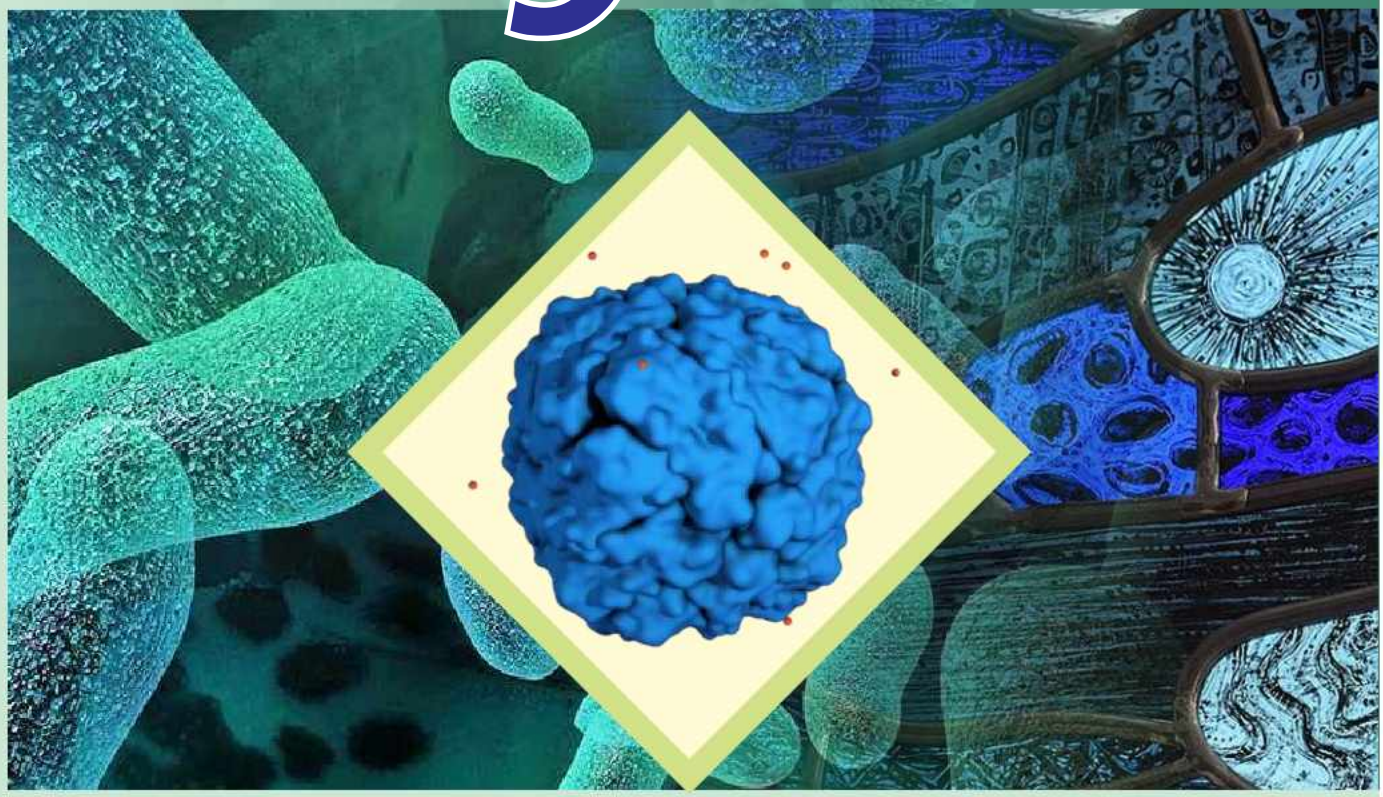
THE TEXTBOOK OF

BIOLOGY

For Class 9



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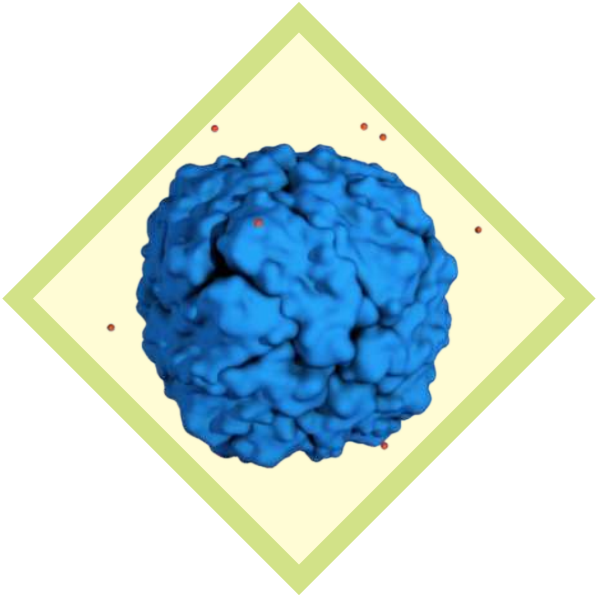

Sindh Textbook Board, Jamshoro

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PREFACE

The century we have stepped in, is the century of Biology. The modern disciplines Biology are strongly influencing not only all the branches of science but each and every aspect human life.

To keep the students. abreast with the recent knowledge, it is a must that the curricula, at all the levels, be updated regularly by introducing the rapid and multidirectional development taking place in all the branches of Biology.

The recent book of Biology for class IX has been written in this preview and in accordance with the revised curriculum prepared by Ministry of Education, Govt of Pakistan, Islamabad reviewed by independent team of Bureau of Curriculum, Jamshoro sindh. Keeping in view of the importance of Biology, the topics have been revised and re-written according to the need of the time.

Since long Biology was teaching only in IX class, the text book was consits of 19 chapters which was unable to complete in working hours. it has been decided now the Biology syllabus will be divided into portions, one should teach in 9th class and other will teach 10th class. So this book is consist of 9 chapters which have been thoroughly revised and re-written to meet the requirement of the curriculum. Special emphasis has also been paid to the applied aspect including the biological problems of daily life. Attention has also been focused on the causes and preventive measures of the common disorders of the human body. Being agriculture country, the agriculture aspects and problems of country are also discussed.

Among the new editions are the introductory paragraphs, information boxes, summaries and a variety of extensive exercises which I think will not only develop the interest but also add a lot to the ut

ility of the book.

The Sind Textbook Board has taken great pains and incurred expenditure in publishing this book inspite to its limitations. A textbook is indeed not the last word and there is always room for improvement. While the authors have tried their level best to make the most suitable presentation, both in terms of concept and treatment, there may still have some deficiencies and omissions. Learned teachers and worthy students are, therefore, requested to be kind enough to point out the short comings of the text or diagrams and to communicate their suggestions and objections for the improvement of the next edition of this book.

In the end, I am thankful to our learned authors, editors and specialist of Board for their relentless service rendered for the cause of education.

Chairman
Sindh Textbook Board

INTRODUCTION TO BIOLOGY

Chapter 1

Major Concept

In this Unit you will learn:

- Introduction of Biology
  - Definition of Biology
  - Divisions and Branches of Biology
  - Relation of Biology with other sciences
  - Quran Instructs to reveal the study of life
- The Levels of Organization

INTRODUCTION

Biology is a branch of natural sciences which deals with the study of living beings. It provides the knowledge about living organisms which differ from each other in shape, size, composition etc. The word biology comes from Greek language "***Bios***" meaning "live" and "***Logos***" meaning "thought or reasoning". Thus biology meaning study of life.

What is life?

Life cannot be defined properly, but on the basis of life processes, it can be identified through following functions of living organisms.

- Digestion
- Respiration
- Metabolism
- Movement
- Growth
- Development
- Excretion
- Irritability
- Reproduction

1.1 Divisions and branches of Biology

1. Division of Biology:

There are three major divisions of biology:

(i) Zoology:

The word Zoology is derived from Greek language, "**Zoon**" meaning animals and Logos meaning "study or knowledge". It deals with the study of animals.

(ii) Botany:

The word Botany is taken from Greek language, "**Butane**" meaning plants and Logus meaning "study or knowledge". It deals with the study of plants.

(iii) Microbiology:

It deals with the study of microscopic organisms such as Bacteria etc, which can be seen only with the help of microscope.

2. Branches of Biology:

Modern biology deals with the structure, function and many other descriptions of living things. Advance research during the 20th Century has led to the division of biology into specialized branches. Some important branches are defined below:

(i) **Morphology** (Gr. morph; form, logos; discourse)**:** The study of external form and structure of organisms.

(ii) **Anatomy** (Gr. ana; part/up, tome; cutting)**:** The study of internal parts of body of living organisms by cutting them open.

(iii) **Cell biology** (L. cells, compartment, Gk. Bios= life; logos; discourse)**:** The study of cell and its organelle.

(iv) **Histology** (Gr. histos: tissue; logos, discourse)**:** The study of structure of tissues of plant and animals.

(v) **Physiology** (Gr. physis; nature, logos, discourse)**:** The study about functions of living organisms.

(vi) **Taxonomy** (Gr. taxis, arrangement, nomos: name)**:** The study of the rules, principles, grouping and naming the living organisms.

(vii) **Genetics** (Gr. genesis; descent, origin)**:** The study of heredity, that is transferring of characters from parents to offspring.

(viii) **Developmental biology** (Gr. embryon; embryo, logos, discourse)**:** The study of formation and development of embryo.

(ix) **Environmental biology:** The study of relationship between living organisms and non-living factors of environment and their effects on each other.

(x) **Paleontology** (Gr. palaios; ancient, ontos; being, logos: discourse)**:** The study of remote past organic life, with the help of fossils.

(xi) **Biotechnology:** The study about techniques for manipulination of gene to bring the changes in structure and location of genes to achieve desireable characters is called biotechnology.

(xii) **Socio-biology** (L. sociare; to associate,)**:** The study of social behavior of living organisms. i.e interaction between themselves.

(xiii) **Parasitology** (Gr. para; up)**:** The study of parasites.

(xiv) **Pharmacology** (Gr. pharmakon, drug;)**.** The study about action of drugs.

(xv) **Molecular biology:** The study of organic molecules which constitute cell and its organelles.

1.1.1 Relationship of biology with other sciences:

Biology is a multidimensional subject and linked with other sciences. For example, the movement of animals follows the laws of motion in physics. Biology is considered as interdisciplinary science, which is related with other sciences. Some of these are mentioned below:

Biophysics:

It is a branch of physics, in which laws and techniques of physics are applied to explain the processes of life. The radiophysics branch where radioactive isotopes are used to trace the translocation of different materials within the organisms. Radio-labeling and carbon-dating also show some uses of radioactive isotopes in determining the age of fossils, uses of sound waves as ultrasound and laser technology show relation of physics with biology.

Biomathematics/Biometry:

The branch of mathematics which collects data of living organisms. It plays very important role in research.

Biochemistry:

It is branch of biology which deals with the study of molecules which form living organisms or cell and requires authentic knowledge about biology and chemistry to explain the synthesis of biomolecules and function of different molecules in the body of an organism.

Biogeography:

It deals with the distribution of different living organisms in different geographical regions of the world. Many living organisms are restricted to particular geographical regions due to environmental conditions.

Bio-economics:

This deals with the economically important organisms involved in production, e.g meat production, etc. are calculated for cost value and profit value.

1.1.2 Careers in biology:

The career of student is subject to obtain a degree. The students, who have chosen the biology, they can plan to adopt some as a career in following fields:

Medicine and Surgery:

Medicine deals with diagnosis and treatment of diseases and surgery deals with repair, replacement or removal the affected organ.

Agriculture:

This deals with production of varieties of crops, fruit, vegetables, dairy products, etc. Pakistan being an agricultural country, it can play very important role.

Horticulture:

This is also part of agriculture, in which work is carried out for the development of new varieties of plants and their products.

Forestry:

Forests are the source of biodiversity of plants and animals of many kinds which live there. It is important in development of new forests as well as preservation of existing ones.

Farming:

In this profession, the development of different kinds of farms takes place, such as fish farm, cattle farm, poultry farm, etc. New technologies are used for the production of animals as source of meat and milk, leather, wool, etc.

Animal husbandry:

This profession is part of agriculture science. It deals with the care and breeding of animals which are beneficial for man.

Fisheries:

This profession deals with the increased quantity and quality of fish production. Fish is one of the best source of protein.

Biotechnology:

This is very important and sensitive profession. It deals with manipulation of gene to produce valuable chemical products, such as insulin, growth hormones, interferon, etc from bacteria as well as others.

1.1.3 Quran and Biology:

The Almighty Allah has conveyed a great knowledge about the origin and characteristics of animals and plants through our Holy Book, the Quran. A few of Ayah are quoted as under:

Allay Says;

وَجَعَلْنَا مِنَ الْمَآءِ كُلَّ شَيْءٍ حَيٍّ ۭ

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

وَاللّٰهُ خَلَقَ كُلَّ دَآبَّةٍ مِّنْ مَّآءٍ فَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى بَطْنِهٖ وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰى رِجْلَيْنِ ۚ
وَمِنْهُمْ مَّنْ يَّمْشِيْ عَلٰٓى اَرْبَعٍ ۭ يَخْلُقُ اللّٰهُ مَا يَشَآءُ ۭ اِنَّ اللّٰهَ عَلٰى كُلِّ شَيْءٍ قَدِيْرٌ ۝

"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 will Lo! Allah is able to do all things."
(Surah Al-Nur, Ayah-45)

Here water is symbolized with the protoplasm as the basis of life and the vital power of protoplasm seems to depend on the constant presence of water.

وَفِي الْأَرْضِ قِطَعٌ مُّتَجٰوِرٰتٌ وَّجَنّٰتٌ مِّنْ أَعْنَابٍ وَّزَرْعٌ وَّنَخِيلٌ
صِنْوَانٌ وَّغَيْرُ صِنْوَانٍ يُّسْقٰى بِمَآءٍ وَّاحِدٍ وَنُفَضِّلُ بَعْضَهَا
عَلٰى بَعْضٍ فِي الْأُكُلِ إِنَّ فِي ذٰلِكَ لَاٰيٰتٍ لِّقَوْمٍ يَّعْقِلُوْنَ ﴿٤﴾

"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! Here in verily are portents for people who have sense."

(Surah: Al-Ra'd, Ayah: 4)

Here Allah has revealed some facts about plant growth and development.

1.1.4 Contribution of Muslim Scientists:

The Muslim scientists have played great role in the development of biological science. They began experiments and observations from the first Century of Hijra. Following are some details about the important Muslim scientists, who made significant contribution towards the development of biology.

1. Jabir Bin Hayan (722-817 A.D):

He was born in Iran. He worked in the field of chemistry but he also wrote a number of books on plants and animals. "Al-Nabatiat" and "Al-Haywan" are his two famous books on plants and animals, respectively.

2. Abdul Malik Asmai (741-828 A.D):

He was great zoologist and wrote many books on animals like "Al-Kheil" on horse, "Al-Ibil" on camels, "Al-Shat" on sheep, "Al-Wahoosh" on wild animals and "Khalqul Insan" on the different parts of human body and their functions.

3. Bu Ali Sina (980-1037 A.D):

He was greatest of all the Muslim scientists and considered as the founder of medicine. He is called as Avicenna in the west. He identified many diseases like tuberculosis, meningitis and other such inflammations. He also worked in the field of mathematics, astronomy, physics, paleontology and music. He wrote book like "Al-Qanoon" and "Fil Tib Al-Shafa".

1.2 THE LEVEL OF ORGANIZATION

The levels of organization in living world are based on chemical foundation. All the living organisms are made up of cells and the protoplasm of cell is the physical as well as chemical basis of life. These levels are as follows:

1. Atomic level of organization:

All the matter is made up of elements, which is composed of atom (a: not, form: cut). Each atom is made up of sub-atomic particles, such as electrons, protons and neutrons.

In nature, there are more than 100 kinds of elements and among these 16 elements are called as bio-elements, which are vital for life. Only six elements such as C, H, O, N, S and P are called basic elements of life.

2. Molecular level of organization:

Molecules are formed by the binding of atoms. These organic molecules of cells are called as bio-molecules. These are constructed in great variety and complexity. They are classified as micro-molecules and macro-molecules.

Glucose, amino acid and fatty acids are micro-molecules, where as carbohydrates, proteins and lipids are macro-molecules. The units of micro-molecules combine together to form macro-molecules.

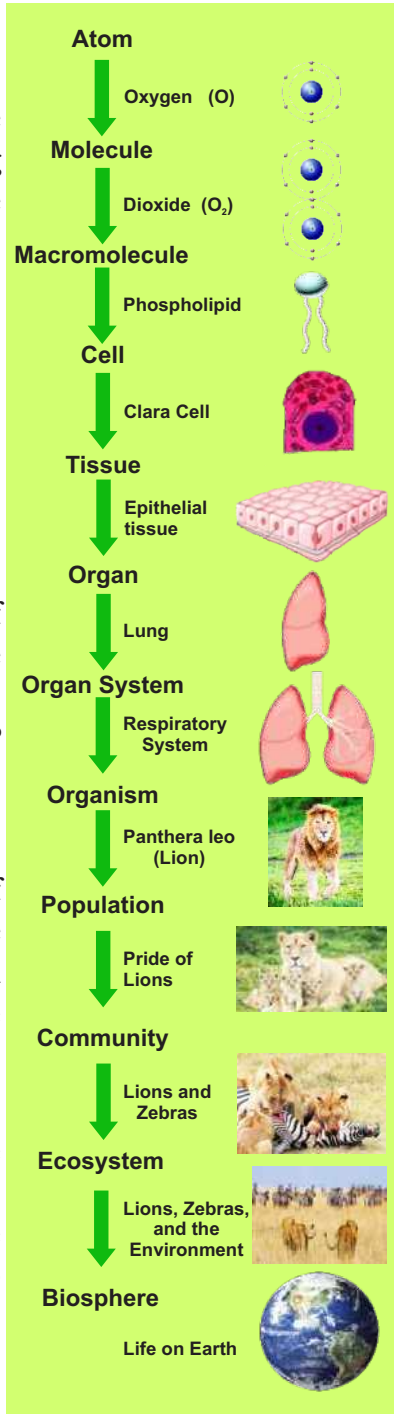

Fig: 1.1 Levels of organization

3. Cellular level of organization:

The biomolecules when work together in the form of suspension, It is called **Protoplasm**. Protoplasm is the combination of organic and specific inorganic substances. When protoplasm work in the form of a unit, this is called **Cell**. Cell is the basic unit of living organisms. When similar type of cells organize together in a group, called tissues. The different types of tissues arranged in a particular manner to work together are called **Organs**.

Organs of different types work in a co-ordinated manner to perform a function is called **Organ-system**. When different organ-system function in co-ordination in as a unit, they form a body or **Multicellular Organism**.

4. Taxonomic level:

There is another level of organization which is related with living organisms. The **Species** is the smallest unit of taxonomic level of organization, which includes morphologically similar living organisms which inter-breed and produce fertile offspring.

5. Population level:

All the members of a species, living in specific habitat are called **Population**. A group of parrots living on tree, is called parrot population.

6. Community level:

The members of different species living in specific habitat are called as **Community**. A group of different kind of birds, living on tree, is called as bird community.

7. Ecological system:

Communities always depends upon their non-living environment in a reciprocal interaction for their survival. For example oxygen for respiration is obtained from environment and in turn given out CO_2. This interaction is called Ecosystem or Ecological system.

8. Biosphere level:

The part of earth where life exists is called biosphere. It consists of different kinds of eco systems.

1.2.1 Unicellular Organizations:

All single cell organisms carry out all activities of life. They digest the food, respire, excrete, move etc on the cellular base by simple methods. Bacteria, Amoeba, Paramecium and Euglena are common examples of unicellular organisms.

1.2.2 Colonial Organization:

Many unicellular organisms live together by forming colonies but do not have any division of labor among them. In colonial type of cellular organization, each unicellular organism lives its own life, they are not dependent on each other and never form any multicellular structure. *Volvox* is a green alga (as shown in figure 1.4), is an example of colonial form of organization.

1.2.3 Multicellular Organization:

The organism formed by many cells is called as multicellular organism. Frog and mustard plant are examples of multicellular organization.

Mustard plant:

Brassica campestris is commonly known as mustard plant and locally it is called "**Sarsoon**". It is multicellular and cultivated in winter season. The leaves of this plant are used as vegetable while seeds are used for oil extraction. The length of this plant is 1 to 1.5 meter. This plant has two parts, the vegetative part, which consists of root, stem and leaves and reproductive part which consists of flowers. Each flower is yellowish in color and produce seeds.

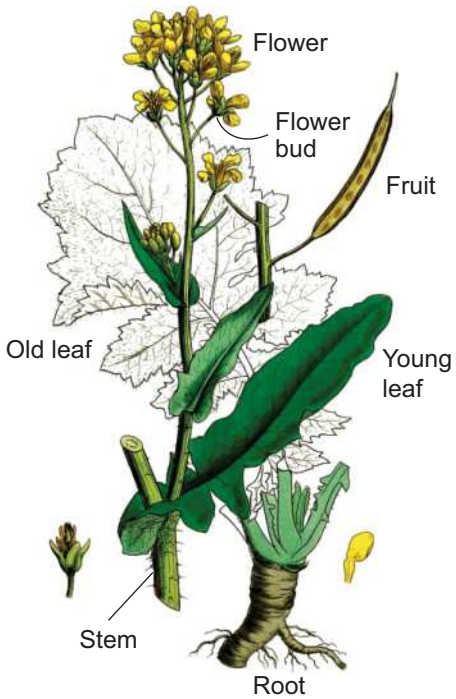

Fig: 1.2 Brassica campestris

Frog:

Fig: 1.3 Frog

Rana tigrina is the scientific name of spotted frog found commonly in our region. It is multicellular animal. It lives in both water as well as on land. Its body is divided into head and trunk. There is no neck. Its body is made of organ system with different organs.

All organs are made of different tissues such as epithelial, glandular, muscular, nervous etc. Frog lives near ditches, pools, ponds, stagnant stream and slow moving rivers. It feeds on small insects.

Activity: Identification of organs and organ-system in dissected frog:

Material Required:

- Preserved frog
- dissecting tray
- dissection box
- pins

Procedure:

Place the preserved frog on a dissecting tray on its back, as all vertebrates are dissected ventrally, pin down the fore limbs and hind limbs. Take scissor to cut the abdomen ventrally, from cloaca to the mouth. Again cut down the skin of limbs from each side and pin down. Expose the visceral organs clearly and make observation with the help of diagram. Locate the organs and identify them as below:

Table showing different organs with the relative organ system.

Organs	Organ System
Mouth, buccal cavity, Pharynx, Esophagus, stomach, small intestine, large intestine, cloaca, liver, gall bladder,pancreas.	Digestive system
Heart, atria ventricle, Aortae, Vena cavae	Circulatory system
Lungs, trachea, nostrils	Respiratory system
Kidneys, Ureter, Urinary Bladder	Excretory system
Testes, vasa efferentia, Ovaries, Oviduct, Ovisac	Reproductive system
Brain, Spinal Cord, Nerves	Nervous system

Draw the labelled diagram of dissected frog.

Fig: 1.4 Dissected frog

Amoeba:

Amoeba is a unicellular organism found in the mud of shallow pond, pools and at any stagnant water. Its size is about 0.25mm. Amoeba has a irregular shape. It has a cell membrane which helps in movement of molecules and protects cytoplasm. The outer part of cytoplasm is clear and transparent, called ectoplasm (gel) and inner part is called endoplasm (sol). The cytoplasm contains nucleus, food vacuoles, mitochondria etc. Amoeba moves by false foot, called pseudopodia.

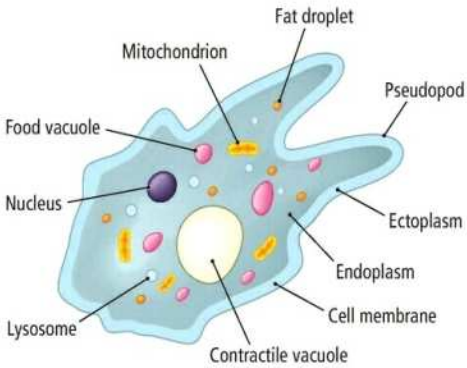

Fig: 1.5 Amoeba

Volvox:

Volvox is a polyphyletic (many ancestors) genus of chlorophyte green algae in the family Volvocaceae. It forms spherical colonies of upto 50,000 cells. They live in a variety of fresh water habitats and were first reported by ***Antonie Van Leeuwen Hoek*** in 1700.

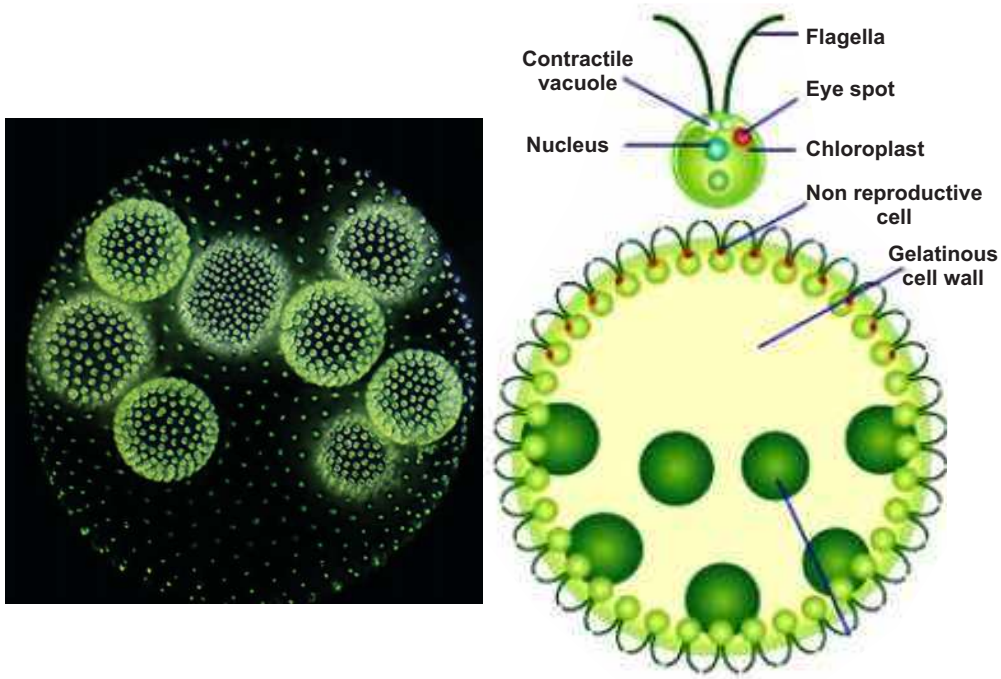

Fig: 1.6 Volvox colony

Volvox once called algae that live together in a colony. Each Volvox cell has two flagella. The flagella beat together to roll the body in water. Volvox cells have chlorophyll and make their own food by photosynthesis. These photosynthesis organisms are an important part of many aquatic eco system. Volvox are not harmful to humans because they do not produce any toxic substance.

Summary

- Biology deals with the study of living beings.
- Life can be identified on the basis of certain processes.
- Biology can be divided in three major divisions.
- Biology is linked with other sciences such as Physics, Chemistry, Mathematics, etc.
- Economically, Biology is very important for food, medicines, forestry and farming etc.
- The Almighty Allah has conveyed a great knowledge about origin and characteristics of living beings in the Holy Quran.
- Muslim Scientists have played great role in the development of biological science.
- Various levels of organization have been identified in the living world.
- Protoplasm is the chemical basis of life.
- Smallest unit of protoplasm is cell.
- Organisms could be unicellular or multicellular.
- Brassica campastris is commonly known as Mustard (Sarsoon) plant.
- Rana tigrina is biological name of frog.
- Amoeba is unicellular organism.
- Volox belong polyphylectic group of algae. It lives in colonial form.

Review Questions

1. Encircle the correct answer:

(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:

(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 are applied to explain the living processes of life.

(a) Biometry (b) Biostatistics

(c) Biophysics (d) Bio-economics

(v) Choose the incorrect statement:

(a) Six elements such as C, H, O, N, S and P are called basic elements of life.

(b) Foundation of life based on chemicals.

(c) Members of different species form population.

(d) Part of earth where life exists is called biosphere

(vi) Science of diagnosis and 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

(a) Atom → Cell → Tissue → Molecule → Organ

(b) Atom → Tissue → Cell → Molecule → Organ

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

(d) Atom → Cell → Molecule →Tissue → Organ

(x) *Volvox* is a polyphyletic genus of

(a) Green algae (b) Red algae

(c) Brown algae (d) None of these

2. Fill in the blanks

(i) Techniques for manipulation of gene to achieve desirable characters are called_____.

(ii) Distribution of different living organisms in different regions of the world_____.

(iii) Part of agriculture for the development of new varieties of plant, and their fruit is _____.

(iv) Bio elements considered as vital for life are _____ in members.

(v) Members of different species living in specific habitat are called _____.

(vi) The Muslim scientists who identified many diseases like tuberculosis, meningitis and other such inflammations was _____.

(vii) Part of earth where life exists is called_____.

(viii) Foundation of life based on _____.

(ix) Fish is one of the best source of_____.

(x) Radio labeling and carbon dating also show some uses of radioactive isotopes in determining the _____ of fossils.

3. Define the following terms

(i) Anatomy (ii) Histology (iii) Immunology

(iv) Pharmacology (v) Entomology (vi) Biometry

(vii) Biogeography (viii) Surgery (ix) Animal husbandry

(x) Bioelements

4. Distinguish between the following in tabulated form

(i) Colonial organization and multicellular organization

(ii) Agriculture and horticulture

5. Write short answers of following questions.

(i) Why subject biology is named as multidimensional subject?

(ii) How farming profession helps mankind?

(iii) Why species is called as smallest taxonomic level?

(iv) How population is different from community?

(v) How new varieties of plant are produced?

(vi) Draw a labeled diagram of frog's digestive system.

6. Write detailed answers of the following questions.

(i) Describe the role of Muslim scientists in the field of biology.

(ii) Describe the relationships of biology to other sciences.

(iii) Describe the level of organization.