

KARACHI EDU

COMPREHENSIVE STUDY NOTES & EXAM GUIDE • CLASS IX BIOLOGY

Chapter 1: Introduction to Biology

Board: Sindh Textbook Board (STBB)

Target: SSC Part-I Examinations

1.0 Chapter Overview & Core Concepts

Welcome to **Chapter 1: Introduction to Biology**. This comprehensive learning booklet is meticulously engineered according to the latest Sindh Textbook Board (STBB) curriculum for Class IX. It provides an exhaustive, professor-level conceptual breakdown covering every definition, division, branch, interdisciplinary connection, career pathway, Quranic insight, historical contribution, biological level of organization, and cellular pattern.

1.1 Introduction to Biology

1.1.1 Etymology and Definition

The word **Biology** is derived from two classic Greek words:

- **Bios**: Meaning "Life".
- **Logos**: Meaning "Thought, Reasoning, Discourse, or Study".

Formal Definition of Biology

Biology is defined as the branch of natural sciences that deals with the scientific study of living organisms, including their structure, function, growth, origin, evolution, distribution, taxonomy, and interactions with their environment.

1.1.2 What is Life? (Life Processes & Functions)

Life cannot be defined by a single simple sentence; instead, life is identified through a set of fundamental chemical and physiological functions performed by living organisms that distinguish them from non-living matter. These core life processes include:

Life Process	Scientific Description & Significance
1. Digestion	The enzymatic breakdown of complex, insoluble food molecules into simple, soluble molecules for absorption and cellular intake.
2. Respiration	The biochemical process occurring within cells (cellular respiration) where organic nutrients (glucose) are oxidized to release biological energy in the form of ATP.
3. Movement	The ability of an organism to change its position or move body parts in response to internal or environmental stimuli.
4. Growth	An irreversible, permanent increase in the size, mass, and volume of an organism due to cell division (mitosis) and synthesis of protoplasm.
5. Excretion	The metabolic elimination of toxic nitrogenous waste products and metabolic by-products from the organism's body to maintain internal balance.
6. Irritability (Sensitivity)	The capacity of living organisms to detect changes in their internal or external environment (stimuli) and produce appropriate biological responses.
7. Metabolism	The sum total of all chemical reactions occurring inside a cell or living organism. It comprises <i>Anabolism</i> (constructive processes like photosynthesis) and <i>Catabolism</i> (destructive processes like cellular respiration).
8. Development	The progressive series of structural and functional changes an organism undergoes throughout its lifecycle from single-celled zygote to adult maturity.
9. Reproduction	The biological process by which living organisms produce new offspring of their own kind to ensure species continuity and prevent extinction.

1.2 Major Divisions and Branches of Biology

1.2.1 Three Major Divisions of Biology

To facilitate systematic study, biology is broadly divided into three primary divisions based on the main groups of living organisms:

1. **Zoology:** Derived from Greek "*Zoon*" (animal) + "*Logos*" (study/knowledge). It is the division of biology dealing with the scientific study of animals (e.g., anatomy, physiology, behavior, and classification of animals).
2. **Botany:** Derived from Greek "*Botane*" (plant/pasture) + "*Logos*" (study/knowledge). It is the division of biology dealing with the scientific study of plants (e.g., photosynthesis, plant tissue structure, and taxonomy).
3. **Microbiology:** The division of biology dealing with the study of microscopic organisms—such as bacteria, viruses, microscopic fungi, and protozoa—which cannot be seen with the naked eye and require a microscope for observation.

1.2.2 Specialized Branches of Biology

Advanced scientific discoveries in the 20th and 21st centuries led to the establishment of specialized branches:

Branch	Etymology / Origin	
1. Morphology	Gr. <i>morph</i> (form) + <i>logos</i> (discourse)	Study of the external form, shape, and physical structure of living organisms.
2. Anatomy	Gr. <i>ana</i> (up/part) + <i>tome</i> (cutting)	Study of the internal parts and structures of living organisms by cutting them open (dissection).
3. Cell Biology	L. <i>cella</i> (compartment) + Gr. <i>bios</i> + <i>logos</i>	Study of the structure, function, and life cycles of cells and their organelles.
4. Histology	Gr. <i>histos</i> (tissue) + <i>logos</i> (discourse)	Microscopic study of the structure, arrangement, and function of biological tissues.
5. Physiology	Gr. <i>physis</i> (nature) + <i>logos</i> (discourse)	Study of the vital functions and mechanical/chemical working of living organs and systems.
6. Taxonomy	Gr. <i>taxis</i> (arrangement) + <i>nomos</i> (name)	Study of the rules, principles, grouping, identification, and naming (nomenclature) of organisms.
7. Genetics	Gr. <i>genesis</i> (descent / origin)	Study of genes, heredity, and the transmission of traits from parents to offspring.
8. Developmental Biology	Gr. <i>embryon</i> (embryo) + <i>logos</i>	Study of the formation, cleavage, growth, and development of an embryo into a complete organism.
9. Environmental Biology	Environs (surroundings) + Biology	Study of the interrelationships between living organisms and non-living factors of their environment.
10. Paleontology	Gr. <i>palaios</i> (ancient) + <i>ontos</i> (being) + <i>logos</i>	Study of ancient organic life through fossils (remains or impressions of prehistoric organisms).
11. Biotechnology	Bios + Techne (art/skill) + Logos	Techniques for gene manipulation to alter gene structure/ location to achieve desirable traits and useful chemical products.
12. Socio-biology	L. <i>sociare</i> (to associate) + Biology	Study of social behaviors, animal societies, and structural interactions among living organisms.
13. Parasitology	Gr. <i>para</i> (beside/up) + <i>logos</i>	Study of parasites, their life cycles, host-parasite interactions, and vector diseases.
14. Pharmacology	Gr. <i>pharmakon</i> (drug) + <i>logos</i>	Study of drugs, their chemical composition, mode of action, therapeutic uses, and side effects.
15. Molecular Biology	Molecules + Biology	Study of biological activity at the molecular level, including DNA, RNA, proteins, and cellular biomolecules.
16. Immunology	L. <i>immunis</i> (exempt) + <i>logos</i>	Study of the immune system, antibodies, and host defense mechanisms against pathogens.
17. Entomology		

Branch	Etymology / Origin	
	Gr. <i>entomon</i> (insect) + <i>logos</i>	Scientific study of insects, their physiology, morphology, ecology, and impact on agriculture and health.

1.3 Relationship of Biology with Other Sciences (Interdisciplinary Sciences)

Biology is an interdisciplinary, multidimensional field. Life processes cannot be fully understood in isolation without integrating fundamental principles from Physics, Chemistry, Mathematics, Geography, and Economics.

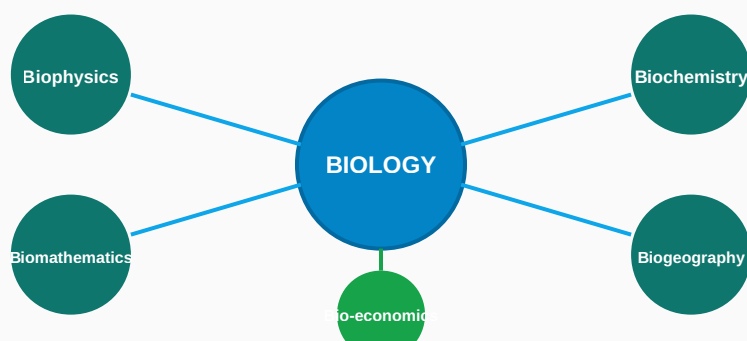


Figure 1.1: Interdisciplinary Branches of Biology Linking Pure Sciences with Life Sciences

- **Biophysics:** The branch of physics where physics principles, laws, and techniques are applied to explain living processes.
 - *Laws of Motion:* Animal locomotion and skeletal movement obey physical mechanics and lever principles.
 - *Radiophysics & Radioactive Isotopes:* Radio-isotopes trace nutrient translocation in plants/animals. Carbon-dating (^{14}C dating) is used to determine fossil age.
 - *Medical Technology:* Sound waves in ultrasound imaging and light amplification in laser surgery demonstrate physics in biological research.
- **Biochemistry:** Deals with the study of organic and inorganic molecules constituting living cells, requiring knowledge of chemistry to explain biomolecule synthesis (photosynthesis, respiration, protein synthesis) and enzyme kinetics.
- **Biomathematics / Biometry:** The application of mathematical and statistical tools to collect, process, analyze, and interpret biological experimental data. Crucial for epidemiology, genetics probability, and population studies.
- **Biogeography:** Studies the geographical distribution of living organisms across different regions of the world. Species distribution is shaped by climate, latitude, altitude, and physical barriers.
- **Bio-economics:** Evaluates the economic viability, production costs, yield, and net profit values of organisms used in commercial agriculture, fish farming, and livestock (e.g., calculating cost-benefit ratios of wheat yield or meat production).

1.4 Careers and Professional Pathways in Biology

Students who pursue biological education can choose from several vital professional careers:

Career Field	Core Focus & Practical Application
1. Medicine and Surgery	Medicine: Diagnosis and non-surgical treatment of human diseases. Surgery: Physical repair, replacement, or excision of diseased/damaged organs (e.g., kidney transplant, heart surgery). Requires MBBS degree.
2. Agriculture	Deals with crop production (wheat, rice, cotton) and livestock maintenance. Highly crucial for Pakistan's agricultural economy.
3. Horticulture	An agricultural branch focusing on ornamental plants, fruit cultivation, garden management, and breeding new plant varieties.
4. Forestry	Focuses on protecting natural forests, managing forest biodiversity, and developing artificial afforestation projects for soil conservation and climate stability.
5. Farming	Establishment and scientific management of specialized farms (poultry, dairy, cattle, fish) to increase high-quality yield of meat, milk, wool, and eggs.
6. Animal Husbandry	An agricultural specialization focused on the care, breeding, selective genetic enhancement, and disease management of domestic livestock.
7. Fisheries	Professional management aimed at enhancing both the quantity and protein quality of fish yield in freshwater and marine habitats.
8. Biotechnology	Advanced technology manipulating bacterial and cellular DNA to produce life-saving bio-products like human insulin, growth hormones, vaccines, and interferons.

1.5 Quran Instructs to Reveal the Study of Life

The Holy Quran revealed over 1400 years ago contains profound biological insights regarding the origin, creation, water dependence, and agricultural diversity of living organisms.

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ

"We made every living thing from water."

(Surah Al-Anbiya, Verse 30)

Scientific Reflection: Modern biology confirms that 70% to 90% of cellular protoplasm consists of water. Protoplasm is the physical basis of life, and all metabolic chemical reactions require an aqueous medium.

وَاللَّهُ خَلَقَ كُلَّ دَابَّةٍ مِّن مَّاءٍ ۖ فَمِنْهُمْ مَّن يَمْشِي عَلَىٰ بَطْنِهِ وَمِنْهُمْ مَّن يَمْشِي عَلَىٰ رِجْلَيْنِ وَمِنْهُمْ مَّن يَمْشِي عَلَىٰ أَرْبَعٍ ۚ يَخْلُقُ اللَّهُ مَا يَشَاءُ ۚ إِنَّ اللَّهَ عَلَىٰ كُلِّ شَيْءٍ قَدِيرٌ

"And Allah has created every animal from water. Of them there are some that creep on their bellies; some that walk on two legs; and some that walk on four. Allah creates what He wills. Lo! Allah is able to do all things."

(Surah Al-Nur, Verse 45)

Scientific Reflection: This Ayah highlights the common aquatic origins of cellular life and points to the diverse modes of animal locomotion (reptiles creeping on bellies, humans walking on two legs, quadrupeds on four).

وَفِي الْأَرْضِ قِطْعٌ مُّتَجَاوِرَاتٌ وَجَنَّاتٌ مِّنْ أَعْنَابٍ وَزُرْعٌ وَنَخِيلٌ وَنُحُلٌ ۚ وَإِنَّ فِي ذَٰلِكَ لَآيَاتٍ لِّقَوْمٍ يَعْقِلُونَ

"And in the earth are neighboring tracks, vineyards and ploughed lands, and date-palms, like and unlike, which are watered with one water. And We have made some of them to excel others in fruit. Lo! Herein verily are portents for people who have sense."

(Surah Al-Ra'd, Verse 4)

Scientific Reflection: Points out plant genetic diversity and differential soil nutrient utilization, where plants growing in adjacent plots irrigated by identical water yield distinct fruit tastes, textures, and qualities.

1.6 Historical Contributions of Muslim Scientists

Muslim scholars laid the foundation of empirical observational science, experimental botany, and clinical medicine during the Islamic Golden Age.

Muslim Scientist	Lifespan & Origin	Key Contributions & Major Books
1. Jabir Bin Hayan	722 – 817 A.D. (Born in Iran)	- Renowned founder of early chemistry and experimental science. - Authored pioneering books on botany and zoology: "<i>Al-Nabatiat</i>" (Exhaustive treatise on Plants) "<i>Al-Haywan</i>" (Treatise on Animal Characteristics)
2. Abdul Malik Asmai	741 – 828 A.D. (Arab Scholar)	- Regarded as the first prominent specialist zoologist. - Conducted detailed anatomical and behavioral studies of animals. - Authored famous books: "<i>Al-Kheil</i>" (On Horses) "<i>Al-Ibil</i>" (On Camels) "<i>Al-Shat</i>" (On Sheep) "<i>Al-Wahoosh</i>" (On Wild Animals) "<i>Khalqul Insan</i>" (On Human Body Parts and Functions)
3. Bu Ali Sina (Avicenna)	980 – 1037 A.D. (Central Asia)	- Recognized in the West as Avicenna; dubbed the "Founder of Medicine". - Identified infectious diseases including Tuberculosis (TB) and Meningitis. - Polymath who worked in medicine, mathematics, astronomy, physics, and paleontology. - Masterpiece Books: "<i>Al-Qanoon fi al-Tibb</i>" (The Canon of Medicine - standard text in Europe for centuries) "<i>Kitab al-Shafa</i>" (Book of Healing)

1.7 Levels of Biological Organization

The living world exhibits a hierarchy of complexity, built upon a chemical foundation. Protoplasm represents the physical and chemical basis of life.

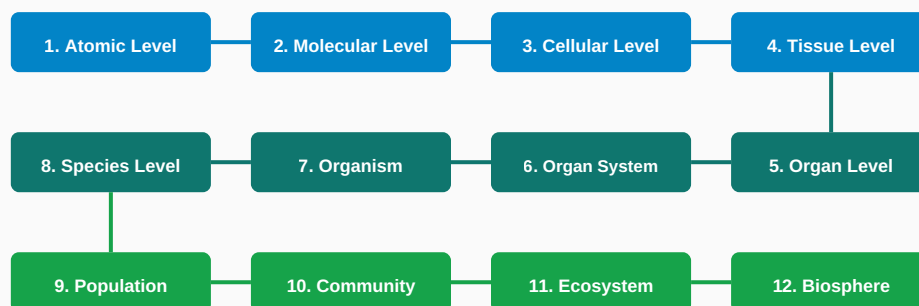


Figure 1.2: Biological Hierarchy from Subatomic Particles to the Global Biosphere

Detailed Breakdown of Organizational Levels:

1. Atomic Level:

All matter consists of elements built of **Atoms** (Gr. *a* = not, *tome* = cut). Atoms consist of sub-atomic particles (electrons, protons, neutrons). Out of over 100 natural elements, **16 elements** are termed **Bio-elements** as they form body mass.

Basic Bio-elements vs Trace Elements

6 Basic Bio-Elements (99% of Total Mass): Carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Sulfur (S), Phosphorus (P).

Remaining 10 Bio-elements (1% of Total Mass): Calcium (Ca), Potassium (K), Sodium (Na), Chlorine (Cl), Magnesium (Mg), Iron (Fe), Copper (Cu), Manganese (Mn), Zinc (Zn), Iodine (I).

2. Molecular Level (Biomolecules):

Atoms bind via ionic or covalent bonds to form stable units called molecules or **Biomolecules**.

- **Micro-molecules:** Low molecular weight molecules (e.g., Glucose, Amino acids, Fatty acids, Water).
- **Macro-molecules:** High molecular weight polymers formed by joining micro-molecules (e.g., Starch, Proteins, Lipids, DNA/RNA).

3. Cellular Level:

Biomolecules suspended in aqueous medium form **Protoplasm**. When protoplasm is enclosed within a cell membrane, it forms a functional **Cell**—the basic structural and functional unit of life.

4. Tissue Level:

A group of similar cells specialized to perform a common unified function (e.g., Epithelial tissue, Muscular tissue, Xylem, Phloem).

5. Organ Level:

Different tissue types organized together in a unit to perform specific functions (e.g., Stomach, Heart, Plant Leaf).

6. Organ-System Level:

A combination of different interconnected organs working in coordination (e.g., Digestive system, Circulatory system).

7. Multicellular Organism:

An individual biological entity where all organ systems operate harmoniously (e.g., Human, Frog, Mustard plant).

8. Taxonomic Level (Species):

Species is the basic, smallest unit of taxonomic classification. Defined as a group of morphologically similar living organisms that interbreed freely in nature to produce fertile offspring.

9. Population Level:

A group of organisms belonging to the *same species* living in the same geographical area at a specific time (e.g., a population of green parrots living on a tree).

10. Community Level:

An assemblage of *different populations* of different species interacting together within the same habitat (e.g., a forest community of birds, insects, trees, and fungi).

11. Ecological System (Ecosystem):

A biological community interacting reciprocally with its non-living physical environment (water, soil, sunlight, O_2 , CO_2) through nutrient cycling and energy flow.

12. Biosphere Level:

The zone of Earth where life exists—encompassing all ecosystems from ocean beds to upper atmospheric layers.

1.8 Cellular Patterns of Organization

Living organisms display three distinct cellular organizational frameworks:

1.8.1 Unicellular Organization

Organisms consisting of a single independent cell capable of carrying out all metabolic functions (digestion, respiration, excretion, movement, reproduction) at the cellular level.

Examples: Bacteria, Amoeba proteus, Paramecium, Euglena.

Exhaustive Focus: *Amoeba proteus*

- **Habitat:** Shallow freshwater ponds, mud, and stagnant pools.
- **Size:** Approximately **0.25 mm (250 μm)**.
- **Structure & Cytoplasm:** Irregular shape enclosed by a flexible cell membrane. Cytoplasm is divided into:
 - *Ectoplasm*: Clear, rigid outer gel layer.
 - *Endoplasm*: Granular, fluid inner sol layer containing organelles (nucleus, food vacuoles, contractile vacuole, mitochondria, lysosomes).
- **Locomotion & Feeding:** Moves and captures prey via finger-like protoplasmic extensions called **Pseudopodia** ("false feet").
- **Osmoregulation:** Contractile vacuole collects and expels excess water to prevent cell lysis.

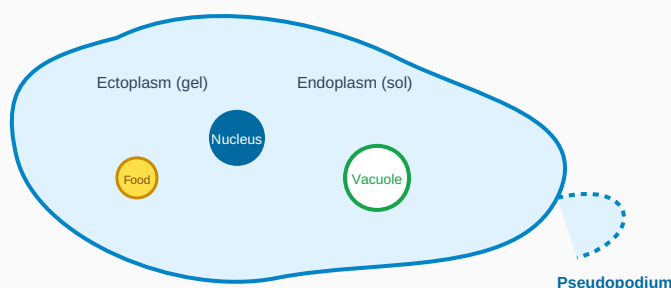


Figure 1.3: Detailed Anatomy of *Amoeba proteus*

1.8.2 Colonial Organization

A cellular arrangement where many independent unicellular organisms live attached together in a collective group or colony. **Crucial Point:** There is *no division of labor* or true tissue differentiation; each cell performs its own vital functions independently without multicellular dependency.

Exhaustive Focus: *Volvox*

- **Classification:** Polyphyletic genus of chlorophyte green algae (Family Volvocaceae). First observed by **Antonie van Leeuwenhoek** in 1700.
- **Colony Structure:** Forms hollow spherical colonies consisting of up to **50,000 cells** embedded in a gelatinous matrix wall.
- **Cell Morphology:** Individual cells feature **two flagella**. Synchronization of flagellar movement causes the entire spherical colony to roll through water.
- **Nutrition & Ecology:** Contains chloroplasts with chlorophyll; performs photosynthesis. Serves as vital primary producers in aquatic freshwater ecosystems. Non-toxic to humans.

1.8.3 Multicellular Organization

Organisms composed of multiple cells organized into specialized tissues, organs, and organ systems with complete division of labor.

Exhaustive Plant Focus: Mustard Plant (*Brassica campestris*)

- **Local Name & Cultivation:** Commonly known as "*Sarsoon*". Cultivated in Pakistan during winter.
- **Economic Significance:** Leaves are used as a green vegetable (*Sarsoon ka Saag*); seeds are pressed for mustard oil extraction.
- **Physical Dimensions:** Reaches a height of **1 to 1.5 meters**.
- **Anatomical Division:**
 - *Vegetative Part:* Roots, stems, and leaves (involved in growth and nutrition; non-reproductive).
 - *Reproductive Part:* Yellow flowers that produce fruits and seeds (involved in sexual reproduction).

Exhaustive Animal Focus: Frog (*Rana tigrina*)

- **Scientific Classification:** Amphibian adapted for dual terrestrial and aquatic life near ponds, ditches, and slow streams.
- **Morphology:** Streamlined body divided into **Head** and **Trunk**. Neck and tail are completely absent. Feeds on small insects.
- **Tissue Diversity:** Composed of specialized tissues including Epithelial, Glandular, Muscular, Nervous, and Connective tissues.

1.9 Dissection Practical Protocol: Frog Visceral Organs

Laboratory Practical Guide & Board Exam Questions

Required Materials: Preserved frog, dissection board/tray, dissection box (scissors, scalpel, forceps, needles), pins.

Ventral Dissection Rule: All vertebrates (including frogs) are dissected *ventrally* (laying on their back) because major blood vessels and visceral organ systems are ventrally positioned relative to the spinal cord.

Organ System	Constituent Organs and Structures
1. Digestive System	Mouth, Buccal cavity, Pharynx, Esophagus, Stomach, Small intestine, Large intestine, Cloaca, Liver, Gall bladder, Pancreas.
2. Circulatory System	Heart (3-chambered: 2 Atria, 1 Ventricle), Aortae, Vena Cavae, blood vessels.
3. Respiratory System	Nostrils, Lungs, Trachea, Larynx (also cutaneous skin respiration).
4. Excretory System	Pair of Kidneys, Ureters, Urinary Bladder, Cloaca.
5. Reproductive System	Male: Testes, Vasa efferentia. Female: Ovaries, Oviducts, Ovisacs.
6. Nervous System	Brain, Spinal Cord, Peripheral Nerves, Sense Organs.

1.10 Common Exam Mistakes & Critical Points

Mistake 1: Confusing Colonial vs. Multicellular Organization

Students often assume Volvox is multicellular because it contains thousands of cells. *Correction:* Volvox is **colonial** because its cells act independently without true tissue differentiation or specialized division of labor.

Mistake 2: Transposing Muslim Scientists' Books

Mixing up *Al-Nabatiat* with *Al-Haywan* or *Al-Qanoon*.

Memory Trick: **J**abir = **N**abatiat & **H**aywan. **A**smi = **K**heil (Horse), **I**bil (Camel), **S**hat (Sheep), **W**ahoosh, **K**halqul Insan. **B**u Ali Sina = **Q**anoon & **S**hafa.

1.11 Complete Chapter Revision Section

Bullet Summary for Quick Revision

- **Biology:** Study of life (*Bios* + *Logos*). Identified by 9 core processes: Digestion, Respiration, Movement, Growth, Excretion, Irritability, Metabolism, Development, Reproduction.
- **3 Divisions:** Zoology (Animals), Botany (Plants), Microbiology (Microscopic organisms).
- **17 Specialized Branches:** Morphology, Anatomy, Cell Biology, Histology, Physiology, Taxonomy, Genetics, Developmental Biology, Environmental Biology, Paleontology, Biotechnology, Socio-biology, Parasitology, Pharmacology, Molecular Biology, Immunology, Entomology.
- **Interdisciplinary Sciences:** Biophysics (laws of motion, radiophysics, carbon-dating), Biochemistry, Biomathematics/Biometry, Biogeography, Bio-economics.
- **Quranic Principles:** Protoplasm & life originated from water (Surah Ambia:30, Surah Nur:45); Plant genetic diversity (Surah Ra'd:4).
- **Muslim Scientists:** Jabir Bin Hayan (*Al-Nabatiat, Al-Haywan*), Abdul Malik Asmai (*Al-Kheil, Al-Ibil, Al-Shat, Al-Wahoosh, Khalqul Insan*), Bu Ali Sina (Founder of medicine, identified TB & Meningitis, *Al-Qanoon, Fil Tib Al-Shafa*).
- **Bio-elements:** 16 total. 6 basic elements form 99% mass: C, H, O, N, S, P.
- **Hierarchy Levels:** Atomic → Molecular → Cellular → Tissue → Organ → Organ System → Organism → Species → Population → Community → Ecosystem → Biosphere.
- **Cellular Patterns:**
 - *Unicellular:* Single cell handles all functions (e.g., *Amoeba proteus*, **0.25 mm**, pseudopodia).
 - *Colonial:* Independent cells form colonies without division of labor (e.g., *Volvox*, up to 50,000 cells).
 - *Multicellular:* Tissue-level specialization (e.g., Mustard plant / *Brassica campestris*, Frog / *Rana tigrina*).

1.12 Chapter-End Assessment & Solution Key

Part A: Multiple Choice Questions (MCQs)

(i) A localized group of organisms that belong to the same species is called a:

- (a) Biosphere (b) Community (c) Ecosystem **(d) Population**

(ii) Increased quantity and quality of fish production is dealt in:

- (a) Fisheries** (b) Farming (c) Animal husbandry (d) Forestry

(iii) Study of remote past organic life with the help of fossils:

- (a) Entomology **(b) Paleontology** (c) Taxonomy (d) Histology

(iv) Laws and techniques of physics applied to explain living processes:

- (a) Biometry (b) Biostatistics **(c) Biophysics** (d) Bio-economics

(v) Choose the INCORRECT statement:

- (a) Six elements (C, H, O, N, S, P) are basic elements of life.
 (b) Foundation of life is based on chemicals.
(c) Members of different species form population. (Correction: Same species form population)
 (d) Part of earth where life exists is called biosphere.

(vi) Science of diagnosis and non-surgical/surgical treatment of diseases:

- (a) Agriculture (b) Medicine (c) Surgery **(d) Both B and C**

(vii) Similar cells combine together to form:

- (a) Organs (b) System **(c) Tissue** (d) Body

(viii) Scientific name of frog is:

- (a) Palaeon **(b) Rana tigrina** (c) Periplaneta (d) Pheretima

(ix) Select the correct sequence of biological organization:

- (c) Atom → Molecule → Cell → Tissue → Organ**

(x) Volvox is a polyphyletic genus of:

- (a) Green algae** (b) Red algae (c) Brown algae (d) None of these

Part B: Fill in the Blanks

- Techniques for manipulation of gene to achieve desirable characters are called **Biotechnology**.
- Distribution of different living organisms in different regions of the world is **Biogeography**.
- Part of agriculture for the development of new varieties of plant and fruit is **Horticulture**.
- Bio-elements considered as vital for life are **16** in number.

5. Members of different species living in specific habitat are called **Community**.
6. The Muslim scientist who identified many diseases like tuberculosis and meningitis was **Bu Ali Sina**.
7. Part of earth where life exists is called **Biosphere**.
8. Foundation of life is based on **Chemicals / Protoplasm**.
9. Fish is one of the best sources of **Protein**.
10. Radio-labeling and carbon-dating show uses of radioactive isotopes in determining the age of **Fossils**.

Part C: Tabulated Comparisons

Difference 1: Colonial Organization vs. Multicellular Organization

Feature	Colonial Organization	Multicellular Organization
Cell Dependency	Cells live together but remain functionally independent.	Cells are inter-dependent and specialized.
Division of Labor	No true division of labor among cells.	High degree of tissue and organ specialization.
Tissue Formation	Never forms true tissues or organ systems.	Forms complex tissues, organs, and systems.
Example	<i>Volvox</i>	<i>Brassica campestris, Rana tigrina</i>

Difference 2: Agriculture vs. Horticulture

Feature	Agriculture	Horticulture
Scope	Broad field dealing with overall crop production and livestock.	Specialized branch of agriculture focused on gardens and fruits.
Primary Focus	Staple field crops (wheat, rice, cotton) and food security.	Ornamental plants, flowering plants, fruit orchards, and vegetables.
Techniques	Large-scale field farming and agronomy.	Specialized plant breeding, grafting, and nursery production.

Part D: Short Answer Questions

Q1: Why is the subject Biology named as a multidimensional subject?

Answer: Biology is termed a multidimensional subject because life processes cannot be studied in isolation. It interconnects with multiple pure sciences—such as Physics (Biophysics), Chemistry (Biochemistry), Mathematics (Biometry), Geography (Biogeography), and Economics (Bio-economics)—to comprehensively explain physical mechanics, chemical metabolic pathways, data analytics, geographic distribution, and commercial valuation of living systems.

Q2: How does the farming profession help mankind?

Answer: The farming profession applies modern scientific principles to establish specialized farms (dairy, poultry, cattle, fisheries). It significantly benefits mankind by increasing the quality and yield of protein sources (meat, milk, eggs), supplying industrial raw materials (wool, leather), and ensuring national food security and economic growth.

Q3: Why is species called the smallest taxonomic level?

Answer: Species is considered the fundamental, smallest unit of taxonomic classification because it represents a distinct group of organisms sharing identical morphological characters that interbreed freely in nature to produce fertile offspring. It cannot be subdivided into smaller natural interbreeding taxonomic ranks.

Q4: How is a population different from a community?

Answer: A **Population** consists of individuals belonging to the *same species* living in a specific geographical area at a given time (e.g., all parrots on an island). In contrast, a **Community** is an assemblage of *different populations belonging to multiple species* interacting together within the same habitat (e.g., birds, trees, and insects in a forest).

Q5: How are new varieties of plants produced?

Answer: New plant varieties are produced through scientific methods in **Horticulture** and **Biotechnology**. Techniques include artificial hybridization (cross-breeding desirable parent plants), genetic engineering (gene manipulation and insertion), recombinant DNA technology, and tissue culture propagation to achieve improved crop yield, disease resistance, and superior fruit quality.

Part E: Detailed Long Answer Questions

Q1: Describe the role of Muslim scientists in the field of biology.

Answer: Muslim scientists played a transformative role in establishing empirical research, direct observation, and clinical medicine during the Golden Age of Islam.

1. Jabir Bin Hayan (722–817 A.D.): Born in Iran, he worked extensively in chemistry and biological sciences. He authored two landmark treatises: "*Al-Nabatiat*" detailing plant taxonomy and morphology, and "*Al-Haywan*" focusing on animal classification and behavior.

2. Abdul Malik Asmai (741–828 A.D.): Regarded as the pioneer of specialized zoological studies. He wrote detailed books on domestic and wild animals, including "*Al-Kheil*" (horses), "*Al-Ibil*" (camels), "*Al-Shat*" (sheep), "*Al-Wahoosh*" (wild beasts), and "*Khalqul Insan*" describing human anatomical structures and organ functions.

3. Bu Ali Sina (980–1037 A.D.): Known in Europe as Avicenna, he is celebrated as the founder of modern medicine. He accurately diagnosed infectious diseases like Tuberculosis and Meningitis. His classic encyclopedia "*Al-Qanoon fi al-Tibb*" (The Canon of Medicine) served as the primary medical textbook in European universities for over five centuries. He also wrote "*Kitab al-Shafa*".

Q2: Describe the relationships of biology to other sciences.

Answer: Biology is an interdisciplinary field that relies on basic physical and social sciences to explain biological phenomena:

- 1. Biophysics:** Applies physical laws and techniques to biological systems. For example, limb movement follows physical levers and mechanics; radiophysics utilizes radioisotopes for plant translocation studies; carbon-dating determines fossil ages.
- 2. Biochemistry:** Studies chemical compounds and metabolic reactions within living cells (e.g., breakdown of glucose during respiration, synthesis of proteins and DNA).
- 3. Biomathematics / Biometry:** Uses mathematical formulas, statistics, and data collection tools to analyze experimental biological data, genetics percentages, and population surveys.
- 4. Biogeography:** Analyzes the spatial and geographic distribution of living species across Earth's biome regions influenced by climate and geographic barriers.
- 5. Bio-economics:** Evaluates biological production (crops, livestock, fisheries) from an economic perspective by calculating production costs, yield revenues, and net profit values.

Q3: Describe the levels of biological organization.

Answer: Biological organization ranges from subatomic particles to the global biosphere:

- 1. Atomic Level:** Matter is made of atoms. 16 bio-elements exist, with 6 basic elements (C, H, O, N, S, P) forming 99% of body mass.
- 2. Molecular Level:** Bio-elements bond to form micro-molecules (glucose, amino acids) and macro-molecules (proteins, starch, lipids).
- 3. Cellular Level:** Protoplasm forms the cell—the fundamental unit of life.
- 4. Tissue Level:** Groups of similar cells working together (e.g., epithelial, muscular).
- 5. Organ & System Level:** Tissues group to form organs (stomach), and organs coordinate in systems (digestive system).
- 6. Multicellular Organism:** Integrated individual living entity (human, frog).
- 7. Ecological Levels:** Includes *Species* (interbreeding organisms), *Population* (same species in an area), *Community* (different populations), *Ecosystem* (community interacting with abiotic environment), and *Biosphere* (zone of Earth supporting life).

«MR.PROFESSOR FT TEAM FIGHTERS 🐸 LEAK PAPER'S & SOLVE PAPER'S 🧠❤️»