

## Biology

Chapter #1.

### **Q.1 Define Science.**

Ans: Science is the study in which observations are made, experiments are done and logical conclusions

are drawn in order to understand the principles of nature.

### **Q. 2 Define biology. What are 3 major divisions of biology?**

Ans: Biology is the scientific study of life. The word "biology" has been derived from two Greek words; 'bios' meaning 'life' and 'logos' meaning 'thought or reasoning'.

#### **Divisions of biology :**

There are three major divisions of biology which study the different aspects of the lives of the major groups of organisms.

#### **ZOOLOGY**

This division of biology deals with the study of animals.

#### **BOTANY**

This division of biology deals with the study of plants.

#### **MICROBIOLOGY**

This division of biology deals with the study of microorganisms such as bacteria etc.

### **Q. 3 Describe the branches of biology in detail.**

Ans: In order to study all the aspects of life, these divisions are further divided into different branches

as defined below.

#### **Morphology**

This branch deals with the study of form and structures of living organisms.

#### **Anatomy**

The study of internal structures is called anatomy.

#### **Histology**

The microscopic study of tissues is called histology.

#### **Cell biology**

The study of the structures and functions of cells and cell organelles is called cell biology. This branch also deals with the study of cell division.

#### **Physiology**

This branch deals with the study of the functions of different parts of living organisms.

#### **Genetics**

The study of genes and their roles in inheritance is called genetics. Inheritance means the transmission of characters from one generation to the other.

#### **Embryology**

It is the study of the development of an embryo to new individual.

#### **Taxonomy**

It is the study of the naming and classification of organisms into groups and subgroups.

#### **Palaeontology**

It is the study of fossils, which are the remains of extinct organisms.

#### **Environmental biology**

It deals with the study of the interactions between the organisms and their environment.

**Socio-biology**

This branch deals with the study of social behaviour of the animals that make societies

Parasitology:

This branch deals with the study of parasites.

**Biotechnology:**

It deals with the practical application of living organisms to make substances for the welfare of mankind.

**Immunology**

It is the study of the immune system of animals, which defends the body against invading microbes.

**Entomology**

It is the study of insects.

**Pharmacology**

It is the study of drugs and their effects on the systems of human body.

**Q. 4 Describe the relationship of biology with other sciences.**

Ans: Relationship of biology to other sciences

Biology includes information on various aspects of living things but these information relate to the other branches of science as well.. For example, when studying the process of movement in animals, the biologists have to refer to the laws of motion in physics.

**Biophysics:**

It deals with the study of the principles of physics, which are applicable to biological phenomena.

For example there is a similarity between the working principles of lever in physics and limbs of animals in biology.

**Biochemistry:**

It deals with the study of the chemistry of different compounds and processes occurring in living organisms. For example the study of basic metabolism of photosynthesis and respiration involves the knowledge of chemistry.

**Biomathematics / Biometry:**

It deals with the study of biological processes using mathematical techniques and tools. For example to analyze the data gathered after experimental work, biologists have to apply the rules of mathematics.

**Biogeography:**

It deals with study of the occurrence and distribution of different species of living organisms in different geographical regions of the world. Bioeconomics:

It deals with the study of organisms from economical point of view. For example the cost value and profit value of the yield of wheat can be calculated through bioeconomics and benefits or losses can be determined.

**Q. 5 Describe the major careers in the feild of biology.**

Ans: The following are the careers that a student of biology can plan to adopt.

**Medicine / Surgery:**

The profession of medicine deals with the diagnosis and treatment of diseases in human. In surgery the parts of the body may be repaired, replaced or removed, for example the removal of stones through renal surgery, transplantation of kidney, liver etc. Both these professions are studied in the same basic course (MBBS) and then students go for specializations.

**Fisheries:**

Fisheries is the professional study of fish production. There are departments in Pakistan where professionals of fisheries are employed. They serve for enhancing the quality and quantity of fish production. In Pakistan, this profession can be adopted after the bachelor or masters level study of zoology and fisheries.

**Agriculture:**

This profession deals with the food crops and animals which are the source of food. An agriculturist works for the betterment of crops like wheat, rice, corn etc and animals like buffalo cow etc from which we get food. In Pakistan there are many universities which offer professional courses on agriculture after the higher secondary education in biology.

**Animal husbandry:**

It is the branch of agriculture concerned with the care and breeding of domestic animals (livestock)

e.g. cattle, sheep etc. Professional courses in animal husbandry can be adopted after the higher secondary education in biology.

**Horticulture:**

It deals with the art of gardening. A horticulturist works for the betterment of existing varieties and for the production of new varieties of ornamental plants and fruit plants. Biology students can adopt this profession after their higher secondary education.

**Farming:**

It deals with the development and maintenance of different types of farm. For example in some farms animal breeding technologies are used for the production of animals which are better protein and milk source. In poultry farms chicken and eggs are produced. Similarly in fruit farms, different fruit yielding plants are grown. A student who has gone through the professional course of agriculture, animal husbandry or fisheries etc. can adopt this profession.

**Forestry:**

In forestry, professionals look after natural forests and advises to the government for planting and

growing artificial forests. Many universities offer professional courses in forestry after the higher secondary education in biology or after bachelor level study of zoology and botany.

**Biotechnology:**

It is the latest profession in the field of biology. Biotechnologists study and work for the production

of useful products through microorganisms. Universities offer courses in biotechnology after the higher secondary education in biology and after the bachelor level studies of botany or zoology.

**Q. 6 Describe some Quranic introductions which reveal the study of life.**

Ans: **Quran and biology:**

At many places in Holy Quran, Allah hints about the origin and characteristics of living organisms.

Here are few examples of such guidelines.

“We made every living thing from water.”

(Sura: Ambia, Verse: 30)

We know that water makes the 60-70% of the composition of protoplasm of all living things. The above Verse hints at the common origin of all living things in water.

“He made man from clay like the potter.”

(Sura: Rehman, Verse: 14)

In another verse, God says:

“Then fashioned We the drop a clot, then fashioned We the clot a little lump, then fashioned We the little lump bones, then clotted the bones with flesh” (Sura: Al-Mominoon, Verse: 14)

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

“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)

### **Q.7 Describe the contribution of Muslim Scientists in the feild of biology.**

#### **Jabir Bin Hayan (721 - 815 AD):**

He was born in Iran and practised medicine in Iraq. He introduced experimental investigation in chemistry and also wrote a number of books on plants and animals. His famous books are “AlNabatat” and “Al-Haywan”.

#### **Abdul Malik Asmai (740 - 828 AD):**

He is considered the first Muslim scientist who studied animals in detail. His famous writings include

“Al-Abil (camel)”, “Al-Khail (horse)”, “Al-Wahoosh (animal)”, and “Kalq al-Ansan”.

#### **Bu Ali Sina (980 - 1037 AD):**

He is honoured as the founder of medicine and called as Avicenna in the West. He was a physician, philosopher, astronomer and poet. One of his books “Al-Qanun-fi al-Tib” is known as the canon of medicine in West.

### **Q. 8 Describe the levels of organization of life.**

Ans: In order to understand the various phenomena of life, biologists study biological organization at different levels, which are as follows.

#### **1. Subatomic and Atomic level**

All types of matter are made up of elements and each element contains a single kind of atoms (‘a’:

not, ‘tom’: cut). The atoms are actually made up of many subatomic particles.

The most stable subatomic particles are electrons, protons and neutrons.

#### **Bio element:**

Out of the 92 kinds of elements that occur in nature, 16 are called bioelements. These take part in making the body mass of a living organism (Figure 1.2). Out of these bioelements; Only six (O, C, H, N, Ca, & P) make 99% of the total mass. Other ten (K, S, Cl, Na, Mg, Fe, Cu, Mn, Zn, & I) collectively make 01% of the total mass.

#### **2. Molecular level**

In organisms, bioelements usually do not occur in isolated forms rather they combine through ionic or covalent bonding. The stable particle formed by such bonding is called as molecule or biomolecule.

**Molecule:**

A molecule is the smallest part of a compound that retains the properties of that compound.

**Types of molecules:**

Biomolecules are classified as micromolecules and macromolecules. Micromolecules are with low molecular weight e.g. glucose, water etc. and macromolecules are with high molecular weights e.g. starch, proteins, lipids etc.

**3. Organelle and Cell level**

Biomolecules assemble in a particular way and form organelles. The organelles are actually subcellular structures and when they assemble together, units of life i.e. cells are formed. Each type of organelle is specialized to perform a specific function. For example; mitochondria are specialized for cellular respiration and ribosomes are specialized for protein synthesis. In the case of prokaryotes and most protists, the entire organism consists of a single cell. In the case of most fungi, all animals and all plants, the organism consists of up to trillions of cells.

**4. Tissue level**

In multicellular organisms, similar cells (performing similar functions) are organized into groups, called tissues. We can define a tissue as a group of similar cells specialized for the performance of a common function. Each cell in a tissue carries on its own life processes (like cellular respiration, protein synthesis), but it also carries on some special processes related to the function of the tissue.

There are different types of plant tissues e.g. epidermal tissue, ground tissue, etc. Animal tissues are also of different types e.g. nervous tissue, muscular tissues etc.

**5. Organ and Organ system level**

In higher multicellular organisms more than one type of tissue having related functions are organized together and make a unit, called organ. Different tissues of an organ perform their specific functions and these functions collectively become the function/s of that organ.

**Example:**

For example stomach is an organ specialized for the digestion of proteins and for storing food. Two major types of tissue are present in its structure. Epithelial (glandular) tissue secretes gastric juice for the digestion of proteins.

Muscular tissue performs contractions of stomach walls for grinding of food and moving food to posterior end. So two tissues perform their specific functions, which collectively become the function of stomach.

**Organ system level:**

The next level of organization in multicellular organisms is the organ system level. Different organs performing related functions are organized together in the form of an organ system.

For example, digestive system is an organ system that carries out the process of digestion. Major organs in its framework are oral cavity, stomach, small intestine, large intestine, liver, and pancreas. All these organs help in the process of digestion.

The organ system level is less complex in plants (e.g. root system) as compared to animals.

This is

due to a greater range of functions and activities in animals than in plants.

### **6. Individual level**

Different organs and organ systems are organized together to form an individual or organism.

In organism, the functions, processes and activities of various organs and organ systems are coordinated. For example, when a man is engaged in continuous and hard exercise, not only his muscles are working but also there is an increase in the rate of respiration and heart beat. This accelerated rate of respiration and heart beat supplies more oxygen and food to the muscles which they need for continuous work.

### **7. Population level**

Biologists extend their studies to the population level where they study interactions among member of the same species living in the same habitat. A population is defined as a group of organisms of the same species located at the same place, in the same time. For example, human population in Pakistan in 2010 comprises of 173.5 million individuals (according to the Ministry of Population Welfare, Government of Pakistan).

#### **Species:**

A species is defined as a group of organisms capable of interbreeding and producing fertile offspring.

#### **Habitat:**

Habitat means the area of the environment in which organism lives.

### **8. Community Level**

A community is an assemblage of different populations, interacting with one another within the same environment. A forest may be considered as a community. It includes different plant, microorganisms, fungi and animal species.

#### **Types of community:**

e. Some communities are complex e.g. a forest community, a pond community etc. Other communities may be simple e.g. a fallen log with various populations under it. In a simple community number and size of populations is limited. So any change in biotic or abiotic factors may have drastic and long lasting effects.

### **9. Biosphere level**

The part of the Earth inhabited by organisms' communities is known as biosphere. It constitutes all ecosystems (areas where living organisms interact with the nonliving components of the environment) and is also called the zone of life on Earth.

#### **Q. 9 Describe the various types of cellular organization in living organisms.**

Ans: **Major groups of organisms:**

All the organisms have been divided into five major groups i.e. prokaryotes, protists, fungi, plants and animals.

**Types of cells:**

All organisms are made of cells. There are two basic types of cells. The organisms in first group are made of prokaryotic cells while all other groups have eukaryotic cells.

**Cellular organization:**

Cells organize in three ways to make the bodies of organisms. Cells make unicellular, colonial and

multicellular organizations and the organisms formed through these organizations are unicellular organisms, colonial organisms and multicellular organisms.

In **unicellular organisms**, only one cell makes the life of an organism. All the life activities are carried out by the only cell. Amoeba, Paramecium, and Euglena are common examples.

In **colonial type** of cellular organization, many unicellular organisms live together but do not have any division of labour among them. Each unicellular organism in a colony lives its own life and does not depend on other cells for its vital requirements. Volvox is a green alga found in water that shows colonial organization. Hundreds of Volvox cells make a colony.

In **multicellular organization**, cells are organized in the form of tissues, organs and organ systems. Frog and mustard are the familiar examples of multicellular organization.

Mustard plant

Mustard plant (scientific name: *Brassica campestris*) is sown in winter and it produces seeds at the

end of winter. The plant body is used as vegetable and its seeds are used for extracting oil.

**Q.10 Differentiate between vegetative and reproductive organs in plants.**

Ans: The organs of the body can be divided into two groups on the basis of their functions. Root, stem, branches and leaves are the vegetative organs, which do not take part in the sexual reproduction of the plant. Flowers are the reproductive parts of the plant because they take part in sexual reproduction and produce fruits and seeds.

Frog

Frog (scientific name: *Rana tigrina*) shows the multicellular organization. The body is made of organ systems and each organ system consists of related organs. All the organs are made of specific tissues (epithelial, glandular, muscular, nervous etc). Some organs and organ systems of frog have been described in the practical activity given next.

