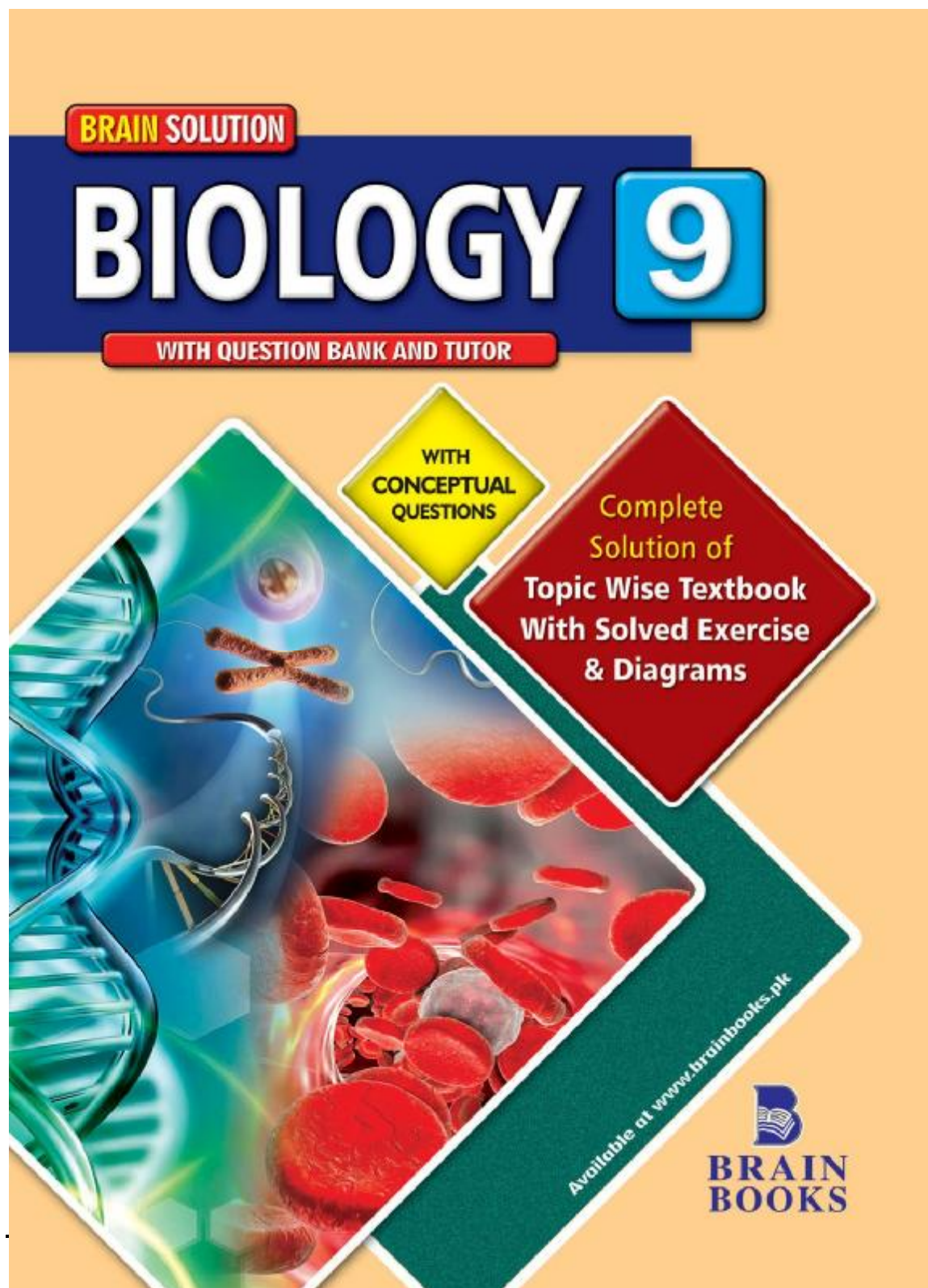




BRAIN SOLUTION**WITH TUTOR**

BIOLOGY

with
CONCEPTUAL
Questions (CQs)



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Unit - 1

The Science of Biology

1.1 BIOLOGY AND ITS BRANCHES

Q1 Define Biology. Also discuss the major fields of Biology.

Ans: Biology:

Biology is the science of life. The word "Biology" comes from two Greek words i.e., "bios" and "logos" (study). It explores the structures, function, and interactions of living organisms. Understanding biology helps us to address issues related to health, Food, and the environment. Biology offers a fascinating journey of discovery from the **microscopic world** of bacteria to the vast ecosystems of our planets.

TUTOR

Microscopic world: The microscopic world is a fascinating realm filled with wonders waiting to be discovered. With the help of various microscope types, we can explore and unravel the intricate details of the tiniest organisms and objects.

Major Fields of Biology:

Biology is vast field that explores the incredible diversity of life on Earth. To better understanding this complexity, scientist have to divided Biology into **three** main fields.

i) **Zoology:**

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

TUTOR

Diversity means the state of being diverse; variety.

ii) **Botany:**

Botany is the study of plants, including their structure, function, behavior and **diversity**.

TUTOR

Microorganisms are organism which can not be seen from naked eye like bacteria.

iii) **Microbiology:**

The study of **microorganisms**, such as bacteria and microscopic fungi is called microbiology. Includes the study of the structures, functions,

TUTOR

Habitat: Habitat is the natural home or environment of a plant, animal, or other organism.

habitats and reproduction of microorganisms, and their impacts on health sand environment.

Q2 Explain different branches of Biology in detail.

Ans: Biology is divided into different branches to better understand the aspects of life. Each branch offers unique insights into the fascinating world of life, contributing to our understanding of the complexity and beauty of our planet. Important branches of Biology are given below.

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

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

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

ii) **Physiology:** Physiology is the branch of Biology that deals with the functioning

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of body parts.

Scope: how the blood circulatory system transports vital substances throughout the body is studied in physiology.

- iii) **Embryology:** Embryology is the study of the process of development of organism from fertilized egg.

Scope: In Embryology, scientists study organ and tissue formation, identify birth defects, and develop medical treatments.

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

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

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

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

- vi) **Histology:**

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

Scope:

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

- vii) **Paleontology:**

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

Scope:

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.

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

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

- ix) **Ecology:** Ecology is the branch of Biology that deals with the relationships

TUTOR

Carbohydrates means sugar molecules. It includes sugars, starch, and cellulose, containing hydrogen and oxygen in the same ratio as water (2:1)

Protein is a class of nitrogenous organic compounds that have large molecules composed of one or more long chains of amino acids.

Lipid is a class of organic compounds that are fatty acids or their derivatives and are insoluble in water but soluble in organic solvents.

Nucleic acids is a complex organic substance present in living cells, especially DNA or RNA.

TUTOR

Fossil fuels are non-renewable energy sources such as coal, coal products, natural gas, derived gas, crude oil, petroleum products and non-renewable wastes.

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

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

between organisms and their environment.

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

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

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

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

xi) Pathology: Pathology is the study of diseases, their causes, and effects.

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

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

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

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

Scope: This helps in the development of new drugs.

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

TUTOR

Corel reefs: Corel reefs provide habitat for diverse marine life and protect coastlines from erosion.

TUTOR

Cancer: Uncontrolled cell growth leading to tumor formation, often caused by genetic mutations.
OR Abnormal cell growth that can invade surrounding tissues and spread to other parts of the body.

TUTOR

Vaccines: A substance used to stimulate immunity to a particular infectious disease or pathogen.

TUTOR

Antibiotics Essential for treating bacterial infections, but overuse can lead to antibiotic resistance.

1.2 RELATION OF BIOLOGY WITH OTHER SCIENCES

Q3 Link all study of biology with physics, chemistry, statics, geography, economics and computer science.

Ans: 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.

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

Example: In Biophysics we study the rules of lever and motion for understanding

the function of muscles, bones and joints.

3. **Computational Biology:** In Computational Biology, scientists use Mathematical models, algorithms, and computer simulations to understand biological systems and relationships.
Scope: Computational Biology involves analysing biological data, such as sequence of amino acids in a protein.
4. **Biogeography:** Biogeography deals with the study of the distribution of living organisms in different geographical regions of the world.
Scope: The influence of climate change on the distribution of organisms is also studied in Biogeography.
5. **Biostatistics:** Biostatistics deals with the principles of statistics to analyse and interpret data related to living organisms.
Scope: Biostatistics plays a crucial role in biological research, healthcare, and public health etc.
6. **Biotechnology:** Biotechnology deals with the use of living organisms or their components to develop beneficial products or processes, for various fields including healthcare, agriculture, and environmental management.
Example: Biotechnologists use bacteria for the production of insulin to treat diabetic patients.

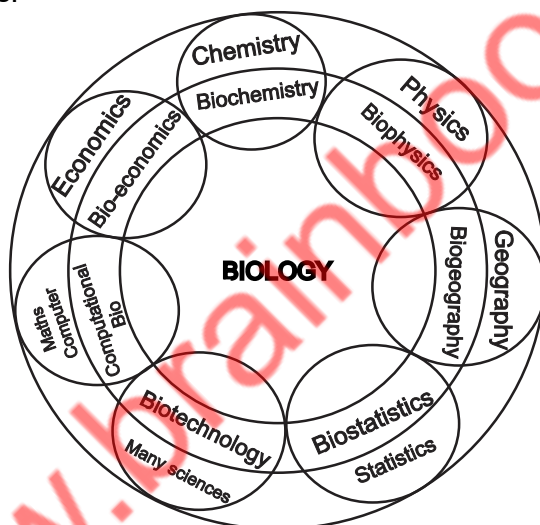


FIGURE 1.1: Relation of Biology with other sciences

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

1.3 CAREERS IN BIOLOGY

Q4 Explain how study of biology can lead to different professional studies?

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

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For example:

- 1. Medicine and Surgery:** The profession medicine deals with the diagnosis and treatment of diseases. In surgery the defective parts of the body are repaired, replaced or removed.

Qualification: Medicine and surgery 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.

Qualification: Dentistry 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.

Qualification:

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

- 4. Physiotherapy:**

Physiotherapy is the **therapy** that is used to restore movement and physical function of body that has been impaired by disease or injury. Physiotherapists use physical exercise and physical modalities (such as massage) to improve patient's physical movement and function.

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

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

- 6. Agriculture:** Agricultural scientists improve farming practices, crop production, and sustainable agriculture techniques.

Qualification: A 4-year BS degree in Agriculture is required.

- 7. Animal Husbandry**

Animal Husbandry field involves breeding and caring for **livestock** to improve their quality and

More Careers in Biology

Career	Major Jobs
Veterinary Medicine	Diagnosis and treatment of diseases in animals and surgeries
Environmental Science	Solving issue and related to pollution and natural resources
Microbiology	Research on microorganisms to understand their impact.
Genetic counseling	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

TUTOR

Therapy: Treatment to cure or manage mental or physical health disorders, improving overall well-being.

TUTOR

Livestock is domesticated

productivity.

animals raised to use for agricultural purposes.

Qualification:

Students can pursue a 4-year BS degree in Animal Husbandry.

8. Horticulture:

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

Qualification:

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

9. Forestry:

Foresters manage and conserve forests and wildlife.

Qualification:

A 4-year BS degree in Forestry is necessary.

10. Farming:

The professional of farming prepare farms e.g., animal farms, poultry farms, fruit farms. In such farms, they grow crops and raise animals for food and other products.

Qualification:

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

11. Biotechnology

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

Qualification:

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

12. Forensics:

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

Qualification:

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

TUTOR

Ornamental Plants: Cultivated for aesthetic value, used in landscaping and decoration.

1.4 QURANIC INSTRUCTIONS TO REVEAL THE STUDY OF LIFE

Q5 Describe the Quranic instructions to reveal the study of Life.

Ans: 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:

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ ۖ

"We made every living thing from water." (Sura: Ambia, Verse: 30)

The Quran mentions in multiple verses that all living things were created from water.

Water is described as a divine blessing from Allah. Living things consists of 85 to 90 per cent of water, and the above Verse hint at the common origin of all living things in the water.

خَلَقَ الْإِنْسَانَ مِنْ صَلْصَالٍ كَالْفَخَّارِ

"He made man from clay like the potter." (Sura: Rehman, Verse: 14)

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. Allah also hints at the method of the development of animals including human beings.

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً وَخَلَقْنَا الْعَلَقَةَ مُضْغَةً
فَخَلَقْنَا الْمُضْغَةَ عِظًا فَكَسَوْنَا الْعِظَ لَحْمًا

"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."

(Sura: Al-Mominoon, Verse: 14)

Now, Quran also describes the common origin and modification of animals.

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

"Allah hath created every animal from water. Then some of them creep up over their bellies, others walk on two legs, and others on four. Allah creates what He pleases."

(Sura: Al-Nur, Verse: 45)

This verse explains that Allah 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.

1.5 SCIENCE AS A COLLABORATIVE FIELD

Q6 Science is a collaborative field in which scientists work together to share knowledge. Prove this statement with examples.

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

Examples: Few examples of interdisciplinary collaboration in science are given below.

1. Human Genome Project:

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

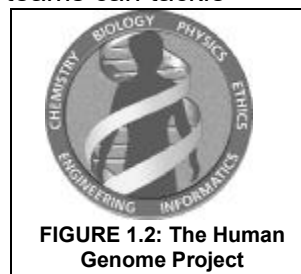


FIGURE 1.2: The Human Genome Project

TUTOR

Genome: Complete set of genetic instructions encoded in an organism's DNA.

2. Climate Change Research:

Climate change requires collaboration among many disciplines, such as atmospheric science,

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Climate means the weather conditions prevailing in an area in

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ecology, economics, and sociology.

general or over a long period.

3. Medical Research:

Advances in medical research often rely on interdisciplinary collaboration.

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

4. Robotics and Artificial Intelligence (AI):

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

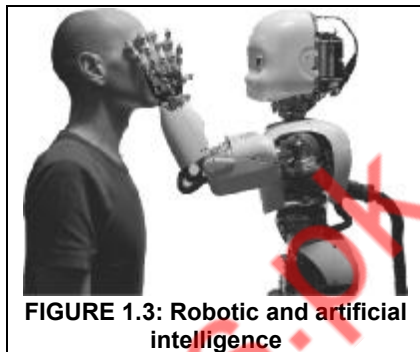


FIGURE 1.3: Robotic and artificial intelligence

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.

1.6

SCIENTIFIC METHOD

Q7 What are basic steps a scientist adopts in order to solve scientific problem? Explain observation and their types.

Ans: Scientific Method:

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

Biological method: For biological research, scientist take specific steps for research these steps are called biological method.

The following scientist take specific for research there are involved in scientific method:

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

In all branches of science, new things are being discovered and old theories are modified or replaced with better ones.

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. Such 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

Observations:

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

Types of observation:

- i) Qualitative or quantitative observations
- ii) Quantitative observation

i) Qualitative Observations:

Qualitative observations involve characteristics that cannot be measured with numbers.

Example:

Describing the colour and texture of a flower.

ii) Quantitative Observations:

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

Example:

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

Quantitative:

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

Q8 What is Hypothesis? Write its characteristics.

Ans: Hypothesis:

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

Information is also gathered by reading books. It helps you to understand existing knowledge and formulate a hypothesis.

Scientists make many hypotheses for a single problem. 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.

Deduction:

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

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

TUTOR

Five Senses: Sight, hearing, taste, smell, and touch, which enable humans to perceive and interact with the environment. It enables human to perceive and interact with environment.

- **Deduction:**
"If iron deficiency is causing the symptoms, then adding iron to the soil will lessen the leaf discoloration and promote healthier plant growth";

Q9 Explain the most basic step of biological method. How scientist draw results from this basic step?

Ans: Experiments:

Experiments 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 Group and Control group

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

For example, you want to do experiment to test the necessity of carbon dioxide for photosynthesis. You will arrange two similar plants. You will not provide carbon dioxide to one plant (experimental group). While you will provide carbon dioxide to the other plant (control group). The necessity of carbon dioxide will be proved, when photosynthesis does not occur in the experimental group but occurs in the control group.

Results:

Scientists gather data from their experiments. 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. 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)

Q10 Describe Theory and Law with examples.

Ans: 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. 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**.

Scientific laws:

Scientists keep on testing the theories by making new hypotheses from theories. They try their best to disprove the theory.

Definition: If a theory is proved again and again by experiments, it becomes a law or principle. A scientific law is a uniform or constant fact of nature.

Example:

TUTOR

Natural Selection: Process by which favorable traits are passed on to offspring, driving evolution and adaptation.

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

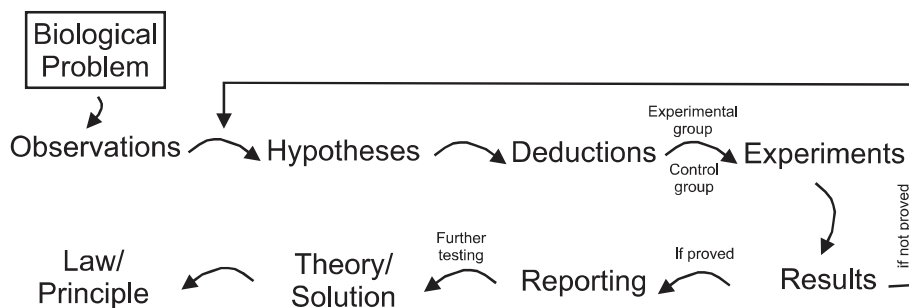


FIGURE 1.4: Scientific method

1.8 MALARIA - AN EXAMPLE OF BIOLOGICAL METHOD

Q11 Describe the work of different scientists in discovery the cause of malaria.

OR How malaria was discovered? Explain by using biological method.

Ans: Malaria is a common disease in many countries including Pakistan.

In human history, malaria has killed more people than any other disease.

Cause of Malaria:

History:

Malaria was known to physicians of the ancient times (more than 2000 years ago). In the last part of 19th century, there were four major observations about Malaria.

Quinine was the only remedy for malaria from the 17th to the 20th century.

Observations:

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

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**.

Hypothesis:

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

Deduction:

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

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

Experiment and Results:

In order to test the deduction biologists performed

In these experiments, the malarial patients were the

TUTOR

Marshy areas meanwet areas of land, such as the shores of rivers or lakes.

TUTOR

Plasmodium:Genus of parasites that cause malaria in humans.

experiments. They examined the blood samples of 100 malarial patients and 100 healthy persons under microscope.

experimental group while, the healthy persons were the control group.

Result: The following were the results of these experiments;

Most of the malarial patients had Plasmodium in their blood.

The results proved that the hypothesis "Plasmodium is the cause of malaria" was

true.

Q12 How plasmodium gets into the blood of man is a biological problem solved by scientist in past?

OR Write a descriptive note on experiments performed by Ross.

Ans: How Plasmodium gets into the blood of man is a biological problem.

1 **Observation:** Biologists were having following observations;

- i) Malaria is associated with marshes.
- ii) People who slept under fine nets had less chances to get malaria than those who did not use such nets;
- iii) Individuals who slept near a smoky fire usually did not get malaria.

2 **Hypothesis:**

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

3 **Deduction:**

Following deduction was made from this hypothesis.

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

Experiment and Results:

4 **Ronald Ross:**

In order to test the deduction "If mosquitoes are involved in the spread of malaria, then Plasmodium should be present in mosquitoes.

Ronald Ross performed important experiments in 1880s. He was a British army physician who was working in India.

Experiments:

- i) Ronald Ross 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.
- ii) 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

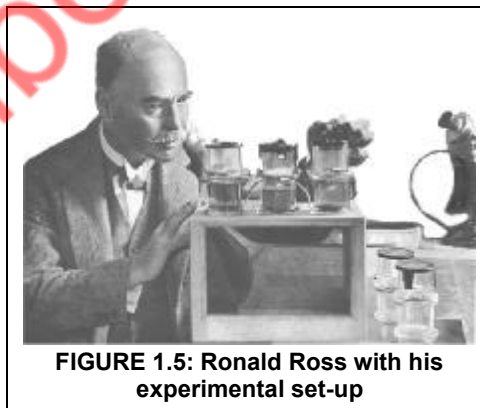


FIGURE 1.5: Ronald Ross with his experimental set-up

these healthy sparrows got malaria. When he examined the blood of these previously healthy sparrows, he found many *Plasmodia* in it.

Results: It proved the hypothesis; *Mosquitoes transmit Plasmodium*. So, *mosquitoes are involved in the spread of malaria*.



Aedes mosquito transmits dengue fever.

Experiments on 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.

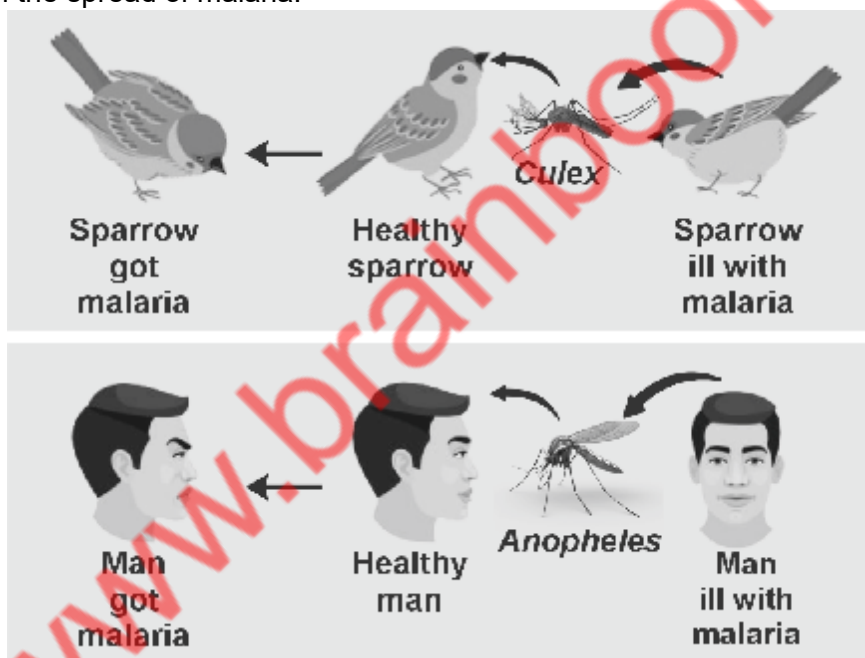


FIGURE 1.6: Malaria in sparrow and man is transmitted by *Culex* and *Anopheles* mosquitoes respectively

KEY POINTS

Biology is the study of life. It deals with the structure of **living things** and the processes

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that occur in them.

Major divisions of Biology are **Zoology** (study of animals), **Botany** (study of plants) and **Microbiology** (study of microorganisms).

Major fields or branches of Biology include:

Branch	Study of:
Cytology	Cells
Histology	Tissues
Morphology	Form and structure of organisms
Anatomy	Internal physical structure of organisms
Physiology	Functioning of body parts
Embryology	Development of organism from fertilized egg
Genetics Molecular	Transfer of characteristics from parents to offspring
Biology	Biological molecules like carbohydrates, proteins, lipids, and nucleic acids.
Paleontology	
Taxonomy	Classification of organisms
Ecology	relationships between organisms and their environment
Marine Biology	Life in oceans and saltwater
Pathology	Diseases, their causes, and effects
Immunology	Components of immune system and their role against diseases
Pharmacology	Drugs and their effects on the body

Students of Biology can adopt careers like medicine and surgery, fisheries, agriculture, animal husbandry, biotechnology, horticulture, forestry and forensics.

The scientific method involves basic steps like recognition of problem, taking observations, making hypothesis, making deductions, performing experiments and summarizing and reporting results.

A hypothesis is a tentative answer to the scientific problem.

Deduction is the logical result of hypothesis.

- A scientific theory is an explanation based on the facts that -have been. repeatedly confirmed through experiments.
- If a theory is proved again and again by experiments, it becomes a law or principle.
- A scientific law is a uniform or constant fact of nature.

EXERCISE

A. Select the correct answers for the following questions.

- Which branch of Biology focuses on the study of the structure and function of cells?
a) Cytology✓ b) Microbiology c) Histology d) Ecology
- The study of the processes of heredity and variation, in living, organisms is known as:
a) Ecology b) Genetics✓ c) Anatomy d) Proteomics
- Insulin made through bacteria is an example of the technique of.
a) Parasitology b) Biotechnology✓ c) Biochemistry d) Histology

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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) Paleontology 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 working the laboratory

A. Write short answers.

1. Define the following branches of Biology.
Genetics, Anatomy, Paleontology, Marine Biology, Pathology.

Ans:

- i) **Genetics:** Genetics is the branch of Biology that deals with the study of transfer of characteristics from parents to offspring.
Scope: In Genetics, scientists also study the causes of genetic diseases, and develop better varieties of plants.
- ii) **Anatomy:** Anatomy is the branch of Biology that explores the internal physical structure of organisms, particularly humans.
Scope: Scope helps in disease diagnosis, medical device development, and improving quality of life.
Example: The study of the organs of the digestive system.
- iii) **Paleontology:** Paleontology is the branch of Biology that deals with, the study of fossils.

Scope: 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.

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

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

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

- v) **Pathology:** Pathology is the study of diseases, their causes, and effects.

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

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

Ans: Embryology is the branch of Biology involves the study of the development and growth of organism from fertilization to adulthood.

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

Ans:

Medicine and Surgery	Animal Husbandry
The profession medicine deals with diagnosis and treatment of diseases. In surgery the defective parts of the body are repaired, replaced or removed.	Animal Husbandry field involves breeding and caring for livestock to improve their quality and productivity.
Qualification: Medicine and surgery profession, students need to complete a 5-year Bachelor of Surgery (MBBS) degree.	Qualification: students can pursue a 4-year BS degree in Animal Husbandry.

4. **Differentiate between Morphology and Physiology**

Ans:

Morphology	Physiology
Morphology is the branch of biology that examines the shape, size and organization of living organism. It also includes study of organs, Tissues and cells.	Physiology is the branch of biology that examines the processes and mechanisms that occur within living organism. It includes of how organism maintaining homeostasis, responds to stimuli and adapt to environment.

5. **What is Computational Biology?**

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

Scope: It involves analysing biological data, such as sequence of amino acids in

a protein.

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

Ans: Role of observation and experimentation in scientific method:

Observation: In observation researchers observe the phenomena, patterns, or unusual events, and collect data for hypothesis.

Experiment: Experiments test hypothesis generated from observations. Experiments generate data that can be analyzed to draw conclusions.

B. Write answers in detail.

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

Ans: For Answer See Question # 3

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

Ans: For Answer See Question # 4

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

Ans: For Answer See Question 6

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

Ans: For Answer See Question # 10

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

Ans: For Answer See Question # 7, 8, 9

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

Ans: For Answer See Question # 11

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

Ans: For Answer See Question # 12

D Inquisitive Questions

1. **Why is it important to classify biology into different branches such as botany, zoology, and microbiology? how does specialization benefit scientific research?**

Ans: Classifying biology into branches like botany, zoology, and microbiology is important because:

Facilitates Organization and Study

- i) **Focused study:** Each branch concentrates on specific organisms or systems, making it easier to study and understand complex biological concepts.
- ii) **In-depth knowledge:** Specialization allows researchers to delve deeper into their chosen area, leading to a more comprehensive understanding.

Enhances Specialization and Expertise

- i) **Develops expertise:** By focusing on a specific branch, researchers become experts in that area, driving innovation and advancements.
- ii) **Interdisciplinary collaborations:** Specialization fosters collaborations between experts from different branches, leading to a more holistic understanding of

biological systems.

Accelerates Scientific Progress

- i) Targeted research: Specialization enables researchers to tackle specific problems or questions, leading to more efficient and effective research.
- ii) Breakthroughs and discoveries: Focused research in specific branches can lead to groundbreaking discoveries, driving scientific progress and improving our understanding of the biological world.

By classifying biology into different branches, researchers can focus on specific areas, develop expertise, and drive scientific progress, ultimately leading to a deeper understanding of the biological world and its many complexities.

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

Ans: To confirm the observation using the scientific method:

Step 1: Make Observations and Ask Questions

- Observe the plant species growing in shady and sunny conditions.
- Ask questions: "Does the plant species really grow faster in shady conditions?" "What factors contribute to this difference?"

Step 2: Research and Hypothesis

- Research existing literature on plant growth, light requirements, and photosynthesis.
- **Formulate a hypothesis:** "The plant species grows faster in shady conditions due to reduced water loss and optimal light intensity."

Step 3: Experiment Design

- Design an experiment to test the hypothesis.
- Independent variable: Light intensity (shady vs. sunny).
- Dependent variable: Plant growth rate.
- Control variables: Water, temperature, soil and fertilizers.
- Experimental groups: Shady and sunny conditions.

Step 4: Data Collection

- Measure and record plant growth (height, leaf size, biomass) over a set period.
- Collect data on light intensity, temperature, and water usage.

Step 5: Data Analysis

- Compare plant growth rates between shady and sunny conditions.
- Use statistical methods to determine significance and correlation.

Step 6: Draw Conclusions

- If data supports the hypothesis, conclude that the plant species grows faster in shady conditions.

Step 7: Communicate Results

- Present findings in a scientific paper, presentation, or poster.
- Share results with the scientific community and stakeholders.

QUESTION BANK**General MCQs with Conceptual Questions (CQs)****1.1 BIOLOGY AND ITS BRANCHES**

1. The study of internal structure is called:
(A) Histology (B) Anatomy ✓ (C) Cell biology (D) Botany
2. The Fossils are studied in the following branch of biology:
(A) Taxonomy (B) Physiology (C) Paleontology ✓ (D) Zoology
3. The branch of biology which deals with functioning of body parts is:
(A) Physiology ✓ (B) Embryology (C) Histology (D) Morphology
4. The knowledge of inheritance is called:
(A) Molecular biology (B) Genetics ✓ (C) Histology (D) Immunology
5. The branch in which scientists use living organisms for the welfare of mankind is called:
(A) Biotechnology ✓ (B) Genetics
(C) Immunology (D) Biochemistry
6. The microscopic study of tissue is called:
(A) paleontology (B) Morphology (C) Anatomy (D) Histology ✓
7. Molecular biology may be called as:
(A) Physiology (B) Morphology (C) Biochemistry ✓ (D) Cytology
8. The study of classification and naming of organisms is called:
(A) Histology (B) Taxonomy ✓ (C) Physiology (D) None of these
9. Relation between organism and their environment are studied in:
(A) Ecology ✓ (B) Sociology (C) Biodiversity (D) Paleontology
10. Who support a wide use variety of marine life?
(A) Shark (B) Coral reefs ✓ (C) Sponges (D) None of these
11. What is the term use for the study of organism growth and development?
(CQs)
(A) Physiology ✓ (B) Anatomy (C) Pathology (D) Morphology
12. Animal and plant structure are studied in:
(A) Anatomy ✓ (B) Physiology (C) Morphology (D) None of these
13. Diseases and their causes are study in:
(A) Parasitology (B) Immunology (C) Pathology ✓ (D) Pharmacology
14. The study of immune system of animals is called:
(A) Immunology ✓ (B) Pathology (C) Pharmacology (D) None of these
15. The study of drugs and their effects is called:
(A) Ecology (B) Pharmacology ✓ (C) Entomology (D) Pathology

16. The use of living organism for welfare of mankind is called:
(A) Biochemistry (B) Biotechnology ✓ (C) Genetics (D) Taxonomy

1.2 RELATION OF BIOLOGY WITH OTHER SCIENCES

17. One of the following related to study of physics which apply to biological process:
(A) Biophysics ✓ (B) Biochemistry (C) Morphology (D) Anatomy
18. The study of distribution of living organisms in different region of the world is: (CQs)
(A) Taxonomy (B) Systematics (C) Biodiversity (D) Biogeography ✓
19. The branch that related to the study of chemical substances and their reactions that occur in living organism is:
(A) Biochemistry ✓ (B) Bioinformatics
(C) Computational Biology (D) Biophysics
20. The scientist use mathematical models, algorithms and computer simulations to understand biological systems in: (CQs)
(A) Biomathematics ✓ (B) Computational Biology
(C) Biophysics (D) Biostatistics

1.3 CAREERS IN BIOLOGY

21. Which career belongs to diagnosis and treatment of diseases in animals?
(A) Veterinary ✓ (B) Fisheries
(C) Medicine and Surgery (D) Dentistry
22. The profession that deals with the diagnosis and treatment of diseases is:
(A) Dentistry (B) Biotechnology
(C) Medicine and Surgery ✓ (D) All of these
23. Specialization in oral health and treatment of dental issues is:
(A) Dentistry ✓ (B) Medicine
(C) Pharmacology (D) Biotechnology
24. Identify the profession that is used to restore movement and physical function of body:
(A) Physiology ✓ (B) Technology (C) Histology (D) Bioinformatics
25. Scientists of which field improve the crop production?
(A) Histology (B) Pharmacology (C) Immunology (D) Agriculture ✓
26. Which field involves breeding to animals?
(A) Horticulture (B) Husbandry ✓ (C) Gardening (D) Farming
27. A person who analyse crime scenes is:
(A) Forensic scientist ✓ (B) Pharmacist
(C) Biotechnologist (D) None of these

1.4 QURANIC INSTRUCTIONS TO REVEAL THE STUDY OF LIFE

28. Allah says "We made everything from water" in:
(A) Sura-Ambia ✓ (B) Sura Al-mominoon
(C) Sura-Al-Imran (D) Surah Rehman
29. In which sura Allah say about creation of man?
(A) Sura-Ambia (B) Sura-Rehman

- (C) Sura Al-mominoon (D) All of these ✓
 30. Allah created early life in:
 (A) Air (B) Water ✓ (C) Soil (D) in sky

1.5 SCIENCE AS A COLLABORATIVE FIELD

31. Human Genome project was completed in:
 (A) 2003 ✓ (B) 2002 (C) 2001 (D) 1999

1.6 SCIENTIFIC METHOD

32. How many steps are involved in scientific method?
 (A) 4 (B) 5 (C) 6 ✓ (D) 7
33. First step of biological method is:
 (A) Solution of problem (B) Identification of a problem ✓
 (C) Experiment (D) Hypothesis
34. Main types of observation are:
 (A) 2 ✓ (B) 3 (C) 4 (D) 5
35. How many senses a scientist can use to make observation about scientific problem?
 (A) 1 (B) 3 (C) 4 (D) 5 ✓
36. A researcher study the previous researches for:
 (A) Solution of problem (B) observation ✓
 (C) Experiment (D) for results
37. Counting the numbers of Trees in a garden is:
 (A) Experiment (B) Observation ✓ (C) Deduction (D) None of these
38. Which of the following is essential skill for biologist? (CQs)
 (A) Data analysis (B) Observation
 (C) Experimentation (D) All of these ✓
39. Which of the following is an example of Quantitative Observation is Biology? (CQs)
 (A) Describing the color of flower (B) Measuring the length of leaf ✓
 (C) Observing the behavior of an animal (D) None of these
40. What is the purpose of a hypothesis in biological method? (CQs)
 (A) To prove a theory (B) To disprove a theory
 (C) To make prediction (D) To explain a phenomenon ✓
41. Identify the purpose of experiment. (CQs)
 (A) to prove a hypothesis (B) to test a hypothesis ✓
 (C) to disprove a hypothesis (D) Entertainment

1.7 THEORY AND LAW (PRINCIPLE)

42. Constant fact of nature is:
 (A) Theory (B) Law ✓ (C) A and B both (D) None of these
43. If a Theory is proved again and again by experiments it becomes:
 (A) Hypothesis (B) New hypothesis (C) Law ✓ (D) All of these

1.8 MALARIA -AN EXAMPLE OF BIOLOGICAL METHOD

44. Effective drug against malaria was in 17th to 20th century:

- (A) Quna - Quna (B) Paracetamol (C) Quinine ✓ (D) Aspirin
45. **How many years ago malaria was known to physicians?**
(A) 1000 years (B) 2000 years ✓ (C) 5000 years (D) 100 years
46. **Which one of the following observant ions is NOT about malaria?**
(A) Malaria and marshy area have some relation
(B) There is no any relation between malaria and marshy area ✓
(C) Quinin is effective drug for malaria (D) None of these
47. **When Laveran did research on cause of malaria?**
(A) 1778 (B) 1670 (C) 1878 ✓ (D) 1678
48. **The causative agent of malaria is:**
(A) Paramecium (B) volvox (C) Fungi (D) Plasmodium ✓
49. **How is malaria casually Transmitted?** (CQs)
(A) Through contaminated food
(B) Through direct contact with an infected person
(C) Through the bite of an infected mosquito ✓
(D) Through air born transmission
50. **What is a common method of preventing malaria?** (CQs)
(A) using insecticide (B) wearing protective clothing
(C) Applying insect repellent (D) All of the above ✓
51. **Scientist developed a logical result by taking a hypothesis as true and forms:**
(A) Deduction ✓ (B) Theory (C) Law (D) Principle
52. **Identify the insect that Transmits malaria?**
(A) House fly (B) mosquito ✓ (C) Moth (D) All of these
53. **Ronald Ross performed his experiments in:**
(A) 1680 (B) 1780 (C) 1880 ✓ (D) 1980
54. **What was the main objective of Ronald Ross's Experiments?**
(A) To discover the cause of malaria (B) To develop a vaccine for malaria
(C) To study the life cycle of Malaria parasite
(D) To investigate the role of mosquitoes in transmitting malaria ✓
55. **Ronald Ross observe plasmodium multiplying in _____ of mosquito:**
(A) Saliva (B) Stomach ✓ (C) Eggs (D) Midgut
56. **A scientist uses his five senses in the formation of:** (CQs)
(A) Hypothesis (B) Observation ✓ (C) Deduction (D) Theory
57. **The step of biological method which involves the use of if and then is:**
(A) Deduction ✓ (B) Observation (C) Theory (D) Law
58. **Plasmodium was discovered for the first time by:**
(A) Ross (B) Laveran ✓ (C) Darwin (D) Newland
59. **The mosquito which causes malaria is birds:**
(A) Male culex (B) Female culex ✓

- (C) Male anopheles (D) Female anopheles
 60. Who performed experiment about malaria on sparrows?
 (A) Ross ✓ (B) Pasture (C) Larvan (D) Darwin

General Short Questions with Conceptual Questions (CQs)

1.1 BIOLOGY AND ITS BRANCHES

1. Define anatomy and physiology.
 OR Differentiate between anatomy and physiology.

Ans:

Anatomy	Physiology
Anatomy is the branch of Biology that explores the internal physical structure of organisms, particularly humans. Scope: It helps in disease diagnosis, medical device development, and improving quality of life the study of the organs of the digestive system.	Physiology is the branch of Biology that deals with the functioning of body parts. Scope: how the blood circulatory system transports vital substances throughout the body is studied in physiology.

2. What do you know about Embryology?

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

Scope: In Embryology, scientists study organ and tissue formation, identify birth defects, and develop medical treatments.

3. Define genetics and write its scope.

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

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

4. Briefly explain molecular biology.

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

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

5. Which branch of biology concern with study of Tissue? Write its scope.

OR Define Tissue. Which branch of biology concern with the study of Tissue?

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

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

6. What is paleontology? Also write its scope.

Ans: **Paleontology:** Paleontology is the branch of Biology that deals with the study of fossils.

Scope: 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.

7. What are Fossils? Also write age of oldest Fossil.

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

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

8. Define Taxonomy and also write its importance.

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

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

9. What do you know about marine biology? Briefly explain.

OR Write significance of marine biology. (CQs)

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

Significance: Marine Biology helps to understand ocean biodiversity, discover new species, and address marine conservation issues.

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

10. Define Ecology. Write its scope.

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

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

11. In which branch diseases their causes and effects are studied briefly explain? (CQs)

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

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

12. Which branch of biology concern with the study of immune system? Highlight their contributions. (CQs)

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

Scope: Immunologist study to develop vaccines, treat autoimmune diseases, and improve immune responses to infections.

13. Name the branches of biology.

Ans: Name of Branches of biology:

- | | | |
|----------------------|----------------------|-------------------|
| i) Molecular biology | ii) Histology | iii) Parasitology |
| iv) Anatomy | v) Molecular Biology | vi) Embryology |
| vii) Genetics | viii) Physiology | |

14. In which branch of biology, we study about drugs?

Ans: Pharmacology: Pharmacology is the branch-in which we study drugs and their

effects on the body.

Scope: Pharmacology helps in the development of new drugs.

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

1.2 RELATION OF BIOLOGY WITH OTHER SCIENCES

15. **How biology relates with chemistry? Give examples.**

Ans: 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.

16. **How physics apply in biological processes? Explain.**

(CQS)

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

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

17. **What is computational biology? Writ its scope.**

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

Scope: Computational Biology involves analysing biological data, such as sequence of amino acids in a protein.

18. **What role of Biogeography in biology?**

Ans: Biogeography deals with the study of the distribution of living organisms in different geographical regions of the world.

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

19. **Write the role of biostatistics in biology.**

Ans: Biostatistics deals with the principles of statistics to analyse and interpret data related to living organisms.

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

20. **Define biotechnology with an example.**

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

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

1.3 CAREERS IN BIOLOGY

21. **What is the role of Economics in biology?**

OR Define Bio-economics.

Ans: Bio-economics deals with the study of organisms from economical point of view.

Scope: In bio-economics, scientists calculate and compare the cost and profit of the biological projects e.g., production of new variety of crops.

22. What qualification requires for profession medicine and surgery?

Ans: Medicine and surgery profession, students need to complete a 5-year Bachelor of Medicine, Bachelor of Surgery (MBBS) degree.

23. What do you know about profession veterinary and environmental science?

Ans:

Career	Major Jobs
Veterinary Medicine	Diagnosis and treatment of diseases in animals and
Environmental Science	Solving issue and related to pollution and natural resources

24. In which profession dental issues are resolved? Briefly explain.

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

Qualification: Dentistry the students can pursue, a 4-year Bachelor of Dental Surgery (BDS) degree.

25. Who is pharmacologist?

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

Qualification: Pharmacology career, a Bachelor of Studies (BS) degree in Pharmacy or Doctor of Pharmacy (D. Pharm) degree is required.

26. Write about profession of Physiotherapy.

Ans: Physiotherapy is the therapy that is used to restore movement and physical function of body that has been impaired by disease or injury. Physiotherapists use physical exercise and physical modalities (such as massage) to improve patient's physical movement and function.

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

27. Define Medicine and Surgery.

Ans: The profession medicine deals with the diagnosis and treatment of diseases. In surgery the defective parts of the body are repaired, replaced or removed.

28. Write about the jobs of microbiology and genetic counseling.

Ans:

Career	Major Jobs
Nutrition and Dietetics	Advising on proper dietary habits to promote health.
Public Health	Improving the health of communities through education, policy-making, and research.

29. Write major jobs of the following career:

i) **Nutrition and Dietetics** ii) **Public health**

Ans:

Career	Major Jobs
Microbiology	Research on microorganisms to understand their impact.
Genetic counseling	Providing support to people on genetic conditions and testing

30. Write the jobs of Biomedical engineering and Bioinformatics.

Ans:

Career	Major Jobs
Biomedical Engineering	Designing and making medical equipment to improve patient care.
Bioinformatics	Analysis of biological data by using computational tools

31. What qualification requires for Job in fisheries and wildlife departments?

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

32. How a person becomes agricultural scientist? Write about their work.

Ans: A person become agricultural scientist after a 4-year BS degree in Agriculture. Agricultural scientists improve farming practices, crop production, and sustainable agriculture techniques.

33. Differentiate between profession animal husbandry and Horticulture.

Ans:

Animal Husbandry	Horticulture
Animal Husbandry field involves breeding and caring for livestock to improve their quality and productivity. Qualification: students can pursue a 4year BS degree in Animal Husbandry.	Horticulture cultivate fruits, vegetables, flowers, and ornamental plants. Qualification: A 4- year BS degree in Horticulture is required for it.

34. Who are forensic scientists?

Ans: Forensic scientists analyse physical evidence from crime scenes to helping criminal investigations.

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

1.4 QURANIC INSTRUCTIONS TO REVEAL THE STUDY OF LIFE

35. How Quran describe that all living things created from water?

Ans:

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ

"We made every living thing from water." (Sura: Ambia, Verse: 30)

The Quran mentions in multiple verses that all living things were created from water.

Water is described as a divine blessing from Allah. The average water content in different organisms ranges between 60% to 90%. The above verse hints at the common origin of all living things in the water.

36. How Allah says in Quran about the development of animals including human beings?

Ans: Allah says:

ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً وَخَلَقْنَا الْعَلَقَةَ مُضْغَةً

فَخَلَقْنَا الْمُضْغَةَ عِظًا فَكَسَوْنَا الْعِظَ لَحْمًا

"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." (Sura: Al-Mominoon, Verse: 14)

37. How Quran describes the common origin and modification of animals?

Ans: Quran describes the common origin and modification of animals.

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

"Allah hath created every animal from water. Then some of them creep up over their bellies, others walk on two legs, and others on four. Allah creates what He pleases." (Sura: Al-Nur, Verse: 45)

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.

1.5 SCIENCE AS A COLLABORATIVE FIELD

38. Science is a collaborative field with various disciplines briefly. Explain.

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

39. What is aim of human genome project? When it was completed?

Ans: The Human genome project aimed to sequence and map the entire human, genome. This project was completed in 2003. It involved researchers from various disciplines, including Biology, genetics, informatics, and computer science.

40. Name the disciplines whose collaboration require for climate change research.

Ans: Climate Change Research:

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

41. Name different discipline collaborates in medical research.

Ans: Medical Research:

Advances in medical research often rely on interdisciplinary collaboration. **Example:** Cancer research involves oncologists (cancer consultants), biologists, biochemists, geneticists, pharmacologists and statisticians.

42. Briefly explain the role of different disciplines of sciences in the field of Robotic and Artificial Intelligence.

Ans: Robotics and Artificial Intelligence (AI):

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

processing.

43. How different discipline of science helps in space exploration.

Ans: 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.

1.6 SCIENTIFIC METHOD

44. Define scientific method and biological methods.

Ans: Scientific method:

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

45. Name the steps involve in scientific method.

Ans: The following step are steps of scientific method:

- | | |
|-----------------------------|-----------------|
| i) Recognition of a problem | ii) Observation |
| iii) Hypothesis | iv) Deduction |
| v) Experiments | vi) Results |

46. From which step scientist starts his scientific inquiry?

Ans: 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. Such problem is either asked by someone or comes in biologist's mind by himself.

Examples: 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.

47. How scientist makes observation during his scientific inquiry?

Ans: Observations:

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

48. Name the types of observation.

Ans: Types of observations:

- | | |
|----------------------------|------------------------------|
| i) Qualitative observation | ii) Quantitative observation |
|----------------------------|------------------------------|

49. Differentiate between quantitative and qualitative observation.

Ans:

Qualitative observations	Quantitative observations
Qualitative observations involve characteristics that cannot be measured with numbers.	Quantitative observations involve measurements or numerical data that can be expressed in terms of quantity.
Example: Describing the colour and texture of a flower.	Example: Counting the number of birds in a tree (e.g., 5 birds).

50. Why quantitative observation are more accurate then qualitative

observation?

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

51. Define Hypothesis.

Ans: Hypothesis:

"Tentative statement made by scientist on the basis of observations called hypothesis."

52. Write characteristics of good hypothesis.

Ans: Hypothesis:

Characteristics of hypothesis are given below:

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

53. Define deduction with examples.

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

Examples:

- **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".

54. How hypothesis is tested? Briefly explain.

Ans: Hypothesis are tested by experiments.

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.

55. What are experimental group and controlled group?

Ans: Control group:

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.

56. How scientist reports his work?

Ans: 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)**57. Define theory and scientific law with examples.**

Ans: Define 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. 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.

Scientific law:

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

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

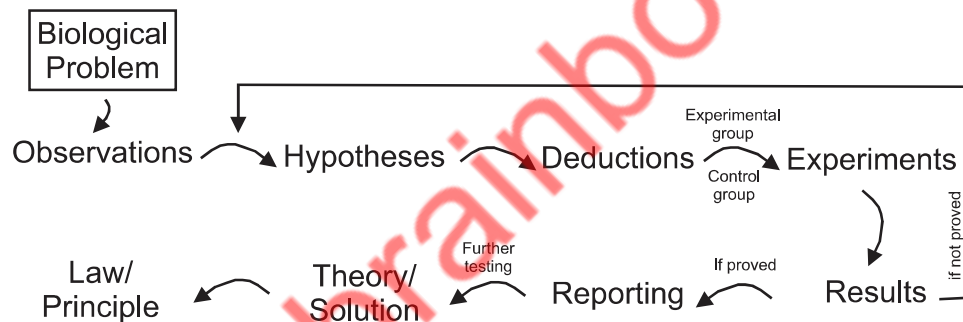


FIGURE 1.4: Scientific method

1.8 MALARIA - AN EXAMPLE OF BIOLOGICAL METHOD

Biological Problem 1:

What is the cause of malaria?

58. Write observation about malaria gathered by physicians of ancient time.

Ans: History of Malaria:

Malaria was known to physicians of the ancient times (more than 2000 years ago). In the last part of 19th century, there were four Observations:

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

59. How did Laveran find the cause of malaria?

OR What is Plasmodium?

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.

60. Hypothesis "plasmodium is the cause of malaria" write deduction about this hypothesis.

Ans: The deduction was; "If Plasmodium is the cause of malaria, then all malarial patients should have Plasmodium in their blood."

61. How deduction about malaria was tested?

OR What experiment was done to concluded the cause of malaria? (CQs)

Ans: Experiment and Results:

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

Results:

The following were the results of these experiments;

i) Most of the malarial patients had Plasmodium in their blood.

ii) Some healthy persons also had Plasmodium in their blood.

The results proved that the hypothesis "Plasmodium is the cause of malaria" was true.

In these experiments, the malarial patients were the experimental group while, the healthy persons were the control group.

62. Write observation of A.F.A King.

Ans: Observations of A.F.A King:

i. Malaria is associated with marshes.

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

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

63. "Mosquitoes transmit plasmodium" Draw hypothesis about this statement.

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

64. Why did ross use sparrows in his experiment instead of man? (CQs)

Ans: There are two reasons:

i) Sparrow suffering from malaria show same symptoms as in man.

ii) Malaria was fatal in those days and Ross was reluctant to use man as an experimental organism.

65. Give symptoms of malaria.

Ans: Malaria causes chill headache fever, new sea while recurring attacks.

66. Give any two examples of biological law.

Ans: i) Hardy-Weinberg law

ii) Mendal's law of inheritance

Unit - 2

BIODIVERSITY

2.1 BIODIVERSITY

Q1 Discuss the concept of biodiversity and its significance in maintaining the health of ecosystem.

OR Define Biodiversity and discuss its distribution on earth.

OR Describe the importance of Biodiversity.

Ans: **Biodiversity:** Biodiversity means the variety of organisms in a particular area. Biologists have different ways of measuring biodiversity

Bases of measuring diversity: Biodiversity of an area is measured by considering the number of different kinds of organisms and the variation within each kind.

Biologists have named and classified almost 2 million kinds of organisms. However, they estimate that the total kinds of organisms on Earth is much greater.

Distribution of Biodiversity: Biodiversity is not evenly spread out. The biodiversity in a place depends on factors like climate, altitude, and soil type. **Tropical regions** have more biodiversity than polar regions.

Importance of Biodiversity:

Biodiversity provides many essential services for humans and the planet. Here are some key benefits of biodiversity:

- i) **Ecosystem stability:** Biodiversity helps maintain the balance of ecosystems by contributing to the biogeochemical cycle such as water cycle, carbon cycle and nitrogen cycle.
- ii) **Climate regulation:** Plants and algae absorb carbon dioxide, helping to regulate the climate.
- iii) **Natural resources:** Biodiversity provides a vast array of resources, from food and medicine to building materials and fuel.
Economic benefits:
- iv) Biodiversity supports numerous industries, including agriculture, tourism, and pharmaceuticals.

TUTOR

Tropical region: Area near the equator with high temperatures and high humidity

22, May

International
Biodiversity Day

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

TUTOR

Climate: Weather conditions prevailing in an area over a long period.

2.2 CLASSIFICATION

Q2 Describe the classification of Biodiversity and also write its aims and basis.

Ans: Biologists have identified and described about 02 million kinds of organisms. Out of these, 0.5 million are the kinds of plants and 1.5 million are the kinds of

Some people don't respect biodiversity on the grounds that is useful for humans. Rather,

animals. It is only a small percentage of the total kinds which live on Earth. Every year, biologists discover thousands of new kinds of organisms, they are challenged to organize their knowledge of such diversity.

they respect biodiversity on aesthetic and moral grounds.

To study such a large collection of organisms, biologists classify them.

Classification:

Classification is a method by which biologists divide organisms into groups and subgroups on the basis of similarities found in them.

Aims and Principles of Classification

a **Aims** The main aims of classification are:

To determine similarities and differences among organisms so that they can be studied easily

TUTOR

Evolution: Gradual change in species over time through natural selection and genetic variation.

b To find the **evolutionary** relationships among organisms

Basis of Classification:

i) Biologists classify organisms into groups and subgroups on the basis of similar physical characteristics.

ii) In recent times, they also take help from genetics. They find the genetic similarities and differences among organisms. Then they use this information to know similarities and differences in their structures and functions.

Q3 Explain the importance of classification in biology and how it helps us to understand the relationship between different organisms.

Ans: Advantages of Classification:

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

ii) Classification provides a framework for studying and comparing different species.

iii) It explains the inter-relationship amongst various organisms.

iv) It helps in the identification of new species and in understanding their evolutionary relationships.

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

vi) Overall, classification is crucial for our understanding of the natural world and for the conservation and management of biologic diversity.

2.3

TAXONOMIC RANKS

Q4 Describe the Carl Linnaeus system of taxonomic hierarchy in detail outlining the seven major rank and their relationship.

Ans: Taxa or taxonomic ranks:

The groups into which organisms are classified are known as taxonomic ranks or taxa (singular taxon).

Carl Linnaeus: The Swedish botanist Carl Linnaeus devised the Linnaean system of taxonomic ranks in 1735 in this system Linnaeus suggested seven taxonomic ranks.

- i) Kingdom ii) Phylum (division) iii) Class
 iv) Order v) Family vi) Genus and Species

In 1977, the rank of domain was added to this system.

The taxonomic ranks are defined as below:

- i) **Domain:** The highest taxonomic rank is domain. All organisms are divided into three domains: Bacteria, Archaea, and Eukarya.
- ii) **Kingdom:** Domain is further divided into kingdoms. For example, the domain Eukarya is divided into four kingdoms i.e., Animalia, Plantae, Fungi, Protista.
- iii) **Phylum (Division: for plants and fungi):** Each kingdom is subdivided into related phyla or divisions.
- iv) **Class:** Each phylum/division is divided into related classes.
- v) **Order:** Each class is further divided into related orders.
- vi) **Family:** Each order is broken down into related families.
- vii) **Genus:** Each family is divided into related genera (singular genus).
- viii) **Species:** It is the most specific level of classification. A species consists of similar organisms that can interbreed and produce offspring.

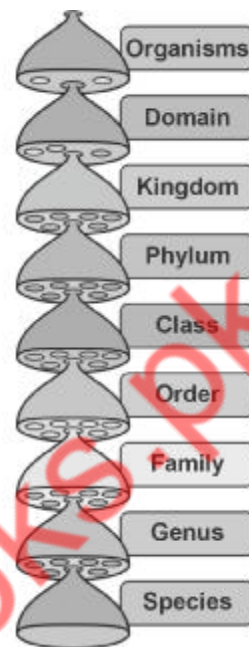


Figure 2.1: Taxonomic ranks

Table: Classification of fruit fly, human and pea

Taxonomic Rank	Fruit fly	Human	Pea
Kingdom	Animalia	Animalia	Plantae
Phylum or Division	Arthropoda	Chordata	Magnoliophyta
Class	Insect	Mammalia	Magnoliopsida
Order	Diptera	Primates	Fabales
Family	Drosophilidae	Hominidae	Fabaceae
Genus	Drosophila	Homo	Pisum
Species	D. melanogaster	H. sapiens	P sativum

2.4 HISTORY OF CLASSIFICATION

Q5 Explain the history of classification in detail.

OR Trace the history of classification back to ancient time.

Ans: The history of the classification system can be traced back to **ancient times**.

Aristotle: The Greek philosopher **Aristotle** (384-322 BC) Was the first who classified organisms into two groups i.e. plants and animals.

In 1172 Ibn Rushd (Averroes) translated Aristotle's book "de.Anima (On the Soul)" into Arabic.

- The Arab scholar Abu Usman Al Jahiz (781 - 869 AD) describe the characteristics of 350 species of animals. He wrote a lot about the life of Ants.

TUTOR

Ancient Time: Period of time long past, often referring to prehistoric eras.

- The Italian botanist Andrea Caesalpinia (1519-1603 AD) divided plants into fifteen groups and called them genera.
- **Tournefort:** The French botanist Tournefort (1656-1708 AD) introduced the taxa of class and species.
- **Carl Linnaeus:** The Swedish biologist Carl Linnaeus (1707-1778 AD) created a taxonomic hierarchy of organisms with seven taxa

i) Kingdom	ii) Phylum	iii) Class	iv) Order
v) Family	vi) Genus	vii) Species	

Q6(a) What is two kingdom classification system? What was objections on these systems?

Ans: Two-Kingdom Classification System:

It was the earliest classification system in which all organisms were classified into two kingdoms. 1) Plantae 2) Animalia

1 Kingdom plantae: The organisms that can prepare their own food (autotrophs) were classified in the kingdom plantae.

2 Kingdom Animalia: The organisms that cannot make their own food (heterotrophs) were classified in kingdom animalia. According to this system, **prokaryotes** (bacteria, archaea) and fungi were members of kingdom plantae.

TUTOR

Prokaryotes: Single celled organisms lacking a nucleus, such as bacteria.

Objections:

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

TUTOR

Eukaryotes: Organisms with cells containing a nucleus, including plants, animals, and fungi.

Q6(b) Write note on Three Kingdom Classification System.

(b) Three-Kingdom Classification System

Ans: In 1866, the German zoologist Ernst Haeckel proposed a third kingdom Protista for Euglena like organisms. He also included prokaryotes (bacteria and archaea) in the Kingdom Protista. In this system, fungi were still included in the kingdom Plantae. **Objections:** Some taxonomists disagreed about the position of fungi in kingdom Plantae.

TUTOR

Chitin: Tough, flexible polysaccharide found in exoskeletons of arthropods.

Cellulose: Complex carbohydrate forming the main structure of plant cell walls.

Reasons of objection: Fungi resemble plants in many ways, but are heterotrophs which get their food by absorption. They do not have cellulose in their cell walls but possess chitin.

TUTOR

Chitin: Tough, flexible polysaccharide found in exoskeletons of arthropods.

Q6(c) Describe the Five Kingdom Classification System of Robert Whittaker in detail.

Ans: Five-Kingdom Classification System:

Work of E-Chatton:

In 1937, French biologist E-Chatton suggested the terms, "Prokaryotic" to describe bacteria and "Eukaryotic" to describe Protista, fungi, animal and plant cells.

Work of Robert Whittaker

In 1967, American ecologist Robert Whittaker introduced the five-kingdom classification system.

Bases of five kingdom system:

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

Five kingdoms on this basis, organisms were classified into five kingdoms:

- | | | |
|-------------|--------------|------------|
| i) Monera | ii) Protista | iii) Fungi |
| iv) Plantae | v) Animalia | |

Modification in five-kingdoms:

In 1988, American biologists Margulis and Schwartz modified the five-kingdom classification of Whittaker. They considered genetics along with cellular organization and mode of nutrition in classification. They classified the organisms into the same five kingdoms as proposed by Whittaker.

Q7 Discuss Three-Domain classification system in detail with examples.

Ans: Three-Domain Classification System:

In 1977, American microbiologist Carl Woese (1928-2012 AD) added a level of classification (the domains) above the kingdoms present in the previously used five-kingdom system. He classified organisms into three domains.

- | | | |
|------------|--------------|--------------|
| i) Archaea | ii) Bacteria | iii) Eukarya |
|------------|--------------|--------------|

It was actually a division of the prokaryotes in two domains (Archaea and Bacteria). While all eukaryotes were placed in a single domain i.e., Eukarya. This classification is based on the differences between Archaea and Bacteria.

(a) 2-Kingdom System					
Plantae				Animalia	
(b) 3-Kingdom System					
Protista		Plantae		Animalia	
(c) 5-Kingdom System					
Monera	Protista	Plantae	Fungi	Animalia	
(d) 3-Domain System					
Archaea	Bacteria	Eukarya			
Many Kingdoms	Many Kingdoms	Protista	Plantae	Fungi	Animalia

2.5 DOMAINS OF LIVING ORGANISMS

Q8(a) Discuss the characteristics of Domain Archaea.

Ans: Domain Archaea:

Characteristics: The characteristics of domain arches are given bellow:
These are the most primitive organisms on Earth.

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- (i) They are prokaryotes but their cell walls do not contain peptidoglycan.
- (ii) Their rRNA (ribosomal RNA) is more closely related to eukaryotes than to bacteria.
- (iii) Their cell membrane contains unique lipids which enable them to live in extreme environments e.g., hot springs, salt lakes, deep-sea hydrothermal vents, and acidic or alkaline waters. However, they also exist in more common environments, like soil and oceans.
- (iv) Some archaea obtain energy from inorganic compounds such as Sulphur or ammonia. Other groups perform photosynthesis but do not produce oxygen.

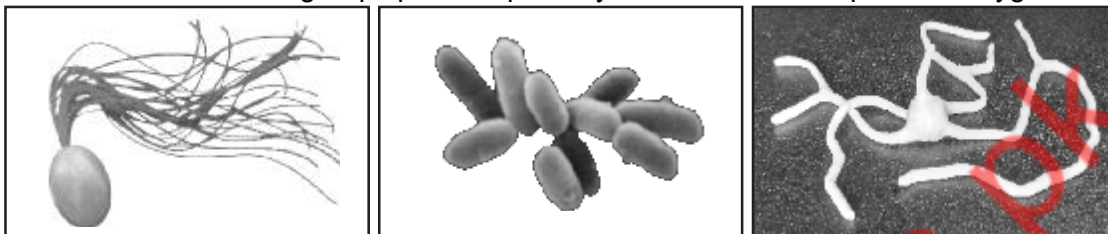


FIGURE 2.3: Diversity in domain Archaea

Examples:

The domain Archaea contains kingdom

- i. **Archaeobacteria** (ancient bacteria) Major archaeobacteria include.
- ii. **Methanogens** produce methane as byproduct.
- iii. **Halophiles** found in extremely salty environments.
- iv. **Thermophiles** found in hot springs.
- v. **Acidophiles** found in extremely acidic environments.

Q8(b) Write characteristics of Domain Bacteria and Eukarya.

Ans: Domain Bacteria

Characteristics: Characteristics of Domain bacteria are given bellow:

- i) They are the true bacteria.
- ii) They are also prokaryotic and have cell wall made of peptidoglycan.
- iii) Bacteria are found everywhere including soil, water, air, and living-organisms.
- iv) They are unicellular. Many live solitarily although some form chains, clusters, or colonies of cells.
- v) Most are heterotrophic but some perform photosynthesis because they have **chlorophyll**.

TUTOR

Chlorophyll: Green pigment essential for photosynthesis in plants.

Examples: Domain bacteria contains kingdom Eubacteria. Major groups in this kingdom are bacteria and cyanobacteria. Some bacteria cause diseases and many play essential roles in nutrient recycling.

Domain Eukarya**Characteristics:**

- i) Characteristics of domain Eukarya are given bellow.
- ii) Eukarya consists of kingdoms Protista, fungi, plantae and animalia.
- iii) It includes all eukaryotes which consist of complex, eukaryotic cells containing nucleus and other membrane bound organelles.
- iv) Eukarya cells are larger and contain more complex structures.

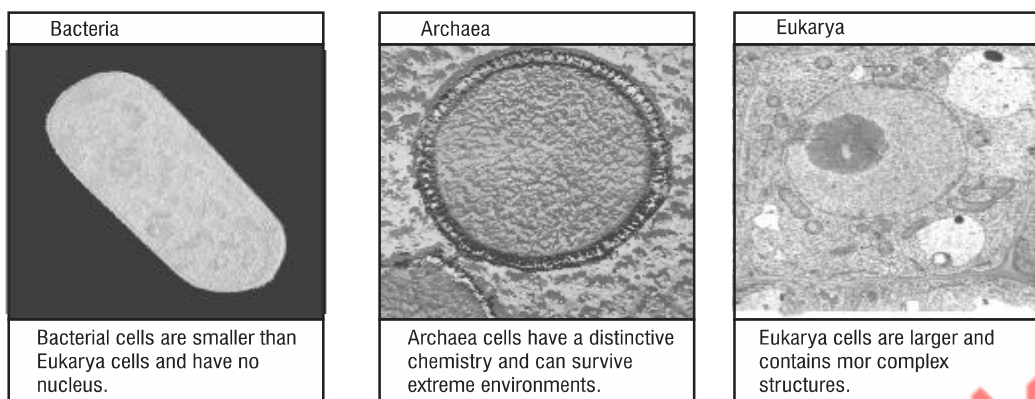


FIGURE 2.4: Three Domains

2.6 CLASSIFICATION OF DOMAIN EUKARYA

Q9(a) What are Protists? Describe its types with examples.

(a) Kingdom Protista

Features of Kingdom Protista:

- Kingdom Protista includes eukaryote which are unicellular or colonial or filamentous or simple multicellular.
- Simple multicellular means that they do not have multicellular sex organs.

Certain protists are parasitic and cause diseases e.g., Plasmodium causes malaria, Entamoeba histolytica causes amoebic dysentery, and Trypanosoma causes sleeping sickness.

Types of protists:

There are three types of protists.

- Plants like protists (algae)** Plant-like protists have cell walls made of cellulose. They have chlorophyll in chloroplasts and are autotrophs. They are called algae (e.g., *Euglena*, diatoms).
- Animal-like (protozoans) protists** are heterotrophs and ingest food. They have no cell wall they are called protozoans e.g., Amoeba, Paramecium.
- Fungus like protest:** Fungus like protists produce hyphae like structure and are **saprophytic** e.g. slime molds and water molds.

TUTOR

Slime Molds: Organisms that combine characteristics of fungi and animals.

Water Molds: Fungus-like organisms that thrive in aquatic environments.

TUTOR

Saprophytic: Organisms that obtain nutrients by decomposing dead organic matter.

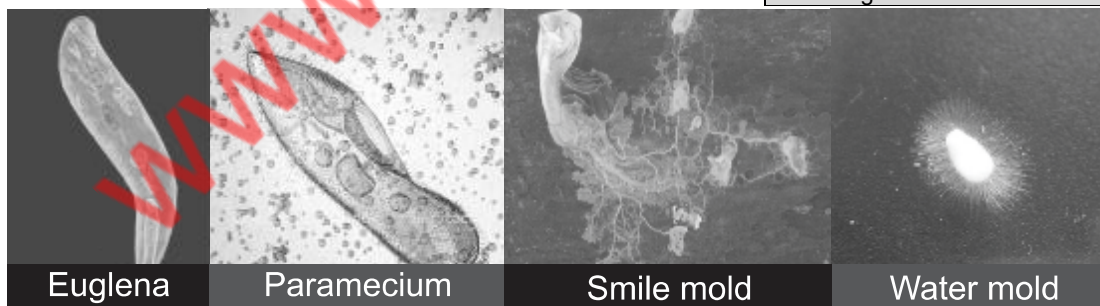


FIGURE 2.5: Common protists

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Q9(b) Write Note on Kingdom Fungi, Kingdom Animalia and Kingdom Plantae.

Ans: Kingdom Fungi:

Fungi like protest consist of fungi which eukaryotic heterotrophic organism. This kingdom that are unicellular or multicellular. Their cells are covered by cell wall made of chitin (polysaccharide). Fungi nutrients in. a unique way.

They do not ingest food like animals and some protists. They absorb food from surrounding.

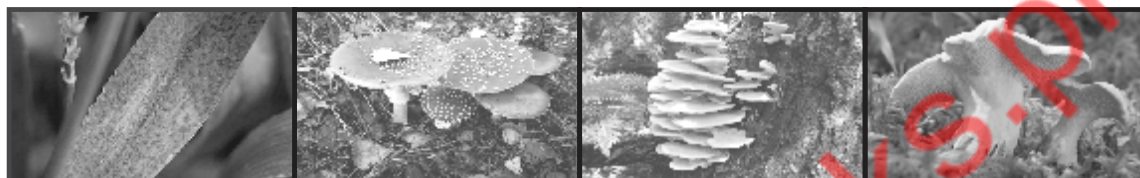
Examples: Mushrooms, **rusts, smuts** and **molds** are examples of fungi.

Uses of fungi:

Some fungi are used in the production of bread cheese and beer. Others have medicinal properties such as penicillin an antibiotic derived from the fungus *Penicillium*.

TUTOR

Rust, smut, mold: Types of fungal diseases that infect plants.



Smut on leaf

Toadstool

Bracket fungi

Sweet Tooth Fungi

FIGURE 2.6: Common fungi

Kingdom Plantae:

- It includes plants which are eukaryotic, multicellular organisms with cell walls made of cellulose.
- They are autotrophic and prepare food through photosynthesis.
- All plants have multicellular sex organs.
- During sexual reproduction they form embryos.
- A sexual reproduction through vegetative parts is also common.

Example: Mosses, ferns, conifers and flowering plants are examples of kingdom plantae.



Moss

Fern

Conifer

Flowering plant

FIGURE 2.7: Common plants

Kingdom Animalia:

- Kingdom of eukaryotes includes animals which are eukaryotic, multicellular and **heterotrophic**.
- They develop from embryos.
- They ingest food and digest it within their bodies.

Examples: Human, Donkey, Lion, lizard etc.

TUTOR

Heterotrophic: Organisms that cannot produce their own food and rely on others for nutrition.

2.7 STATUS OF VIRUS IN CLASSIFICATION

Q10(a) What is position of virus in classification system? Explain why it is not included in any kingdom?

Ans: Status of Virus in Classification:

Viruses:

Viruses are ultramicroscopic creatures that are at the borderline of living and non-living.

Structure: They are acellular i.e.; they are not made of cells and do not have organelles. A virus consists of nucleic acid (DNA or RNA) surrounded by a protein coat.

Life activities: They cannot run any metabolism and depend upon the host cell (including plants, animals, and bacteria) to replicate and synthesize their proteins. life viruses are not included in five kingdoms.

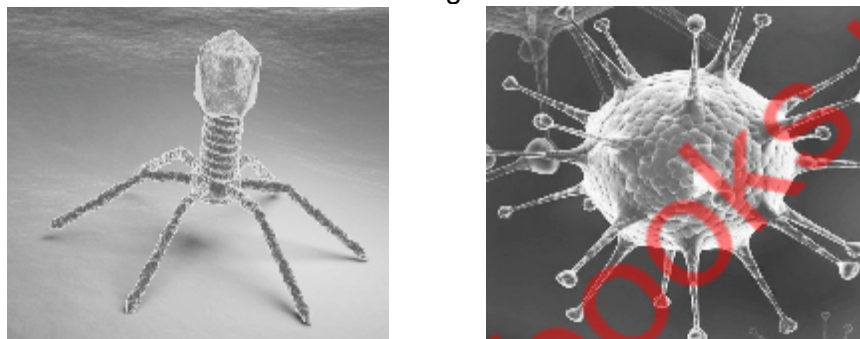


FIGURE 2.8: Two common viruses – Left; A bacteriophage (virus which attacks bacteria) and Right; Influenza virus

Prions and viroids are also acellular particles and are also included in classification system. Prions are composed of protein only and Viroids are composed of circular RNA only. Both these particles cause infectious diseases in certain plants.

Q10(b) Compare characteristics of Domains and Kingdoms of life.

Ans:

Domain	Archaea	Bacteria	Eukarya			
Kingdom	Archaeobacteria	Eubacteria	Protista	Fungi	Plantae	Animalia
Cell Type	Prokaryotic		Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Nuclear Envelope	Absent		Present	Present	Present	Present
Cell Wall	Archaeobacteria: polypeptides And proteins Eubacteria: peptidoglycan		Present in some, various types	Chitin	Cellulose and other polysaccharides	Absent
Mode of Nutrition	Autotroph or heterotroph		Autotroph or heterotroph or combination	Absorptive heterotroph	Autotroph	Ingestive heterotroph
Multi cellularity	- Absent in all		Absent in most	Present in most	Present in all	Present in all

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Q10(c) Write short note on Corona Virus.

Ans: **Coronavirus** is a virus, identified in late 2019 in Wuhan, China.

Effects: It caused a pandemic of respiratory illness, called COVID-19.

Made of Transmission of Corona Virus:

The virus primarily spreads through respiratory droplets when an infected person coughs, sneezes, talks, or breathes.

It can also spread by touching surfaces contaminated with the virus.

Preventions: Wearing a mask over nose and mouth can help prevent the spread of disease.

Symptoms:

Common symptoms of COVID-19 disease include fever, cough shortness of breath, fatigue, body aches, loss of taste or smell, sore throat, and headache.

In some cases, it can lead to severe respiratory problems, especially in older adults and people with underlying health conditions.

Preventions: Washing hands frequently with soap for at least 20 seconds or use hand sanitizer with at least 60% alcohol can also prevent the spread of disease.

Vaccination: Vaccination plays a crucial role in protecting from COVID-19. Vaccines help immune system recognize and fight the virus, reducing the severity of the disease.

2.8 BINOMIAL NOMENCLATURE**Q11(a) What is Binomial Nomenclature? Explain its significance.**

Ans: **Binomial Nomenclature:** The great Swedish naturalist Carolus Linnaeus was the founder of the scientific naming system of organisms. The scientific name of an organism consists of two parts. The first part is the name of genus to which organism belongs. The second part is the name of the species. The of scientific naming of organism is termed as binomial nomenclature.

Common Name	Scientific names
Onion	<i>Allium Cepa</i>
Potato	<i>Solanum Tuberosum</i>
Tomato	<i>Solanum Esculentum</i>
Honey Bee	<i>Apis cerana</i>
Tiger	<i>Panthera tigris</i>
Human Being	<i>Homo sapiens</i>

Significance of Binomial Nomenclature: In binomial nomenclature two organisms cannot have the same name. The words of scientific name are taken from Latin language (spoken by no country) so that no country is favored. The scientific name of an organism is the same anywhere in the world. This system provides a standard way of communication, whether the language of a particular biologist is Chinese, Arabic, Spanish, or English.

Problems with common name:**Case 1: different name of same organism:**

Various regions have different names for the same, organism e.g. the common name of onion in Urdu is 'Piyaz' but in different, regions of Pakistan it is also known as

'ganda' or 'bassal' or 'vassal'. In other countries it has other sets of names.

Case 2: Different organism with same name:

In some cases, several different organisms are called by the same common name, e.g., 'blue bell' is used for dozens of plants with bell shaped flowers. Similarly, 'black bird' is used for crow as well as for raven.

No scientific basis of common name:

Common names have no scientific basis. For example; a fish is a **vertebrate** animal with a back bone, fins and gills.

But several common names of 'silver fish, cray fish, jell fish, and star fish do not fit to the true definition of fish.

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vertebrate: Animals with a backbone or spinal column.

Q11(b) Write rules for assigning scientific name of an organism.

Rules of Binomial nomenclature:

The scientific naming of an organism is done in accordance with some international rules. Some important rules of binomial nomenclature are:

1. For scientific naming, words are taken from Latin language.
2. Every scientific name has two parts. The genus name always comes first followed by the species name.
3. Every scientific name should have to be unique because the same name cannot be used for naming two different organisms.
4. The first part of the name i.e., genus name should begin with a capital letter. The second part of the name i.e., species name should begin with small letter.
5. At the time of printing of a scientific name, it should be typed in Italics.
6. When a scientific name would be hand written, two parts of it should be separately underlined.

KEY POINTS

- **Biodiversity** is a measure of the variety of living organisms present in different ecosystems including terrestrial, marine and desert ecosystems.
- **Classification** is the process of organizing and classifying living organisms based on their similarities and differences.
- The groups into which organisms are classified are known as **taxonomic ranks** or taxa (singular "taxon").
- The highest level of classification is the **domain**.
- Living organisms are broadly classified into three domains: **Archaeobacteria**, **Bacteria** and **Eukarya**.
- The members of **kingdom Protista** are unicellular or simple multicellular organisms and have eukaryotic cells.
- **Fungi** are eukaryotic heterotrophic organisms which absorb food.
- **Plants** are eukaryotic multicellular autotrophs and have multicellular sex organs.
- **Animals** are eukaryotic multicellular heterotrophs which ingest food and digest it in specialized cavities.
- **Viruses** lack any of the characteristics of the three domains or six kingdoms of life therefore, they are not included in these categories.
- **Binomial nomenclature** is the way of giving scientific names to living organisms.

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EXERCISE

A. Select the correct answers for the following questions.

1. Which of the following taxonomic ranks represents the broadest rank of classification?
a) Species b) Genus c) Kingdom d) Domain ✓
2. Which characteristics is unique to organisms in the domain Archaea?
a) Cell walls made of peptidoglycan b) Presence of a nucleus
c) Ability to live in extreme environments ✓ d) Lack of ribosomes
3. Which of these statements is NOT related to bacteria?
a) Do not have a nucleus b) Cell wall made of peptidoglycan
c) Most are heterotrophic d) Hate chlorophyll in their chloroplast ✓
4. Which of these organisms belong to the domain Eukarya?
a) Escherichia coli b) Yeast ✓
c) Coronavirus d) None of these
5. Which of the following is a key characteristic that distinguishes eukaryotic cells from prokaryotic cells?
a) Lack of a cell wall b) Presence of a nucleus ✓
c) Absence of ribosomes d) Smaller size
6. Which kingdom includes organisms that are primarily unicellular, eukaryotic and often heterotrophic?
a) Archaea b) Protista c) Fungi d) Plantae
7. Why are fungi classified as heterotrophs?
a) Have chitin in cell wall b) Absorb nutrients ✓
c) Reproduce by spores d) Form symbiotic Relationships with plants
8. Why are viruses challenging to classify within traditional biological kingdoms?
a) They lack cellular structure and organelles ✓
b) They can perform photosynthesis
c) They are larger than most bacteria
d) They have a complex nervous system
9. Which of the following is the correct way for writing the scientific name of?
a) *Homo sapiens* ✓ b) Homo sapiens
c) Homo Sapiens d) homo sapiens
10. Which information you can get if you know the scientific name of an organism?
a) Kingdom and phylum b) Phylum and genus
c) Genus and species ✓ d) Class and species

B. Write short answers.

1. What is the term used to describe the variety of life on Earth?

Ans: Term "Biodiversity" used to describe the variety of life on Earth. The term "biodiversity" has been taken from "bio" and "diversity". Diversity means variety within a specie and among species.

2. How is the biodiversity crucial for humans and for the planet Earth?

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Ans: Importance of Biodiversity:

- i) Biodiversity provides food for humans.
- ii) Many drugs are produced from living organisms directly or indirectly.
- iii) Biodiversity makes and maintains ecosystems by following means.
- iv) It regulated the chemistry of our atmosphere.
- v) It ensures water supply.
- vi) It involved in recycling of Nutrients.
- vii) It provides fertile soil.

3. What are the seven taxonomic ranks used in the Linnaean system?

Ans: Carl Linnaeus: The Swedish biologist Carl Linnaeus (1707-1778 AD) created a taxonomic hierarchy of organisms with seven Taxa.

- i) Kingdom ii) Phylum iii) Class iv) Order
- v) Family vi) Genus vii) Species

4. Can you provide the taxonomic classification for lions and corn?

Ans: Here are some Taxonomic classification for Lion and corn.

Taxa	Lion	Corn
Kingdom	Animalia	Plantae
Phylum	Cordata	Tracheophyta
Class	Mammalia	Liliopsida
Order	Carnivore	Poales
Family	Felidae	Poaceae
Genus	Panthera	Zea
Species	Panthera leo	Zea mays

5. What are the basic differences between archaea and bacteria?

	Archaea	Bacteria
i) Cell wall	Lack peptidoglycan	Have peptidoglycan
ii) Survival	can survive in extreme environments e.g., hot spring, salt lack.	cannot survive in extreme environments.
iii) Reproduction	Typically reproduce by Fragmentation or budding	Reproduce by Binary fission

6. What were the shortcomings of the three-kingdom classification system?

Ans: Objections: Some taxonomists disagreed about the position of fungi in kingdom Plantae.

Reasons of objection: Fungi resemble plants in many ways, but are heterotrophs which get their food by absorption. They do not have cellulose in their cell walls but possess chitin.

7. Which kingdom includes organisms that are multicellular, heterotrophic, and lack cell walls?

Ans: Kingdom animalia includes organisms that are multicellular, heterotrophic, and lack cell walls.

8. Enlist the distinguishing characteristics of fungi.

Ans: Distinguishing characteristics of Fungi:

- i) Fungi have cell wall composed of chitin
- ii) Fungi are Heterotrophic, obtaining their nutrients by decomposition of organic matter.
- iii) Fungi reproduce by producing spores.

9. List the three main domains that encompass all living organisms.

Ans: Three main domains that encompass

- i) Domain Archaea ii) Domain Bacteria iii) Domain Eukarya

10. Why cannot we classify viruses in any kingdom?

Ans: Viruses are not included in five-kingdom due to following reasons.

- i) Viruses are not composed of cells, only have DNA and RNA surrounding by a protein coat.
- ii) It has inability to reproduce independently and require a host cell to replicate and reproduce.
- iii) It does not carry out metabolic processes like cell do.

11. How does binomial nomenclature facilitate clear communication about organisms across different languages?

Ans:

- i) Binomial nomenclature provides a standardized universally accepted naming system ensuring that each species has unique and consistent name.
- ii) Each species has a unique binomial name (genus + species).

C. Write answers in detail.

1. Discuss the concept of biodiversity and its significance in maintaining the health of ecosystems.

Ans: For Answer, See Question 1.

2. Explain the importance of classification in biology and how it helps us understand the relationships between different organisms,

Ans: For Answer, See Question 3.

3. Describe the Linnaean system of taxonomic hierarchy in detail, outlining the seven major taxonomic ranks and their relationships.

Ans: For Answer, See Question 4.

4. Compare and contrast the domains Archaea and Eubacteria, focusing on their key characteristics.

Ans: For Answer, See Question 8(a) and 8(b).

5. Describe the diagnostic characteristics of the four kingdoms within the domain Eukarya.

Ans: For Answer, See Question 9(a) and 9(b).

6. Discuss the challenges of classifying viruses within the traditional three domains of life.

Ans: For Answer, See Question 10(a).

7. Explain the rules and guidelines for suggesting scientific names to organisms.

Ans: For Answer, See Question 11.

D. Inquisitive Questions.

1. **How might placing an organism in incorrect taxonomic group affect conservation or scientific studies?**

Ans: Placing an organism in an incorrect taxonomic group can have significant consequences for conservation and scientific studies:

Conservation Implications:

- i. Misguided conservation efforts: Incorrect classification can lead to misallocated resources, ineffective conservation strategies, and neglect of the organism's actual needs.
- ii. Overlooking endangered species: If an organism is misclassified, its conservation status might not be accurately assessed, potentially overlooking endangered species.
- iii. Inadequate habitat preservation: Incorrect classification can result in the preservation of incorrect habitats, neglecting the organism's actual ecological requirements.

Scientific Study Implications:

- i. Flawed research conclusions: Incorrect classification can lead to incorrect assumptions, flawed research designs, and misleading conclusions.
- ii. Inaccurate phylogenetic analysis: Misclassification can distort phylogenetic relationships, hindering our understanding of evolutionary processes.

Conclusion:

Accurate taxonomic classification is essential for effective conservation, scientific research, and informed decision-making.

2. **Imagine you discovered a new organism. What steps would you take to classify and name it according to the principle of binomial nomenclature?**

Ans: What an exciting discovery! Here's a step-by-step guide on how I'd classify and name the new organism using binomial nomenclature:

Step 1: Observation and Documentation

Carefully observe the organism's characteristics, such as morphology, anatomy, physiology, and behavior. Document these features through photographs, videos, and detailed notes.

Step 2: Preliminary Classification

Determine the organism's domain (e.g., Archaea, Bacteria, Eukarya), based on its cell structure and metabolism.

Step 3: Kingdom and Phylum Identification

Identify the organism's kingdom (e.g., Animalia, Plantae, Fungi) and phylum (e.g., Chordata, Arthropoda, Ascomycota) based on its body structure, development, and physiology.

Step 4: Class, Order, Family, and Genus Identification

Continue to narrow down the classification by identifying the organism's:

- i. Class (e.g., Mammalia, Aves, Insecta).
- ii. Order (e.g., Carnivora, Passeriformes, Coleoptera).
- iii. Family (e.g., Felidae, Turdidae, Carabidae).
- iv. Genus (e.g., Panthera, Turdus, Carabus).

Step 5: Species Identification and Naming

Determine if the organism represents a new species within the identified genus. If so, choose a specific epithet (species name) that:

- i. Is unique and not already used within the genus.
- ii. Reflects a distinctive characteristic or feature of the organism.

Step 6: Binomial Nomenclature

Combine the genus name and specific epithet to create the organism's binomial nomenclature (e.g., *Panthera tigris*, *Allium cepa*, *Solanum tuberosum*).

By following these steps, the new organism would be properly classified and named according to the principles of binomial nomenclature.

Question Bank**General MCQs with Conceptual Questions (CQs)****2.1 BIODIVERSITY**

1. **Biodiversity is the variety of:**
(A) Ecosystems in an area (B) Material in an ecosystem
(C) Elements in an area (D) Organisms in an area ✓
2. **How many kinds of organisms have named and classified by biologists?**
(A) 1 million (B) 2 million ✓ (C) 4 million (D) 6 million
3. **In which factors biodiversity depends?**
(A) Climate (B) altitude (C) Soil (D) All of these ✓
4. **The number of species are fewer in the region:**
(A) Tropical (B) Polar ✓ (C) Temperate (D) Grassland
5. **International Biodiversity Day is celebrated on:**
(A) 22nd May ✓ (B) 22nd Jun (C) 22nd July (D) 22nd August
6. **Importance of biodiversity is:**
(A) It provides food and shelter for human (B) It maintain ecosystem
(C) It supports the tourism industry (D) All of these ✓
7. **The consequences of losing biodiversity are:**
(A) increased ecosystem resilience (B) improved air and water quality
(C) Decreased ecosystem services ✓ (D) Increased Food security
8. **The industry supported by biodiversity is:**
(A) Agriculture (B) Tourism
(C) pharmaceuticals (D) All of these ✓

2.2 CLASSIFICATION

9. **Biodiversity of plants known for biologists is:**
(A) 0.5 million ✓ (B) 1.5 million (C) 2 million (D) 3 million
10. **Biodiversity of animals known for biologists is:**
(A) 0.5 million ✓ (B) 1.5 million ✓ (C) 2 million (D) 3 million

2.3 TAXONOMIC RANKS

11. **Identify the most general Taxonomic rank:**
(A) species (B) Genus (C) Family (D) Kingdom ✓

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12. Taxonomic rank that is more specific than genus is:
(A) Family (B) Order (C) Species ✓ (D) Kingdom
13. Mark the Taxon between present class and order:
(A) Family ✓ (B) Genus (C) Species (D) phylum
14. Which of the following is correct order of Taxonomic ranks from General to most specific?
(A) Kingdom, Phylum, Class, Order, Family, Genus, Species ✓
(B) Phylum, Species, Genus, Order, Kingdom
(C) Species, Genus, Family, Order, Class, Phylum, Kingdom
(D) None of these
15. Rank that includes related genera:
(A) Family ✓ (B) Order (C) Class (D) Phylum
16. Linnaean System of Taxonomic rank was introduced in:
(A) 1635 (B) 1735 ✓ (C) 1835 (D) 1935
17. How many Taxonomic rank was suggested by Linnaeus?
(A) 4 (B) 5 (C) 6 (D) 7 ✓
18. When was domains introduced in Taxonomic ranks of Linnaeus?
(A) 1677 (B) 1777 (C) 1877 (D) 1977 ✓
19. Highest Taxonic rank today is:
(A) Domain ✓ (B) Kingdom (C) Phylum (D) Species
20. Order of housefly is:
(A) Primate (B) Fabales (C) Pip tera ✓ (D) Hominidae
21. Human belongs to class:
(A) Mammalia ✓ (B) Insects
(C) Magnliopsida (D) None of these
22. Which one of the following is order of Human?
(A) Primates ✓ (B) Fabales (C) Pip tera (D) Hominidae
23. D. Melanogaster is: (CQs)
(A) Housefly (B) Fruit fly ✓ (C) Hony bee (D) None of these
24. Phylum of Monkey and Human is: (CQs)
(A) Arthropoda (B) Chordata ✓ (C) Pory fera (D) Magnoliophyta
25. Aristotle was the first who classified organisms into number of groups:
(A) 2 ✓ (B) 3 (C) 4 (D) 5
26. What is main characteristic that distinguishes the three domains? (CQs)
(A) Cell structure (B) Mode of Neuraton
(C) Presence of cell wall (D) Type of cell membrane and Genetic material ✓

2.4 HISTORY OF CLASSIFICATION

27. Each class is further divided into related:
(A) Orders ✓ (B) Family (C) Genera (D) Phylum
28. Most specific level of classification is:
(A) Kingdom (B) domain (C) Species ✓ (D) Family
29. Ibn Rust in 1172 Translated Book de Anima into:
(A) Arabic ✓ (B) English (C) German (D) Pushto
30. Who is considered the father of Taxonomy?
(A) Aristotle (B) Carl Linnaeus ✓ (C) Darwin (D) Mendel

31. How many Genera of plants were proposed by Andrea Caesalpinia?
(A) 10 (B) 15 ✓ (C) 20 (D) 25
32. Who introduce the Taxa of class and species?
(A) Andrea Caesalpinia (B) Aristotle (C) Tournefort ✓ (D) Darwin
33. In two kingdom system classification system Fungi and Bacteria were placed in:
(A) Kingdom Plantae ✓ (B) Kingdom Monera
(C) Kingdom Animalia (D) Kingdom animalia
34. Mode of Neururation of Kingdom animalia is:
(A) Autotrophic (B) Saprotrophic (C) Heterotrophic ✓ (D) None of these
35. Which group falls in two Kingdom classification system?
(A) Animalia and plantae ✓ (B) Protista and Fungi
(C) Monera and Protista (D) Archean and Bacteria
36. Which of the following characteristics was used to distinguish between Tow kingdom classification system? (CQs)
(A) Presence of cell wall (B) Mode of Neururation ✓
(C) Presence of chloroplast (D) None of these
37. Three kingdom classification system was proposed:
(A) Ernst Hackel ✓ (B) Carl Linnaeus
(C) Aristotle (D) Robert Whittaker
38. Identify the Kingdom includes bacteria and cyanobacteria:
(A) Animalia (B) Plantae (C) Monera ✓ (D) Protista
39. In three kingdom classification system. Fungi was placed in: (CQs)
(A) Kingdom plantae ✓ (B) Kingdom Fundi
(C) Kingdom Animalia (D) Kingdom Monera
40. What is main mode of nutrition in Fungi?
(A) Autotrophic (B) Heterotrophic (C) absorption ✓ (D) Mixotrophic
41. Cell Wall of Fungi made up of:
(A) Chitin ✓ (B) Cellulose (C) Protein (D) lipid
42. What is the term for the process by which Fungi obtain nutrients? (CQs)
(A) Decomposition (B) Fermentation (C) Respiration (D) Saprotrophy ✓
43. Five Kingdom classification system was proposed by:
(A) Robert Whittaker ✓ (B) Carl Linnaeus
(C) Ernst Haeckel (D) Aristotle
44. Term procaryote is used to describe:
(A) Bacteria ✓ (B) Plants (C) Animals (D) Viruses
45. Term eukaryotic use to describe the cells of:
(A) Plants (B) Animals (C) Fungi (D) All of these ✓
46. Who modified the five-kingdom classification system?
(A) Margulis and Schwartz ✓ (B) Whittaker
(C) Carl Lanneus (D) Ernst Haeckel
47. Kingdom of organisms that are unicellular and eukaryotes is:
(A) Animalia (B) Plantae (C) Fungi (D) Protista ✓
48. What is basis for distinguishing between the Monera and Protista kingdom? (CQs)
(A) Presence of Nucleus ✓ (B) Mode of Neururation

- (C) Presence of cell wall (D) All of above
49. Identify the following characteristics used to distinguish between Fungi and Animalia Kingdoms: (CQs)
(A) Presence of Chitin (B) Presence of cellulose
(C) Mode of Neururation✓ (D) None of above

2.5 DOMAINS OF LIVING ORGANISMS

50. In how many domains all organism is classified?
(A) 2 (B) 3 ✓ (C) 4 (D) 5
51. Which one of the following is not domain?
(A) Bacteria (B) Archaea (C) Eukarya (D) Virus ✓
52. Domain Eukarya is divided into Kingdoms:
(A) 2 (B) 4 ✓ (C) 6 (D) 8
53. How many domains are recognized in modern classification system?
(A) 2 (B) 3 ✓ (C) 4 (D) 5
54. Who classified all organism in three domains in 1977?
(A) Carl Woese ✓ (B) Hopkin (C) Darwin (D) Pasture
55. Mark the domain of procaryotes:
(A) Domain Archaea (B) Bacteria
(C) Both B and A ✓ (D) only Bacteria
56. Domain of all eukaryotic multicellular organism is:
(A) Archaea (B) Bacteria (C) Eukarya ✓ (D) Protista
57. Which domain include Prokaryotic organism that are thermophilic and halophilic? (CQs)
(A) Bacteria (B) Archaea ✓ (C) Eukarya (D) Protista
58. Which structure enable the organism of Domain Archaea to live in extreme environment like hot springs, Salt Lake?
(A) Cell wall (B) Cell membrane ✓ (C) Genetic material (D) All of above
59. Thermophiles Bacteria found in:
(A) Hot springs ✓ (B) Cold spring (C) Salty spring (D) snow
60. Which one of the following is NOT example of Domain Archaea? (CQs)
(A) Methanogens (B) Halophiles
(C) Thermophiles (D) Basophiles ✓
61. Organism of Domain Bacteria founded in:
(A) Air (B) Soil (C) water (D) Everywhere ✓
62. The cell structure of bacteria is:
(A) Eukaryotic (B) Prokaryotic ✓ (C) Monocytic (D) Dendritic
63. Cell wall of Bacteria made up of:
(A) Cellulose (B) Chitin (C) Peptidoglycan ✓ (D) None of the above
64. Identify eukaryotic organism:
(A) Bacteria (B) Archaea (C) Protist ✓ (D) Virus
65. The main characteristics of Domain Eukarya is: (CQs)
(A) absence of nucleus (B) Presence of cell wall

- (C) Presence of membra-bonded organelles✓ (D) Absence of mitochondria

2.6 CLASSIFICATION OF DOMAIN EUKARYA

66. Parasitic protest plasmodium causes:
(A) Malaria✓ (B) amoebic dysentery (C) Trypanosoma (D) All of the above
67. Sleeping sickness disease is caused by:
(A) Entamoeba (B) Plasmodium (C) Trypanosoma✓ (D) Paramecium
68. Which of the following group is included in kingdom Protista?
(A) Algae✓ (B) Fungi (C) Bacteria (D) Protozoon
69. Slime molds and water molds belong to which kingdom?
(A) Monera (B) Protista✓ (C) Fungi (D) Plantae
70. Cell of Fungi made up of:
(A) Chitin✓ (B) Cellulose (C) Peptidoglycan (D) Lipids
71. Organism that is NOT belonged to Kingdom Fungi:
(A) Mushroom (B) Rust / smut (C) Molds (D) Cyanobacteria✓
72. Antibiotic that derived from Fungi is:
(A) Penicillin✓ (B) Siphonariidae (C) Tetra cyclone (D) aspirin
73. Cell call of Plants made up of:
(A) Chitin (B) Cellulose✓ (C) Peptidoglycan (D) Lipids

2.7 STATUS OF VIRUS IN CLASSIFICATION

74. Why are viruses NOT considered living organisms in the traditional sense?
(CQs)
(A) Lack of cell structure (B) Inability to reproduce on their own
(C) Both A and B✓ (D) None of the above
75. Viruses are place in Kingdom:
(A) Plantae (B) Animalia (C) Protista (D) None of these✓
76. Viroid composed of:
(A) Protein only (B) Circular RNA only✓
(C) Circular DNA only (D) Lipids only

2.8 BINOMIAL NOMENCLATURE

77. Who is credited to develop the system binomial nomenclature?
(A) Carl Linnaeus✓ (B) Darwin (C) Gregor Mendel (D) Aristotle
78. What are the two parts of binomial nomenclature?
(A) Genus and family (B) Species and Kingdom
(C) Genus and Species✓ (D) Phylum and Class
79. Advantage of using Binomial nomenclature is:
(A) It provides a unique and universal name
(B) It allows easy identification of organism
(C) It provides information about organism

(D) All of the above✓

General Short Questions with Conceptual Questions (CQs)

2.1 BIODIVERSITY

1. Define biodiversity also write the bases of measuring diversity.

Ans: Biodiversity means the variety of organisms in a particular area.

Bases of measuring diversity:

Biologists have different ways of measuring biodiversity, but many focus on the number of different kinds of organisms and the variation within each kind.

Biologists have named and classified almost 2 million kinds of organisms.

2. Write about the distribution of biodiversity on earth.

Ans: **Distribution of Biodiversity:**

Biodiversity is not evenly spread out. The biodiversity in a place depends on factors like climate, altitude, and soil type. Tropical regions have more biodiversity than polar regions.

3. What is importance of Biodiversity?

Ans: Biodiversity provides many essential services for humans and the planet. Some key benefits of biodiversity are given below:

- i) Biodiversity helps biogeochemical cycle.
- ii) Plants and algae absorb carbon dioxide helping to regulate the climate.
- iii) It provides vast array for resources like food, medicine, building material and fuel.
- iv) It supports numerous industries, including agriculture, Tourism and pharmaceuticals.

3a. How Biodiversity maintain ecosystem?

Ans: **Ecosystem stability:**

Biodiversity helps maintain the balance of ecosystems by contributing to the biogeochemical cycle such as water cycle, carbon cycle and nitrogen cycle.

4. What kind of resources we get from biodiversity?

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

5. Name the industries that get support from biodiversity.

Ans: Biodiversity supports numerous industries, including agriculture, tourism, and pharmaceuticals.

6. When and why international biodiversity day celebrated?

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

2.2 CLASSIFICATION

7. How many kinds of organisms have identified highlight their numbers?

Ans: Biologists have identified and described about 02 million kinds of organisms. Out of these, 0.5 million are the kinds of plants and 1.5 million are the kinds of animals. It is only a small percentage of the total kinds which live on Earth.

8. What are aims of classification of biodiversity?

Ans: **Aims and Principles of Classification:**

Aims the main aims of classification are;

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

9. What are bases of classification of biodiversity?

Ans: Basis of Classification:

- i) Biologists classify organisms into groups and-subgroups on the basis of similar physical characteristics.
- ii) In recent times, biologist also take help from genetics. They find the genetic similarities and differences among organisms. Then they use this information to know similarities and differences in their structures and functions.

10. Write any four advantages of classification of biodiversity.

Ans: Advantages of Classification:

- i) Classification allows biologists to group similar organisms together, making it easier to identify and understand their characteristics, relationships, and evolutionary history. It helps us understand the vast diversity of living organisms on Earth.
- ii) Classification provides a framework for studying and comparing different species.
- iii) It explains the inter-relationship amongst various organisms.
- iv) It helps in the identification of new species and in understanding their evolutionary relationships.
- v) Classification provides a common language for biologists around the world, enabling effective communication in the study of organisms.
- vi) Overall, classification is crucial for our understanding of the natural world and for the conservation and management of biodiversity.

11. Define Taxa or Taxonomic rank. Who introduce it?

Ans: The group into which organisms are classified are known as taxonomic ranks or Taxa (singular Taxon). The Swedish botanist Carl Linnaeus devised the Linnaean system of Taxonomic ranks in 1735.

2.3 TAXONOMIC RANKS

12. What is Carl Linnaeus system of taxonomic ranks?

Ans: Carl Linnaeus: The Swedish botanist Carl Linnaeus devised the Linnaean system of taxonomic ranks in 1735 in this system Linnaeus suggested seven taxonomic ranks.

- | | | |
|------------|-----------------------|--------------|
| i) Kingdom | ii) phylum (division) | iii) class |
| iv) order | v) family | vi) genus |
| | | vii) species |

13. Define domain and kingdom.

Ans: Domain: The highest taxonomic rank is domain. All organisms are divided into three domains:

- | | | |
|-------------|-------------|---------------|
| i) Bacteria | ii) Archaea | iii) Eukarya. |
|-------------|-------------|---------------|

Kingdom: Domain is further divided into kingdoms. For example, the domain Eukarya is divided into four kingdoms i.e., Animalia, Plantae, Fungi, Protista.

14. Define the followings:

i) Phylum ii) class iii) order iv) Family v) Genus vi) Species

Ans: **Phylum (Division: for plants and fungi):** Each kingdom is subdivided into related phyla or divisions.

i) **Class:** Each phylum/division is divided into related classes.

ii) **Order:** Each class is further divided into related orders.

iii) **Family:** Each order is broken-down into related families.

iv) **Genus:** Each family is divided into related genera (singular genus).

v) **Species:** It is the most specific level of classification. A species consists of similar organisms that can interbreed and produce offspring.

15. Write classification of fruit fly.

Ans:

Taxonomic Rank	Fruit fly
Kingdom	Animalia
Phylum or Division	Arthropoda
Glass	Insect
Order	Pip tera
Family	Drosophilidae
Genus	Drosophila
Species	Drosophila melanogaster

16. What is classification of human?

Ans:

Taxonomic Rank	Human
Kingdom	Animalia
Phylum or Division	Chordata
Glass	Mammalia
Order	Primates
Family	Hominidae
Genus	Homo
Species	H. sapiens

17. Write classification of pea plant.

Ans:

Taxonomic Rank	Pea
Kingdom	Plantae
Phylum or Division	Magnoliophyta
Glass	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Pisum
Species	P, sativum

2.4

HISTORY OF CLASSIFICATION

18. Write classification of Aristotle.

Ans: **Aristotle:** The Greek philosopher **Aristotle** (384-322 B(C) Was the first who classified organisms into two groups i.e., plants and animals.

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19. What was work of Andrea Caesalpinia and Tournefort?

Ans: **Andrea Caesalpinia:** The Italian biologist Andrea Caesalpinia (1519-1603 AD) divided plants into fifteen groups and called them genera.

Tournefort: The French botanist Tournefort (1656-1708 AD) introduced the taxa of class and species.

20. Write the Taxonomic Hierarchy of Carl Linnaeus.

Ans: Carl Linnaeus:

The Swedish biologist Carl Linnaeus (1707-1778 AD) created a taxonomic hierarchy of organisms with seven Taxa.

- | | | | |
|------------|------------|--------------|-----------|
| i) Kingdom | ii) Phylum | iii) Class | iv) Order |
| v) Family | vi) Genus | vii) Species | |

21. Name the earliest classification system and its kingdoms.

OR Define Kingdom Plantae and Kingdom Animalia.

Ans: Two kingdom classification system in which all organisms were classified into two kingdoms.

- i) Kingdom plantae ii) Kingdom Animalia

i) Kingdom plantae: The organisms that can prepare their own food (autotrophs) classified in the kingdom plantae.

ii) Kingdom Animalia: The organisms that cannot make their own food (heterotrophs) was classified in kingdom animalia.

22. What was objections on two kingdom system?

Ans: Objections:

- i) Some taxonomists found in Two Kingdom classifications system unworkable because many unicellular organisms like *Euglena* have both plant like (presence of chlorophyll and animal like (heterotrophic mode of nutrition in darkness and lack of cell wall) characteristics So, a separate kingdom was proposed for such organisms.
- ii) This system also did not clear the difference between prokaryotes and eukaryotes.

23. What do you know about three kingdom classification system?

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

24. Why three Kingdom system was rejected? Give reason of objection.

Ans: Some taxonomists disagreed about the position of fungi in kingdom Plantae.

Reasons of objection: Fungi resemble plants in many ways, but are heterotrophs which get their food by absorption. They do not have cellulose in their cell walls but possess chitin.

25. Define term prokaryote and eukaryote, who introduce these terms?

Ans: Five-Kingdom Classification System

Work of E-Chatton:

In 1937, French biologist E-Chatton suggested the terms, "Prokaryotic" to describe bacteria and "Eukaryotic" to describe Protista, fungi, animal and plant

cells.

26. Write bases of Five Kingdom Classification System.

Ans: Work of Robert Whittaker:

In 1967, American ecologist Robert Whittaker introduced the Five-Kingdom Classification System.

Bases of five kingdom system:

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

27. Name the five kingdoms.

Ans: i) Kingdom Protista ii) Kingdom Monera
iii) Kingdom Fungi iv) Kingdom Animalia v) Kingdom Plantae

28. What are modifications done in Robert Whittaker classification system?

Ans: Modification in five-kingdoms:

In 1988, American biologists Margulis and Schwartz modified the five-kingdom classification of Whittaker. They considered genetics along with cellular organization and mode of nutrition in classification. They classified the organisms into the same five kingdoms as proposed by Whittaker.

29. Name the domains of Carl Woese.

Ans: In 1977 American microbiologist Carl Woese added a level of classification the domains and classified organisms in to three domains.

- i) Archaea ii) Bacteria iii) Eukarya

30. What are domains of prokaryotes.

Ans: Prokaryote are divided into the domains:

- i) Archaea ii) Bacteria

2.5 DOMAINS OF LIVING ORGANISMS

31. What are bases of Domains?

Ans: Bases of Domains:

- i) Classification into three domains is based on difference in the sequence of nucleotides in the rRNA (ribosomal Ribonucleic acid) of the cell.
- ii) The cell membrane lipid structure and its sensitivity to antibiotics.

32. Write characteristics of Domain Arches.

Ans: Domain Archaea Characteristics:

The characteristics of domain arches are given bellow:

- (i) They are prokaryotes but their cell wall does not contain peptidoglycan.
- (ii) Their rRNA (ribosomal RNA) is more closely related to eukaryotes than to bacteria.
- (iii) Their cell membrane contains unique lipids which enable them to live in extreme environments e.g., hot springs, salt lakes, deep-sea hydrothermal vents, and acidic or alkaline waters. However, they also exist in more common environments, like soil and oceans.
- (iv) Some archaea obtain energy from inorganic compounds such as Sulphur or ammonia. Other groups perform photosynthesis but do not produce oxygen.

33. Give examples of domain Archaea.

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OR What are Methanogens and Halophiles?

OR Where Thermophiles and Acidophiles found?

Ans: The domain Archaea contains kingdom

Archaeobacteria (ancient bacteria) Major archaeobacteria include.

Methanogens (produce methane as byproduct)

Halophiles (found in extremely salty environments)

Thermophiles (found in hot springs)

Acidophiles (found in extremely acidic environments).

34. Write the characteristics of domain bacteria.

Ans: Characteristics of Domain bacteria are given bellow:

- i) They are the true bacteria.
- ii) They are also prokaryotic and have cell wall made of peptidoglycan.
- iii) Bacteria are found everywhere including soil, water, air, and living-organisms.
- iv) They are unicellular. Many live solitaries although some form chains, clusters, or colonies of cells.
- v) Most are heterotrophic but some perform photosynthesis because they have chlorophyll.

35. Why type of organism is in Domain bacteria?

Ans: Domain bacteria contains kingdom Eubacteria. Major groups in this kingdom are bacteria and cyanobacteria. Some bacteria cause diseases and many play essential roles in nutrient recycling.

36. Briefly write about Domain Eukarya.

Ans: Domain Eukarya

Characteristics: Characteristics of domain Eukarya are given bellow:

- i) Eukarya consists of kingdoms Protista, fungi, plantae and animalia.
- ii) It includes all eukaryotes which consist of complex, eukaryotic cells containing nucleus and other membrane bound organelles.
- iii) Eukarya cells are larger and contain more complex structures.

2.6 CLASSIFICATION OF DOMAIN EUKARYA

37. Write features of Kingdom Protista.

Ans: Kingdom Protista

Features of Kingdom Protista:

- i) Kingdom Protista includes eukaryote which are unicellular or colonial or filamentous or simple multicellular.
- ii) Simple multicellular means that they do not have multicellular sex organs.

Certain protists are parasitic and cause diseases e.g., Plasmodium causes malaria, Entamoeba histolytica causes amoebic dysentery, and Trypanosoma causes sleeping sickness.

38. Write types of protists.

Ans: Types of protists:

There are three types of protists.

- i) **Plants like protists(algae):** Plant-like protists have cell walls made of cellulose. They have chlorophyll in chloroplasts and are autotrophs. They are called algae (e.g., *Euglena*, diatoms).
- ii) **Animal like (protozoan)** protists are heterotrophs and ingest food. They have no

- cell wall they are called protozoans.
- iii) **Fungus like protist:** Fungus like protists produce hyphae like structure and are **saprophytic** e.g., slime molds and water molds.
39. **Write characteristics of Kingdom Fungi.**
Ans: Kingdom Fungi consist of Fungi which eukaryotic heterotrophic organism that are unicellular or multi cellular. Their cell is covered by cell wall made of chitin. They absorb food from surroundings.
Examples: Mushroom, rust, smuts and mold.
40. **How Fungi get Nutrients?**
Ans: Fungi get nutrients in a unique. They do not ingest food like animals and some protists they absorb food from surrounding.
41. **Write uses of Fungi.**
Ans: **Uses of fungi:** Some fungi are used in the production of bread cheese and beer. Others have medicinal properties such as penicillin an antibiotic derived from the fungus *Penicillium*.
42. **What type of organism are kingdom plantae?**
Ans: **Kingdom Plantae:**
- It includes plants which are eukaryotic, multicellular organisms with cell walls made of cellulose.
 - They are autotrophic and prepare food through photosynthesis. All plants develop from embryos.
- Example:** Mosses, ferns, conifers and flowering plants are examples of kingdom plantae.
43. **Write characteristics of Kingdom Animalia.**
Ans: **Kingdom Animalia:**
- Kingdom of eukaryotes includes animals which are eukaryotic, multicellular and heterotrophic.
 - They develop from embryos.
 - They ingest food and digest it within their bodies.
- Examples:** Human, Donkey, Lion, lizard etc.

2.7 STATUS OF VIRUS IN CLASSIFICATION

44. **What are viruses? Write their structure.**
Ans: **Viruses:** Viruses are ultramicroscopic creatures that are at the borderline of living and non-living.
Structure: They are acellular i.e.; they are not made of cells and do not have organelles. A virus consists of nucleic acid (DNA or RNA) surrounded by a protein coat.
45. **How virus perform life activities?**
Ans: **Life activities:** They cannot run any metabolism and depend upon the host cell (including plants, animals, and bacteria) to replicate and synthesize their proteins. Life viruses are not included in five kingdoms.
46. **Differentiate between prion and viroids.**
Ans: Prions and viroids are acellular particles. They are included in classification system. Prions are composed of protein only and Viroids are composed of

circular RNA only. Both particles cause infectious and diseases in certain plants.

47. What is corona virus? Write their mode of transmission.

Ans: **Coronavirus:** is a virus, identified in late 2019 in Wuhan, China.

Effects: Corona virus caused a pandemic of respiratory illness, called COVID-19.

Made of Transmission:

- i. The virus primarily spreads through respiratory droplets when an infected person coughs, sneezes, talks, or breathes.
- ii. It can also spread by touching surfaces contaminated with the virus.

48. How can you prevent spread of Covid-19?

Ans: Preventions wearing mask over nose and mouth can help prevent the spread of disease.

49. Write symptoms of Covid-19.

Ans: **Symptoms:** Common symptoms of COVID-19 disease include fever, cough shortness of breath, fatigue, body aches, loss of taste or smell, sore throat, and headache. In some cases, it can lead to severe respiratory problems, especially in older adults and people with underlying health conditions.

50. What are preventions and Covid-19?

Ans: **Preventions:** Washing hands frequently with soap for at least 20 seconds or use hand sanitizer with at least 60% alcohol can also prevent the spread of disease. **Vaccination:** Vaccination plays a crucial role in protecting from COVID-19. Vaccines help immune system recognize and fight the virus, reducing the severity of the disease.

2.8 BINOMIAL NOMENCLATURE

51. What is meant binomial nomenclature?

Ans: Binomial nomenclature is a system of naming scientific of organism using a Two-part name consisting of a genus name and a species name.

52. What is significance of binomial nomenclature? (CQs)

Ans: Binomial nomenclature system provides a universal unique name to an organ is. This system provides a standard way of communication whether the language of particular biologist is Chinese, Arabic or English.

53. Write scientific Name of Onion, Potato and Tomato.

Ans:

Common Name	Scientific Names
Onion	<i>Allium Cepa</i>
Potato	<i>Solanum Tuberosum</i>
Tomato	<i>Solanum Esculentum</i>

54. What is Scientific name of Honey Bee, Tiger and Human beings.

Ans:

Common Name	Scientific Names
Honey Bee	<i>Apis cerana</i>
Tiger	<i>Panthera tigris</i>
Human Being	<i>Homo sapiens</i>

Unit - 3

The Cell

Q1(a) Define Cell. Explain that a cell is like a city.

Ans: Cell: Cells are the incredible microscopic structures that form the foundation of life.

Function: Cells are the essential units that carry out all necessary functions for life.

Cell is like a city: A cell is like a busy city. For example, in a cell There are structures that produce energy (like power plants of the city), some structures process and transport materials (like roads and delivery services), and other structure remove or break wastes like waste disposal units). Finally, just like a city has a government, a cell has a nucleus that directs its activities, by giving instructions for every function of the cell.

3.1 CELL

Q1(b) How cells are the building blocks of all organism. Also write about its size and function.

Ans: Cell: The cell the basic structural and functional unit of life.

Basic types of cells:

There are two basic types of cells:

i) Prokaryotic cells ii) Eukaryotic cells

Eukaryotic cells are more complex than the prokaryotic cells.

Cells as building blocks of organisms:

Just as bricks are the building blocks of a house, cells are the building blocks of living organisms, including, plants, animals, and humans. Every living thing, from the smallest bacterium to the largest whale is made of cells.

Size: Most of the cells are very small, and cannot be seen with the naked eye. Some cells are large enough to be seen with naked eye.

Example: The egg cell of ostrich, a unicellular green algae *Acetabularia*, and a unicellular giant *Amoeba*.

Function: Despite their size, cells are very complex and carry out many essential functions to keep living things alive and functioning.

3.2 STRUCTURE OF CELL

Q1(c) Write about the working of Robert Hooke and Robert Brown on cell structure.

Ans: History of cell structures:

Work of Robert Hooke:

The basic structure of a cell was discovered by a curious scientist Robert Hooke. In 1665, using a simple microscope, Hooke examined a thin slice of cork and discovered tiny, box like structures that he called "cells." He could not study the details of the internal structure of cells.

There are two basic types of cells: prokaryotic and eukaryotic. Prokaryotic cells are simple and do not have membrane-bound organelles. Eukaryotic cells are more complex and have membrane-bound organelles.

Work of Rober Brown:

In 1831, while studying plant cells under a microscope. Robert Brown observed the "nucleus".

Q2 Describe structure and function of Cell Wall in detail.

Ans: Cell Wall:

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

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

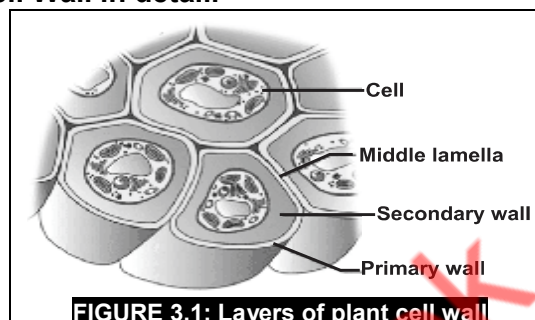
Structure of Cell Wall:

FIGURE 3.1: Layers of plant cell wall

Cell wall of plants: The plant cell wall is made of three layers

- 1) middle-lamella 2) primary wall 3) secondary wall.

1. Primary Cell Wall: The primary wall is present just above the cell membrane.

Components of Primary Wall:

Primary cell wall is mainly composed of three main substances

- i) Cellulose ii) hemicellulose iii) pectin

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

2. Middle Lamella: Middle lamina holds together the primary walls of adjacent cells.

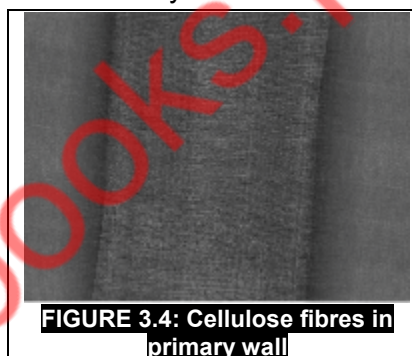


FIGURE 3.4: Cellulose fibres in primary wall

Components:

Middle Lamella contains magnesium, calcium and pectin.

3. Secondary Wall:

Some plant cells e.g., **xylem cells** make secondary wall on the inner side of primary wall.

TUTOR

Xylem: Tissue that transports water and minerals in plants.

Components:

Secondary Wall is mainly made of cellulose, lignin and other chemicals.

Plasmodesmata:

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

Cell wall of algae: The cell wall of algae is also composed of cellulose.

Cell wall of prokaryotes:

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

TUTOR

Prokaryotes: Single-celled organisms lacking a nucleus like bacteria.

Cell wall of Fungi: The cell wall of fungi is made of chitin.

Q3 Draw labeled diagram of Plant and Animal Cell.

Ans:

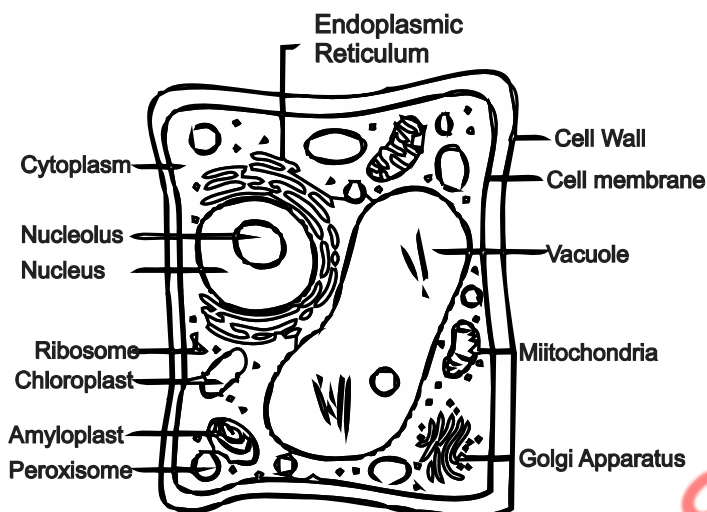


FIGURE 3.2: Structure of a plant cell

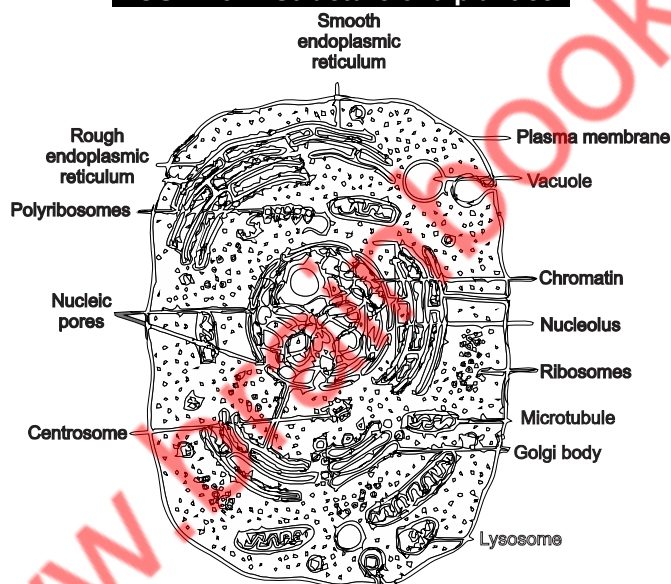


FIGURE 3.3: Structure of an animal cell

Q.4 Explain the Fluid mosaic model of cell membrane in detail.

OR What is cell membrane? Describe its structure and function.

Ans: **Cell Membrane:**

All cells have a thin and elastic cell membrane around the cytoplasm. It is called cell membrane.

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

Structure of Cell Membrane:

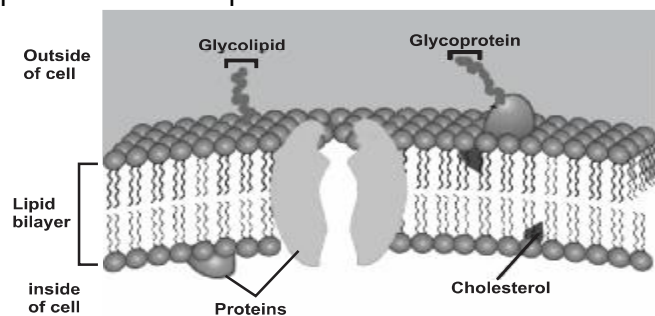
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Cell membrane is composed of proteins and lipids and small quantities of carbohydrates. The structure of cell membrane is described as fluid mosaic model.

Fluid Mosaic Model:

According to Fluid mosaic model the lipids make a fluid like bilayer in which protein molecules are submerged. The lipids and proteins can move laterally. Due to these movements, the pattern or "mosaic," of lipids and proteins constantly changes. Carbohydrates are joined with proteins (in the form of glycoproteins) or with lipids (in the form of glycolipids).

Organelles: In eukaryotic cell many organelles e.g., mitochondria, chloroplasts. Golgi apparatus and endoplasmic reticulum are also bounded by membranes.



Another lipid, cholesterol, is attached with the inner sides of the lipid bilayer. Cholesterol is absent in the membranes of most bacteria.

FIGURE 3.5: The fluid- mosaic model of cell membrane

Q5 What is Cytoplasm? Write about its composition and functions in cell.

Ans: Cytoplasm:

Cytoplasm is the jelly-like substance that fills the inside of a cell.

Composition:

Cytoplasm is a complex mixture of water, proteins, enzymes, salts, and other substances.

Cytosol:

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

Functions of cytoplasm:

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

Q6 Discuss the components of the Nucleus.

OR What do you know about control center of cell? Give detail information.

Ans: Nucleus:

The nucleus serves as the cells "control center". It oversees cellular activities by directing the production of proteins. "All eukaryotic cells have a prominent nucleus."

Location in Cell:

Animal cells: In animal cells, nucleus is present in the center.

Plants cells: In mature plant cells, nucleus is pushed to side due to a large

TUTOR

Enzymes: Biological molecules speeding up chemical reactions.

central vacuole.

Structure of Nucleus:

Nuclear envelope: The nucleus is bounded by a double membrane known as nuclear envelope.

Nuclear pores: Nuclear envelope is semi-permeable and has many small pores called nuclear pores.

Nucleoplasm: The inner jelly-like material of nucleus is called nucleoplasm.

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

TUTOR

Ribosomes: Cell organelles responsible for protein synthesis.

Chromatin: Nucleoplasm contains fine thread-like material known as **chromatin**. It is composed of deoxyribonucleic acid (DNA) and proteins.

Chromosomes: When a cell starts dividing, its chromatin condenses and takes the shape of thick chromosomes.

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

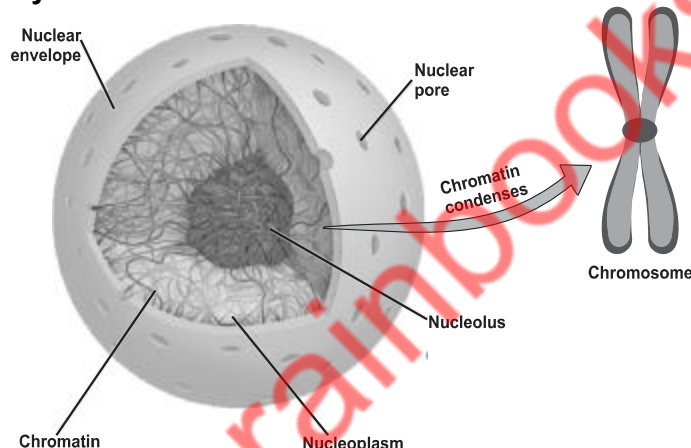


FIGURE 3.6: Structure of Nucleus and chromosome

Prokaryotic cells: The prokaryotic cells do not contain a prominent nucleus. Their chromosome is made of DNA only and floats in cytoplasm.

Q7 What is Cytoskeleton? Describe its function and composition.

Ans: Cytoskeleton:

Cytoskeleton is a network of thin Tubes and filaments present throughout the cytoplasm.

Parts of cytoskeleton: cytoskeleton consists of three parts

- i. Microtubules
- ii. Microfilaments
- iii. Intermediate filaments.

i. **Microtubules:**

Microtubules are hollow tubes made up *tubulin* protein.

Function of microtubules:

- Microtubules holds organelles in place, maintains a cells shape, and act as

tracks for organelles.

- Microtubules also make mitotic spindle, cilia and flagella.

ii. **Microfilaments:**

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

Function of microfilaments:

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

iii. **Intermediate filaments:**

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

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

TUTOR

Contractile proteins: Proteins enabling muscle contraction and movement.

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Vimentin: Protein providing structural support in animal cells.

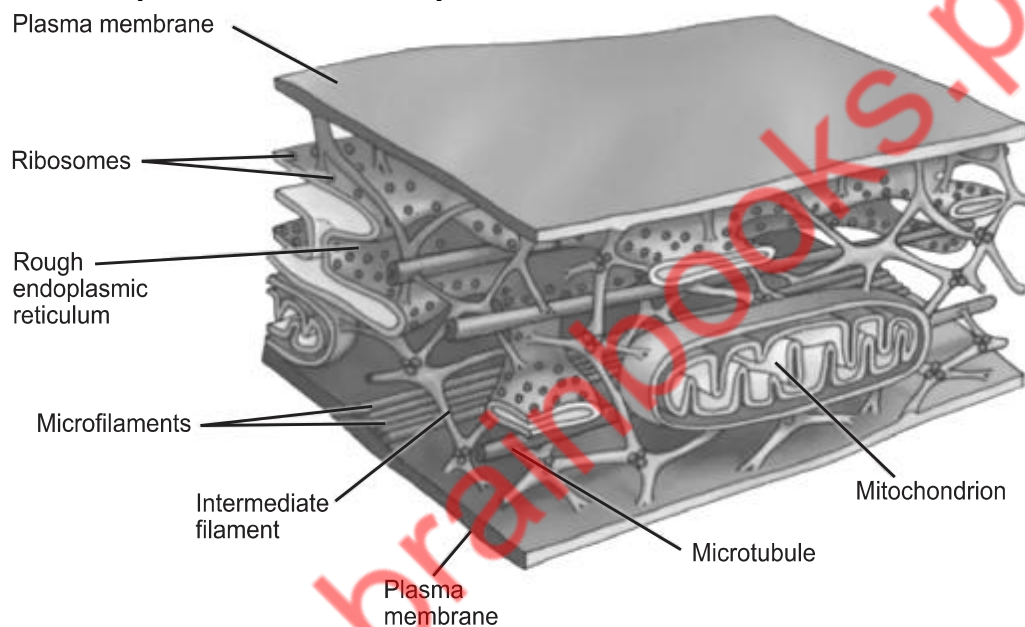


Figure 3.7: Cytoskeleton

Q8 Describe the structure and function of Ribosomes.

Ans: Ribosome:

Ribosomes are tiny granular structures.

They are the sites of protein synthesis.

Location:

Ribosomes float freely in the cytoplasm and are also attached on the surface of rough endoplasmic reticulum.

Structure:

Ribosomes are composed of almost equal amounts of proteins and ribosomal RNA (rRNA).

They are not bounded by membranes and so are also found in prokaryotes. Eukaryotic ribosomes are slightly larger than prokaryotic ones. Each ribosome consists of two subunits.

- i) Large subunit
- ii) Small subunit

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

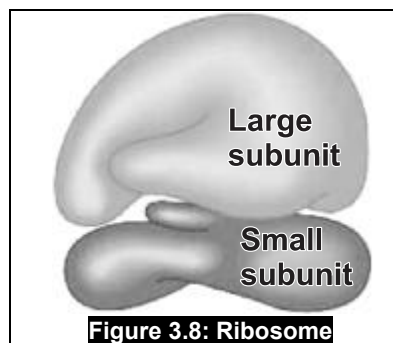


Figure 3.8: Ribosome

Q9 What is Endoplasmic Reticulum? Explain its types and their function in cell.

Ans: Endoplasmic Reticulum:

Endoplasmic Reticulum is a network of membrane bounded channels-present throughout the cytoplasm of eukaryotic cell.

Types of Endoplasmic Reticulum:

There are two types of endoplasmic reticulum.

- i) Rough Endoplasmic Reticulum (RER)
- ii) Smooth Endoplasmic Reticulum (SER)

i) Rough Endoplasmic Reticulum (RER):

Numerous ribosomes are attached on Endoplasmic reticulum and called Rough endoplasmic reticulum.

Function:

Rough Endoplasmic Reticulum serves the function in protein synthesis.

ii) Smooth Endoplasmic Reticulum (SER):

Smooth Endoplasmic Reticulum (SER) lack ribosomes.

Functions of SER:

- i) Smooth Endoplasmic Reticulum involves in lipids metabolism and in the transport of materials from one part of the cell to the other.
- ii) It also detoxifies the harmful chemicals that have entered the cell.
- iii) In muscle cells, the SER is also involved in contraction process.

Q10 Write Note on Golgi Apparatus.

OR Describe the formation and function of Golgi complex.

Ans: Golgi Apparatus:

In 1898, an Italian physician Camillo Golgi discovered a set of flattened sacs in the cytoplasm. These flattened-sacs, called **cisternae**, are stacked over each other and make a structure known as Golgi apparatus.

Occurrence:

Golgi Apparatus is found in both plant and animal cells.

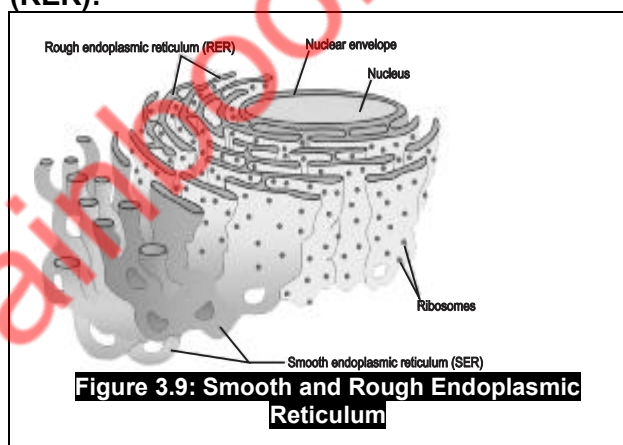
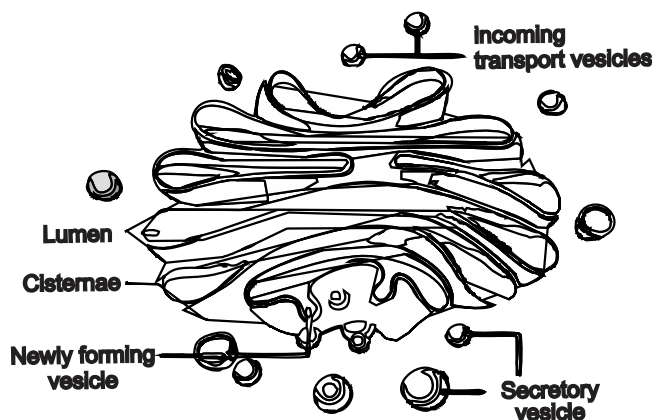


Figure 3.9: Smooth and Rough Endoplasmic Reticulum

Function Golgi Apparatus:

Golgi Apparatus modifies molecules coming from RER and packs them into small membrane bound sacs called Golgi vesicles. Golgi vesicles are kept in cell or are transported to exterior in the form of secretions.



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

Figure 3.10: Golgi apparatus

Q11 Describe the structure and function of Lysosomes.

Ans: Lysosomes: "Lysosomes are small membrane-bound vesicles that contain digestive enzymes."

Discovery: Lysosomes were discovered by Belgian scientist. Christian Rene de Duve.

Occurrence:

Lysosomes are predominantly found in animal cells.

Function of Lysosome: Lysosomes bud off from Golgi apparatus. Cell engulfs the food material in the form of food vacuole.

- Lysosome fuses with food vacuole and its digestive enzymes break down the food present in vacuole.
- Lysosome also have enzymes for breaking cellular wastes.
- Lysosome also engulf the damaged organelles and for later use.

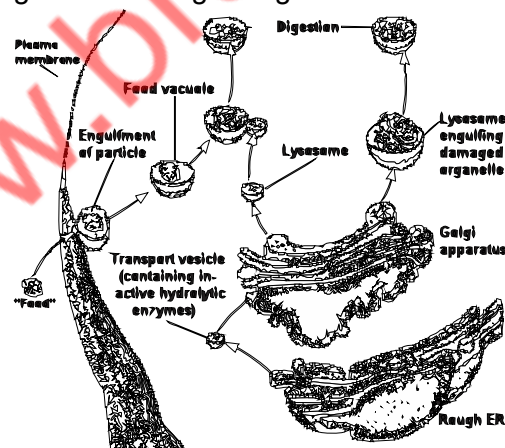


Figure 3.11: Formation and function of Lysosome

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Q12 Describe structure and function of Mitochondria the power house of cell.

Ans: Mitochondria:

Mitochondria are important organelles of eukaryotic cell.

Function:

Mitochondria (singular: mitochondrion) are the “power house” of the cell because they produce energy. They perform the reactions, of aerobic respiration in which oxygen is used to break food (glucose) to release energy (ATP – adenosine triphosphate).

Structure of Mitochondria:

Mitochondria are double membrane-bounded organelles.

Cristae:

The outer membrane of mitochondria is smooth but the inner membrane forms many folds. These folds are called cristae. singular crista). They increase the surface, area for respiration.

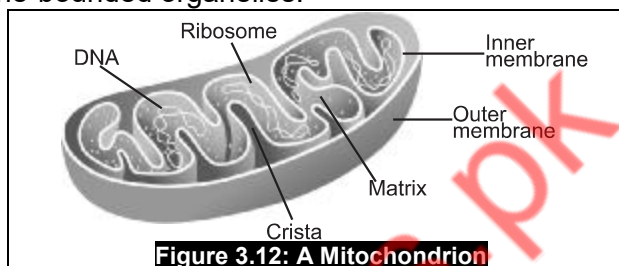


Figure 3.12: A Mitochondrion

Matrix:

The inner fluid-like material is called matrix.

DNA and Ribosomes:

DNA of Mitochondria:

Mitochondria contain their own DNA and ribosomes. They can multiply within the cell on their own.

Ribosomes of Mitochondria:

The ribosomes of mitochondria are more similar to prokaryotic ribosomes than to eukaryotic ribosomes.

Q13 What are Plastids? Explain its types in detail.

OR Describe the structure and function of Chloroplast.

Ans: Plastids:

Membrane bounded and pigment containing organelles found only in plants and photosynthetic protists (algae) are called plastids.

Types of Plastids:

There are three main types of plastids:

1. Chloroplasts
2. Chromoplasts
3. Leucoplasts.

1) Chloroplasts:

Chloroplasts are green plastids present in the cells of green parts of plants and in algae.

Functions:

Chloroplast contain photosynthetic pigments e.g., the green pigment chlorophyll. They carry out photosynthesis with the help of their photosynthetic pigments, they capture light energy and convert it into

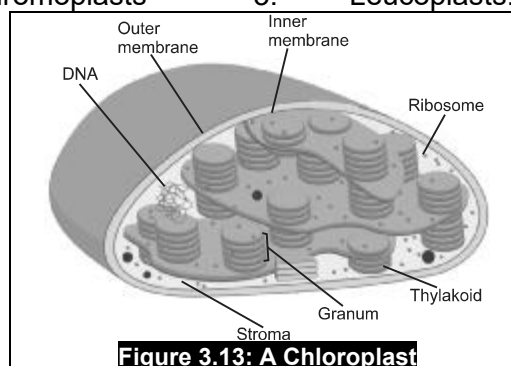


Figure 3.13: A Chloroplast

chemical energy in the form of glucose.

Structure:

Like mitochondria, chloroplast is enclosed within two membranes.

Grana: Grana on the internal side of inner membrane of mitochondria, there are many sets of stacked membranes. These stacks are called **grana** (singular, granum).

Thylakoids: Thylakoids the sac-like structures which make a granum are called **thylakoids**. Photosynthetic pigments are present on the surface of thylakoids.

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

TUTOR

Stroma: Fluid-filled region between thylakoid membranes in chloroplasts.

2) Chromoplasts:

Chromoplasts are the plastids that contain pigments such as carotenoids. These pigments are associated with bright colours and are present in the cells of flower petals and fruits.

Function:

Chromoplasts give colours to these parts, thus helping in **pollination** and dispersal of fruit and seeds.

TUTOR

Pollination: Transfer of pollen from male to female plant reproductive organs.

3) Leucoplasts:

Leucoplasts are plastids that have no pigments.

Function:

They are involved in the storage of starches, lipids, and proteins.

Location:

They are present in the cells of those parts where food is stored e.g., underground stems, seeds, roots etc.

Q14 Write Note on vacuoles.

OR How does Turgor pressure develops in plant cells?

Ans: Vacuoles:

The single membrane-bound sacs filled with fluid are called vacuoles.

Point to ponder!

Why are the vacuoles called the wastebins of the cells?

Vacuoles of animal cell:

Animal cell may have many small temporary vacuoles. They contain water and food substances.

Contractile vacuoles:

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

Food Vacuoles:

Some cells ingest food by forming food vacuoles. Food vacuoles also store food.

Vacuole of plant cells:

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

TUTOR

Amoeba: Single-celled organism with irregular shape and no fixed form.

Sponge: Simple multicellular animals attached to surfaces.

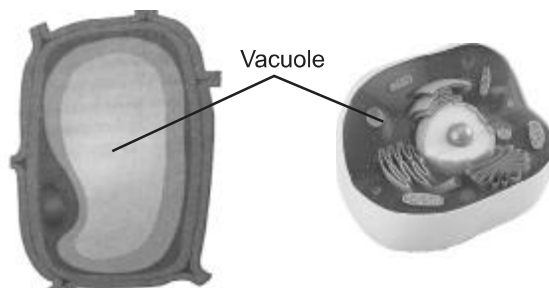


Figure 3.14: Vacuole in plant and animal cell

Tonoplast:

The membrane of plant vacuole is called **tonoplast**.

Cell sap:

The sap inside plant vacuole is called **cell sap**. It is a watery solution of salts.

Turgor Pressure:

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

Q15 Describe the structure and function of centrioles.

Ans: Centrioles:

Centrioles are barrel-shaped organelles found in the cells of animals and most **protists**. They are absent in prokaryotes, higher plants and fungi.

TUTOR

Protists: Diverse group of eukaryotic organisms not classified as plants, animals, or fungi.

Centrosomes:

There is a pair of centrioles in animal cells, this pair is called a centrosome and it is located near the nuclear envelope.

Structure of centrioles:

Each centriole is formed of 9 triplets of microtubule; (made up of tubulin protein).

Functions of centrioles:

- At the start of cell division, the pair of centrioles duplicates. The new pairs move to the opposite pole of the cell. Therefore, they form spindle fibres.
- The cells which have cilia or flagella contain centriole near the cell membranes. These centrioles are called **basal bodies**.

Function of Basal bodies:

Basal bodies are responsible for the formation of cilia and flagella.

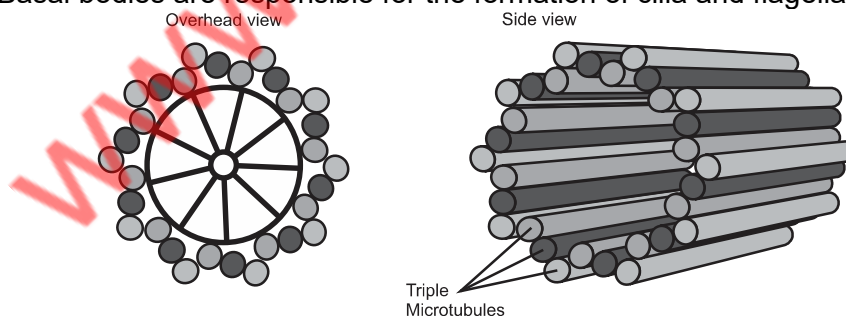
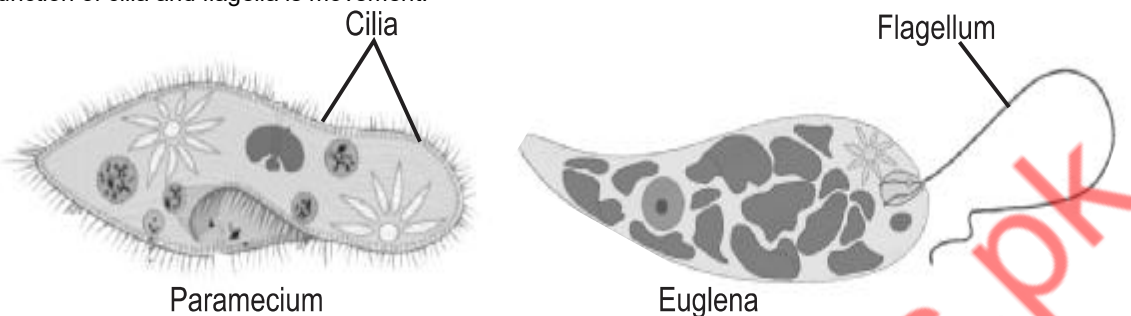


Figure 3.15 The structure of Centriole

Cilia and Flagella

Some cells have thin, tail-like projections called cilia (singular *cilium*) and flagella (singular *flagellum*). Cilia are short in length and are usually numerous in number, while, flagella are longer but less in number. Eukaryotic cilia and flagella consist of nine pairs of microtubules which surround a single central pair of microtubules. Cilia and flagella are connected to the basal body. Prokaryotic cells also have flagella but their structure is completely different. Prokaryotic flagella are made of a protein called flagellin. The function of cilia and flagella is movement.



Q16 Describe comparison between plant and animal cells.

Ans:

Table: Brief Comparison between Plant and Animal Cells

	Component	Description	Where found	Function
Animal and Plant cells	Cytoplasm	Jelly-like, with organelles in it	Between plasma membrane and nuclear envelope	Provides the site to cell organelles, site of metabolic reactions
	Cell membrane	A partially permeable membrane that forms a boundary around the cytoplasm	Around cytoplasm	Prevents cell contents; controls what substances enter and leave the cell
	Nucleus	A spherical or oval organelle containing DNA	In the centre in animal cells, on a side in plant cells	Controls cell division; controls cell activities
Plant cell only	Cell wall	A tough, non-living-outer layer made of cellulose	Around the outside of plant cells	Prevents mechanical support; allows water and salts to pass
	Large Vacuole	A fluid-filled space surrounded by a membrane	Inside the cytoplasm of plant cells	Contains salts and water helps to keep plant cells turgid .

	Chloroplast	An organelle containing, chlorophyll	Inside the cytoplasm of some plant cells	Traps light energy for photosynthesis'
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3.3 STRUCTURAL ADVANTAGES OF PLANT AND ANIMAL CELLS

Q17 Describe advantages of plant cell structures in detail.

Ans: Advantages of plant cell structures:

i) **Cell wall:**

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

ii) **Chloroplast:**

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

iii) **Vacuole:**

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

iv) **Plasmodesmata:**

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

Advantages of Animal Cell Structures:

i) **Centrioles:**

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

ii) **Lysosomes:**

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

iv) **Flagella and cilia:**

Some animal cells have structures called flagella and cilia, which are involved in movement. For example, sperm cells have a flagellum that propels them toward the egg for fertilization.

iv) **Lack of cell wall:**

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

3.4 CELL SPECIALIZATION

Q18 Write note on cell specialization.

OR Write the function of Mesophyll cell and Epidermal cells in plants.

Ans: Cell specialization:

In multicellular organisms, all cells are not exactly alike. Rather, there are different types of cells. Each type has a special structure and performs special function.

When cells are formed by cell division, they are all similar. After their formation of specialization or differentiation. During this process, they get special sizes, structures, and metabolic features.

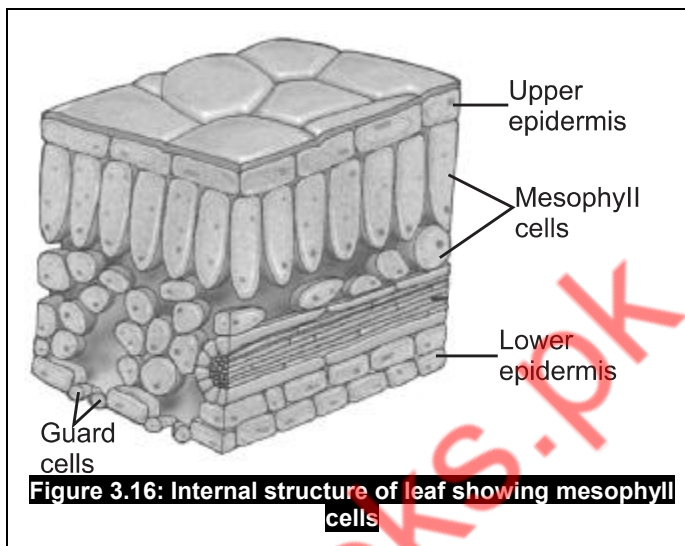
As a result, they become specialized.

Mesophyll Cells:

Mesophyll Cells are green cells present in leaves.

Functions of Mesophyll Cells:

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

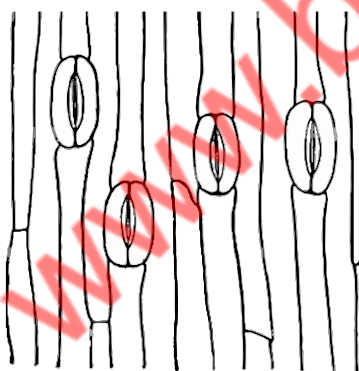


Epidermal Cells:

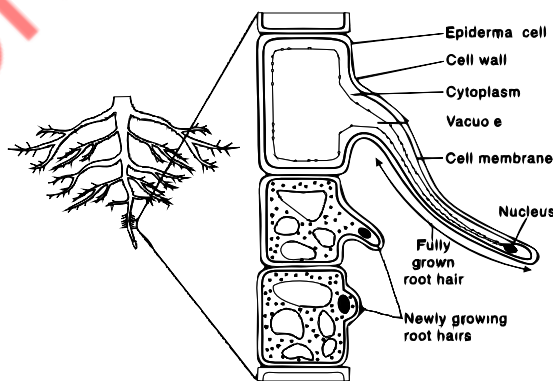
Epidermal Cells are flat and tightly packed cells that make the outer layer (epidermis) of plant organs.

Functions of Epidermal Cells:

- Epidermis protects the internal tissues. Modified cells of epidermis also perform other functions.
- These cells make extensions called root hairs to absorb water and minerals from soil.
- Lower epidermis of leaves contains guard cells which regulate opening, and closing of stomata.



Leaf epidermis



root epidermis

FIGURE 3.17: Epidermis of leaf and root

Q19 Write note on Muscle cells.

OR Discuss different types of Muscles.

Ans: Muscle Cells:

Muscle cells are specialized animal cells that can contract.

Structure:

They are elongated cells filled with actin and other contractile proteins.

1. Skeletal muscles:

Skeletal muscle cells are long striated. They are attached to bones.

Functions:

Muscle cells are voluntary in action and their contractions move the skeleton for body movements and locomotion.

Cardiac muscle:

Cardiac muscle cells are branched and striated.

They are found in the heart walls.

Function:

Cardiac muscles are **involuntary in action** and their contractions result in the pumping action of heart.

Smooth muscle:

Smooth muscle cells are spindle shaped and non-striated.

Function:

Smooth muscle are involuntary in action and present in the walls of many internal organs. For example, smooth muscles in the alimentary canal contract to move food forward, while those in blood vessels regulate blood flow.

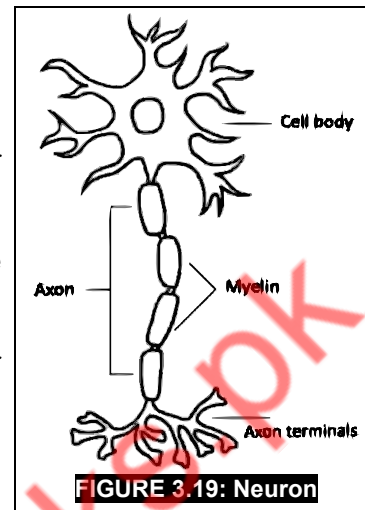
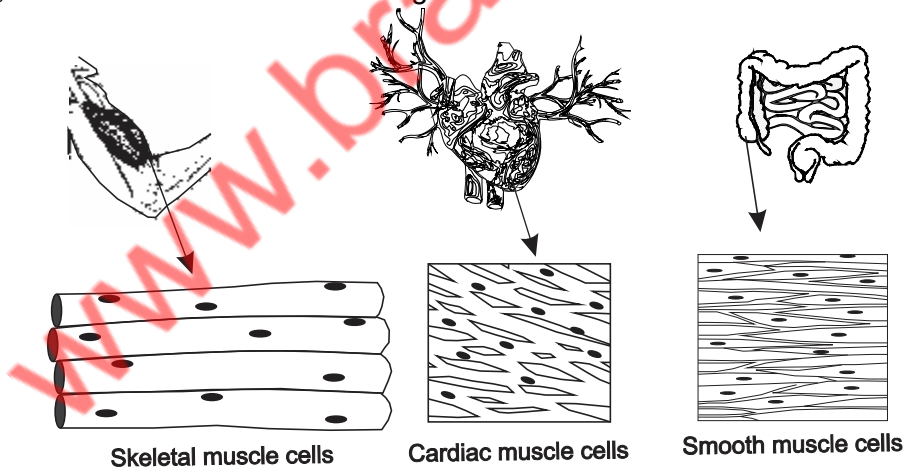


FIGURE 3.19: Neuron

TUTOR

Involuntary actions: Automatic responses controlled by the nervous system without conscious thought.



Skeletal muscle cells

Cardiac muscle cells

Smooth muscle cells

FIGURE 3.18: Muscle cells

Q20 Write note on Neurons and Red Blood cells?

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OR Describe structure and function of Neurons and red blood cells.

Ans: Neurons:

Neurons are the specialized cells of the nervous system.

Function of Neurons:

Neurons responsible for transmitting messages (nerve impulses) throughout the body.

Structure:

To perform their function, neuron have a unique structure. A neuron consists of a cell body and two types of cytoplasmic extensions.

Dendrites:

Dendrites, the shorter extensions, receive nerve impulses and transmit them to the cell body.

Axons:

Axons are the longer extensions, carry nerve impulses away from the cell body.

Red Blood Cell (Erythrocyte):

Red blood cells are specialized to carry oxygen from the lungs to the filled with haemoglobin that actually carries oxygen. In mammals, the mature red blood cells do not contain nucleus, mitochondria, and endoplasmic reticulum etc., It helps to accommodate more haemoglobin.

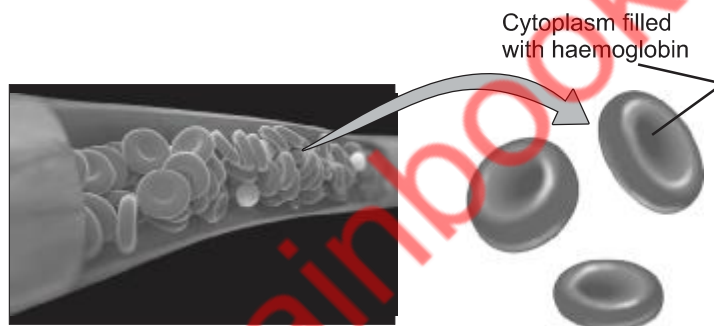


Figure 3.20: Red blood cells

Q21 Describe the function of hepatocytes in liver.

Ans: Liver Cell:

Liver cell are also called hepatocytes.

Function:

Hepatocytes are specialized for a lot of important functions like storage of glycogen, iron and some vitamins; detoxification of toxic substances production of form clotting-proteins of blood, recycling of old red blood cells etc.

Structure:

- Hepatocytes have prominent nuclei for maximum activities required for making enzymes and other proteins.
- Large number of mitochondria provide the necessary ATP for energy-intensive processes.
- Expansive network of SER helps for extensive detoxification and lipid synthesis.
- There are large number of peroxisomes which contain enzymes to neutralize toxic substances.

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

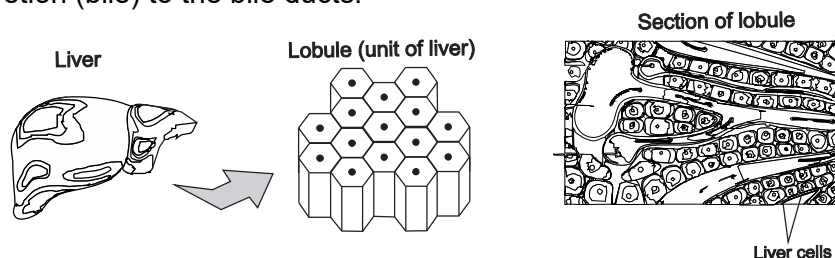


FIGURE 3.21: Liver cells

Q22 Describe the concept of division of labour and how it applies in multicellular organism. Give examples.

Ans: Division of Labour within and across Cells:

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

Division of Labour Within Cells:

Within a cell, division of labour is exemplified by the various organelles that each carry out distinct functions necessary for the cell's survival.

Examples:

- i) **Mitochondria:** Generate energy
Endoplasmic reticulum: Synthesizes proteins and lipids
- ii) **Lysosomes:** Break down waste materials;
In this way, the function of, each organelle contributes to the cell's overall survival growth and functioning.

Division of Labour Across Cells: In multicellular organisms, the division of labour extends across cells. Each type of cell performs a specific role and contributes to the overall functions of the organism.

Example:

- i) **Muscle cells:** Muscle-cells are specialized for contraction and movement, nerve cells for transmitting messages.
- ii) **Red blood cells:** Red blood cells for carrying oxygen.
This intercellular specialization allows complex organisms to perform a wide range of functions.

3.5 STEM CELLS

Q23 Write detail note on Stem Cells.

OR What are stem cells? Describe their functions with examples.

Ans: Stem Cells:

Unspecialized cell that has the ability to differentiate into a variety of specialized cell types is called stem cell.

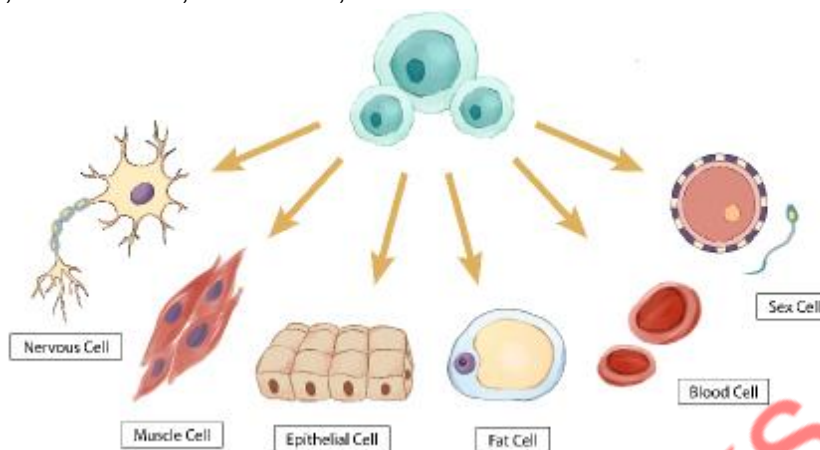
Explanation:

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

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Functions:

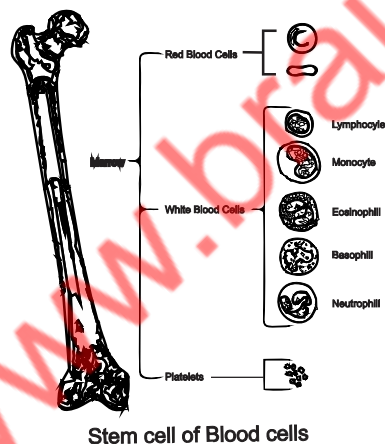
- i. During development, when the earliest stem cell (zygote) divides, it makes different cell lines. The cells of each line differentiate into specific type like skin cells, muscle cells, nerve cells, blood cells etc.

**FIGURE 3.22: Differentiation of stem cell into specialized cells**

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

Examples:

- Stem cells present in skin help in wound healing.
- Stem cells present in liver also help to repair after damage.
- Stem cells present in the bone marrow differentiate to make different types of blood cells and immune cells.

**Figure 3.23 Stem cell of blood cells**

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

KEY POINTS

- **The cell** is the fundamental building block of life.
- **The primary wall** of the cell wall is made up of cellulose and hemicellulose.

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- **The secondary cell wall** is made of lignin.
- **The cell membrane** is made of a lipid bi layer with embedded proteins.
- **Cytoskeleton** is a network of microfilaments, microtubules and intermediate filaments.
- **Ribosomes** are made of ribosomal RNA (rRNA) and proteins.
- **The Golgi apparatus** is a set of many flattened sacs (cisternae) stacked over each other.
- **Lysosomes** have strong digestive enzymes which are responsible for breaking down various biomolecules into simpler compounds that can be used by the cell.
- **Mitochondria** are the "powerhouses" of the cell because they produce energy by cellular respiration.
- **Chloroplasts** are responsible for photosynthesis.
- **Centriole** is formed of 9 groups of microtubule triplets (made-up. of tubulin protein).
- **Nucleus es spherical** or oval in shape and is surrounded by. a double membrane called the nuclear envelope.
- **Chromosomes** are composed of Deoxyribonucleic. acid (DNA) and proteins.
- **Mesophyll cells** are found in the leaves of plants and are responsible for photosynthesis.
- **Epidermal Cells** make up the outermost layer of plant tissues, forming a protective barrier against the environment.
- **Neurons** are specialized cells of the nervous system that transmit nerve impulses throughout the body,
- **Muscle cells** are responsible for movement.
- **Red blood cells** are a type of blood cell that carries oxygen from the lungs to the body's tissues and transport carbon dioxide back to the lungs for exhalation.
- **Stem cells** are undifferentiated or unspecialized cells that can differentiate into specific cells.

EXERCISE

A. Select the correct answers for the following questions.

1. **The process of cellular respiration occurs in:**
a) Nucleus b) Mitochondria✓ c) Ribosomes d) Golgi apparatus
2. **The smooth endoplasmic reticulum (SER) is primarily involved in the synthesis of:**
a) Proteins b) Lipids✓
c) Carbohydrates d) Nucleic acids
3. **Ribosomes are composed of:**
a) RNA and protein✓ b) DNA and protein
c) Carbohydrates and lipids d) RNA and carbohydrates
4. **What is the primary function of ribosomes?**
a) Energy production b) Protein synthesis✓
c) Lipid synthesis d) DNA synthesis
5. **Which cell organelle is involved in packaging and modifying proteins?**
a) Nucleus b) Mitochondria

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- c) Golgi apparatus✓ d) Endoplasmic reticulum
6. Which cell organelle is responsible for breaking down waste materials?
a) Golgi apparatus b) Nucleus
c) Mitochondria d) Lysosome✓
7. Which of the following cell structures is involved in maintaining cell shape?
a) Cytoskeleton✓ b) Centrioles
c) Nucleus d) Lysosome
8. Which specialized region of the nucleus is responsible for ribosome assembly?
a) Nucleoplasm b) Nucleolus✓
c) Chromatin d) Chromatin
9. What is the main function of the nuclear pores?
a) Regulation of cell division b) Control of pH of the cell
c) Protein synthesis d) Control of transport of molecules✓
10. Which of the following cellular structures is found in animal cells and helps in cell division?
a) Cell membrane b) Centriole✓ c) Plasmodesma d) Vacuole
11. Which sub-cellular organelle plays a crucial role in energy production within the cell?
a) Endoplasmic reticulum b) Golgi apparatus
c) Mitochondria✓ d) Lysosomes
12. In a multicellular plant, which cell type is responsible for the production of glucose?
a) Xylem b) Phloem c) Epidermal d) Mesophyll✓
13. Which organelle can double its number by itself?
a) Ribosomes b) Lysosomes
c) Mitochondria✓ d) Golgi apparatus
14. Which of these are present on the surface of rough endoplasmic reticulum?
a) Ribosomes✓ b) Lysosomes c) Mitochondria d) Vacuoles

B. Write short answers.

1. What are the main functions of cell membrane?

Ans. Cell Membrane:

All cells have a thin and elastic cell membrane around the cytoplasm.

Function: It is selectively-permeable. It allows very few molecules to pass through it while blocks many other molecules.

2. What key role does the Golgi apparatus play in eukaryotic cells?

Ans. Golgi Apparatus modifies molecules coming from RER and packs them into small membrane bound sacs called Golgi vesicles. Golgi vesicles are kept in cell or are transported to exterior in the form of secretions.

3. How do lysosomes contribute to the cells functioning?

Ans. **Function of Lysosome:** Lysosomes bud off from Golgi apparatus. Cell engulfs the food material in the form of food vacuole.

i) Lysosome fuses with food vacuole and its digestive enzymes break down the

food present in vacuole.

ii) Lysosome also have enzymes for breaking cellular wastes.

iii) Lysosome also engulf the damaged organelles and for later use.

4. Which organelle detoxifies harmful substances and breaks down lipids?

Ans. Smooth Endoplasmic Reticulum involves in lipids metabolism and in the transport of materials from one part of the cell to the other. It also detoxifies the harmful chemicals that have entered the cell.

5. What is the smooth endoplasmic reticulum responsible for?

Ans. Smooth Endoplasmic Reticulum (SER) lack ribosomes.

Functions of SER:

i) Smooth Endoplasmic Reticulum involves in lipids metabolism and in the transport of materials from one part of the cell to the other.

ii) It also detoxifies the harmful chemicals that have entered the cell.

iii) In muscle cells, the SER is also involved in contraction process.

6. How do the vacuoles in plant cells differ from vacuoles in animal cells?

Ans.

Vacuoles of animal cell	Vacuole of plant cells
Animal cell may have many small temporary vacuoles. They contain water and food substances.	Most mature plant cells have a single, large, central vacuole. It is formed by the fusion of many small vacuoles.

7. What could happen if lysosomal enzymes stop working properly?

Ans. If lysosomal enzymes stop working properly, cellular waste and damaged cellular compounds would accumulate leading to:

i. Cellular respiration

ii. Impaired cellular function

iii. Potential cell death

8. Why are the cristae important for cellular respiration?

Ans. Cristae are important for cellular respiration because they increase the surface area of mitochondria inner membrane.

9. How are chromatin and chromosomes related?

Ans. Chromatin: Nucleoplasm contains fine thread-like material known as **chromatin**. It is composed of deoxyribonucleic acid (DNA) and proteins.

Chromosomes: When a cell starts dividing, its chromatin condenses and takes the shape of thick chromosomes.

10. Which type of cell is responsible for sending nerve signals?

Ans. Neurons:

Neurons are the specialized cells of the nervous system and responsible for sending nerve signals.

Function of Neurons:

Neurons responsible for transmitting messages (nerve impulses) throughout the body.

11. What do mesophyll cells do in plant leaves?

Ans. Mesophyll Cells: Mesophyll Cells are green cells present in leaves.

Functions of Mesophyll Cells:

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

12. How would you define a stem cell?

Ans. Stem Cells:

Unspecialized cell that has the ability to differentiate into a variety of specialized cell types is called stem cell.

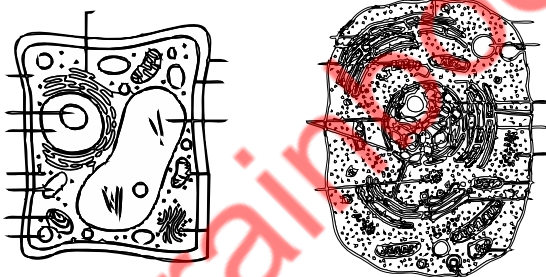
13. Name the chemical compounds that make up:

- | | | |
|------------------------|---------------------|--------------------|
| a. Cell membrane | b. Fungal cell wall | c. Plant cell wall |
| d. Bacterial cell wall | e. Ribosomes | f. Chromosomes |

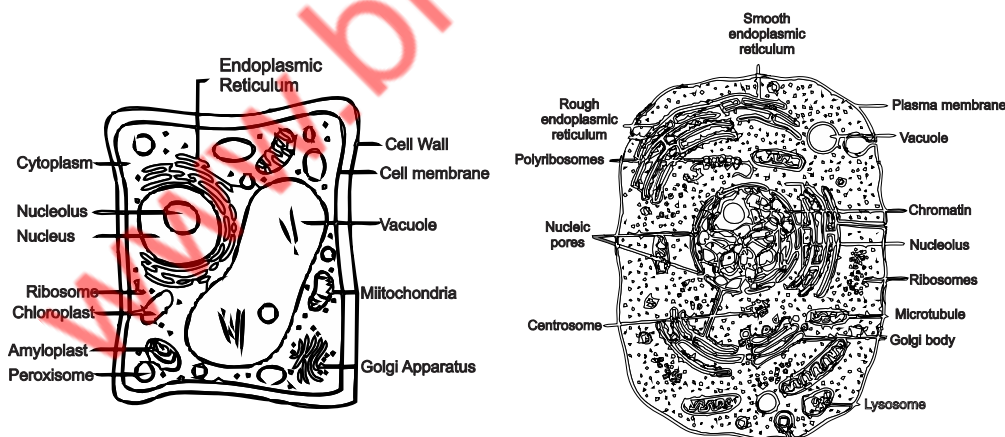
Ans.

- a. **Cell membrane:** Cell membrane composed of lipids, proteins, cholesterol and carbohydrates.
- b. **Fungal cell wall:** Fungal cell wall is composed of chitin.
- c. **Plant cell wall:** Plant cell wall is composed of cellulose, Hemicellulose, pectin and lignin.
- d. **Bacterial cell wall:** Bacterial cell wall is composed of peptidoglycan.
- e. **Ribosomes:** Ribosomes is composed of rRNA and protein.
- f. **Chromosomes:** Chromosomes is composed of DNA and protein.

14. Label the parts of these cell diagrams?



Ans.



C. Write answers in detail.

1. **Explain the fluid mosaic model of the cell membrane.**

Ans. For Answer See Question # 4.

2. **Describe the structure and functions of the cell wall.**

Ans. For Answer See Question # 2.

3. **Discuss the components of the nucleus.**

Ans. For Answer See Question # 6.

4. **Describe structure and function of lysosome and endoplasmic reticulum.**

Ans. For Answer See Question # 9 and 11.

5. **Describe the formation and function of the Golgi complex.**

Ans. For Answer See Question # 10.

6. **Describe the structure and functions of the chloroplast**

Ans. For Answer See Question # 13.

7. **How does turgor pressure develop in a plant cell?**

Ans. For Answer See Question # 14.

8. **Write any four differences between a plant cell and an animal cell.**

Ans. For Answer See Question # 16.

9. **Describe the concept of division of labour and how it applies in multicellular organisms. Give at least three examples.**

Ans. For Answer See Question # 22.

10. **Write a note on cell specialization.**

Ans. For Answer See Question # 18.

D. Inquisitive Questions

1. **What impact might mitochondrial dysfunction or absence have on other organelles ability to operate in a cell?**

Ans: Mitochondrial dysfunction or absence can significantly impact on other organelles' ability to operate in a cell:

Energy Crisis:

1. **Reduced ATP production:** Mitochondria are the primary source of ATP. Without functional mitochondria, cells rely on anaerobic glycolysis, leading to reduced ATP production.

2. **Impaired cellular processes:** Insufficient ATP affects various cellular processes, including muscle contraction, protein synthesis and membrane transport.

Impact on Organelles:

1. **Endoplasmic reticulum (ER):** Mitochondrial dysfunction can affect ER function, leading to impaired protein synthesis and folding.

2. **Lysosomes:** Mitochondrial dysfunction can disrupt lysosomal function, affecting cellular digestion and recycling processes.

3. **Peroxisomes:** Mitochondrial dysfunction can impact peroxisomal function, leading to impaired fatty acid metabolism and antioxidant defenses.

4. **Nucleus:** Mitochondrial dysfunction can affect nuclear function, leading to impaired gene expression and DNA repair.

In summary, mitochondrial dysfunction or absence can have far-reaching consequences for cellular function, impacting various organelles and leading to cellular stress, damage, and potentially cell death.

2. **What may happen if the coordination between the ribosomes and the nucleus were to fail, and why is it so important?**

Ans: If the coordination between ribosomes and the nucleus were to fail:

Consequences

1. **Protein synthesis disruption:** Ribosomes wouldn't receive the necessary mRNA, leading to impaired protein synthesis, affecting cellular structure, function, and signaling.
2. **Cellular malfunction:** Proteins are essential for various cellular processes. Without proper protein synthesis, cells might malfunction, leading to tissue damage, organ dysfunction, or even cell death.
3. **Genetic information mismatch:** The nucleus sends genetic information to ribosomes via mRNA. A failure in coordination could result in incorrect or incomplete genetic information, leading to aberrant protein production.

Importance of Coordination:

1. **Protein synthesis regulation:** The nucleus regulates protein synthesis by controlling mRNA production. Ribosomes rely on this mRNA to synthesize proteins.
2. **Cellular homeostasis:** Proper coordination ensures that cells produce the necessary proteins to maintain homeostasis, respond to stimuli, and adapt to changing environments.
3. **Error correction and quality control:** The nucleus and ribosomes work together to detect and correct errors in protein synthesis, ensuring that cells produce functional proteins.

In summary, the coordination between ribosomes and the nucleus is crucial for maintaining cellular homeostasis, regulating protein synthesis, and ensuring the production of functional proteins. A failure in this coordination can have severe consequences for cellular function and overall organism health.

Question Bank

General MCQs with Conceptual Questions (CQs)

3.1

CELL

1. **Basic structural unit of organisms is:**
OR The essential units that carried out all necessary function for life.
(A) Cell✓ (B) Tissue (C) Organ (D) atom
2. **Which one of the following organelles directs the activities inside cell?**
(A) Ribosome (B) Mitochondria
(C) Nucleus✓ (D) Endoplasmic reticulum
3. **Egg of the ostrich is:** (CQs)
(A) Tissue (B) Organ (C) Cell✓ (D) None of these

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3.2 STRUCTURE OF CELL

4. In 1665 basic structure of cell was discovered by:
(A) Robert Brown (B) Robert Hook ✓
(C) Jhon Dalton (D) Abu Ali Sina
5. On the bases of structure types of cell are:
(A) 2 ✓ (B) 4 (C) 6 (D) 10
6. Nucleus of the plant cell was discovered by:
(A) Robert Brown ✓ (B) Jhon Dalton (C) Jabir Bin Hayan (D) Bohr
7. Rigid non living structure that protect the cell is:
(A) Cell membra (B) Cell wall ✓ (C) Lysosomes (D) Ribosomes
8. Complete living matter of cell is called:
(A) Cytoplasm (B) Protoplasm ✓ (C) Nucleus (D) None of these
9. Plants cell wall composed of number of layers:
(A) 1 (B) 2 (C) 3 ✓ (D) 4
10. Cell wall of plants mainly composed of:
(A) Lignin (B) Chitin (C) Cellulose ✓ (D) None of these
11. Pore in cell wall of plants are called:
(A) Nuclear pores (B) Plasmodesmata's ✓
(C) Plastid (D) None of these
12. Main component of cell wall of Fungi is:
(A) Chitin (B) Lignin (C) Peptidoglycan (D) Cellulose ✓
13. Cell wall of prokaryotes is made of chemical:
(A) Actin (B) Pectin (C) Glycogen (D) Peptidoglycan ✓
14. A single molecule of peptidoglycan composed of:
(A) amino acids and Lipid (B) Lipid and proteins
(C) Sugar and amino acids ✓ (D) Lipid and Sugar
15. Which one of the following is elastic and semipermeable in nature?
(A) Cell wall (B) Cell membrane
(C) Plasma membrane (D) Both B and C ✓
16. Main components of cell membrane are:
(A) Lipid and Carbohydrates (B) Carbohydrates and proteins
(C) Proteins and Lipids ✓ (D) Amino acids and peptidoglycan
17. Which one of the following organelle NOT have membrane?
OR Which one of the following is NOT membrane bounded organelle?
(A) Mitochondria (B) Chloroplast (C) Endoplasmic (D) Ribosomes ✓
18. What helps in the transport of material throughout the cell?
(A) Golgi complex (B) Cytoplasm ✓ (C) Mitochondria (D) Chloroplast
19. Identify the cell that NOT have prominent Nucleus.
(A) Plant cell (B) Animal (C) Bacterial cell (D) None of these
20. Nucleolus is bounded by:
(A) Single membrane (B) double membrane ✓
(C) Cell wall (D) Triple membrane
21. Small pores in the nuclear envelope are called:
(A) Nuclear pores ✓ (B) Valves (C) Plasmodesmata (D) All of these

22. **Ribosomes are formed in:**
(A) Cytoplasm (B) Nucleoli ✓ (C) Mitochondria (D) Plasmids
23. **Fine thread like material in Nucleoplasm is called:**
(A) Chromatin ✓ (B) Chromatids (C) Chromosomes (D) RNA
24. **Chromatin is composed of:**
(A) DNA and RNA (B) RNA and proteins
(C) Proteins and DNA ✓ (D) None of these
25. **Chromatin condenses during cell division and take the shape of:**
(A) Chromatids (B) chromosomes ✓ (C) Plastids (D) DNA
26. **Which one of the following responsible for the transmission of characteristics to next generation?**
(A) DNA ✓ (B) RNA (C) Plasmid (D) Ribosomes
27. **All activities of the cell are control by:**
(A) RNA (B) Genes ✓ (C) Chromatin (D) Chromatid
28. **DNA of Prokaryotes (Bacteria) present in:**
(A) Nucleus (B) Cytoplasm ✓ (C) Nucleoplasm (D) Mitochondria
29. **A Network of thin tubes and filament present throughout the cytoplasm is called:**
(A) Microtubules (B) Microfilament (C) Cytoskeleton ✓ (D) Cytosol
30. **Identify the protein that present in microtubules:**
(A) Actin (B) Myosin (C) Tubulin ✓ (D) Histon
31. **Which one of the following is NOT formed by microtubules?**
(A) Mitotic spindle (B) Cilia (C) Flagella (D) Muscles fibres ✓
32. **Which one of the following help in contraction of muscle cells?**
(A) Microtubules (B) Microfilaments
(C) Both A and B ✓ (D) None of these
33. **Identify the structure that maintain the position of Nucleus in cell?**
OR **Which one of the following anchor the Nucleus?**
(A) Microtubules (B) Microfilament
(C) Intermediate filament ✓ (D) Cytoplasm
34. **The organelle which responsible for protein synthesis is:**
OR **Sites of protein synthesis are:**
(A) Ribosomes ✓ (B) Lysosomes
(C) Nucleosomes (D) Chromosomes
35. **Ribosomes are composed of equal amount of:**
(A) DNA and RNA (B) mRNA and Protein
(C) tRNA and protein (D) rRNA and protein ✓
36. **Identify the organelle present in prokaryotes.**
(A) Endoplasmic reticulum (B) Mitochondria
(C) Ribosomes ✓ (D) Golgi apparatus
37. **Types of endoplasmic reticulum are:**
(A) 2 ✓ (B) 3 (C) 4 (D) 5
38. **RER is involved in synthesis of:**
(A) Lipid (B) Protein ✓ (C) Carbohydrates (D) Glycolipids

39. **Detoxifies the harmful chemicals in the cells?**
(A) SER ✓ (B) RER (C) Ribosomes (D) Nucleosome
40. **Cisternae are present in:**
(A) Mitochondria (B) Golgi Apparatus ✓ (C) Nucleus (D) Plastid
41. **When was Golgi apparatus discovered?**
(A) 1798 (B) 1898 ✓ (C) 1998 (D) 1768
42. **Golgi was awarded Nobel prize for physiology and medicine in:**
(A) 1809 (B) 1806 (C) 1909 (D) 1906 ✓
43. **Who discovered the Lysosomes?**
(A) Camillo Golgi (B) Louis posture (C) De Duve ✓ (D) Robert brown
44. **Strong digestive enzymes are present in:**
(A) Lysosomes ✓ (B) Ribosome (C) Mitochondria (D) Golgi complex
45. **Cristae are present in:**
(A) Ribosomes (B) Endoplasmic reticulum (C) Mitochondria ✓ (D) Lysosomes
46. **Power House of a cell is:**
(A) Ribosomes (B) Lysosomes (C) Mitochondria ✓ (D) Golgi complex
47. **The organelle have pigment:**
(A) Plastid ✓ (B) Mitochondria (C) Ribosome reticulum (D) Endoplasmic
48. **Plastid that is green in colour. (CQs)**
- OR **Identify the structure that work like solar cell.**
(A) Chloroplast ✓ (B) Chromoplast (C) Leucoplast (D) None of these
49. **Types of plastids are:**
(A) 2 (B) 3 ✓ (C) 4 (D) 5
50. **Photosynthetic pigment chlorophyll present in:**
(A) Chromoplast (B) Chloroplast ✓ (C) Leucoplast (D) Plasmids
51. **Which are organelle is NOT present in animal cell?**
(A) Mitochondria (B) Plastids ✓ (C) Ribosomes (D) Golgi complex
52. **The plastid present in petals and fruits:**
(A) Leucoplast (B) Chloroplast (C) Chromoplast ✓ (D) Both A and B
53. **The colour less plastid is:**
(A) Chloroplast (B) Leucoplast ✓ (C) Chromoplast (D) None of these
54. **The stack of Thylakoids is called:**
(A) Stroma (B) Intergranum (C) Granum ✓ (D) Chloroplast
55. **The membranous stack present in chloroplasts is called:**
(A) Grana (B) Thylakoids ✓ (C) Stroma (D) Intergranum
56. **The membrane bounded and usually pigment containing structures are:**
(A) Nuclei (B) Mitochondria (C) Golgi complex (D) Plastids ✓
57. **Identify the following plastid involved in the storage of starches, lipids and proteins?**
(A) Chloroplast (B) Chromoplast (C) Leucoplast ✓ (D) None of these
58. **The function of contractile vacuole is: (CQs)**
(A) Digestion (B) Elimination of wastes ✓ (C) Absorption (D) Egestion
59. **The membrane of plant vacuoles is called:**
(A) Tonoplast ✓ (B) Leucoplast (C) Chloroplast (D) Chromoplast

3.3 STRUCTURAL ADVANTAGES OF PLANT AND ANIMAL CELLS

60. Which one of the following organelles NOT found higher plants and Fungi?
(A) Cell wall (B) Mitochondria (C) Centrioles ✓ (D) Vacuoles
61. The pair of centrioles in animal cells called:
(A) Centromere (B) Centrosome ✓ (C) Chromosome (D) Ribosome
62. Ceilia flagella are connected with:
(A) Basal body ✓ (B) Cell body (C) axon (D) Neurons
63. How many pairs of microtubules forms cilia and flagella?
(A) 6 (B) 7 (C) 8 (D) 9 ✓
64. The function of Cilia and Flagella is:
(A) movement ✓ (B) support
(C) Transportation (D) None of these
65. Which structure propels the sperms toward the egg for fertilization? (CQs)
(A) Cilia (B) Flagellum ✓ (C) Vacuoles (D) Both A and B
66. Recycling in cells carried out by:
(A) Ribosome (B) Lysosome ✓ (C) Mitochondria (D) Centrioles

3.4 CELL SPECIALIZATION

67. Cells that are specialized for photosynthesis. (CQs)
(A) Mesophyll cells ✓ (B) Stem cell
(C) Nerve cell (D) Epidermal cell of Leaves
68. Root hairs are extensions of:
(A) Epidermal cells ✓ (B) Mesophyll cells
(C) Germ cell (D) Stem cell
69. Opening and closing of stomata are controlled by:
(A) Mesophyll cells (B) Meristems
(C) Epidermal cell (D) Guard cells ✓
70. Types of Muscles are:
(A) 2 (B) 3 ✓ (C) 4 (D) 5
71. Which one of the following non-straited muscle? (CQs)
(A) Cardiac muscles (B) Skeletal muscles
(C) Smooth muscles ✓ (D) Bicep and Triceps muscles
72. Identify the voluntary muscle from the following options:
(A) Skeleton muscles ✓ (B) Cardiac muscles
(C) Smooth muscles (D) None of these
73. Who is responsible for transmission of Nerve Impulses?
(A) Neurons ✓ (B) Ganglions
(C) Red blood cells (D) White blood cells
74. Which component of Neuron receive impulses?
(A) Axon (B) Dendrites ✓ (C) Cell body (D) None of these
75. Longer extension neuron that carry impulse away from cell body is:
(A) Dendrites (B) Axon ✓ (C) Both A and B (D) None of these
76. Haemoglobin present in:
(A) WBCs (B) RBCs ✓ (C) Platelets (D) Neurons

77. Cells that are specialized to carry oxygen from lungs are:
(A) Neurons (B) Red Blood cells ✓ (C) White blood cells (D) Platelets
78. Which organ neutralize toxic substances?
(A) Liver ✓ (B) Kidney (C) Spleen (D) Lungs
79. Bile produce in:
(A) Liver ✓ (B) Kidney (C) Pancreas (D) Spleen
80. Which one is unspecialized cell?
(A) Stem cell (B) Zygote ✓ (C) Nerve cell (D) Blood cells

3.5 STEM CELLS

81. Cells that regenerate damage tissue under the right conditions is:
(A) Stem cells ✓ (B) Gametes (C) Germ cells (D) None of these
82. Stem cells present in bone marrow differentiate to make:
(A) Blood cells ✓ (B) Skin cells (C) Nerve cells (D) Gametes
83. Which one of the following is NOT the function of stem cell?
(A) They helps in wound healing (B) helps in cell differentiation
(C) help in repairing of damaged bones (D) None of these ✓

General Short Questions with Conceptual Questions (CQs)

3.1 CELL

1. What is cell? Briefly explain.

Ans. Cell: The cell the basic structural and functional unit of life.

Explanation: Just as bricks are the building blocks of a house, cells are the building blocks of living organisms, including, plants, animals, and humans. Every living thing, from the smallest bacterium to the largest whale, is made of cells.

3.2 STRUCTURE OF CELL

2. What is size of a cell?

Ans. Most of the cells are very small, and cannot be seen with the naked eye. Some cells are large enough to be seen with naked eye.

Examples:

- i) The egg cell of ostrich
- ii) A unicellular green algae
- iii) Acetabularia and unicellular giant Amoeba.

3. When and how first cell was discovered?

Ans. In 1665, using a simple microscope, Hooke examined a thin slice of cork and discovered tiny, box like structures that he called "cells." He could not study the details of the internal structure of cells.

4. Who discovered the Nucleus of cell?

Ans. In 1831, while studying plant cells under a microscope. Robert Brown observed the "nucleus".

5. Define Cell Wall.

OR What is Cell Wall? Where it present?

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

6. **Write function of Cell Wall.**

Ans. Cell wall provides shape, strength, protection and support to the inner living matter (protoplasm) of the cell.

7. **Name the layers of plant Cell Wall.**

OR Write components of plants cell wall.

Ans. Cell wall of plants: The plant cell wall is made of three layers

1) Middle-lamella 2) Primary wall 3) Secondary wall.

8. **Differentiate between Primary Wall and secondary wall of plants.**

Ans:

Primary Wall	Secondary Wall
The primary wall is present just above the cell membrane. It is mainly composed of cellulose, hemicellulose, and pectin. Cellulose forms fibres that crisscross over one another to form strong primary wall.	Some plants cells e.g., xylem cells make secondary wall on the inner side of primary wall. It is mainly made of cellulose, lignin and other chemicals.

9. **What is middle lamina? Write its composition.**

OR What is middle lamina? Write its composition and function.

Ans. Middle lamina: Middle lamina is the layer of cell wall it holds together the primary wall of adjacent cells.

Composition: It contain magnesium, calcium and pectin.

10. **What is composition of Cell Wall of prokaryotes and Fungi.**

Ans. Cell wall of prokaryotes:

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

Cell wall of Fungi: The cell wall of fungi is made of chitin.

11. **What is Cell Membrane? Write its function.**

Ans. Cell Membrane:

All cells have a thin and elastic cell membrane around the cytoplasm is called cell membrane.

Function: Cell Membrane is selectively permeable. It allows very few molecules to pass through it while blocks many other molecules.

12. **What are plasmodesmata?**

Ans. Plasmodesmata:

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

13. **What is composition of Cell Membrane?**

OR What is Fluid Mosaic Model?

Ans. Fluid Mosaic Model: According to Fluid mosaic model the lipids make a fluid-like bilayer in which protein molecules are submerged. The lipids and proteins can move laterally. Due to these movements, the pattern or "mosaic" of lipids and proteins constantly changes Carbohydrates are joined with proteins (in the form of glycoproteins) or with lipids (in the form of glycolipids).

14. **Name the organelles that are bounded by membrane.**

Ans. In eukaryotic cell many organelles e.g. mitochondria, chloroplasts. Golgi

apparatus and endoplasmic reticulum are also bounded by membranes.

15. What is cytoplasm? Write its composition.

Ans. Cytoplasm:

"Cytoplasm is the jelly-like substance that fills the inside of a cell.

Composition:

Cytoplasm is a complex mixture of water, proteins, enzymes, salts, and other substances.

16. What is cytosol?

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

17. Write functions of cytoplasm.

Ans. Functions of cytoplasm:

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

18. Where nucleus present in animal and plant cells?

Ans. Animal cells: In animal cells, nucleus is present in the center.

Plants cells: In mature plant cells, nucleus is pushed to side due to a large central vacuole.

19. Define Nuclear envelope and Nuclear pores.

Ans. Nuclear envelope: The nucleus is bounded by a double membrane known as nuclear envelope.

Nuclear pores: Nuclear envelope is semi-permeable and has many small pores called nuclear pores.

20. Define Nucleoplasm and Nucleoli.

Ans. Nucleoplasm: The inner jelly-like material of nucleus is called nucleoplasm.

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

21. Define chromatin and Chromosome.

OR What is chromatin? Write its composition.

Ans. Chromatin: Nucleoplasm contains fine thread-like material known as chromatin. It is composed of deoxyribonucleic acid (DNA) and proteins.

Chromosomes: When a cell starts dividing, its chromatin condenses and takes the shape of thick chromosomes.

22. What is DNA? Write its function.

OR Why DNA is called hereditary material?

OR How DNA play role in the production of characteristics of Individual.

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

23. Is DNA present in prokaryotic cell?

Ans. Prokaryotic cells: The prokaryotic cells do not contain a prominent nucleus. Their chromosome is made of DNA only and floats in cytoplasm.

24. What is Cytoskeleton? Name its components.

Ans. Cytoskeleton:

Cytoskeleton is a network of thin Tubes and filaments present throughout the cytoplasm.

Parts of cytoskeleton: Cytoskeleton consists of three parts

- i. microtubules ii. microfilaments
- iii. intermediate filaments.

25. What are microtubules?

Ans. Microtubules are the hollow tubes made up tubulin protein these tubes are component of cytoskeleton.

26. Write functions of microtubules.

OR What is role of cytoskeleton in maintain cellular shape?

Ans. Function of microtubules:

- i) Microtubules holds organelles in place, maintains a cell's shape, and act as tracks for organelles.
- ii) Microtubules also make mitotic spindle, cilia and flagella.

27. What are microfilaments? Write their function.

Ans. Microfilament: Microfilament are components of cytoskeleton and finer than microtubules.

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

28. Differentiate between microtubules and microfilaments.

Ans.

Microtubules	Microfilaments
Microtubules are hollow tubes made up tubulin protein.	Microfilaments are finer than microtubules and made up of contractile protein mainly action.
Function: It holds organelles in place, maintain cell's shape. It also make mitotic spindle, cilia and flagella.	Function: They helps in cell movement and contraction of Muscles cells.

29. What are intermediate filaments? Write their function in cell.

Ans. Intermediate filaments:

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

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

30. What are Ribosomes? Write their function.

Ans. Ribosomes are Tiny granular structures in cell.

Function: Ribosomes are the sites of protein synthesis.

31. Briefly explain the structure of Ribosomes.

Ans. Structure:

Ribosomes are composed of almost equal amounts of proteins and ribosomal RNA (rRNA).

They are not bounded by membranes and so are also found in prokaryotes. Eukaryotic ribosomes are slightly larger than prokaryotic ones. Each ribosome consists of two subunits.

32. Write the position of Ribosomes in a cell.

Ans. Ribosomes float freely in the cytoplasm and are also attached on the surface of rough endoplasmic reticulum.

33. What is Endoplasmic Reticulum? Name its types.

Ans. Endoplasmic Reticulum:

Endoplasmic Reticulum is a network of membrane-bounded channels-present throughout the cytoplasm of eukaryotic cell.

Types of Endoplasmic Reticulum:

There are two types of endoplasmic reticulum.

- i) Rough Endoplasmic Reticulum (RER)
- ii) Smooth Endoplasmic Reticulum (SER)

34. What are RER and SER?

OR Differentiate between RER and SER.

OR Write function of SER and RER.

Ans.

RER	SER
Numerous ribosomes are attached on Endoplasmic reticulum and called Rough endoplasmic reticulum. Function: RER serves the function in protein synthesis.	Smooth Endoplasmic Reticulum (SER) lack ribosomes. Functions: i) It involves in lipids metabolism and in the transport of materials from one part of the cell to the other. ii) It also detoxifies the harmful chemicals that have entered the cell. iii) In muscle cells, the SER is also involved in contraction process.

35. Define cisternae and Golgi Apparatus.

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

36. Write functions of Golgi Apparatus.

OR Define Golgi vesicles. How they formed in a cell?

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

37. What are lysosomes?

Ans. Lysosomes are small membrane-bound vesicles that contain digestive enzymes.

38. Briefly explain the working of lysosomes in cell.

OR How lysosomes digest food in a cell?

OR How cell destroy or reuse old cell?

Ans. Function of Lysosome: Lysosomes bud off from Golgi apparatus. Cell engulfs the food material in the form of food vacuole.

Working:

- i) Lysosome fuses with food vacuole and its digestive enzymes break down the food present in vacuole.
- ii) Lysosome also have enzymes for breaking cellular wastes.
- iii) Lysosome also engulf the damaged organelles and for later use.

39. Why mitochondria are called as power house of cell?

OR How cell generate energy?

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

40. Define Cristae and Matrix.

Ans. Cristae: The outer membrane of mitochondria is smooth but the inner membrane forms many folds. These folds are called cristae. singular crista). They increase the surface, area for respiration.

Matrix: The inner fluid-like material is called matrix.

41. What are plastids? Name it types.

Ans. Plastids:

Membrane bounded and pigment containing organelles found only in plants and photosynthetic protists (algae) are called plastids.

Types of Plastids:

There are three main types of plastids:

1. Chloroplasts
2. Chromoplasts
3. Leucoplasts

42. What are chloroplasts?

Ans. Chloroplasts: Chloroplasts are green plastids present in the cells of green parts of plants and in algae.

43. What is the role of chlorophyll in the formation of Food in a cell?

Ans. Chloroplast contain photosynthetic pigments e.g., the green pigment chlorophyll. carry out photosynthesis with the help of their photosynthetic pigments, they capture light energy and convert it into chemical energy in the form of glucose.

44. Define Grana and Thylakoids.

Ans. Grana: Grana on the internal side of inner membrane of mitochondria, there are many sets of stacked membranes. These stacks are called **grana** (singular, granum).

Thylakoids: Thylakoids the sac-like structures which make a granum are called **thylakoids**. Photosynthetic pigments are present on the surface of thylakoids.

45. What are chromoplasts? Write their function.

OR How Chromoplast helps in pollination?

Ans. Chromoplasts:

Chromoplasts are the plastids that contain pigments such as carotenoids. These pigments are associated with bright colours and are present in the cells of flower

petals and fruits.

Function:

Chromoplasts give colours to these parts, thus helping in pollination and dispersal of fruit and seeds.

46. What are Leucoplasts? Where they are located?

Ans. Leucoplasts:

Leucoplasts are plastids that have no pigments.

Function:

They are involved in the storage of starches, lipids, and proteins.

Location:

They are present in the cells of those parts where food is stored e.g., underground stems, seeds, roots etc.

47. How Amoeba and Sponges eliminate their waste?

OR Write function of contractile vacuoles.

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

48. Define Tonoplast and cell sap.

Ans. Tonoplast:

The membrane of plant vacuole is called **tonoplast**.

Cell sap:

The sap inside plant vacuole is called **cell sap**. It is a watery solution of salts.

49. Define Turgor pressure and Turgor.

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

50. What are centrioles?

Ans. Centrioles are barrel-shaped organelles found in the cells of animals and most protists. They are absent in prokaryotes, higher plants and fungi.

51. Define centrosome.

Ans. There is a pair of centrioles in animal cells, this pair is called a centrosome and it is located near the nuclear envelope.

52. Write functions of centrioles.

OR How spindle fibres forms?

OR What are basal bodies?

Ans. Functions of centrioles:

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

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

53. What is primary function of a cell wall in plant and how it differs from bacterial cell wall.

Ans. Function of cell wall:

The primary function of cell wall in plants is to provides, support, protection and maintenance of cell turgor pressure.

Difference from Bacterial cell wall:

Plant cell walls are composed of cellulose, hemicellulose and pectin. While bacterial cell wall composed of peptidoglycan.

54. Elaborate relationship between cell wall structure and cellular function in plants. (CQs)

Ans. Cell wall is hard and rigid in nature it provides cell shape. It act as physical barrier preventing from pathogens.

55. Explain the role of cell wall in plant cell signaling and communication. (CQs)

Ans. The cell wall contains receptors that receive and transmit signals, influencing cellular behavior.

56. Why animal cell don't have cell wall? Give reasons. (CQs)

Ans. Animal cell don't have cell wall for several reasons.

Reason:

- i) Animal cell need to be able to move and change shape.
- ii) Animal cells divide rapidly and a cell wall hinder this process.

57. How does cell membrane maintain cellular homeostasis? Comment. (CQs)

Ans. The cell membrane allows certain substances to pass through while restricting other's maintaining a stable internal environment.

58. How does Nucleus controls cellular activities? (CQs)

Ans. Nucleus controls the cellular activities through Gene expression, cell division, cellular signaling and protein synthesis etc.

59. What is the role of chromatin in Nucleus and how is it organized? (CQS)

Ans. Chromatin play crucial role in Nucleus serve as the storage form of DNA. Chromatin condense during cell division and forms chromosomes.

60. Compare and contrast the Nucleus of prokaryotic and a eukaryotic cell. (CQs)

Ans.

Prokaryotes	Eukaryotes
Prokaryotes have true nucleus.	Eukaryotes have membrane bounded nucleus that contain DNA.
Chromosome located in region cell.	It present in the center of cell in animal cells.

61. What is primary function of Ribosomes? (CQs)

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

62. How cell get energy from food?

Ans. Cell get energy from food by the process of cellular respiration.

63. Which structure of cell work like solar cell? Briefly explain. (CQs)
 OR Which organelle convert solar energy into chemical energy? Briefly explain.

Ans. Chloroplast of cell work like solar cell. They absorb sun light and use it in the process of photosynthesis.

3.3 STRUCTURAL ADVANTAGES OF PLANT AND ANIMAL CELLS

64. Differentiate between plant and animal cell.

Ans.

Plant cell		Animal cell	
i)	Cell wall: Cell wall present made of cellulose.	i)	Cell wall: Cell wall is absent.
ii)	Chloroplast: Chloroplast present for photosynthesis.	ii)	Chloroplast: Chloroplast are absent.
iii)	Vacuole: Larg vacuole is present in the center of cell.	iii)	Vacuole: Small multiple vacuoles are present for storage.

65. Write importance of Plasmodesmata and Vacuole in plant cell.

Ans. **Vacuole:**

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

Plasmodesmata:

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

66. Write importance of Cell Wall and Chloroplast in plant cell.

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

Chloroplast:

They contain chloroplasts, which are responsible for photosynthesis.

67. What are cilia and Flagella? Write their function.

Ans. Some animal cells have structures called flagella and cilia, which are involved in movement. For example, sperm cells have a flagellum that propels them toward the egg for fertilization.

3.4 CELL SPECIALIZATION

68. What are Mesophyll cells? Write their Function.

Ans: **Mesophyll Cells:** Mesophyll Cells are green cells present in leaves.

Function: Mesophyll Cells are specialized for photosynthesis. They contain large number of chloroplasts, which contain the green pigment necessary for capturing light energy. Their shape and arrangement in leaves is suitable for maximum absorption of light.

69. What are epidermal cells?

Ans. **Epidermal Cells:** Epidermal Cells are flat and tightly packed cells that make the

outer layer (epidermis) of plant organs.

70. Write importance of Epidermis.

Ans. Importance of Epidermis:

- i. Epidermis protects the internal tissues. Modified cells of epidermis also perform other functions.
- ii. These cells make extensions called root hairs to absorb water and minerals from soil.
- iii. Lower epidermis of leaves contains guard cells which regulate opening, and closing of stomata.

71. What is structure and function of Muscle cells?

Ans. Muscle Cells:

Muscle cells are specialized animal cells that can contract.

Structure:

They are elongated cells filled with actin and other contractile proteins. Skeletal muscle cells are long striated. They are attached to bones.

Function:

They are voluntary in action and their contractions move the skeleton for body movements and locomotion.

72. Compare cardiac muscles and smooth muscles.

OR Write the functions of Cardiac Muscles.

OR Write is functions of Smooth Muscles.

Ans.

Cardiac Muscles	Smooth Muscles
Cardiac muscle cells are branched and striated. They are found in the heart walls. Function: Cardiac muscles are involuntary in action and their contractions result in the pumping action of heart.	Smooth muscle cells are spindle shaped and non-straited. Function: Smooth muscle are involuntary in action and they are present in the walls of many internal organs. For example, smooth muscles in the alimentary canal contract to move food forward, while those in blood vessels .regulate blood flow.

73. Differentiate between Dendrites and Axon.

Ans.

Dendrites	Axon
Dendrites, the shorter extensions, receive nerve impulses and transmit them to the cell body.	Axons are the longer extensions, carry nerve impulses away from the cell body.

74. What are Neurons? Also write their function.

Ans. Neurons:

Neurons are the specialized cells of the nervous system.

Function:

They responsible for transmitting messages (nerve impulses) throughout the body.

75. What are Erythrocytes or RBC's? Write their function.

Ans. Erythrocytes: Red blood cells are specialized to carry oxygen from the lungs to the filled with haemoglobin that actually carries oxygen. In mammals, the mature red blood cells do not contain nucleus, mitochondria, and endoplasmic reticulum etc., It helps to accommodate more haemoglobin.

76. What are hepatocytes? Write their importance.

Ans. Liver Cell (Hepatocytes):

Liver cell are also called hepatocytes.

Functions of Hepatocytes:

Hepatocytes are specialized for a lot of important functions like storage of glycogen, iron and some vitamins; detoxification of toxic substances production of form clotting-proteins of blood, recycling of old red blood cells etc.

77. What is meant by division of labour within cells?

Ans. Division of Labour:

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

3.5**STEM CELLS**

78. Define stem cells. Write their importance.

Ans. Stem Cells:

"Unspecialized cell that has the ability to differentiate into a variety of specialized cell types is called stem cell."

Importance:

- i. During development, when the earliest stem cell (zygote) divides, it makes different cell lines. The cells of, each line differentiate into specific type like skin cells, muscle cells, nerve cells, blood cells etc.
- ii. Stem cells also remain in different parts of the body throughout life. These stem cells can divide and differentiate into specific cells as the body needs Them.
- iii. They can also regenerate damaged tissue under the right conditions.