagnosis, treatment development, and disease prevention.
- Cancer, for instance, is characterized by uncontrolled growth and spread of abnormal cells.

Q.2 Which branch of Biology involves the study of the development and growth of organisms from fertilization to adulthood?

Ans:

The branch of Biology that involves the study of the development and growth of organisms from fertilization to adulthood is embryology.

Definition:

Embryology is the study of the process of **development of organism** from fertilized egg.

Applications:

In this branch, scientists study organ and tissue formation, identify birth defects, and develop medical treatments.

Example:

Development of human heart

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

Ans:

Medicine and Surgery:

The profession of medicine and surgery (M.B.B.S.) is concerned with diagnosis and treatment of diseases by using either medicine or by the removal, repairing or replacement of defective body part of humans.

Animal Husbandry:

While animal husbandry involves breeding and caring for livestock to improve their quality and productivity.

Higher Studies:

- For the profession of medicine and surgery, students need to complete a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.
- Whereas for animal husbandry, students can pursue a 4-year BS degree in Animal Husbandry.

Q.4 Differentiate between Morphology and Physiology

Ans: **DIFFERENTIATION**

Morphology	Physiology
The study of the form and external structure of the organism is called morphology.	Physiology is the branch of Biology that deals with the functioning of body parts.
Examples	
Study of organs, tissues and cells.	Studying how the blood circulatory system transports vital substances throughout the body.

Q.5 What is Computational Biology?

Ans: **COMPUTATIONAL BIOLOGY**

Definition:

In Computational Biology, scientists use **Mathematical models**, algorithms, and computer simulations to understand biological systems and relationships.

Examples:

It involves analysing biological data, such as sequence of amino acids in a protein.

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

Ans: **COMPUTATIONAL BIOLOGY**

Role of Observations:

Observations are the information related to the problem which is under study. Scientists make observations about the problem, which then helps in making hypotheses.

Role of Observations:

- It 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.

EXTENSIVE ANSWER QUESTIONS

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

See Q.no.1 of topic 1.2

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

See Q.no.1 of topic 1.3

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

See Q.no.1 of topic 1.5

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

See Q.no.1 of topic 1.7

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

- See Q.no.1 of topic 1.6
- Q.6 Describe the work of different scientists in discovering the cause of malaria.**
- See Q.no.1 of topic 1.8
- Q.7 Write a descriptive note on the experiments performed by Ross.**
- Consult Q.no.2 of topic 1.8

INQUISITIVE ANSWER QUESTIONS

- Q.1 Why is it important to classify biology into different branches such as botany, zoology, and microbiology? How does specialization benefit scientists?**

Ans: CLASSIFICATION OF BIOLOGY

Classifying biology into branches like botany, zoology, and microbiology is important because it allows scientists to **focus** on specific areas of study. Each branch deals with different organisms or processes, leading to:

In-Depth Knowledge:

Scientists can gain **detailed understanding** in their field, which is essential for solving complex problems.

Organized Research:

Classification helps in organizing studies and sharing the findings effectively.

Benefits of Specialization:

Specialization benefits scientists by:

1) Increasing Expertise

They become **experts** in their field, leading to important discoveries.

2) Higher Impact

Specialized research often has a greater influence in the scientific community.

3) Collaboration Opportunities

It encourages **teamwork** across different fields to tackle complex issues.

- Q.2 How can a scientist apply the scientific method to confirm an observation that a certain plant species grows more quickly in shady places than in direct sunlight?**

Ans: SCIENTIFIC METHOD

Scientist can apply the scientific method to confirm the observation that a certain plant species grows more quickly in shady places than in direct sunlight.

1. Observation:

The scientist notices that a certain plant species appears to grow faster in **shady areas** compared to areas with **direct sunlight**.

2. Hypothesis:

The scientist forms a hypothesis: "**This plant species grows more quickly in shaded environments than in direct sunlight.**"

3. Deduction:

If this plant species grows more quickly in shaded environments than in direct sunlight, then plants grown in shady conditions should show greater growth (e.g., height) compared to those grown in direct sunlight.

4. Experimentation:

The scientist designs an experiment to test the hypothesis:

Control Group

Grow a set of plants in direct sunlight.

Experimental Group

Grow an identical set of plants in shaded conditions.

5. Results

The scientist collects and analyzes the data:

- If the plants in the shaded area show significantly greater growth than those in direct sunlight, the hypothesis is supported.
- If there is no difference or if the sunlight-grown plants grow better, the hypothesis is not supported.

EXTRA CONCEPTUAL MCQs

- The study of functions of various organs of an organism is:** (K.B)
(A) Morphology (B) Histology
(C) Anatomy (D) Physiology
- Histology is the microscopic study of:** (K.B)
(A) Tissues (B) Cells
(C) Fossils (D) Plants
- Paleontology is the study of:** (K.B)
(A) Environment (B) Development
(C) Fossils (D) Animals
- The other name of environmental biology is:** (K.B)
(A) Ecology (B) Biotechnology
(C) Microbiology (D) Cell biology
- Microbiology is the study of:** (K.B)
(A) Fungi (B) Animals
(C) Plants (D) Microorganisms
- If a scientist is studying the methods of inserting human insulin gene in bacteria, which branch of biology may this be?** (U.B)
(A) Anatomy (B) Physiology
(C) Biotechnology (D) Pharmacy
- The starting point of scientist investigation is:** (K.B)
(A) Hypothesis (B) Theory
(C) Observation (D) Data
- Information that is gathered as a result of an experiment is called:** (K.B)
(A) Hypothesis (B) Data
(C) Theory (D) Observation
- Which of the following statements best distinguishes hypothesis from theories in science?**
(A) Theories are hypothesis that have been proven true
(B) Theories are based on limited data while hypothesis are based on wide range of data
(C) Theories are uncertain while hypothesis are certain
(D) Theories are educated guess while hypothesis are widely accepted explanation of natural phenomenon
- Malarial patient has *Plasmodium* in his blood. What would be the possible explanation if a healthy person who is not having any malarial symptoms shows *Plasmodium* in his blood?**
(A) *Plasmodium* are dead (B) *Plasmodium* are in incubation period
(C) *Plasmodium* are not mature (D) *Plasmodium* are inactive
- You are doing a control experiment which:** (A.B)
(A) Proceeds slowly enough that a scientist can record the results
(B) May include experimental groups and control groups tested in parallel
(C) Is repeated many times to make sure the results are accurate
(D) Proceed slowly enough that a scientist can test predictions
- Which option has correctly matched disease and vector mosquito?** (U.B)

	Malaria in humans	Malaria in birds	Dengue fever
A	<i>Anopheles</i>	<i>Aedes</i>	<i>Culex</i>
B	<i>Aedes</i>	<i>Culex</i>	<i>Anopheles</i>

C	<i>Anopheles</i>	<i>Culex</i>	<i>Aedes</i>
D	<i>Culex</i>	<i>Anopheles</i>	<i>Aedes</i>

STUDENT LEARNING OUTCOMES (SLOs)

Q.1 How horticulture is important OR what are the advantages and associated carries of Horticulture?

Ans: **HORTICULTURE**

Horticulture means the **art of gardening**.

Advantages

It involves for the better meant of existing varieties and for the production of new varieties of or nominal plants and fruits.

Associated Carriers

The associated carriers involved are plant breeders and horticulturist etc.

Q.2 What do you know about forming?

Ans: **Forming**: It deals with the development and maintenance of different types of forms.

Example:

- In some farms, animals breeding technologies are used for the production of animals which are better protein and milk source
- In **poultry farms**, chicken and eggs are produced.
- In fruit farms, different fruit yielding plants are grown.

Q.5 What does a qualitative observation focus on?

Ans: **QUALITATIVE OBSERVATIONS**

- Qualitative observations are related to the **qualities** or **characteristics of something**, such as colour, shape, texture, or behaviour.
- Qualitative observations are also important because they can provide valuable details and context that numbers alone may not convey.

Example:

If you notice a **red rash** on the skin of a dengue fever patient, it is a qualitative observation.

Q.6 Describe the role of an independent variable in an experiment.

Ans: **INDEPENDENT VARIABLE**

In an experiment, the independent variable is the factor that the researcher manipulates or changes to observe its effect on the dependent variable. The independent variable is under the control of the experimenter and is altered or varied to see how it impacts the dependent variable.

Example:

- In a study investigating the effect of fertilizer on plant growth, the independent variable would be the type or amount of fertilizer applied to the plants.
- By manipulating this variable, the researcher aims to see how it influences the dependent variable, which in this case would be the growth of the plants.

Q.7 In what ways are scientific results communicated?

Ans: **SCIENTIFIC RESULTS**

Biologists share their findings in scientific publications or meetings and conferences within the scientific community. This data is also published on international scientific journals, so that scientists around the world can access it and hence, the findings are communicated.

Q.8 How would you differentiate malaria and dengue fever?

Ans: **DIFFERENTIATION BETWEEN**

MALARIAL FEVER	DENGUE FEVER
Patient may feel very chill and cold. Body temperature rise above the normal value of 98.5°F.	Dengue haemorrhage fever is characterized with high fever and bleeding from nose, blood in urine, and enlarged liver.
Vector	
Female <i>Anopheles</i> mosquito	<i>Aedes aegypti</i> mosquito
Caused by	
It is caused by <i>Plasmodium</i> .	It is caused by Dengue virus.
Treatment	
Certain anti-malarial drugs such as quinine are used.	No specific antiviral drugs are available.

Q.9 Design an experiment to check if CO₂ is necessary for photosynthesis.

Ans: **PHOTOSYNTHESIS EXPERIMENT**

To check the necessity of CO₂ for photosynthesis, we will make two groups.

- Experimental Group
- Control Group

Experimental Group:

A group of plants will not be provided with CO₂.

Result: Photosynthesis will not take place and the plant will die out.

Control Group:

A group of plants which will be provided with CO₂.

Result: Photosynthesis will take place and the plant will survive.

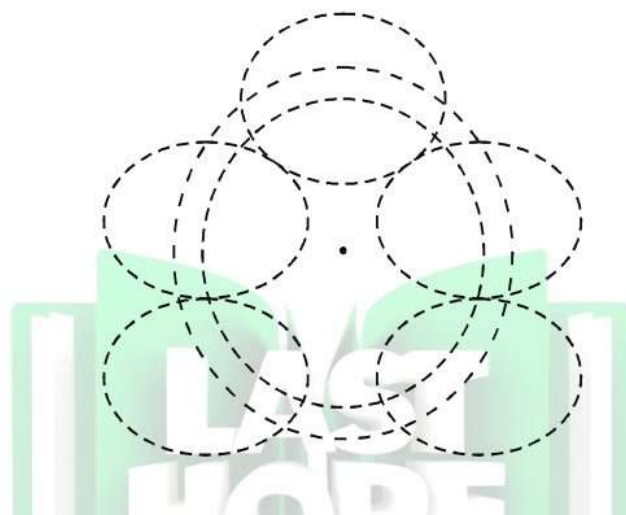
ASSIGNMENT

LET'S DRAW AND LABEL

(A) Relationship of Biology with other Sciences

Instructions:

- Use compass to draw two circles.
- Now, draw the ovals using free hand skills.
- Mention the labels with clarity.



Terms to Know

Microorganism	A microscopic organism, especially a bacterium, virus, or fungus.
Morphology	It deals with study of forms and structure of living organisms.
Palaeontology	Study of fossils
Parasite	Organisms that take food and shelter from living host and in return, harm them.
Parasitology	Study of parasites.
Pharmacology	Study of drugs and their effects on the system of human body.
Physiology	Study of functions of different part of living organisms.
Biogeography	Distribution of plants and animals in different geographical regions of the world.
Horticulture	Art of gardening.
Inheritance	Transmissions of characters from parents to offsprings.
Science	Is the study in which observation are made, experiments are done and logical conclusions are drawn in order to understand the principle of nature.
Socio-biology	Study of social behaviour of the animals
Surgery	The parts of body may be repaired, replaced or removed.
Taxonomy	Study of the naming and classification of organisms into groups and subgroups.

Zoology	Study of animals
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Answer Key**TOPIC 1.1**

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

TOPIC 1.2

1	B	2	B	3	B	4	C	5	B
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TOPIC 1.3

1	C	2	C	3	C	4	C	5	C
6	B	7	B						

TOPIC 1.4

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

TOPIC 1.5

1	B	2	C	3	B	4	A	5	C
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TOPIC 1.7

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

TOPIC 1.8

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

TEXTBOOK EXERCISE MCQs

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

EXTRA CONCEPTUAL MCQs

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