Section I: (MCQs)

Select the correct answer:

1. **The study of functions of various organs of an organism is _____.**
   A. morphology B. histology
   C. anatomy D. physiology
2. **Histology is the microscopic study of _____.**
   A. tissues B. cells
   C. fossils D. plants
3. **Palaeontology is the study of _____.**
   A. environment B. development
   C. fossils D. animals
4. **The other name of environmental biology is _____.**
   A. ecology B. biotechnology
   C. microbiology D. cell biology
5. **Microbiology is the study of _____.**
   A. fungi B. animals
   C. plants D. microorganism
6. **If a scientist is studying the methods of inserting human insulin gene in bacteria, which branch of biology may this be?**
   A. anatomy B. physiology
   C. biotechnology D. pharmacy
7. **The starting point of scientific investigation is:**
   A. hypothesis B. theory
   C. observation D. data
8. **Information that is gathered as a result of an experiment is called:**
   A. hypothesis B. data
   C. theory D. Observation
9. **Which of the following represents the correct sequence of different steps of scientific study?**
   A. observation, ⟶ hypothesis ⟶ experiment ⟶ deduction ⟶ theory
   B. observation, ⟶ deduction ⟶ hypothesis ⟶ theory ⟶ experiment
   C. hypothesis ⟶ observation ⟶ deduction ⟶ experiment ⟶ theory
   D. observation ⟶ hypothesis ⟶ deduction ⟶ experiment ⟶ theory

10. **Which of the following statements best distinguishes hypothesis from theories in science?**
    A. theories are hypothesis that have been proven true
    B. theories are based on limited data while hypothesis are based on wide range of data
    C. theories are uncertain while hypothesis are certain
    D. theories are educated guess while hypothesis are widely accepted explanation of natural phenomenon

11. **Malaria is caused by:**
    A. mosquito
    B. stagnant water
    C. swamp
    D. Plasmodium

12. **Malarial patient has Plasmodium in his blood. What would be the possible explanation if a healthy person who is not having any malarial symptoms shows Plasmodium in his blood?**
    A. Plasmodium are dead
    B. Plasmodium are in incubation period
    C. Plasmodium are not mature
    D. Plasmodium are inactive

13. **You are doing a control experiment which**
    A. proceeds slowly enough that a scientist can record the results
    B. may include experimental groups and control groups tested in parallel
    C. is repeated many times to make sure the results are accurate
    D. proceed slowly enough that a scientist can test predictions

14. **Which option has correctly matched disease and vector mosquito?**

	Malaria in humans	Malaria in birds	Dengue fever
A	Anopheles	Aedes	Culex
B	Aedes	Culex	Anopheles
C	Anopheles	Culex	Aedes
D	Culex	Anopheles	Aedes

ANSWERS:

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

Section II:
Short Answer Questions

Q1. Define the following branches of biology and give at least one significance of studying these branches

a) Molecular biology **b) Physiology**

c) Palaeontology **d) Pharmacology**

Ans:

a) Molecular biology:

Molecular biology is the study of biology at molecular level.

Significance of studying Molecular biology:

It provides the foundational understanding of the molecular mechanisms of life.

b) Physiology:

The study of the functions of various organs of the organisms is called physiology.

The examples of physiology are digestion, respiration, excretion, photosynthesis etc.

Significance of studying Physiology:

Studying physiology is crucial for understanding how the body's systems function both in health and disease, which directly informs medical treatment and healthcare practices.

c) Paleontology:

It is the study of the history of life on Earth as based on fossils.

Fossils are remains of the living things preserved by natural process. Study of fossils help us to understand the life of past and process of evolution.

Significance of studying Paleontology:

Studying paleontology is significant because it provides crucial insights into the Earth's biological and environmental past, which, in turn, helps us understand current environmental changes and predict future ecological impacts.

d) Pharmacology:

The science that deals with the study of drugs is called pharmacology. In pharmacology, a drug is a chemical substance.

For example, Aspirin is a pharm of drug often used to treat pain, fever, and inflammation. The other example of drugs is morphine, insulin, penicillin etc.

Significance of studying Pharmacology:

Studying pharmacology is crucial because it underpins the development and use of drugs to treat diseases, improving health outcomes worldwide.

Q2. Can you distinguish between?

a) **Anatomy and Morphology** b) **Cytology and Genetics**

c) **Biotechnology and Immunology**

d) **Marine Biology and Ecology**

Ans:

a) Distinguish between Anatomy and Morphology:

Anatomy	Morphology
i. The study of the internal structure of the organisms is called anatomy. Anatomy is also called internal morphology.	**i.** The study of the form and external structure of the organisms is called morphology.
ii. Anatomy studies the presence of structures.	**ii.** Morphology studies the relationships of structures.
iii. Anatomy is a subdivision of morphology.	**iii.** Morphology is a branch of biology.

b) Distinguish between Cytology and Genetics:

Cytology	Genetics
i. The study of the structure and functions of the cell is called cytology. It is also called cell biology. For example, the study of plant and animal cells.	**i.** The study of genes, and heredity in organisms is called genetics. For example the plants having red flowers produce red flowerers. The white cats produce white kittens.
ii. The study of cells and their structures, functions, and chemistry.	**ii.** The study of genes, genetic variation, and heredity in organisms.
iii. Cell structure (e.g., nucleus, cytoplasm), cell function, cell life cycle, and cellular interactions.	**iii.** Structure and function of genes, genetic inheritance, gene regulation, and expression.
iv. Microscopy (light, fluorescence, electron), staining methods, and cytometric analysis.	**iv.** DNA sequencing, PCR, gel electrophoresis, CRISPR-Cas9, and bioinformatics.

c) Distinguish between Biotechnology and Immunology:

Biotechnology	Immunology
i. The study of use of different techniques to manipulate the living organisms for the benefit of mankind is called biotechnology.	**i.** The ability of the body to protect itself from foreign substances and cells including infectious microbes is called immunity and the study of immunity is called immunology.
ii. The most prominent area of biotechnology is the production of therapeutic proteins and other drugs through genetic engineering	**ii.** There are two types of immunity: active and passive.

d) Distinguish between Marine Biology and Ecology:

Marine Biology	Ecology
i. The study of organisms that live in sea is called marine biology. For example the study of fish, whales, dolphins, and porpoises, sponges, crustaceans, and molluscs etc.	**i.** The study of the interrelationship of organisms and their environment is called ecology. It is also known as environmental biology. For example the study of ecology of pond, lake, forest, desert etc.
ii. The study of organisms in the ocean and other saltwater environments, including their behaviors, biology, and interactions.	**ii.** The study of interactions between organisms and their environment, across ecosystems.
iii. Primarily focuses on life forms found in marine environments, from microscopic plankton to the largest whales.	**iii.** Focuses on the relationships between living organisms, including plants, animals, and microbes, and their physical surroundings.
iv. Often concentrates on specific organisms or specific aspects of the marine environment, such as the biology of a particular species.	**iv.** Broadly looks at the patterns and processes that govern life across different environments, not limited to marine ecosystems.

Q3. Healthy life of a person depends on healthy life choices. How study of biology is going to help you to live a healthy life.

Ans: Biology helps us to lead a healthy life as it helps us to know about the following things.

i. Its a branch of science that gives us clear knowledge about all the living beings.

ii. It helps the doctors to detect the diseases and treat accordingly.

iii. It gives us knowledge about the microbes, and other small insects.

iv. It also gives us the knowledge in an order to keep a balanced diet.

v. It tells us that we have to exercise daily to stay healthy.

vi. It gives information about how the unclean surroundings or things may lead to several diseases.

vii. It promotes the idea of conserving trees as it teaches us about the importance of the trees.

viii. It also teaches us to prevent global warming.

ix. It tells us to preserve the natural resources.

x. It helps to power the plant.

Q4. What is the contribution of the following scientists?

a) A.F.A King b) Ronald Ross c) Laveran

Ans:

a) Contribution of A.F.A King:

King was one of the earliest to suggest the connection between mosquitoes and malaria. A.F.A King listed 20 observations about malaria. On the basis of his

observations King suggested a hypothesis about malaria; "Mosquitoes transmit Plasmodium so are involved in spread of malaria."

a) Contribution of Ronald Ross:

Ronald Ross was a British Army physician working in India. He received the Nobel Prize for Physiology or Medicine in 1902 for his work on malaria. He performed important experiments on humans and sparrows. He is famous for being the discoverer of the mosquito transmission of malaria. He discovered that the salivary gland in the mosquito was the storage site of malarial parasites and using infected birds, he demonstrated the role of Mosquitoes in spread of malaria.

a) Contribution of Laveran:

Charles Louis Alphonse Laveran (18 June 1845 – 18 May 1922) was a French physician who won the Nobel Prize in Physiology or Medicine in 1907 for his discoveries of parasitic protozoans as causative agents of infectious diseases such as malaria and trypanosomiasis. Following his father, Louis Théodore Laveran, he took up military medicine as his profession. He obtained his medical degree from University of Strasbourg in 1867.

Q5. Observations are mainly of two types i.e., qualitative and quantitative. Sort the following observation according to these two types. Colour of cat, Height of giraffe, Weight of mango fruits, Body temperature of birds, Volume of blood in humans, Shape of leaves, Climate of desert, Speed of tiger, Song of a bird.

Ans:

Qualitative observation	Quantitative observation
Colour of cat	Weight of mango fruits
Shape of leaves	Body temperature of birds
Climate of desert	Volume of blood in humans
Song of a bird	Speed of tiger
	Height of giraffe

Q6. A Noble prize winner gave a hypothesis about effects of COVID-19 vaccine. Can it be wrong? Why? Develop deduction from this hypothesis, "Vaccination of COVID-19 can reduce the severity of complications in case of infection."

Ans: Luc Montagnier was a French Nobel prize winner virologist. He won the Nobel Prize in Physiology or Medicine for his discovery of the human immunodeficiency virus (HIV). A baseless quote has been widely attributed to a Nobel Prize winner French virologist Luc Montagnier says "has confirmed that there is no chance of survival for people who have received any form of the vaccine". People will die from antibody-dependent enhancement after receiving a COVID-19 vaccine.

There is no evidence to back up this claim, nor was Reuters able to find any instance where the laureate made this comment.

However, this is not accurate. Moreover, COVID-19 vaccines have been shown to save thousands of lives. "Overwhelmingly, vaccinated people are showing protection against severe COVID-19 cases and hospitalisations," said medical experts.

Deduction:

"If the theory that the COVID-19 vaccine can lessen the seventy of problems in the event of infection is accepted, we can infer that becoming vaccinated is an effective COVID-19 preventative approach. People who receive the vaccine are less likely to develop severe symptoms or other problems if they contract the virus. Public health may be significantly impacted by this since mass immunization may lessen the COVID-19 pandemic's overall severity and effects."

Q7. Why it is impossible to eradicate malaria?

Ans:

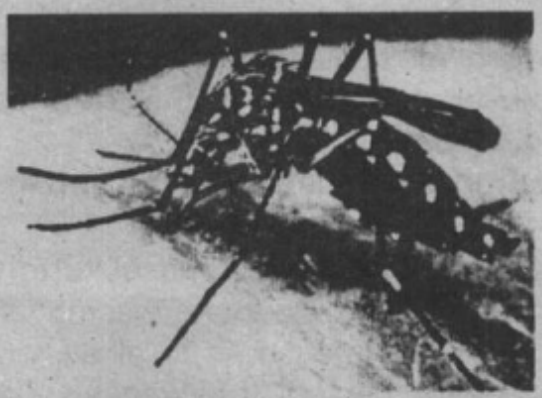
i. Complex Life Cycle:

The parasite that causes malaria, Plasmodium, has a complex life cycle that involves both humans and mosquitoes. This complexity makes it difficult to interrupt transmission completely.

ii. Vector Control Challenges:

Malaria is primarily transmitted through the bites of infected mosquitoes. Controlling mosquito populations and preventing their bites through measures like insecticide-treated bed nets and indoor residual spraying can reduce transmission, but mosquitoes can develop resistance to insecticides, and reaching all affected areas with these interventions is challenging.

Q8. The diagram shows one insect. Answer the following questions related to it.



i. Why do we use word vector for mosquito?

ii. What is name of organism which transmit malaria disease in man and birds?

iii. What was the main purpose of experiment by Ronald Ross?

Ans:

i. Why do we use word vector for mosquito?

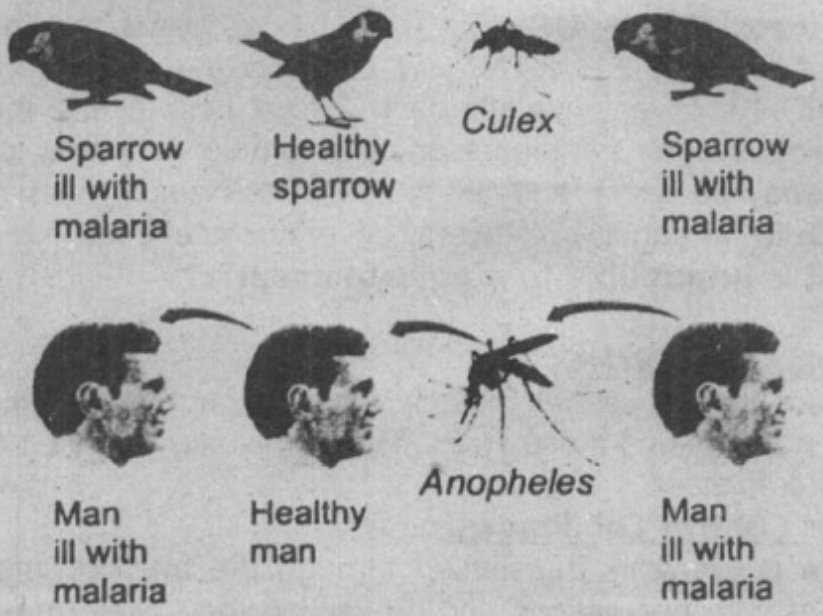
Ans: The term "vector" is used in the context of diseases like malaria because it refers to an organism, typically an insect or other arthropod, that transmits infectious pathogens from one host to another.

In the case of malaria, the Anopheles mosquito acts as the vector, transmitting the Plasmodium parasite from infected humans to uninfected individuals through its bites.

ii. What is name of organism which transmit malaria disease in man and birds?

Ans: **Name of organism in man:** Anopheles

Name of organism in bird: Culex



iii. What was the main purpose of experiment by Ronald Ross?

Ans: Ross was a British Army physician working in India. On 20th August 1897, Ronald Ross made his land mark discovery. He performed important experiments on humans and sparrows. The main purpose of experiment by Ronald Ross were as follows;

- to find out the role of mosquitoes in spreading malaria.
- to prove the role of mosquitoes in the transmission of malarial parasites (Plasmodium) to humans.

Q9. Why Ross did not allow the infected mosquitoes to bite a healthy person?

Ans: Ross allowed a female Anopheles mosquito to bite a malarial patient. He killed the mosquito some days later and found Plasmodium multiplying in mosquito's stomach. The next logical experiment was to allow an infected mosquito (having Plasmodium) to bite a healthy person. If hypothesis was true, the healthy person would have got malaria. But scientists avoid using human beings for experiments when results can be so serious. That's why Ross didn't allow the infected mosquitoes to bite a healthy person. He used sparrows and redesigned his experiments.

Q10. A student wants to investigate the effect of different factors on the activity of salivary amylase. He will design an experiment in order to reach conclusion. What would be the most appropriate first step to initiate?

Ans: The most appropriate first step to initiate an experiment investigating the effect of different factors on the activity of salivary amylase would be to formulate a clear and specific hypothesis. A hypothesis is a testable statement that predicts the outcome of the experiment based on the understanding of the scientific principles involved.

For example, the student might hypothesize that "The activity of salivary amylase decreases as the pH of the solution deviates from the enzyme's optimal pH level." This hypothesis suggests a specific relationship between the pH level (the independent variable) and the activity of salivary amylase (the dependent variable).

Q11. Hepatitis B virus was found in blood of 10 persons. Only 6 of them were suffering from Hepatitis B disease. Why?

Ans: The situation where the Hepatitis B virus (HBV) is found in the blood of 10 individuals, but only 6 of them are suffering from Hepatitis B disease, can be explained by several factors related to the immune response, the nature of HBV infection, and the diagnostic criteria for the disease. Here are some key points to consider:

i. **Asymptomatic Carriers:**

Some individuals infected with HBV do not show any symptoms of the disease, especially in the early stages of infection. These asymptomatic carriers have the virus in their bloodstream, and it can be detected through blood tests, but they do not exhibit the clinical symptoms associated with Hepatitis B.

ii. **Immune Response Variability:**

The immune system's response to HBV can vary significantly among individuals. Some people may mount an effective immune response that controls the virus to a point where it does not cause noticeable illness, while others may develop acute or chronic hepatitis with more severe symptoms.

iii. **Chronic vs. Acute Infection:**

HBV can cause both acute and chronic infections. In acute infection, some individuals might clear the virus from their bodies and never progress to chronic infection or show symptoms of liver disease. In contrast, those with chronic HBV infection may have the virus in their blood for extended periods, and the infection can lead to symptoms and liver damage over time. The 4 individuals without apparent Hepatitis B disease symptoms could be in an early stage of infection or may have a chronic infection that has not yet manifested with significant symptoms.

iv. **Window Period:**

There's a "window period" in hepatitis B infection where the virus is present in the blood, but the immune response (specific antibodies) has not yet reached detectable levels. During this time, an individual might not test positive for certain markers of infection that are typically used to diagnose active disease.

v. **Diagnostic Criteria:**

The diagnosis of Hepatitis B disease typically relies on a combination of clinical symptoms (like jaundice, abdominal pain, and fatigue) and specific blood tests that detect viral antigens and antibodies. Individuals who have the virus but do not meet the full criteria for diagnosis based on symptoms and test results may not be classified as suffering from the disease.

Section III:
Extensive Answer Questions

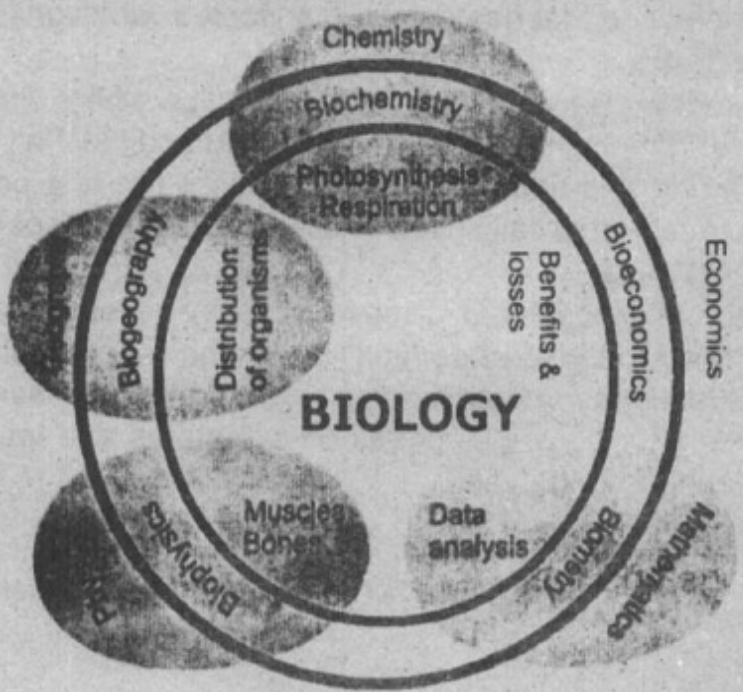
Q1. How biology is related with other sciences? Show and explain the link.

OR

Relate that biology connects with other natural sciences. Students should be able to distinguish in terms of the broad subject matter the below fields:
Biophysics - Biochemistry - Computational Biology - Biogeography - Biostatistics - Biotechnology -Bioeconomics.

Ans: **Relationship of biology with other sciences:**

Biology in one way or other is integrated with other disciplines of science. The animals move, walk or run on the principles of physics. There is a similarity between working principle of lever in physics and human limbs. The behaviour of atoms and molecules underline and explain the behaviour of living cell. The physical structure of atoms and molecules determine their chemical properties and the roles they play in cells. To understand biology, basic knowledge of chemistry is necessary. So, biology is not an isolated science and is associated with other branches of science.



Relationship of biology with other sciences

RELATIONSHIP OF BIOLOGY WITH OTHER SCIENCES	
Biophysics	Biological organisms work on the principles of physics e.g., movement of muscles and bones. The study of biological phenomena according to the principles and laws of physics is called biophysics.

Biochemistry	The study of chemical constituents found in an organism and chemical reactions taking place in the living organism is called biochemistry. Living organisms consist of carbon, hydrogen, oxygen, nitrogen, etc., and chemical reactions such as digestion of food, respiration, and photosynthesis takes place in the organism.
Biostatistics	Statistics is related to collecting and analysing various data or facts. The collection of biological data or facts through observations, experiments and analysing them according to statistical rules for biological study. It is also is called biometry.
Computational biology	The study of the use of data analysis, mathematical modeling, and computational simulations to understand biological system is called computational biology. The example of computational biology includes the process of locating fragments of DNA on chromosomes.
Biogeography	The study of distribution of plants and animals in different geographical regions of the world is called biogeography.
Biotechnology	The study of use of different techniques to manipulate the living organisms for the benefit of mankind is called biotechnology.
Bio-economics	The study of biology from economic point of view is called bio-economics. Production of wheat, fish, rice and studying their export value etc., are the examples of bio-economics.

Q2. How biology can lead to career of medicine, surgery, fisheries, agriculture, animal husbandry, biotechnology, horticulture, farming, forestry.

Ans: **Careers that require a background in biology:**

After studying the basic courses in biology at secondary and higher secondary level a person has to select a career or profession. Pursuing a career in biology can be immensely rewarding and exciting. There are several applied fields in biology that you can select as a career e.g., medicine, surgery, fisheries, agriculture, animal husbandry, biotechnology, horticulture, farming and forestry etc.

CAREERS THAT REQUIRE A BACKGROUND IN BIOLOGY	
Medicine and surgery	MBBS stand for bachelor of medicine and bachelor of surgery. Medicine is the diagnosis and treatment of different diseases. Surgery is the branch which treats diseases by removal, or replacement of the defective parts or organs. After MBBS a student can specialize in various fields of medicine and surgery.
Fisheries	The fisheries sector makes a significant contribution to the economy of Pakistan. Careers associated with it are fish farming, fishery management and related research.
Agriculture	Careers associated with agriculture are food science, agricultural engineering, agricultural entomology (a person who studies insects) etc.

Animal Husbandry	Animal husbandry is the care and breeding of domestic animals. The careers associated with animal husbandry are veterinary science, animal breeding, animal training etc.
Biotechnology	Biotechnology is the use of living organisms or their components to make useful products. The careers associated with biotechnology are bacteriology, virology, molecular genetics etc.
Horticulture	Horticulture means the art of gardening. The careers involved are plant breeding, horticulture etc.
Farming	Careers associated with agriculture are food science, agricultural engineering, agricultural entomology (a person who studies insects) etc.
Forestry	It is the science of planting, managing and caring for forests. The careers related to forestry are forest ecology, environmental engineering etc.

Q3. Explain that science is a collaborative field.

Ans: **Science is a collaborative field:**

Scientists from all around the world team up to share ideas and make progress in their research. Some are studying similar things, while others have different knowledge that can help.

When researchers from different fields work together to create new scientific knowledge, it's called interdisciplinary research collaboration. This is important because they can work on research, find solutions, and use what they learn to solve problems and discover new things.

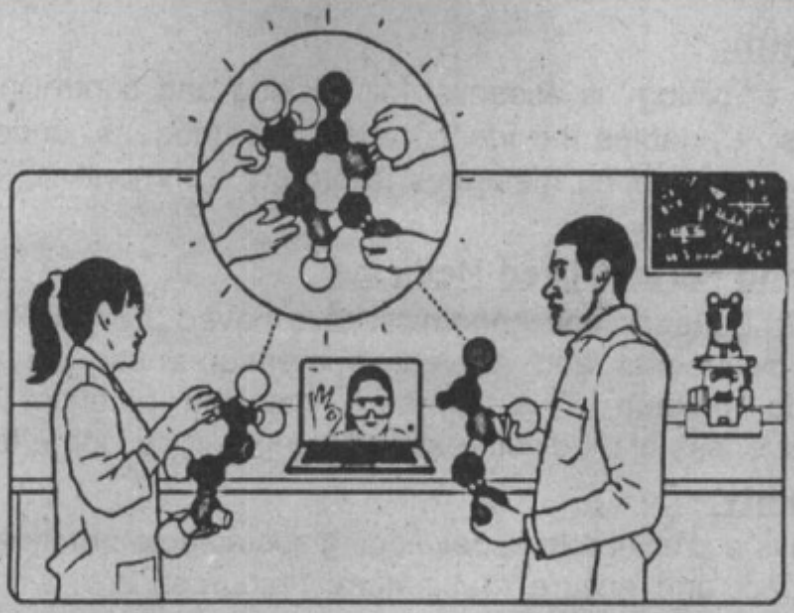
For example, Cognitive Science combines knowledge from neurology, psychology, anthropology, linguistics, environmental, engineering, Pharmacology and statistics.

Women's Studies combines what we know about gender, history, literature, and biology. Public health combines information from medicine, sociology, and psychology.

Bioinformatics is a combination of biology and information technology. It helps to understand complex biological data. The new emerging careers of biology are bio informaticians (apply their computer skills in solving problems in life science), biomedical engineers (develop new devices and equipment for improving human health), Astrobiologists (study effects of outer spaces on living organisms), Cryobiologists (study of effects of low temperature on living organisms) etc.

There was a special issue about research collaboration during the COVID era, showing how it was good for both science and society, when we work together across borders, cultures, and different fields of study.

One famous example of scientists working together is the International Space Station, where space agencies from Europe, the USA, Russia, and Japan all team up.



Q4. Why is biology important for the welfare of human beings? Give reasons.

Ans: Biology, the study of life and living organisms, is fundamentally important for the welfare of human beings for a multitude of reasons. It not only enhances our understanding of the human body, the environment, and the myriad forms of life with which we share the planet, but it also applies this knowledge to improve our quality of life. Here are several key reasons why biology is crucial for human welfare:

i. Medical Advances:

Biology is at the core of medical science and research. It helps us understand the mechanisms of diseases, leading to the development of treatments, vaccines, and diagnostic tools. This knowledge is crucial for combating existing diseases, responding to emerging health crises, and improving public health outcomes.

ii. Agricultural Improvements:

The study of plant biology and genetics has led to the development of agricultural practices and technologies that increase food production, improve nutritional quality, and ensure food security. Biotechnological advancements, such as genetically modified organisms (GMOs), have the potential to address challenges related to pests, drought, and soil quality.

iii. Environmental Conservation:

Biology informs conservation efforts by helping us understand the complexities of ecosystems and the impacts of human activity on biodiversity. This knowledge is crucial for developing strategies to protect endangered species, restore habitats, and maintain ecological balance.

iv. Biotechnology:

The field of biotechnology applies biological knowledge to develop products and technologies that improve our lives. These include the production of biofuels, biodegradable plastics, and pharmaceuticals. Biotechnology also plays a role in environmental cleanup through the use of organisms to remove pollutants.

v. Understanding Human Physiology:

Biology helps us understand the functioning of our own bodies, including nutrition, reproduction, and aging. This knowledge influences public health policies, fitness, and wellness practices, and helps individuals make informed decisions about their health and lifestyle.

vi. Public Health:

Knowledge of biology is essential for tracking and controlling outbreaks of infectious diseases. It enables the identification of pathogens, understanding their transmission, and implementing measures to protect communities, which is crucial for global health security.

vii. Genetics and Personalized Medicine:

Advances in genetics and genomics have paved the way for personalized medicine, where treatments and preventive measures can be tailored to the individual's genetic makeup. This approach has the potential to significantly increase the effectiveness of medical treatments and reduce side effects.

viii. Sustainability:

Biology plays a crucial role in developing sustainable practices that minimize environmental impact and ensure that natural resources are available for future generations. This includes sustainable agriculture, waste management, and the use of renewable resources.

In conclusion, the importance of biology for the welfare of human beings cannot be overstated. It underpins advancements in healthcare, environmental protection, agriculture, and numerous other areas that are critical for the survival and flourishing of humanity. Through continued research and application of biological knowledge, we can address many of the challenges facing the world today.

Q5. Give at least ten examples of farming of animals which can improve economy of Pakistan. Describe the products and benefits of each example as well.

Ans: Pakistan's economy can significantly benefit from diversified animal farming practices. By investing in the farming of various animals, not only can the country enhance its food security but also increase its export potential, create job opportunities, and improve the livelihoods of many, especially in rural areas. Here are ten examples of animal farming that could bolster Pakistan's economy, along with the products and benefits they offer:

i. Dairy Farming (Cows and Buffaloes):

Products: Milk, cheese, yogurt, and butter.

Benefits:

Pakistan is among the top milk-producing countries. Expanding dairy farming can meet domestic demand and allow for export of dairy products. It also creates employment opportunities in rural areas.

ii. Poultry Farming:

Products: Eggs, meat, and feathers.

Benefits:

Poultry farming can rapidly increase to meet the growing demand for protein-rich foods. It requires relatively low investment and can provide quick returns, supporting smallholder farmers.

iii. Goat Farming:

Products: Meat, milk, skin, and fiber.

Benefits:

Goat farming is adaptable to Pakistan's varied climates. Goats are raised for their high-quality meat (mutton) and milk, which are in high demand both domestically and internationally. Goat skin is also valuable in the leather industry.

iv. Sheep Farming:

Products: Meat, wool, and skin.

Benefits:

Sheep provide high-quality wool for the textile industry, in addition to meat. Wool is a valuable export commodity, and sheepskin is used in the leather industry.

v. Camel Farming:

Products: Milk, meat, and leather.

Benefits:

Camels are well-suited to the arid regions of Pakistan. Camel milk is highly nutritious, and there is a growing market for camel milk products. Camel leather is highly valued for its durability.

vi. Fish Farming (Aquaculture):

Products: Fish and shrimp.

Benefits:

Aquaculture can be a significant source of seafood without depleting wild stocks. It can contribute to food security and provide export opportunities, particularly with high-value species like shrimp.

vii. Beekeeping (Apiculture):

Products: Honey, beeswax, and pollen.

Benefits:

Beekeeping can supplement incomes with minimal investment. Honey and beeswax have high demand domestically and internationally. Beekeeping also supports agriculture through pollination.

viii. Cattle Fattening:

Products: Beef and leather.

Benefits:

Focused on producing high-quality beef for domestic consumption and export, cattle fattening can improve the quality of meat in the market and provide leather for the textile industry.

ix. Silkworm Farming (Sericulture):

Products: Silk.

Benefits:

Silk farming can revitalize rural economies through the production of high-quality silk, a valuable export product. It requires low investment and provides employment opportunities, particularly for women in rural areas.

x. Ostrich Farming:

Products: Meat, feathers, and leather.

Benefits:

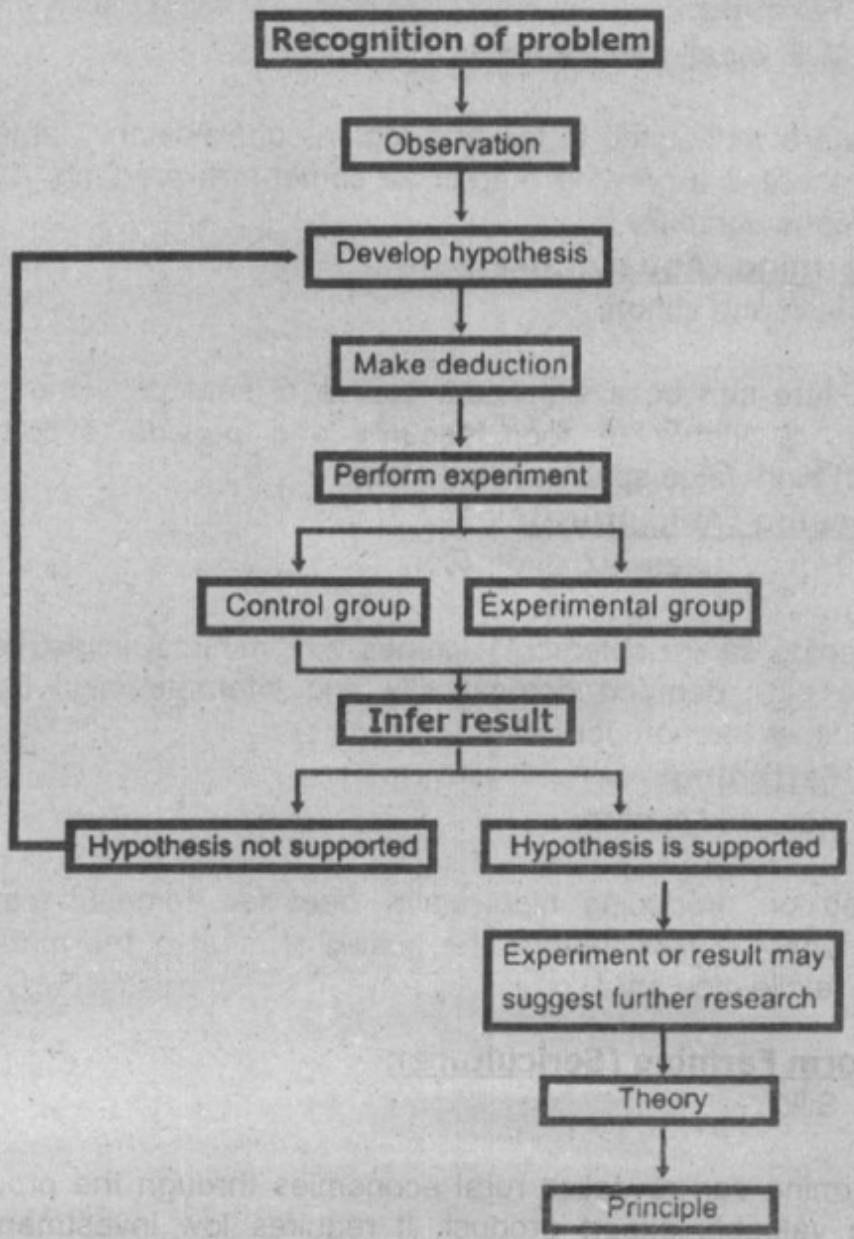
Ostrich farming is relatively new but has significant potential due to the high value of ostrich products. Ostrich meat is lean and healthy, feathers are used for decoration, and ostrich leather is a luxury item.

Each of these farming practices offers unique advantages and can contribute to Pakistan's economy through diversification, increased exports, and job creation. By investing in training, infrastructure, and market development, Pakistan can optimize the benefits from these animal farming sectors.

Q6. Discuss biological method of study and its application.

Ans: Biological Method:

There is nothing magical about science. You already have some of the qualities of a scientist e.g., you are curious. You like to do new and different things. You like to explore new places. These are the natural talents or skills of a scientist which he may use to solve different scientific problems.



Scientists, including biologists, employ an approach for solving scientific problem that is known as the scientific method. Biological problems are solved by a series of steps of biological method.

Biological method: It has the following steps:

i. Recognition of a biological problem **ii.** Observation and identification
iii. Building up hypothesis **iv.** Drawing deductions
v. Devising experiment **vi.** Inferring result

i. **Recognition of the biological problem:**

Biological problem is a question related to living organisms. This question is either asked by someone or comes in mind of a researcher.

ii. **Observations:**

Observations are very important step in solving a biological problem. Observations are made by five senses of vision, hearing, smell, taste and touch. Observations are of two types;

Qualitative observations; which are based on some quality or characteristic.

Quantitative observations; which are based on measurable value. Quantitative observations being measurable are invariable and can be expressed in terms of numbers, so are more accurate.

iii. **Formulation of Hypothesis:**

Hypothesis is a statement that may prove to be the answer of the biological problem under study. Hypothesis is a tentative explanation of the observations that might be true. A hypothesis should have following characteristics;

a. It should be a general statement.

b. It should be tentative idea.

c. It should agree with the available observations.

d. It should be testable and potentially falsifiable.

iv. **Deductions:**

Deductions are the logical consequences of the hypothesis. To draw deductions hypothesis is taken as true. Deductions involve "if" and "then" logic.

v. **Experimentation:**

It is the most important step of biological method. Experiments are performed to prove if hypothesis is true or not. The deductions drawn from the hypothesis are subjected to rigorous testing. Through experimentation, biologist learns which hypothesis is correct.

vi. **Summarization of the results:**

The biologist gathers actual quantitative data from experiments. This data arranged to draw results.

Applications of the Biological Method:

i. **Medical Research:**

Understanding diseases, developing treatments, and vaccines. For example, the biological method has been crucial in developing vaccines for diseases like COVID-19 by understanding the virus's biology, how it infects cells, and how the immune system can counter it.

ii. **Conservation Biology:**

Identifying the causes of species decline and devising strategies for conservation. Observations on declining bee populations have led to research into pesticides' effects, climate change, and habitat loss.

iii. **Agriculture:**

Enhancing crop yields, developing pest-resistant crops, and improving agricultural practices. Genetic studies and experiments have led to the development of genetically modified organisms (GMOs) that can withstand harsh conditions or

iv. Environmental Science:

Understanding ecosystems, biodiversity, and the impacts of human activity on the environment. The biological method helps in studying pollution effects on aquatic life, leading to better waste management practices.

v. Biotechnology:

Application of biological knowledge to develop technologies and products that improve lives, such as producing biofuels from algae or developing biodegradable plastics.

Q7. How biological method is applied to find the cause of malaria?

OR

Describe the steps of the scientific method: that is Recognition, Observation, Hypothesis, Deduction, Experiments, and Results to find the cause of malaria.

Ans: Malaria an example of biological method of study:

Malaria has killed more people than any other disease. The malaria is an example of a biological problem and how such problems can be solved.

Symptoms of Malaria:

The patient of malaria feels very chill and cold. His temperature rises above normal value of **98.6° F**. The patient suffers from headache and has feeling of nausea. After some time, the person begins to sweat, feels better. The whole series of events are repeated after every 24, 48 or 72 hours depending upon the species of Plasmodium.

i. Cause of malaria:

By adopting the steps of biological method, it was proved that malaria is caused by Plasmodium.

Recognition of the problem:

Malaria was a problem since ancient times, but its cause was not known.

Observations:

In 19th century, many different causes of malaria were being suggested. By that time, there were four major observations about malaria.

a. Malaria and marshy areas have some relation.
b. Quinine is an effective drug for treating malaria.
c. Drinking the water of marshes does not cause malaria.
d. Plasmodium is seen in the blood of a malarial patient.

Hypothesis:

Based on these observations and other information, following hypothesis was formulated by a French physician Laveran in 1882.

"Plasmodium is the cause of malaria".

Deduction:

Although hypothesis is a tentative idea, to draw deductions it is accepted to be true. One of the deductions from the above hypothesis was;

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

Experiments:

This deduction was tested through experiment. Experiment was designed as; Blood of 100 patients was examined under microscope. For the purpose of

having control group, the blood of 100 healthy persons was also examined under microscope.

Results:

The results of experiments showed that almost all malarial patients had Plasmodium in their blood. Only 07 out of 100 healthy persons had Plasmodium in their blood. Other 93 healthy persons were without any trace of Plasmodium in their blood.

In the 07 healthy persons with Plasmodium in their blood, Plasmodium was in incubation period. The incubation period is time between the entry of parasite in the host and the appearance of the symptoms of disease. After few days those 07 healthy persons became ill with malaria.

Results were quite convincing to prove the hypothesis that "Plasmodium is the cause of malaria"

Reporting the results:

Results of these experiments were announced worldwide which helped to control malaria.

Q8. Explain use of biological method to understand the spread of malaria.

OR

Elaborate on the steps of the scientific method and explain how they contribute to the development of scientific knowledge.

Ans: Spread of malaria:

Biological method helped to find that mosquitoes spread malaria.

Recognition of the problem:

Malaria is a fatal disease since ancient times. After the confirmation that malaria is caused by Plasmodium, it was important to find how Plasmodium gets into the blood of man. This disease was more common in areas near stagnant water ponds where mosquitoes breed. It was found that;

a. Malaria is associated with marshes.

b. Drinking water of marshes does not cause malaria.

From these points, it can be concluded that Plasmodium was not present in the marshy water. So Plasmodium must be carried by something that comes to marshy water. Problem in this study was to find that agent.

Observations:

An American scientist A. F. A. King listed 20 observations in 1883 about spread of malaria. Some important observations were;

a. People who slept outdoors were more likely to get malaria than those who slept indoors.

b. People who slept under fine nets were less likely to get malaria than those who did not use such nets.

c. People who slept near smoky fire usually did not get malaria.

Hypothesis:

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

Deductions:

Following deductions were made considering the hypothesis true.

Deduction I: "Plasmodium should be present in mosquito".

Deduction II: "A mosquito can get Plasmodium by biting a malarial patient".

Experiments:

In order to test the above deductions, many experiments were performed.

Experiments of Ronald Ross:

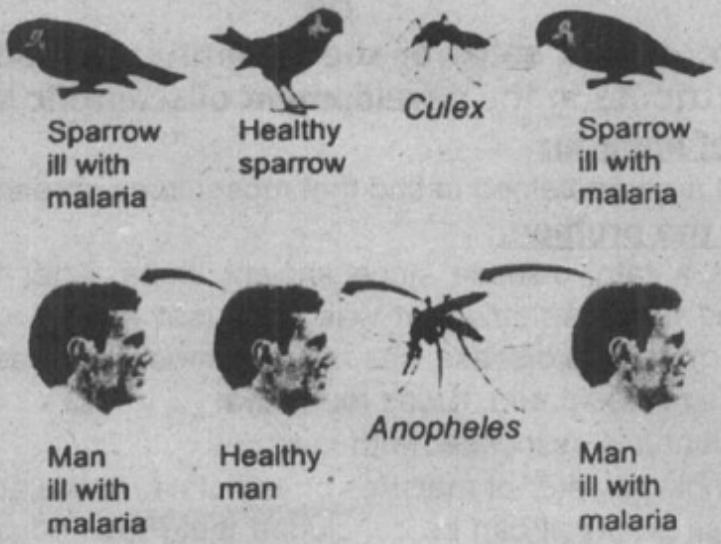
Ross, a British army physician working in India performed an important experiment in 1897.

He allowed a female Anopheles mosquito to bite a malarial patient. He killed the mosquito some days later and found Plasmodium multiplying in mosquito's stomach.

Next Ross used sparrows in his experiments. He allowed female Cutex mosquitos to bite the sparrows suffering from malaria. He then allowed these mosquitoes to bite healthy sparrows.

After few days these sparrows became ill with malaria.

In the end, the hypothesis was tested by direct experimentation on human beings. An Italian biologist allowed an Anopheles mosquito to bite a malarial patient. The mosquito was kept for few days and then it was allowed to bite a healthy man. The person later became ill with malaria.



Results:

All these experiments confirmed that mosquito transmit Plasmodium and spread malaria.