APPENDIX I

CONSTRUCTIVE LEARNING STRATEGY (CLS) FOR TEACHING BIOLOGY IN CLASS XI

CONTENTS

UNIT 1 : DIVERSITY IN THE LIVING WORLD

Teacher's Talk in the classroom: Biology is the science of life forms and living processes. The living world comprises an amazing diversity of living organisms. Early man could easily perceive the difference between inanimate matter and living organisms. Early man worshiped some of the inanimate matter wind, sea, fire and some among the animals and plants. A common feature of all such forms of inanimate and animate objects was the sense of awe or fear that they evoked. The description of living organisms including human beings began much later in human history. Societies which indulged in anthropocentric view of biology could register limited progress in biological knowledge. Systematic and monumental description of life forms brought in, out of necessity, detailed systems of identification, nomenclature and classification. The biggest spin off of such studies was the recognition of the sharing of similarities among living organisms both horizontally and vertically. That all present day living organisms are related to each other and also to all organisms that ever lived on this earth, was a revelation which humbled man and led to cultural movements for conservation of biodiversity. In the following chapters of this unit, you will get a description, including classification of animals and plants from a taxonomist's perspective.

Chapter 1: The Living World

Teacher's Talk in the classroom: How wonderful is the living world! The wide range of living types is amazing. The extraordinary habitats in which we find living organisms, be it cold mountains, deciduous forests, oceans, fresh water lakes, deserts or hot springs, leave us speechless. The beauty of a galloping horse, of the migrating birds, the valley of flowers or the attacking shark evokes awe and a deep sense of wonder. The ecological conflict and cooperation among members of a population and among populations of a community or even the molecular traffic inside a cell make us deeply reflect on what indeed is life? This question has two implicit questions within it. The first is a technical one and seeks answer to what living is as opposed to the non-living, and the second is a philosophical one, and seeks answer to what the purpose of life is. As a teacher and student we shall not attempt answering the second question. We will try to reflect on – what is living? We will be exploring following points in this chapter.

- Characteristics of Living World
- Diversity in The Living World
- Taxonomy and Systematics
- Nomenclature

- Taxonomic Hierarchy
- Concepts of Species

Constructive Learning Strategies (CLS) Used:

The nature of the above point were explorative therefore the researcher has adopted following constructive learning strategies.

1. Brainstorming: Following questions were raised in the class for the brainstorming-
   a. Why do you think that you are a living beings?
   b. What similarities do you find between animals and Plant?
   c. Why living beings are classified?
   d. If you are asked to classify human being what criteria will you select for classification?
2. Visit to Botanical Garden: Field trip to botanical garden was organized for student to get first-hand experience of plant biodiversity in various kingdoms. They were asked to make their record in their observation sheet provided.
3. Exploration of Surrounding of School Campus: To link their observation in the botanical garden student were asked to explore the school campus and identify diverse group of living organism in it.
4. Visit to Zoological Park: Field trip to Zoo was organized for student to get first-hand experience of animal biodiversity in various kingdoms. They were asked to make their record in their observation sheet provided.
5. Observation sheet: This sheet was used for collecting various information about the observed living organisms. The student were asked to write their observation on this sheet and submitted for the evaluation.

Chapter 2: Biological Classification

Teacher's Talk in the classroom: R.H. Whittaker (1969) proposed a Five Kingdom Classification. The kingdoms defined by him were named Monera, Protista, Fungi, Plantae and Animalia. The main criteria for classification used by him include cell structure, thallus organisation, mode of nutrition, reproduction and phylogenetic relationships. Let us look at this five kingdom classification to understand the issues and considerations that influenced the classification system. Earlier classification systems included bacteria, blue green algae, fungi, mosses, ferns, gymnosperms and the angiosperms under 'Plants'. The character that unified this whole kingdom was that all the organisms included had a cell wall in their cells.

This placed together groups which widely differed in other characteristics. It brought together the prokaryotic bacteria and the blue green algae with other groups which were eukaryotic. It also grouped together the unicellular organisms and the multicellular ones, say, for example, Chlamydomonas and Spirogyra were placed together under algae. The classification did not differentiate between the heterotrophic group – fungi, and the autotrophic green plants, though they also showed a characteristic difference in their walls composition – the fungi had chitin in their walls while the green plants had a cellulosic cell wall. When such characteristics were considered, the fungi were placed in a separate kingdom – Kingdom Fungi. All prokaryotic organisms were grouped together under Kingdom Monera and the unicellular eukaryotic organisms were placed in Kingdom Protista. Kingdom Protista has brought together Chlamydomonas, Chlorella (earlier placed in Algae within Plants and both having cell walls) with Paramecium and Amoeba (which were earlier placed in the animal kingdom) which lack it. It has put together organisms which, in earlier classifications, were placed in different kingdoms. This happened because the criteria for classification changed. This kind of changes will take place in future too depending on the improvement in our understanding of characteristics and evolutionary relationships. Over time, an attempt has been made to evolve a classification system which reflects not only the morphological, physiological and reproductive similarities, but is also phylogenetic, i.e., is based on evolutionary relationships. In this chapter we will study characteristics of Kingdoms Monera, Protista and Fungi of the Whittaker system of classification.

- Systems Of Classification Of Living Organisms
- Kingdom Monera
- Kingdom Protista
- Kingdom Fungi
- Kingdom Plantae
- Kingdom Animalia

Constructive Learning Strategies (CLS) Used:

1. Brainstorming: Situational brain storming will be done as per the requirement of the condition of learning.
2. Visit to Botanical Garden: As above.
3. Exploration of Surrounding of School Campus: Student were asked to explore the school campus for understanding diversity of living organisms.
4. Visit to Zoological Park
5. Kingdom Sheet: Sheet will be provided by researcher to note down the observations.

KINGDOM SHEET

CHRACTERESTICS OBSERVED:

1.
2.
3.
4.
5.

Chapter 3: Plant Kingdom

Teacher's Talk in the classroom: In the previous chapter, we looked at the broad classification of living organisms under the system proposed by Whittaker (1969) wherein he suggested the Five Kingdom classification viz. Monera, Protista, Fungi, Animalia and Plantae. In this chapter, we will deal in detail with further classification within Kingdom Plantae popularly known as the plant kingdom. We must stress here that our understanding of the plant kingdom has changed over time. Fungi, and members of the Monera and Protista having cell walls have now been excluded from Plantae though earlier classifications put them in the same kingdom. So, the cyanobacteria that are also referred to as blue green algae are not algae any more. In this chapter, we will discuss about Plantae under Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. We will also look at classification within angiosperms to understand some of the concerns that influenced the classification systems. The earliest systems of classification used only gross superficial morphological characters such as habit, colour, number and shape of leaves, etc. They were based mainly on vegetative characters or on the androecium structure (system given by Linnaeus). Such systems were artificial; they separated the closely related species since they were based on a few characteristics. Also, the artificial systems gave equal weightage to vegetative and sexual characteristics; this is not acceptable since we know that often the vegetative characters are more easily affected by environment. As against this, natural classification systems developed, which were based on natural affinities among the organisms and consider, not only the external features, but also internal features, like ultrastructure, anatomy, embryology and phytochemistry. Such a classification for flowering plants was given by George Bentham and Joseph Dalton Hooker. At present phylogenetic classification systems based on evolutionary relationships between the various organisms are acceptable. This assumes that organisms belonging to the same taxa have a common ancestor. We now use information from many other sources too to help resolve difficulties in classification.

These become more important when there is no supporting fossil evidence. Numerical Taxonomy which is now easily carried out using computers is based on all observable characteristics. Number and codes are assigned to all the characters and the data are then processed. In this way each character is given equal importance and at the same time hundreds of characters can be considered. Cytotaxonomy that is based on cytological information like chromosome number, structure, behaviour and chemotaxonomy that uses the chemical constituents of the plant to resolve confusions, are also used by taxonomists these days. We will be exploring following points in this chapter.

- Systems of Biological Classification
- Branches of Taxonomy
- Classification of Plant Kingdom
- Thallophyta
- Bryophyta
- Pteridophyta
- Gymnosperms
- Angiosperms
- Different Life Cycles And Alternation Of Generation

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Visit to Botanical Garden
3. Exploration of Surrounding of School Campus
4. Visit to Zoological Park
5. Specimen Sheet

SPECIMEN SHEET FOR PLANTS

Classification :

Kingdom :

Division :

Class :

Genus :

Species :

Salient Features:

Chapter 4: Animal Kingdom

Teacher's Talk in the classroom: When you look around, you will observe different animals with different structures and forms. As over a million species of animals have been described till now, the need for classification becomes all the more important. The classification also helps in assigning a systematic position to newly described species. We will be exploring following points in this chapter.

- Terminology Related To Animal Classification
- Phylum Protozoa
- Phylum Porifera
- Phylum Cnideria
- Phylum Ctenophore
- Phylum Platyhelminthes
- Phylum Nemathelminthes
- Phylum Annelida
- Phylum Arthopoda
- Phylum Mollusca
- Phylum Echinodermata
- Phylum Hemichordata
- Phylum Chordata

Constructive Learning Strategies (CLS) Used:

The nature of this chapter was explorative thus researcher has used following CLS.

1. Brainstorming: As Above
2. Exploration of Surrounding of School Campus
3. Visit to Zoological Park
4. Specimen Sheet

SPECIMEN SHEET FOR ANIMALS

Classification:

Kingdom:

Phylum:

Class:

Genus:

Species:

Salient Features:

UNIT II : STRUCTURAL ORGANIZATION IN PLANTS AND ANIMALS

Teacher's Talk in the classroom: The description of the diverse forms of life on earth was made only by observation through naked eyes or later through magnifying lenses and microscopes. This description is mainly of gross structural features, both external and internal. In addition, observable and perceivable living phenomena were also recorded as part of this description. Before experimental biology or more specifically, physiology, was established as a part of biology, naturalists described only biology. Hence, biology remained as a natural history for a long time. The description, by itself, was amazing in terms of detail. While the initial reaction of a student could be boredom, one should keep in mind that the detailed description, was utilised in the later day reductionist biology where living processes drew more attention from scientists than the description of life forms and their structure. Hence, this description became meaningful and helpful in framing research questions in physiology or evolutionary biology.

Chapter 5: Morphology of Flowering Plants

Teacher's Talk in the classroom: The wide range in the structure of higher plants will never fail to fascinate us. Even though the angiosperms show such a large diversity in external structure or morphology, they are all characterised by presence of roots, stems, leaves, flowers and fruits. In chapters 2 and 3, we talked about classification of plants based on morphological and other characteristics. For any successful attempt at classification and at understanding any higher plant we need to know standard technical terms and standard definitions. We also need to know about the possible variations in different parts, found as adaptations of the plants to their environment, e.g., adaptions to various habitats, for protection, climbing, storage, etc. If you pull out any weed you will see that all of them have roots, stems and leaves. They may be bearing flowers and fruits. The underground part of the flowering plant is the root system while the portion above the ground forms the shoot system. We will be exploring following points in this chapter.

- The Root
- The Stem
- The Leaf
- The Inflorescence
- The Flower
- The Fruit
- The Seed
- Semi-Technical Description of a Typical Flowering Plant

- Description of Some Important Families

Constructive Learning Strategies (CLS) Used:

1. Brainstorming- student were asked following question to brainstorm their mind-
   a. Name some plant with underground leaf and stem.
   b. What are various functions of root, stem and leaves of plants?
   c. Discuss the differences in shape, size, pattern etc. of different parts of flowering plants
2. Visit to Botanical Garden: student were asked to collect different types of stem, root, leaves, flowers, fruits, and seed and study their various features. They were also asked to visit to grain, vegetable and fruit market for recording various features.
3. Exploration of Surrounding of School Campus
4. Herbarium Sheet: Students were asked to prepare herbarium records of plant life of their surroundings.
5. Laboratory Work: Student were asked to bring the material and do the experimental analysis of internal parts of plants and share the knowledge with teacher and their classmates.

Chapter 6: The Anatomy of Flowering Plant

Teacher's Talk in the classroom: You can very easily see the structural similarities and variations in the external morphology of the larger living organism, both plants and animals. Similarly, if we were to study the internal structure, one also finds several similarities as well as differences. This chapter introduces you to the internal structure and functional organisation of higher plants. Study of internal structure of plants is called anatomy. Plants have cells as the basic unit, cells are organised into tissues and in turn the tissues are organised into organs. Different organs in a plant show differences in their internal structure. Within angiosperms, the monocots and dicots are also seen to be anatomically different. Internal structures also show adaptations to diverse environments. We will be exploring following points in this chapter.

- The Tissues
- The Tissue System
- Anatomy of Dicotyledonous and Monocotyledonous Plants
- Secondary Growth

Constructive Learning Strategies (CLS) Used:

1. Laboratory Work: The nature of the above contents are experimental thus student were asked to do rigorous experiment and note down their microscopic findings in the sheet provided for this purpose.
2. Anatomical observation Sheet: Different types of sheet prepared as per the need of specimen and student were asked to observer various anatomical structures and record their observation in this sheet.

ANATOMICAL OBSERVATION SHEET

Name of the Student:

1. **Epidermis:**
2. **Cortex:**
3. **Endodermis:**
4. **Stele:**
    a. **Pericycle**
    b. **Vascular bundles:**
    c. **Pith**
5. **Identification**

Chapter 7: Structural Organization in Animals

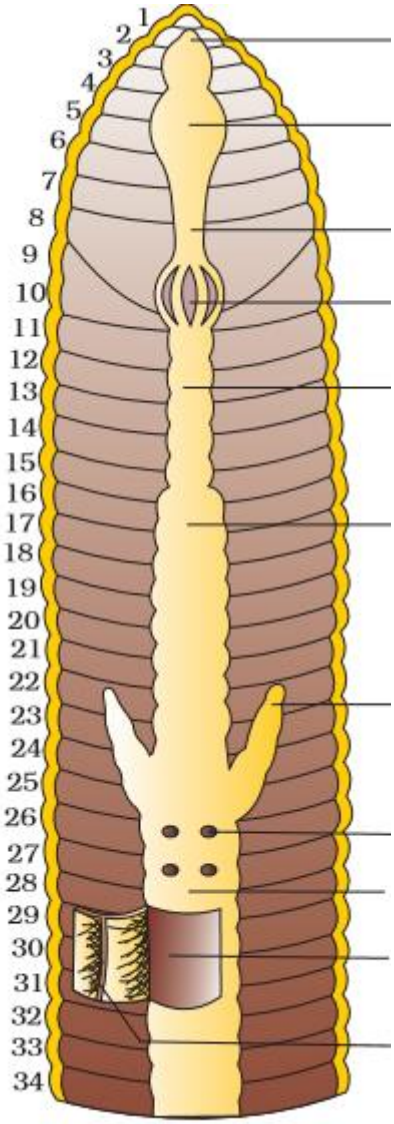
Teacher's Talk in the classroom: In the preceding chapters you came across a large variety of organisms, both unicellular and multicellular, of the animal kingdom. In unicellular organisms, all functions like digestion, respiration and reproduction are performed by a single cell. In the complex body of multicellular animals the same basic functions are carried out by different groups of cells in a well organised manner. The body of a simple organism like Hydra is made of different types of cells and the number of cells in each type can be in thousands. The human body is composed of billions of cells to perform various functions. How do these cells in the body work together? In multicellular animals, a group of similar cells along with intercellular substances perform a specific function. Such an organisation is called tissue. You may be surprised to know that all complex animals consist of only four basic types of tissues. These tissues are organised in specific proportion and pattern to form an organ like stomach, lung, heart and kidney. When two or more organs perform a common function by their physical and/or chemical interaction, they together form organ system, e.g., digestive system, respiratory system, etc. Cells, tissues, organs and organ systems split up the

work in a way that exhibits division of labour and contribute to the survival of the body as a whole.

- Animal Tissues
- Organ and Organ System
- Earthworm
- Cockroach
- Frog

Constructive Learning Strategies (CLS) Used:

1. Laboratory Work
2. Educational Video
3. Anatomical Systems Labelling Sheet



UNIT III : CELL: STRUCTURE AND FUNCTIONS

Teacher's Talk in the classroom: Biology is the study of living organisms. The detailed description of their form and appearance only brought out their diversity. It is the cell theory that emphasised the unity underlying this diversity of forms, i.e., the cellular organisation of all life forms. A description of cell structure and cell growth by division is given in the chapters comprising this unit. Cell theory also created a sense of mystery around living phenomena, i.e., physiological and behavioural processes. This mystery was the requirement of integrity of cellular organisation for living phenomena to be demonstrated or observed. In studying and understanding the physiological and behavioural processes, one can take a physico-chemical approach and use cell-free systems to investigate. This approach enables us to describe the various processes in molecular terms. The approach is established by analysis of living tissues for elements and compounds. It will tell us what types of organic compounds are present in living organisms. In the next stage, one can ask the question: What are these compounds doing inside a cell? And, in what way they carry out gross physiological processes like digestion, excretion, memory, defence, recognition, etc. In other words we answer the question, what is the molecular basis of all physiological processes? It can also explain the abnormal processes that occur during any diseased condition. This physico-chemical approach to study and understand living organisms is called 'Reductionist Biology'. The concepts and techniques of physics and chemistry are applied to understand biology.

Chapter 8: The Unit of Life

Teacher's Talk in the classroom: When you look around, you see both living and non-living things. You must have wondered and asked yourself – 'what is it that makes an organism living, or what is it that an inanimate thing does not have which a living thing has'? The answer to this is the presence of the basic unit of life – the cell in all living organisms. All organisms are composed of cells. Some are composed of a single cell and are called unicellular organisms while others, like us, composed of many cells, are called multicellular organisms.

- What is the Cell?
- Cell Theory
- An Overview of Cell
- Prokaryotic Cell
- Eukaryotic Cell

Constructive Learning Strategies (CLS) Used:

1. Jigsaw I & II: Students were divided into group as per their comfort level and shared their knowledge with their peers and again they were asked to refine their findings and again gave their presentation to experts.
2. Video: The microscopic nature of the contents need magnification thus video related to the above contents were shown to students.
3. Cross word puzzle: Students were asked to design the cross-word puzzle related with different cellular organelles.

Chapter 9: Biomolecules

Teacher's Talk in the classroom: There is a wide diversity in living organisms in our biosphere. Now a question that arises in our minds is: Are all living organisms made of the same chemicals, i.e., elements and compounds? You have learnt in chemistry how elemental analysis is performed. If we perform such an analysis on a plant tissue, animal tissue or a microbial paste, we obtain a list of elements like carbon, hydrogen, oxygen and several others and their respective content per unit mass of a living tissue. If the same analysis is performed on a piece of earth's crust as an example of non-living matter, we obtain a similar list. What are the differences between the two lists? In absolute terms, no such differences could be made out. All the elements present in a sample of earth's crust are also present in a sample of living tissue.

- How to Analyse Chemical Composition?
- Primary and Secondary Metabolites
- Biomacromolecules
- Proteins
- Polysaccharides
- Nucleic Acids
- Structure of Proteins
- Nature of Bond Linking Monomers in a Polymer
- Dynamic State of Body Constituents- Concept of Metabolism
- The Living State
- Enzymes

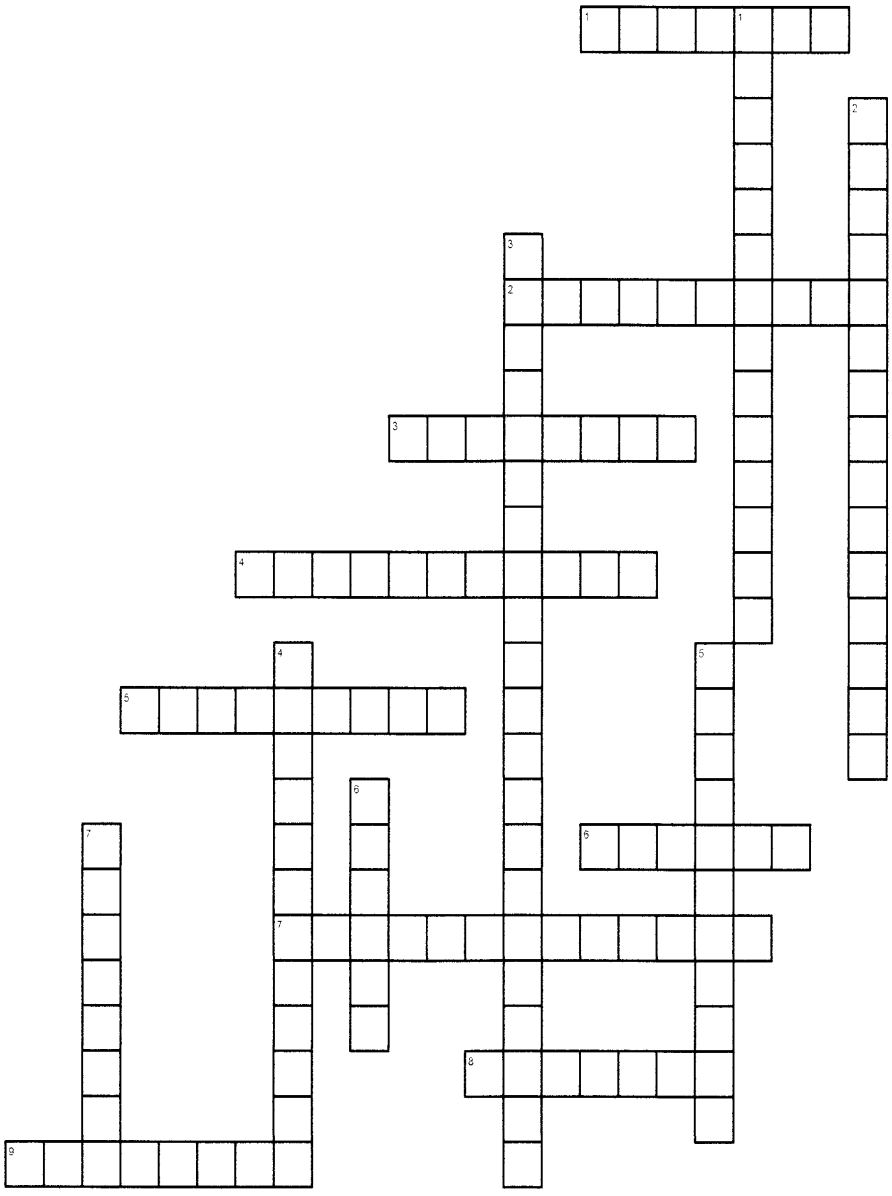
Constructive Learning Strategies (CLS) Used:

1. Jigsaw I & II
2. Video
3. Cross Word Puzzle
4. Chemical Modelling

Crossword Puzzle - Biomolecules

Name:_____ Class:_____ Date:_____

Fill in the crossword puzzle by using the clues.



Across

1. ___ ___ ___ ___ ___ ___ ___ are proteins catalysts that speed up the rate of a chemical reactions in the body.
2. ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ are the building blocks/subunits of proteins.
3. ___ ___ ___ ___ ___ ___ ___ ___ are macromolecules made os many monomers joined together.
4. ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ are the building blocks/subunits of nucleic acids.

5. ___ ___ ___ ___ ___ ___ ___ ___ ___ is a polysaccharide made of glucose units hooked together found in plant cell walls.

6. ___ ___ ___ ___ ___ ___ are organic compounds commonly called fats and oils.

7. ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ are organic compounds used to store and release energy.

8. A ___ ___ ___ ___ ___ ___ ___ contains the elements carbon, hydrogen,oxygen and nitrogen and is composed of amino acids examples are insulin,hemglobin and enzymes.

9. ___ ___ ___ ___ ___ ___ ___ ___ are the small building blocks of polymers.

Down

1. A ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ is a simple one unit sugar such as glucose or fructose having the formula C6H12O6

2. ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ are the largest carbohydrate molecules, they are polymers composed of many monosaccharides linked together for example starch,glycogen and cellulose.

3. ___ are the building blocks/subunits of lipids which are arranged in the shape of a letter E.

4. ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ are macromolecules such as DNA and RNA.

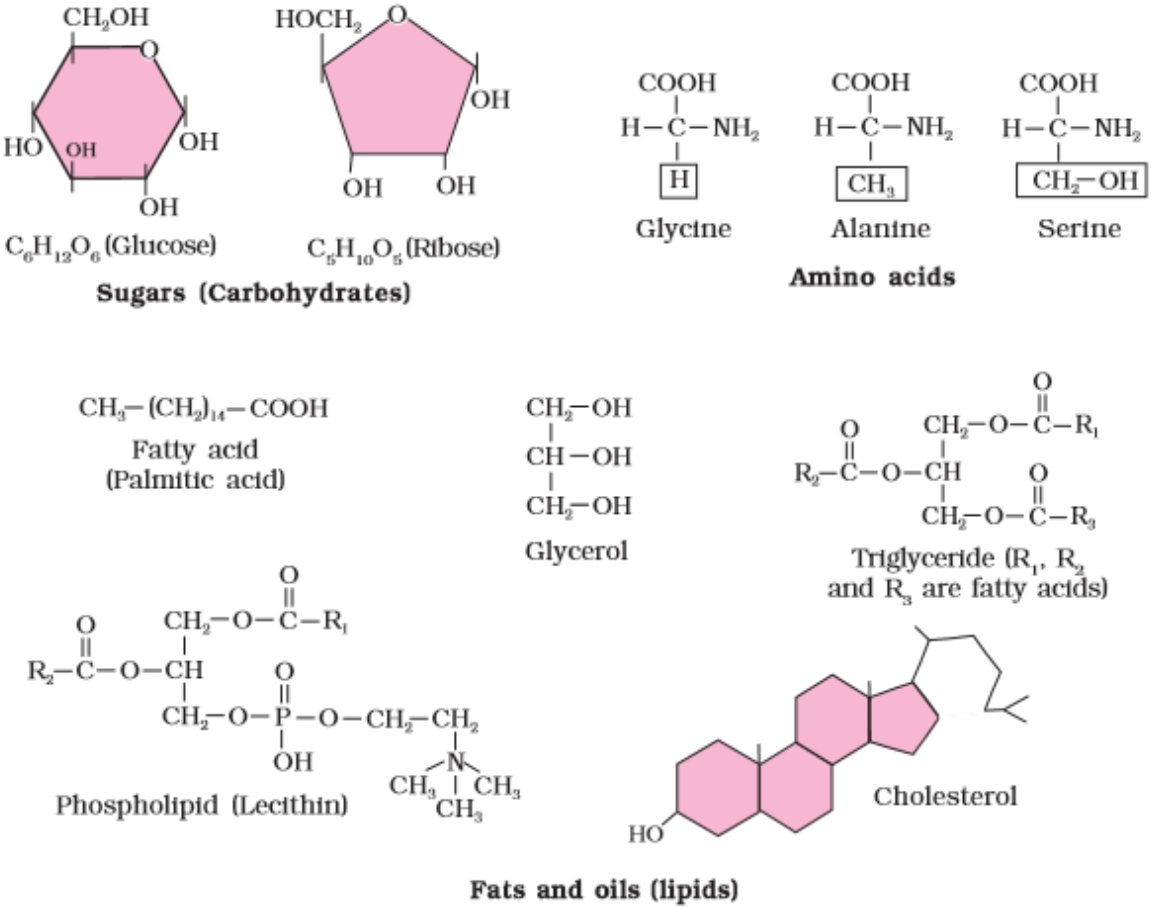
5. A ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ links amino acids together.

6. ___ ___ ___ ___ ___ ___ is a polysaccharide consisting of highly branched chains of glucose units used as food storage in plants

7. ___ ___ ___ ___ ___ ___ ___ ___ is a polysaccharide with highly branched chains of glucose units, used by animals as a food store.

Select your answers from the following words:

Monomers	Lipids	Glycogen	Nucleic acids
Polymers	Cellulose	starch	protein
Fatty acids and glycerol	carbohydrates	polysaccharides	Enzymes
Amino acids	monosaccharide	Nucleotides	peptide bond



Chapter 10: Cell Cycle and Cell Division

Teacher's Talk in the classroom: Are you aware that all organisms, even the largest, start their life from a single cell? You may wonder how a single cell then goes on to form such large organisms. Growth and reproduction are characteristics of cells, indeed of all living organisms. All cells reproduce by dividing into two, with each parental cell giving rise to two daughter cells each time they divide. These newly formed daughter cells can themselves grow and divide, giving rise to a new cell population that is formed by the growth and division of a single parental cell and its progeny. In other words, such cycles of growth and division allow a single cell to form a structure consisting of millions of cells.

- Introduction
- Cell cycle
- Significance of mitosis
- Meiosis
- Significance of meiosis

Constructive Learning Strategies (CLS) Used:

1. Jigsaw I & II
2. Video
3. Cross Word Puzzle
4. Tug of War Game: Spindles fibres play very crucial role in movement of chromosome during cell division which look like this game.

UNIT IV : PLANT PHYSIOLOGY

Teacher's Talk in the classroom: The description of structure and variation of living organisms over a period of time, ended up as two, apparently irreconcilable perspectives on biology. The two perspectives essentially rested on two levels of organisation of life forms and phenomena. One described at organismic and above level of organisation while the second described at cellular and molecular level of organisation. The first resulted in ecology and related disciplines. The second resulted in physiology and biochemistry. Description of physiological processes, in flowering plants as an example, is what is given in the chapters in this unit. The processes of mineral nutrition of plants, photosynthesis, transport, respiration and ultimately plant growth and development are described in molecular terms but in the context of cellular activities and even at organism level. Wherever appropriate, the relation of the physiological processes to environment is also discussed.

Chapter 11: Transport in Plants

Teacher's Talk in the classroom: Have you ever wondered how water reaches the top of tall trees, or for that matter how and why substances move from one cell to the other, whether all substances move in a similar way, in the same direction and whether metabolic energy is required for moving substances. Plants need to move molecules over very long distances, much more than animals do; they also do not have a circulatory system in place. Water taken up by the roots has to reach all parts of the plant, up to the very tip of the growing stem. The photosynthates or food synthesised by the leaves have also to be moved to all parts including the root tips embedded deep inside the soil. Movement across short distances, say within the cell, across the membranes and from cell to cell within the tissue has also to take place. To understand some of the transport processes that take place in plants, one would have to recollect one's basic knowledge about the structure of the cell and the anatomy of the plant body. We also need to revisit our understanding of diffusion, besides gaining some knowledge about chemical potential and ions. When we talk of the movement of substances we need first to define what kind of movement we are talking about, and also what

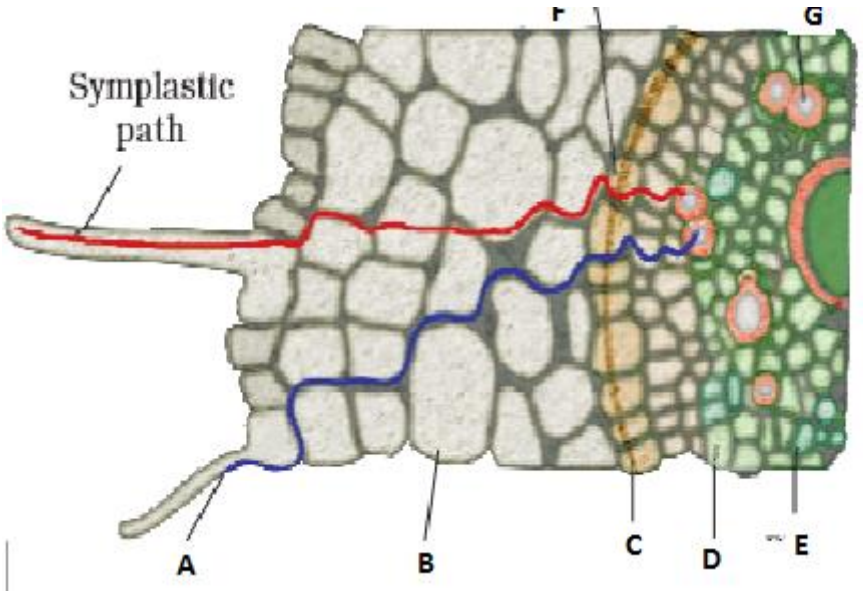
substances we are looking at. In a flowering plant the substances that would need to be transported are water, mineral nutrients, organic nutrients and plant growth regulators. Over small distances substances move by diffusion and by cytoplasmic streaming supplemented by active transport. Transport over longer distances proceeds through the vascular system (the xylem and the phloem) and is called translocation. An important aspect that needs to be considered is the direction of transport. In rooted plants, transport in xylem (of water and minerals) is essentially unidirectional, from roots to the stems. Organic and mineral nutrients however, undergo multidirectional transport. Organic compounds synthesised in the photosynthetic leaves are exported to all other parts of the plant including storage organs. From the storage organs they are later re-exported. The mineral nutrients are taken up by the roots and transported upwards into the stem, leaves and the growing regions. When any plant part undergoes senescence, nutrients may be withdrawn from such regions and moved to the growing parts. Hormones or plant growth regulators and other chemical stimuli are also transported, though in very small amounts, sometimes in a strictly polarised or unidirectional manner from where they are synthesised to other parts. Hence, in a flowering plant there is a complex traffic of compounds (but probably very orderly) moving in different directions, each organ receiving some substances and giving out some other molecule?

- Means of Transport
- Plant-Water Relations
- Long Distance Transport of Water
- Transpiration
- Uptake And Transport of Mineral Nutrients
- Phloem Transport: Flow from Source to Sink

Constructive Learning Strategies (CLS) Used:

1. Brainstorming: Questions will be situational and depends upon curiosity of the students.
2. Educational Video
3. Diagram Labelling Sheets

DIAGRAM LABELING WORK SHEET



Chapter 12: Mineral Nutrition

Teacher's Talk in the classroom: The basic needs of all living organisms are essentially the same. They require macromolecules, such as carbohydrates, proteins and fats, and water and minerals for their growth and development. This chapter focusses mainly on inorganic plant nutrition, wherein you will study the methods to identify elements essential to growth and development of plants and the criteria for establishing the essentiality. You will also study the role of the essential elements, their major deficiency symptoms and the mechanism of absorption of these essential elements. The chapter also introduces you briefly to the significance and the mechanism of biological nitrogen fixation.

- Introduction
- Methods to Study the Mineral Requirements of Plants
- Essential Mineral Elements
- Mechanism of Absorption of Elements
- Translocation of Solutes
- Soil as Reservoir of Essential Elements
- Metabolism of Nitrogen

Constructive Learning Strategies (CLS) Used:

1. Brainstorming: Question will be situational.
2. Educational Video: Student will be asked to download educational video from different website and share the knowledge among themselves.
3. Power Point Presentation by Student: Student will be asked to prepare PowerPoint presentation and present it in the class.

4. Diagram Labelling Worksheets: Researcher will provide these sheet for evaluation and other purposes.

DIAGRAM LABELING WORK SHEET

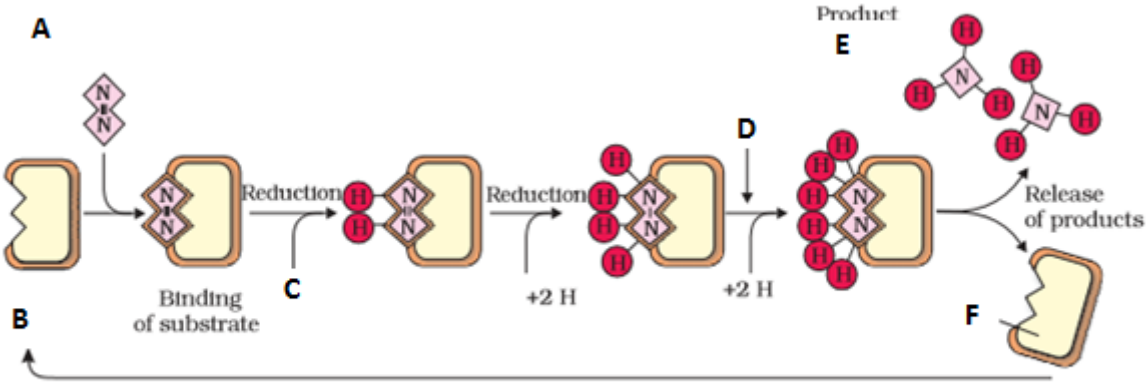


Figure 12.5 Steps of conversion of atmospheric nitrogen to ammonia by nitrogenase enzyme complex found in nitrogen-fixing bacteria

Chapter 13: Photosynthesis in Higher Plants

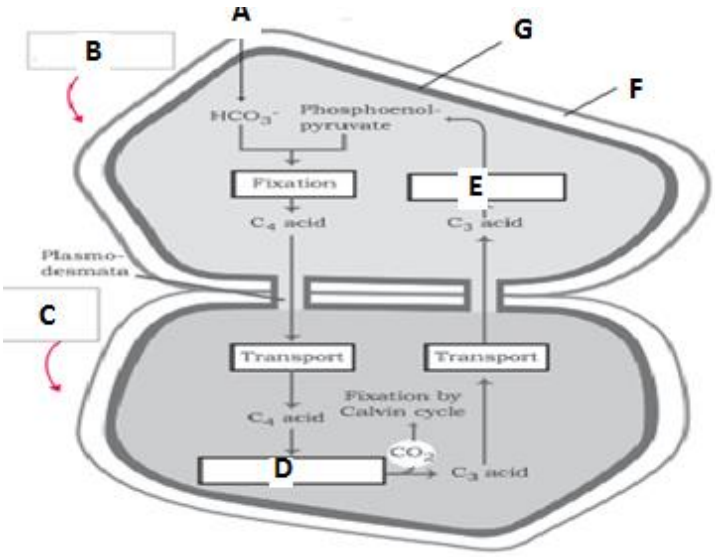
Teacher's Talk in the classroom: All animals including human beings depend on plants for their food. Have you ever wondered from where plants get their food? Green plants, in fact, have to make or rather synthesise the food they need and all other organisms depend on them for their needs. Green plants carry out 'photosynthesis', a physico-chemical process by which they use light energy to drive the synthesis of organic compounds. Ultimately, all living forms on earth depend on sunlight for energy. The use of energy from sunlight by plants doing photosynthesis is the basis of life on earth. Photosynthesis is important due to two reasons: it is the primary source of all food on earth. It is also responsible for the release of oxygen into the atmosphere by green plants. Have you ever thought what would happen if there were no oxygen to breath? This chapter focusses on the structure of the photosynthetic machinery and the various reactions that transform light energy into chemical energy.

- What do we Know
- Early Experiments
- Where does Photosynthesis Take Place?
- How Many Pigments are involved in Photosynthesis?
- What is Light Reaction?
- The Electron Transport System
- Where are the ATP and NADPH Used?
- The C4 Pathway
- Photorespiration
- Factors affecting Photosynthesis

Constructive Learning Strategies (CLS) Used:

1. Brainstorming: Questions will be situational and depends upon curiosity of the students.
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheets

DIAGRAM LABELING WORK SHEET



Chapter 14: Respiration in Plants

Teacher's Talk in the classroom: All of us breathe to live, but why is breathing so essential to life? What happens when we breathe? Also, do all living organisms, including plants and microbes, breathe? If so, how? All living organisms need energy for carrying out daily life activities, be it absorption, transport, movement, reproduction or even breathing. Where does all this energy come from? We know we eat food for energy – but how is this energy taken from food? How is this energy utilised? Do all foods give the same amount of energy? Do plants 'eat'? Where do plants get their energy from? And micro-organisms – for their energy requirements, do they eat 'food'? You may wonder at the several questions raised above – they may seem to be very disconnected. But in reality, the process of breathing is very much connected to the process of release of energy from food. Let us try and understand how this happens. All the energy required for 'life' processes is obtained by oxidation of some macromolecules that we call 'food'. Only green plants and cyanobacteria can prepare their own food; by the process of photosynthesis they trap light energy and convert it into chemical energy that is stored in the bonds of carbohydrates like glucose, sucrose and starch. We must remember that in green plants too, not all cells, tissues and organs photosynthesise; only cells

containing chloroplasts, that are most often located in the superficial layers, carry out photosynthesis. Hence, even in green plants all other organs, tissues and cells that are non-green, need food for oxidation. Hence, food has to be translocated to all nongreen parts. Animals are heterotrophic, i.e., they obtain food from plants directly (herbivores) or indirectly (carnivores). Saprophytes like fungi are dependent on dead and decaying matter. What is important to recognise is that ultimately all the food that is respired for life processes comes from photosynthesis. This chapter deals with cellular respiration or the mechanism of breakdown of food materials within the cell to release energy, and the trapping of this energy for synthesis of ATP. Photosynthesis, of course, takes place within the chloroplasts (in the eukaryotes), whereas the breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria (also only in eukaryotes). The breaking of the C-C bonds of complex compounds through oxidation within the cells, leading to release of considerable amount of energy is called respiration. The compounds that are oxidised during this process are known as respiratory substrates. Usually carbohydrates are oxidised to release energy, but proteins, fats and even organic acids can be used as respiratory substances in some plants, under certain conditions. During oxidation within a cell, all the energy contained in respiratory substrates is not released free into the cell, or in a single step. It is released in a series of slow step-wise reactions controlled by enzymes, and it is trapped as chemical energy in the form of ATP. Hence, it is important to understand that the energy released by oxidation in respiration is not (or rather cannot be) used directly but is used to synthesise ATP, which is broken down whenever (and wherever) energy needs to be utilised. Hence, ATP acts as the energy currency of the cell. This energy trapped in ATP is utilised in various energy-requiring processes of the organisms, and the carbon skeleton produced during respiration is used as precursors for biosynthesis of other molecules in the cell.

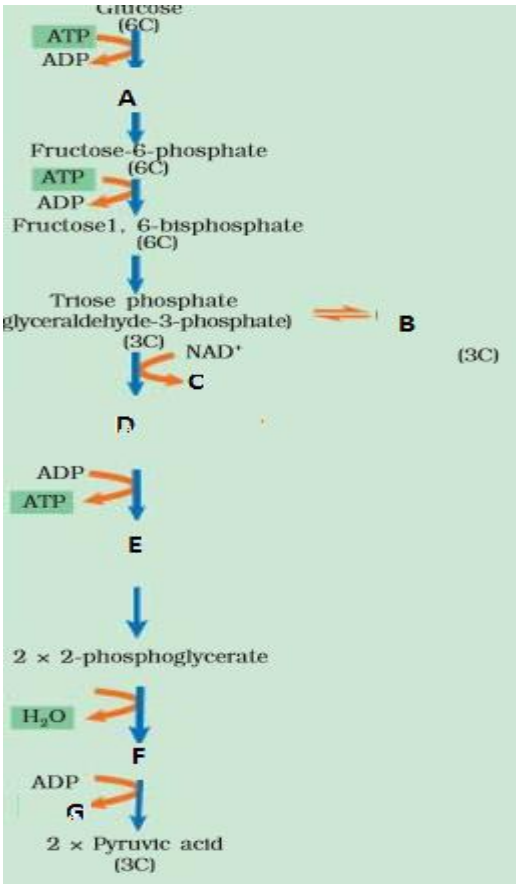
- Do Plants Breathe?
- Glycolysis
- Fermentation
- Aerobic Respiration
- The Respiratory Balance Sheet
- Amphibolic Pathway
- Respiratory Quotient

Constructive Learning Strategies (CLS) Used:

1. Brainstorming: Questions will be situational and depends upon curiosity of the students.
2. Educational Video

3. Power Point Presentation by Student
4. Diagram Labelling Worksheets

DIAGRAM LABELING WORK SHEET



Chapter 15: Plant Growth and Development

Teacher's Talk in the classroom: You have already studied the organisation of a flowering plant in Chapter 5. Have you ever thought about where and how the structures like roots, stems, leaves, flowers, fruits and seeds arise and that too in an orderly sequence? You are, by now, aware of the terms seed, seedling plantlet, mature plant. You have also seen that trees continue to increase in height or girth over a period of time. However, the leaves, flowers and fruits of the same tree not only have limited dimensions but also appear and fall periodically and sometime repeatedly. Why does vegetative phase precede flowering in a plant? All plant organs are made up of a variety of tissues; is there any relationship between the structure of a cell, a tissue, an organ and the function they perform? Can the structure and the function of these be altered? All cells of a plant are descendants of the zygote. The question is, then, why and how do they have different structural and functional attributes? Development is the sum of two processes: growth and differentiation. To begin with, it is essential and sufficient to

know that the development of a mature plant from a zygote (fertilised egg) follow a precise and highly ordered succession of events. During this process a complex body organisation is formed that produces roots, leaves, branches, flowers, fruits, and seeds, and eventually they die (Figure 15.1). In this chapter, you shall also study some of the factors which govern and control these developmental processes. These factors are both intrinsic (internal) and extrinsic (external) to the plant.

- Growth
- Differentiation, Dedifferentiation and Redifferentiation
- Development
- Plant Growth Regulators
- Photoperiodism
- Vernalisation

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheets

DIAGRAM LABELING WORK SHEET

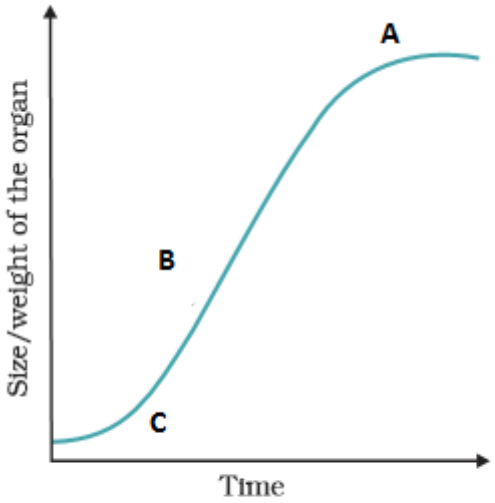


Figure An idealised sigmoid growth curve typical of cells in culture, and many higher plants and plant organs

UNIT V : ANIMAL PHYSIOLOGY

Teacher's Talk in the classroom: The reductionist approach to study of life forms resulted in increasing use of physico-chemical concepts and techniques. Majority of these studies

employed either surviving tissue model or straightaway cell free systems. An explosion of knowledge resulted in molecular biology. Molecular physiology became almost synonymous with biochemistry and biophysics. However, it is now being increasingly realised that neither a purely organismic approach nor a purely reductionist molecular approach would reveal the truth about biological processes or living phenomena. Systems biology makes us believe that all living phenomena are emergent properties due to interaction among components of the system under study. Regulatory network of molecules, supra molecular assemblies, cells, tissues, organisms and indeed, populations and communities, each create emergent properties. In the chapters under this unit, major human physiological processes like digestion, exchange of gases, blood circulation, locomotion and movement are described in cellular and molecular terms. The last two chapters point to the coordination and regulation of body events at the organismic level.

Chapter 16: Digestion and Absorption

Teacher's Talk in the classroom: Food is one of the basic requirements of all living organisms. The major components of our food are carbohydrates, proteins and fats. Vitamins and minerals are also required in small quantities. Food provides energy and organic materials for growth and repair of tissues. The water we take in, plays an important role in metabolic processes and also prevents dehydration of the body. Biomacromolecules in food cannot be utilised by our body in their original form. They have to be broken down and converted into simple substances in the digestive system. This process of conversion of complex food substances to simple absorbable forms is called digestion and is carried out by our digestive system by mechanical and biochemical methods.

- Digestive system
- Digestion of food
- Absorption of digested products
- Disorders of digestive system

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheets
5. Visit to Medical College

DIAGRAM LABELING WORK SHEET

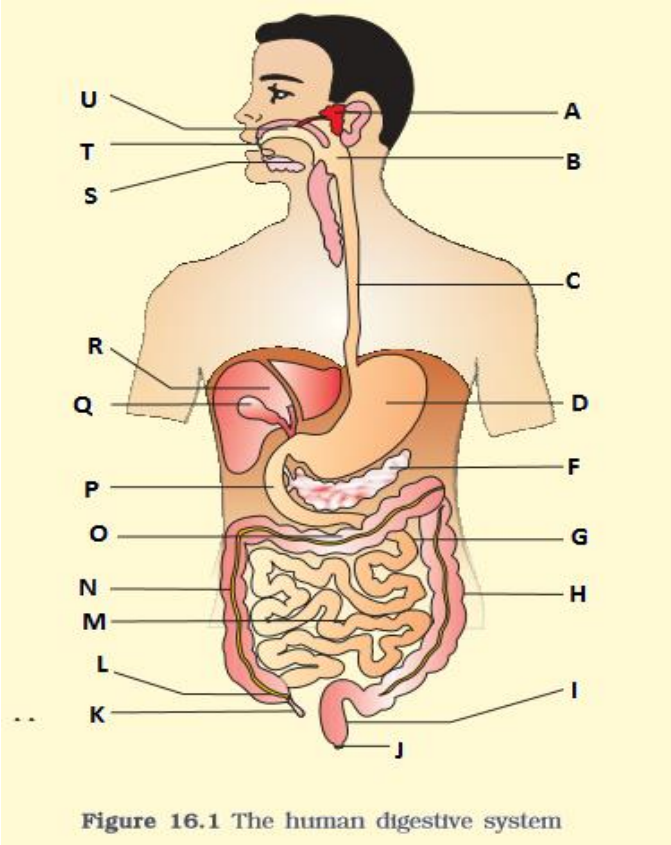


Figure 16.1 The human digestive system

Chapter 17: Breathing and Exchange of Gases

Teacher's Talk in the classroom: As you have read earlier, oxygen (O2) is utilised by the organisms to indirectly break down nutrient molecules like glucose and to derive energy for performing various activities. Carbon dioxide (CO2) which is harmful is also released during the above catabolic reactions. It is, therefore, evident that O2 has to be continuously provided to the cells and CO2 produced by the cells have to be released out. This process of exchange of O2 from the atmosphere with CO2 produced by the cells is called breathing, commonly known as respiration. Place your hands on your chest; you can feel the chest moving up and down. You know that it is due to breathing. How do we breathe? The respiratory organs and the mechanism of breathing are described in the following sections of this chapter.

- Respiratory Organs
- Mechanism of Breathing
- Exchange of Gases
- Transport of Gases
- Regulation of Respiration
- Disorders of Respiratory System

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheets
5. Visit to Medical College

DIAGRAM LABELING WORK SHEET

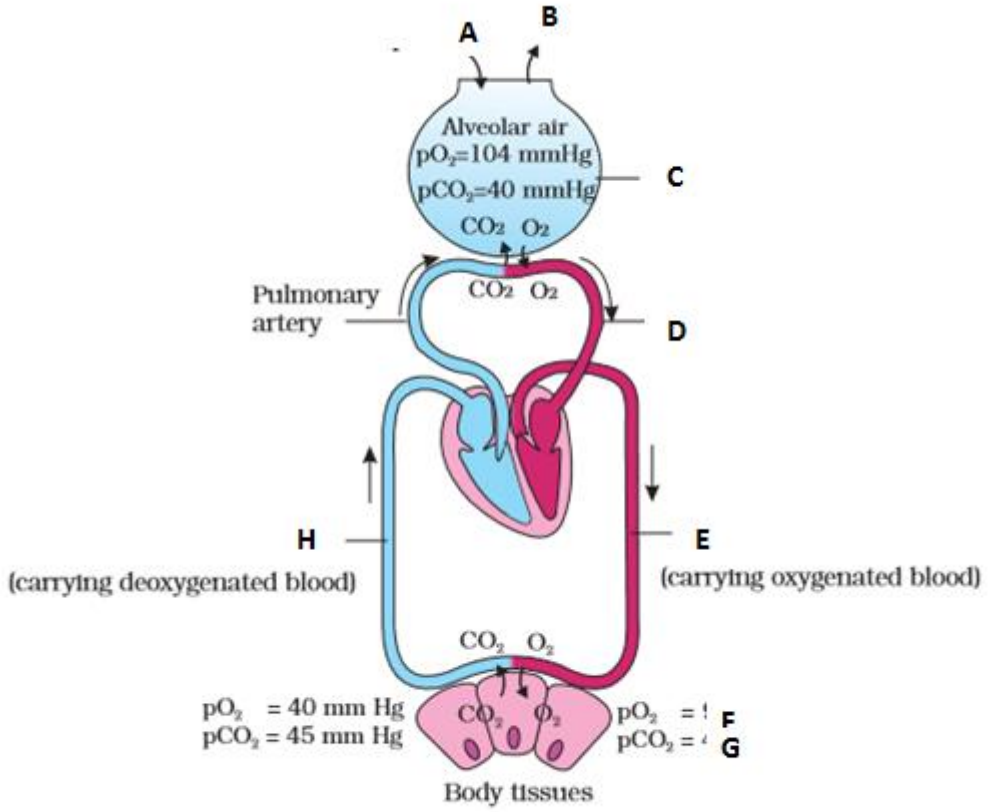


Figure 17.3 Diagrammatic representation of exchange of gases at the alveolus and the body tissues with blood and transport of oxygen and carbon dioxide

Chapter 18: Body Fluids and Circulation

Teacher's Talk in the classroom: You have learnt that all living cells have to be provided with nutrients, O2 and other essential substances. Also, the waste or harmful substances produced, have to be removed continuously for healthy functioning of tissues. It is therefore, essential to have efficient mechanisms for the movement of these substances to the cells and from the cells. Different groups of animals have evolved different methods for this transport. Simple organisms like sponges and coelenterates circulate water from their surroundings through their body cavities to facilitate the cells to exchange these substances. More complex organisms use special fluids within their bodies to transport such materials. Blood is the most commonly used body fluid by most of the higher organisms including humans for this

purpose. Another body fluid, lymph, also helps in the transport of certain substances. In this chapter, you will learn about the composition and properties of blood and lymph (tissue fluid) and the mechanism of circulation of blood is also explained herein.

- Blood
- Lymph (Tissue Fluid)
- Circulatory Pathways
- Double Circulation
- Regulation of Cardiac Activity
- Disorders of Circulatory System

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheet
5. Visit to Medical College

DIAGRAM LABELING WORK SHEET

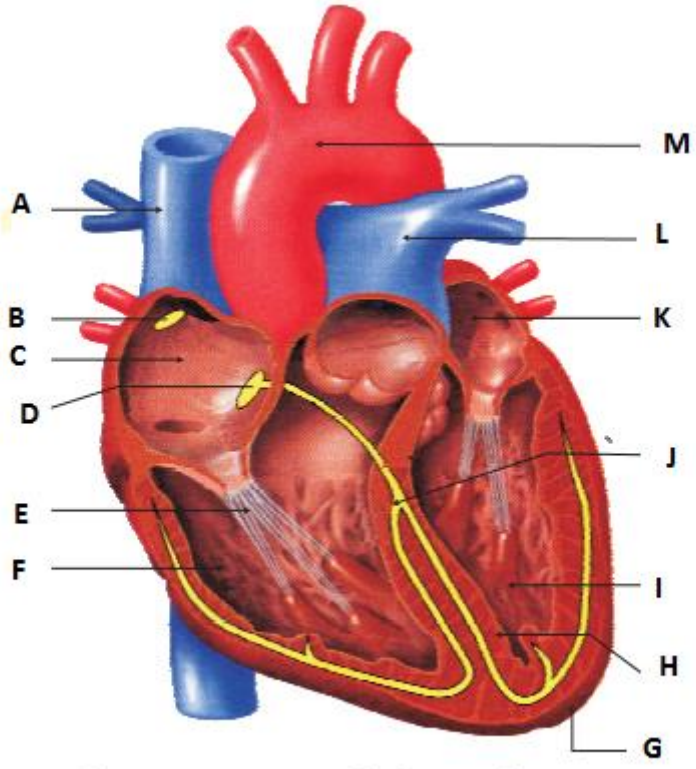


Figure 18.2 Section of a human heart

Chapter 19: Excretory Products and Their Elimination

Teacher's Talk in the classroom: Animals accumulate ammonia, urea, uric acid, carbon dioxide, water and ions like Na+, K+, Cl–, phosphate, sulphate, etc., either by metabolic activities or by other means like excess ingestion. These substances have to be removed totally or partially. In this chapter, you will learn the mechanisms of elimination of these substances with special emphasis on common nitrogenous wastes. Ammonia, urea and uric acid are the major forms of nitrogenous wastes excreted by the animals. Ammonia is the most toxic form and requires large amount of water for its elimination, whereas uric acid, being the least toxic, can be removed with a minimum loss of water. The process of excreting ammonia is Ammonotelism. Many bony fishes, aquatic amphibians and aquatic insects are ammonotelic in nature. Ammonia, as it is readily soluble, is generally excreted by diffusion across body surfaces or through gill surfaces (in fish) as ammonium ions. Kidneys do not play any significant role in its removal. Terrestrial adaptation necessitated the production of lesser toxic nitrogenous wastes like urea and uric acid for conservation of water. Mammals, many terrestrial amphibians and marine fishes mainly excrete urea and are called ureotelic animals. Ammonia produced by metabolism is converted into urea in the liver of these animals and released into the blood which is filtered and excreted out by the kidneys. Some amount of urea may be retained in the kidney matrix of some of these animals to maintain a desired osmolality. Reptiles, birds, land snails and insects excrete nitrogenous wastes as uric acid in the form of pellet or paste with a minimum loss of water and are called uricotelic animals.

- Human Excretory System
- Urine Formation
- Functions of the Tubules
- Mechanism of Concentration of the Filtrate
- Regulation of Kidney Function
- Micturition
- Role of Other Organs in Excretion
- Disorders of the Excretory System

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheet
5. Visit to Medical College

DIAGRAM LABELING WORK SHEET

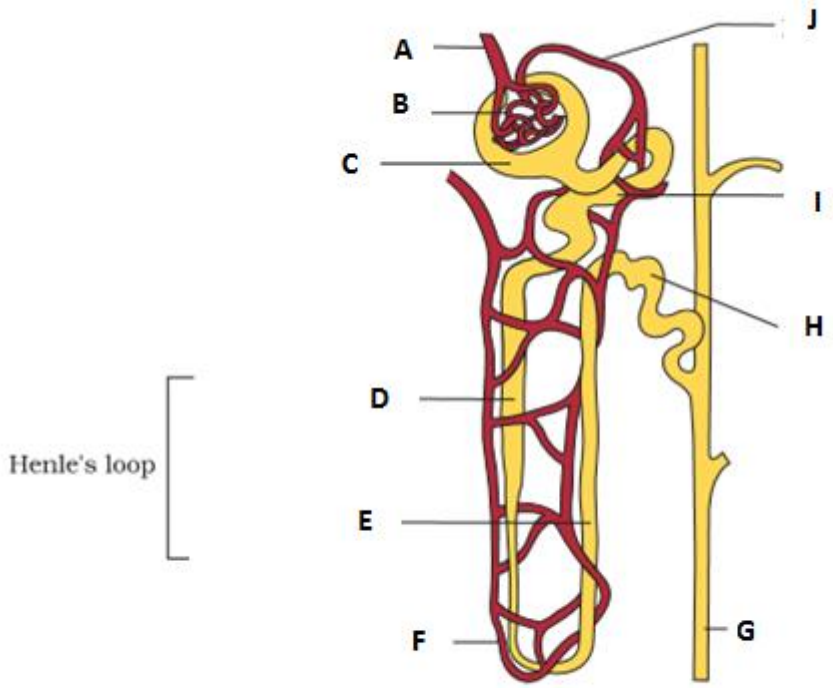


Figure 19.3 A diagrammatic representation of a nephron showing blood vessels, duct and tubule

Chapter 20: Locomotion and Movement

Teacher's Talk in the classroom: Movement is one of the significant features of living beings. Animals and plants exhibit a wide range of movements. Streaming of protoplasm in the unicellular organisms like Amoeba is a simple form of movement. Movement of cilia, flagella and tentacles are shown by many organisms. Human beings can move limbs, jaws, eyelids, tongue, etc. Some of the movements result in a change of place or location. Such voluntary movements are called locomotion. Walking, running, climbing, flying, swimming are all some forms of locomotory movements. Locomotory structures need not be different from those affecting other types of movements. For example, in Paramecium, cilia helps in the movement of food through cytopharynx and in locomotion as well. Hydra can use its tentacles for capturing its prey and also use them for locomotion. We use limbs for changes in body postures and locomotion as well. The above observations suggest that movements and locomotion cannot be studied separately. The two may be linked by stating that all locomotions are movements but all movements are not locomotions. Methods of locomotion performed by animals vary with their habitats and the demand of the situation. However,

locomotion is generally for search of food, shelter, mate, suitable breeding grounds, and favourable climatic conditions or to escape from enemies/predators.

- Types of Movement
- Muscle
- Skeletal System
- Joints
- Disorders of Muscular and Skeletal System

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheet
5. Visit to Medical College

DIAGRAM LABELING WORK SHEET

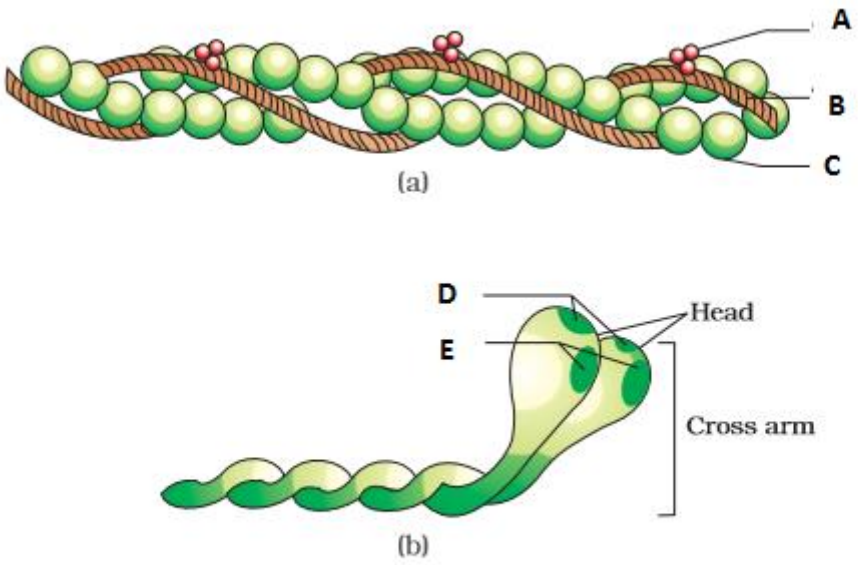


Figure 20.3 (a) An actin (thin) filament (b) Myosin monomer (Meromyosin)

Chapter 21: Neural Control and Coordination

Teacher's Talk in the classroom: As you know, the functions of the organs/organ systems in our body must be coordinated to maintain homeostasis. Coordination is the process through which two or more organs interact and complement the functions of one another. For example, when we do physical exercises, the energy demand is increased for maintaining an increased muscular activity. The supply of oxygen is also increased. The increased supply of oxygen necessitates an increase in the rate of respiration, heart beat and increased blood flow

via blood vessels. When physical exercise is stopped, the activities of nerves, lungs, heart and kidney gradually return to their normal conditions. Thus, the functions of muscles, lungs, heart, blood vessels, kidney and other organs are coordinated while performing physical exercises. In our body the neural system and the endocrine system jointly coordinate and integrate all the activities of the organs so that they function in a synchronised fashion. The neural system provides an organised network of point-to-point connections for a quick coordination. The endocrine system provides chemical integration through hormones. In this chapter, you will learn about the neural system of human, mechanisms of neural coordination like transmission of nerve impulse, impulse conduction across a synapse and the physiology of reflex action.

- Neural System
- Human Neural System
- Neuron As Structural and Functional Unit of Neural System
- Central Neural System
- Reflex Action and Reflex Arch
- Sensory Reception and Processing

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheet
5. Visit to Medical College

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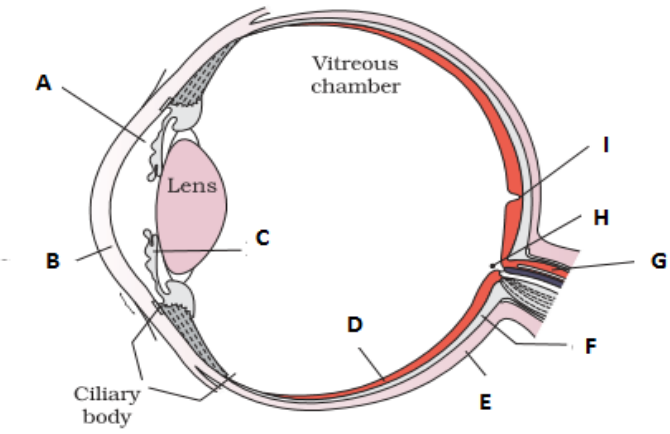

Figure 21.6 Diagram showing parts of an eye

Chapter 22: Chemical Coordination and Integration

Teacher's Talk in the classroom: You have already learnt that the neural system provides a point-to-point rapid coordination among organs. The neural coordination is fast but short-lived. As the nerve fibres do not innervate all cells of the body and the cellular functions need to be continuously regulated; a special kind of coordination and regulation has to be provided. This function is carried out by hormones. The neural system and the endocrine system jointly coordinate and regulate the physiological functions in the body.

- Introduction
- Endocrine Glands and Hormones
- Human Endocrine System
- Hormones of Heart, Kidney and Gastrointestinal Tract
- Mechanism of Hormone Action

Constructive Learning Strategies (CLS) Used:

1. Brainstorming
2. Educational Video
3. Power Point Presentation by Student
4. Diagram Labelling Worksheets
5. Visit to Medical College

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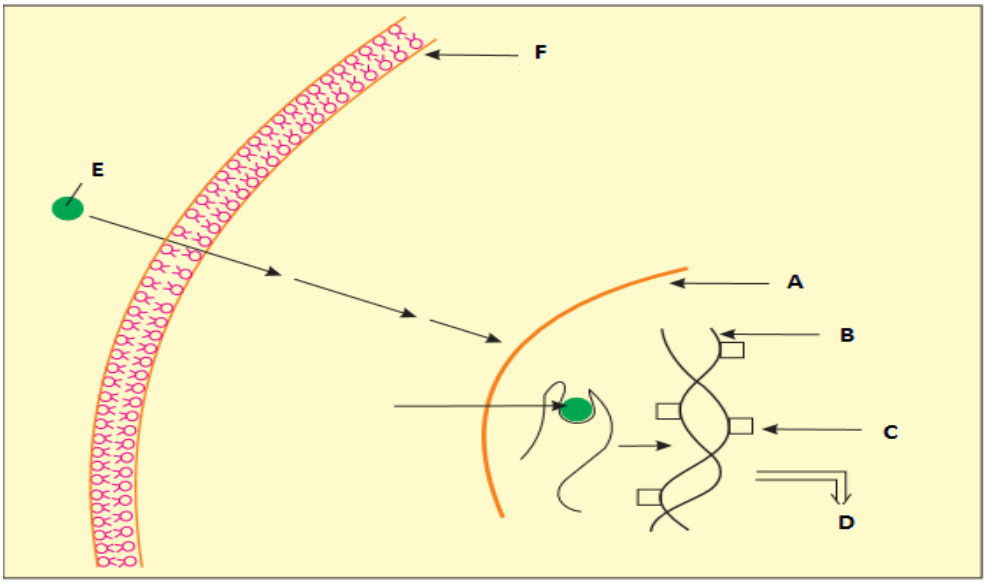


Figure Diagramatic representation of the mechanism of hormone action : Steroid hormone

APPENDIX II

BLUE PRINT OF THE BIOLOGY QUESTION PAPER
Subject- Biology (Theory)
Class- XI

Name of the Unit	**MCQ**	**Total Marks**	**Weightage (%)**
Unit I: Diversity in the Living World	20	40	20
Unit II: Structural Organization in Plant and Animals	20	40	20
Unit III: Structure and Functions	20	40	20
Unit IV: Plant Physiology	20	40	20
Unit V: Animal Physiology	20	40	20
Total	100	200	100

APPENDIX III

BIOLOGY ACHIEVEMENT TEST

Name of student: ----------

Class and Section:----------

Date: ----/----/----. Time: 03:00 Hrs. Max. Marks: 200

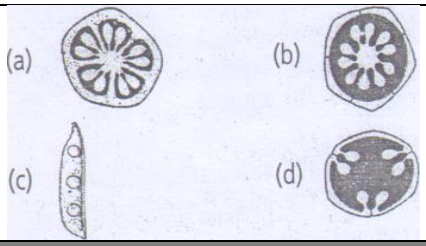
IMPORTANT INSTRUCTIONS:

- Immediately fill your all details on this page of the test booklet with blue/black ball point pen.
- The test booklet consists of 100 questions.
- Each question is allotted 2 marks for the correct response. There is no negative marking.
- There is only one correct response for each question out of four responses.
- Please do not fold the Answer sheet and do not make any stray mark on it.
- The rough work is to be done on the space provided for this purpose in the test booklet only.
- On the completion of the test, the candidate must handover the Answer sheet to the invigilator on duty in the examination hall.
- No candidate is allowed to use calculators, cellphones or any other electronic devices during the time of examination.

Q-1	‘Taxon’s is the unit of
A	Order
B	Species
C	Genus
D	Taxonomy
Q-2	Hornworts are represented by
A	Hepaticopsida
B	Bryopsida
C	Anthocerotopsida
D	Psilopsida
Q-3	In gymnosperms, the endosperm is formed by
A	Fusion of two polar nuclei
B	Fertilized egg
C	Fusion of one polar nucleus
D	Germination of one megaspore
Q-4	Linnaeus described 5900 species of plants in his book-------- (1753) and 4326 species of animals in his Book (1758)---------.
A	Philosophia Botanica, Genera Plantarum
B	Historia Naturalis, Species Plantarum
C	System Naturae, Species Plantarum
D	Species Plantarum, Systema Naturae
Q-5	In which of the following groups would you place a plant, which produces spores, has vascular tissues and bears seeds without fruits?
A	Angiosperms
B	Bryophytes
C	Gymnosperms
D	Pteridophytes
Q-6	Taxonomic hierarchy refers to
A	Stepwise arrangement of all categories for classification of plants and animals
B	A group of senior taxonomists who decide the nomenclature of plants and animals
C	A list of botanists or zoologists who have worked on taxonomy of a species or group
D	Classification of a species based on fossil record

Q-7	Colletotrichum and Trichoderma belong to which class of fungi?
A	Ascomycetes
B	Deuteromycetes
C	Basidiomycetes
D	Zygomycets
Q-8	Peat, obtained from Sphagnum moss, is used as
A	Fuel
B	Manure
C	Corrosive
D	Both (a) and (c).
Q-9	Gymnosperms bear seeds but lack fruits because they lack
A	Cotyledon
B	Embryo
C	Ovary
D	Ovule.
Q-10	A gymnospermic leaf carries 16 chromosomes. The number of chromosomes in its endosperm will be
A	16
B	8
C	24
D	12
Q-11	The smallest organisms which are self-reproducing in free living state are known as
A	Bacteria
B	Viruses
C	PPLO
D	Prions
Q-12	Bryophytes are called amphibians of plant kingdom because
A	Their reproductive phase requires water
B	Their sex organs are multicellular and jacketed
C	They have tracheids
D	All of the above

Q-13	If you are asked to classify the various algae into distinct groups, which of the following characters you should choose ?
A	Type of habitat
B	Structural organization of thallus
C	Chemical composition of the cell wall
D	Types of pigments present in the cell
Q-14	Which of the following categories contain least common features as compared to genus?
A	Species
B	Division
C	Class
D	Family
Q-15	The blue green algae are so called because in addition to green pigment chlorophyll, they have blue pigments known as
A	Phycocyanin and Allophycocyanin
B	Cyanophycin and Phycocyanin
C	Chromoplasm and Phycoerythrin
D	Phycoerythrin and Phycocyanin
Q-16	The basic unit of classification is
A	Species
B	Genus
C	Family
D	Phylum
Q-17	Jacobson's organ is concerned with
A	Touch
B	Hearing
C	Smell
D	Sight
Q-18	Haemocoel is found in-
A	Hydra and Aurelia
B	Balanglossus and Herdmania
C	Taenia and Ascaris
D	Periplanta and Pila
Q-19	Which of the following characters does not fit for Aves?
A	Skin is dry, without glands except oil/preen glands at the base of tail

B	Alimentary canal has 2 additional chambers, crop and gizzard
C	Hind limbs are modified for walking, swimming or clasping. Fore limbs are modified into wings
D	Beak has teeth
Q-20	Chordates differ from non-chordates in having
A	Notochord
B	Dorsal hollow nerve cord
C	Pharyngeal gill slits
D	All of these
Q-21	The cells of the quiescent centre are characterized by
A	Having dense cytoplasm and prominent nuclei
B	Having light cytoplasm and small nuclei
C	Dividing regularly to add to the corpus
D	Dividing regularly to add to tunica.
Q-22	Which one of the following is not a characteristic of meristematic cells?
A	Presence of intercellular spaces
B	Thin cellulosic cell walls
C	Presence of prominent nucleus
D	High metabolic rate
Q-23	Which one of the following figures represents the placentation in ***Dianthus***?
	
Q-24	Dry indehiscent single-seeded fruit formed from bicarpellary syncarpous inferior ovary is
A	Berry
B	Cremocarp
C	Caryopsis
D	Cypsela
Q-25	Long filamentous threads protruding at the end of a young maize are
A	Hairs
B	Anthers
C	Styles
D	Ovaries.

Q-26	In Gloriosa, the tendrillar part is formed by
A	Leaf petiole
B	Stipule
C	Axillary bud
D	Leaf apex.
Q-27	Modified stem present in Gladiolus is
A	Bulb
B	Rhizome
C	Corm
D	Bulbil
Q-28	In _____ flowers, margin of thalamus grows upward enclosing the ovary completely and getting fused with it.
A	Hypogynous
B	Perigynous
C	Epigynous
D	Both (B) and (C)
Q-29	Dorsi-ventral leaf has-
A	Spongy parenchyma on upper side
B	Spongy parenchyma on both side
C	Palisade parenchyma on lower side
D	Palisade parenchyma on upper side
Q-30	In cockroach, the ootheca is formed by the secretion of
A	Phallic gland
B	Collaterial gland
C	Mushroom gland
D	Conglobate gland
Q-31	In cockroach, oxygen is transported by
A	Trachea
B	Plasma
C	Hemoglobin
D	Histamine.
Q-32	Which of the following statements is correct regarding the difference between male and female cockroach?
A	In male, anal cerci are present
B	In male, anal styles are present.
C	In female, anal style are present.

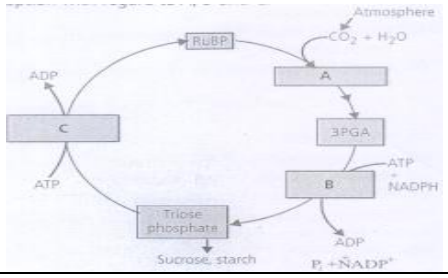
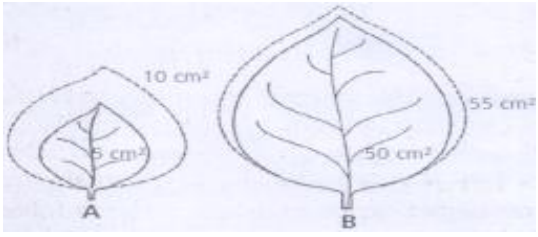
D	In female, anal cerci are present
Q-33	The young one of cockroach is called…
A	Caterpillar
B	Nymph
C	Fingerling
D	Maggot.
Q-34	Tendon is made up of
A	Yellow fibrous connective tissue
B	White fibrous connective tissue
C	Areolar tissue
D	Adipose tissue.
Q-35	Ligament is a
A	Inelastic white fibrous tissue
B	White fibrous tissue
C	Yellow elastic fibrous tissue
D	None of the above
Q-36	Which of the following statement is correct regarding areolar connective tissue?
A	It is a loose connective tissue
B	It is the most widely distributed connective tissue in the body.
C	Its primary function is to bind the different parts together.
D	All of these.
Q-37	Which one of the following statements is correct regarding cockroach?
A	It possesses ventral nerve cord.
B	Its spiracles help in excretion.
C	Its spiracles do not help in excretion.
D	Compound eye is also called as ocellus.
Q-38	Which cell cannot divide following birth in humans?
A	Muscle cells
B	Erythroblasts
C	Osteoblasts
D	Neurons
Q-39	Cartilage is formed by
A	Chondrocytes
B	Osteoblasts

C	Osteoclasts
D	Fibroblasts.
Q-40	Stele includes
A	Pericycle
B	Vascular bundles
C	Pith
D	All of these.
Q-41	At metaphase, chromosomes are attached to the spindle fibers by their
A	Satellites
B	Osteoclasts
C	Kinetochores
D	Terminals.
Q-42	An elaborate three dimensional network of membrane lined channels present in the cytoplasm is called
A	Thylakoid
B	Endoplasmic reticulum
C	Plasmalemma
D	Mitochondria.
Q-43	Some of the cells remain metabolically active; however they do not appear to exhibit proliferation. This stage of inactivation is known as-
A	G_0 phase
B	G_1 phase
C	G_2 phase
D	S phase.
Q-44	Extra-nuclear genes are present in
A	Mitochondria
B	Ribosomes
C	Gynandromorphy
D	All of these.
Q-45	Structure which helps in crossing over is-
A	Synaptonemal complex
B	Synapetic knot
C	Kinetochore
D	Chromocentre.

Q-46	Mitochondria perform all of the following functions except
A	Nucleic acid synthesis
B	Fatty acid synthesis
C	ATP synthesis
D	Polysaccharide degradation.
Q-47	Which of the following cell organelles is rich in hydrolytic enzymes?
A	Ribosomes
B	Mitochondria
C	Lysosomes
D	Chloroplast
Q-48	Which of the following cell organelles constitute a part of endomembrane system?
A	ER and Lysosomes
B	ER and Peroxisomes
C	Golgi complex and mitochondria
D	ER and Golgi complex.
Q-49	GERL is associated with
A	Lysosome
B	Golgi body
C	Mitochondria
D	Lomasome.
Q-50	Protein tubulin is absent in
A	Flagella
B	Cilia
C	Encrotopes
D	Plasma membrane.
Q-51	A cell organelle essential for photorespiration is
A	Ribosome
B	Dictyosome
C	Peroxisome
D	Glyoxisome.
Q-52	Which of the following is basic amino acid?
A	Alanine
B	Aspartate
C	Glutamate
D	Arginine.

Q-53	The desmosomes are concerned with
A	Cell division
B	Cell adherence
C	Cytolysis
D	Cellular excretion.
Q-54	Which of the following is a reducing sugar?
A	Maltose
B	Sucrose
C	Lactose
D	Both (A) and (B)
Q-55	Which of the following is not a disaccharide?
A	Maltose
B	Starch
C	Sucrose
D	Lactose.
Q-56	Which of the following is a saturated fatty acid?
A	Stearic acid
B	Oleic acid
C	Linoleic acid
D	Linoleic acid
Q-57	Which one of the following decides cell to divide?
A	G_1 –phase
B	G_2 –phase
C	S –phase
D	None of these.
Q-58	Exchange of segments between non-sister chromatids of homologous chromosomes is called
A	Synapsis
B	Terminalization
C	Crossing over
D	None of these
Q-59	The chief component of the middle lamella in plant cell is
A	Potassium
B	Calcium

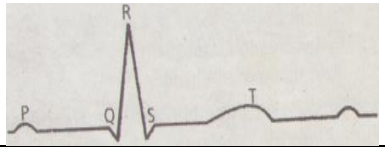
C	Manganese
D	Phosphorus.
Q-60	Zonula adherens is a kind of
A	Filament
B	Desmosome
C	Membrane
D	Mesosome.
Q-61	Select the incorrect statement regarding facilitated diffusion.
A	It is a very specific process
B	It is a passive process.
C	It helps the hydrophilic substances to be transported across the membrane.
D	It is faster than active process.
Q-62	Stomata : : Transpiration Hydathode :_____.
A	Guttation
B	Root pressure
C	Bleeding
D	Oozing
Q-63	Loss or excretion of water in the form of liquid droplets from the margins and tips of leaves is called
A	Transpiration
B	Guttation
C	Bleeding
D	Precipitation
Q-64	Chlorosis i.e. loss of chlorophyll leading to yellowing in leaves, is caused by the deficiency of
A	N, K, Mg
B	S, Fe, Zn
C	Mn, Mo, Mg
D	All of these.
Q-65	Which of the following is a non-symbiotic nitrogen fixing prokaryote?
A	Azotobacter
B	Clostridium
C	Beijerinckia
D	All of these.
Q-66	Necrosis refers to

A	Inhibition of cell division
B	Delay in flowering
C	Death of tissues
D	Falling of leaves.
Q-67	Red color of tomatoes, carrots and chillies is due to the presence of a type of carotene pigment called as
A	Lutein
B	Lycopene
C	Fucoxanthin
D	Phycoerythrin.
Q68	In the given representation of Calvin cycle, select the correct option with regard to A, B and C. 
A	A represents regeneration of RuBP
B	B represents carboxylation
C	C represents reduction reactions that lead to the formation of glucose
D	None of these
Q-69	Pyruvic acid, the key product of glycolysis can have many metabolic fates. Under aerobic condition it forms
A	Lactic acid
B	$CO_2 + H_2O$
C	Acetyl CoA + CO_2
D	Ethanol + CO_2
Q-70	Study the given figures and select the correct answer for relative growth rates (RGR) of leaves A and B respectively 
A	1% and 2%
B	10% and 100%

C	100% and 10%
D	100% and 100%
Q-71	The dedifferentiated cells mature to form some specific cells to perform specific functions, this is referred to as
A	Differentiation
B	Dedifferentiation
C	Redifferentiation
D	Development.
Q-72	In plant tissue culture experiments, high auxin to cytokinin ratio favours _____ development and high cytokinin to auxin ratio favours development_____
A	Root, Shoot
B	Shoot, Root
C	Root, Root
D	Shoot, Shoot
Q-73	Function of auxin include
A	Promoting flowering in pineapple
B	Inducing parthenocarpy in tomato
C	Use as herbicides to kill dicot weeds
D	All of these.
Q-74	Internodal elongation is stimulated by
A	Auxin
B	ABA
C	Cytokinin
D	Gibberellins.
Q-75	The stimulus of cold treatment (vernalization) is perceived by
A	Leaves
B	Flowers
C	Roots
D	Shoot apices.
Q-76	Which among the following is not a sunction of cytokinins?
A	Essential for cytokinesis during cell division
B	Delays the senescence of leaves
C	Helps in fruit ripening
D	Helps to overcome apical dominace
Q-77	If the apical bud has been removed then we observe
A	Less lateral branches
B	More auxiliary buds

C	Plant growth stops
D	Flowering stops.
Q-78	When water moves through a semi-permeable membrane then which of the following pressure develops?
A	Osmotic pressure
B	Suction pressure
C	Turgor pressure
D	Wall pressure.
Q-79	PEP (Phosphoenol pyruvic acid) is primary CO_2 acceptor in
A	C_4 plants
B	C_3 plants
C	C_2 plants
D	Both C_3 and C_4 plants.
Q-80	Hormone involved in phototropism is
A	IAA
B	Gibberellins
C	Kinetin
D	2, 4-D.
Q-81	Dental formula of rabbit is
A	$\frac{1023}{2033}$
B	$\frac{2033}{1023}$
C	$\frac{2102}{1102}$
D	$\frac{1003}{1003}$
Q-82	Which of the following vitamins has some physiological effects similar to those of parathormone?
A	Vitamin A
B	Vitamin D
C	Vitamin C
D	Vitamin B.
Q-83	Glenoid cavity is associated with
A	Scapula and Humerus
B	Scapula and Femur
C	Acetabulum and Humerus
D	Scapula and Femur.
Q-84	The respiratory rhythm centre is present air is

A	Cerebrum
B	Cerebellum
C	Hypothalamus
D	Medulla oblongata.
Q-85	Dialysis is done when person is suffering from
A	Diabetes
B	Uraemia
C	Polyurea
D	Haemolysis
Q-86	Which of the following is a reflex action?
A	Blinking
B	Cycling
C	Jumping
D	All of these
Q-87	Which of the following is not related to the autonomic nervous system?
A	Peristalsis
B	Digestion
C	Excretion
D	Memory and learning.
Q-88	Islets of Langerhans are found in
A	Anterior pituitary
B	Kidney cortex
C	Spleen
D	Endocrine pancreas.
Q-89	The hormone responsible for “Fight and Flight” response is
A	Adrenaline
B	Thyroxin
C	ADH
D	Oxytocin
Q-90	One of the constituents of the pancreatic juice which is poured into duodenum in human is
A	Trypsinogen
B	Chymotrypsin
C	Trysin
D	Enterokinase
Q-91	When the oxygen supply to the tissue is inadequate, the condition is
A	Dyspnea
B	Hypoxia
C	Asphyxia

D	Apnea.
Q-92	Given below is the ECG of a normal human. Which one of its components is correctly interpreted below 
A	Complex QRS – one complete pulse
B	Peak T – initiation of total cardiac contraction
C	Peak P and peak R together – systolic and diastolic blood pressures
D	Peak P – initiation of left atrial contraction only
Q-93	Inner lining of the kidney has
A	Nephrocyte
B	Podocyte
C	Choanocyte
D	Amoebocyte.
Q-94	ADH deficiency shows the following condition
A	Only polydipsia
B	Polyuria
C	Polydipsia and polyuria
D	Glucosuria.
Q-95	The ball and socket joint is found in
A	Skull
B	Shoulder
C	Knee
D	Atlas and axis.
Q-96	The volume of blood that enters into the aorta with each ventricular systoles is called
A	Cardiac cycle
B	Stroke volume
C	Cardiac output
D	Vital capacity.
Q-97	The thickening of walls of arteries is called
A	Arteriosclerosis
B	Arthritis
C	Aneurysm
D	Both (b) and (c)
Q-98	The 24 hour (diurnal) rhythm of our body such as the sleep-wake cycle is regulated by the hormone
A	Calcitonin

B	Prolactin
C	Adrenaline
D	Melatonin.
Q-99	Which of the following is known as master endocrine gland?
A	Adrenal gland
B	Thyroid
C	Pituitary
D	Pineal gland.
Q-100	Which of the following hormones has no effect on heart beat?
A	Thyroxine
B	Oxytocin
C	Adrenaline
D	Noradrenaline.

APPENDIX IV

REACTION SCALE

Dear Students,

I wish to approach you with a reaction scale which is a part o my doctoral study at the Center of Advanced Study in Education (CASE), Department of Education, Faculty of Education and Psychology, The M. S. University of Baroda, Vadodara. Kindly respond to the various statements related to different constructivist teaching strategies. These statements do not have right or wrong answers. These statements aim only at finding out your attitude towards constructivist learning strategies.

Your truthfulness in answering to the statements would be valued and your cooperation highly appreciated. I would like to assure you that your responses will be treated as confidential and be used exclusively for the research study only.

Thanking for your cooperation.

(Sunil Kumar)

Researcher

Name: _____ Class: _____ Date: _____

No.	Statements	SD	D	N	A	SA
1	Brainstorming helps to develop knowledgein depth					
2	Brainstorming helps in understanding the topics					
3	Brainstorming encourages thinking					
4	Brainstorming helps in organizing ideas					
5	Brainstorming helps to generate new ideas					
6	Visit to botanical garden and Zoological Park help in developing better understanding of living diversity					
7	Visit to BotanicalGarden,Zoological Parkencourageinvestigation, observation, and thinking.					
8	Visit to botanical garden and Zoological Park were helpful in gathering various information about the characteristics of plants.					
9	Visit to botanical garden and Zoological Park provide time to interact with Nature.					
10	Visit to botanical garden and zoological park help students to communicate their understanding of concepts with their parents, peer, and teachers.					
11	Laboratory investigation promotes skill of anatomical investigations					
12	Laboratory investigation helps in handling laboratory instruments and materials with care					

No.	Statements	SD	D	N	A	SA
13	Laboratory investigation arouses curiosity in observing microscopic pattern					
14	Laboratory investigation develops skills of drawing internal anatomy					
15	Laboratory investigation helps in identifying differences between different parts of living organisms					
16	Jigsaw I and Jigsaw II were helpful in sharing ideas					
17	Jigsaw I and II develop team spirit among students to complete any project					
18	Jigsaw I and II increase reasoning ability of students					
19	Jigsaw I and II help to respect others ideas.					
20	Jigsaw I and II help in better understanding of the content.					
21	Animated films help in better understanding of course content.					
22	Animated films make learning interesting.					
23	Animated filmsmake learning faster.					
24	Animated films increaseconcentration in the classroom.					
25	Animated films make revision easy during examination.					
26	Visit to medical college helps in exploring the internal anatomy of human body.					

No.	Statements	SD	D	N	A	SA
27	Visit to medical college helps to see different types of surgical instruments.					
28	Visit to medical college helps in understanding the functioning of hospital.					
29	Visit to medical college developsconcern for patients.					
30	Visit to medical college helps to promote healthy life among students.					
31	Constructivist approach helps learning a joyful experience.					
32	Constructivist approach helps in better understanding of concepts.					
33	Constructivist approach helps in developing creative ideas.					
34	Constructivist approach focuses on construction rather than only giving instruction.					
35	Constructivist approach helps to widen the concept of learning within and outside school					
	Mean of Intensity Index					

APPENDIX V

The Published Research Paper

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Effectiveness of Filed Work in Teaching Human Physiology at Senior Secondary Level

INTRODUCTION

Fieldwork is considered to be a major component within plant diversity, animal diversity, human physiology and environmental sciences curricula and is advocated as an effective learning environment. Kent *et al.* (1997) suggest that the objectives of any fieldwork exercise need to be clearly identified considering it as an educational exercise. In addition, the design of a fieldwork programme must be integrated into the structure and learning objectives. Fuller *et al*. (2000) consider the following to be key educational objectives of fieldwork(i)development of observational skills, (ii)facilitation of experiential learning, (iii) encouragement of student responsibility for their own learning, (iv) development of analytical skills, (v) provision of a taste of research, (vi) kindling of a respect for the environment, (vii) development of personal skills and (viii) lessening of barriers between staff and student.

Keeping these points in mind the researchersdesigned the fieldwork to see its effectiveness with the following aims and objectives.

Aim and Objectives of the Research

The aim of the present study was to know the effectiveness of fieldwork in teaching human physiology at senior secondary level. It also aim to ascertain whether students studying human physiology find fieldwork a valuable way of learning. The objectives were: (i)toknow the effectiveness of fieldwork in terms of developing various skills among students,(ii) to know the attitude of student towards field work. The research is contextualized by the need to ensure cost-effectiveness of the student learning and to ensure that such learning is also realistic, innovative, focused and relevant.

Population

All the standard XI English medium students with biology as the specialization of the schools in Gujarat affiliated to CBSE constituted as the population of the present study.

Sample

Non-Probability sampling design was adopted by the researcher for the present study. P. P. Savani Chaitanya Vidya Sankul, Surat, Gujarat, which is an English Medium CBSE school, was selected purposively. All 36students enrolled in standard XI Biology class constituted as the sample for the study. Of these 16 students were male and 20 students were female aged between 16 & 18 years.

The Experiment: Field Trip

The researchers identified the content of class XI CBSE, worth to be taught by organizing field trip. The Human Physiology Unit was selected for this study and field visits to different departments of Surat Municipal Institute of Medical Education &Researchat Surat was planned to facilitate the teaching learning process. Permission from authorities was takenand all necessary inputs were provided to students along with learning objectives. All 36 students ofclass XI with biology as their major subjectvisited the Institute and gained various skill related with human physiology for a period of one week.The students were accompanied with researchers and assistant laboratory in-charge of the school.

Tools for Data Collection

To achieve the objectives of the present study, a questionnaires and a reaction scale were constructed by the researcher.

Questionnaire was constructed to study the various skill gained by student during the fieldwork. Statements were aimed to know the benefits gained by the students related with fieldwork and to know whether they acquired the expected set of skills or not. The researcher has selected ten skills namely (i) observation skill, (ii) interpretation and identification skill, (iii) surveying skill; (iv) information gatheringskill, (v) data analysis skill, (vi) communication skill, (vii) data recording skill, (viii) measurement and sampling skill, (ix) advanced scientific methods skill and (x) safety skill.

A Likert type three point reaction scale was developed to assess the reaction of student towards fieldwork. It contained 10 statements. The three points of reaction were strongly agree, no response and disagree.

The constructed questionnaire and reaction scale were validated by ten experts in the field of education. Suggestions of experts were incorporated in the tools.

Data Collection and Data Analysis

The researchers administered the developed tools on the entire class XI student enrolled in Biology after completion of the field visit. All students were asked to complete the given questionnaire and give their responses.Students were also asked to give their reaction by putting a tick mark (√) in the appropriate box for each statement.

The researcher used quantitative data analysis techniques to analyse the data obtained by questionnaire and reaction Scale by frequency, percentageand intensity index.

Research Findings

Following findings were drawn from analysis and interpretation of the Data.

(A) Finding related to the Development of Skill:72.22% of the student felt that fieldwork experiences had enabled them to enhance their observation skill. 69.44% of the student felt that fieldwork experiences had enabled them to enhance their interpretation and identification skill. 72.22% of the student felt that fieldwork experiences had enabled them to enhance theirsurveying skill.83.33% of the student felt that fieldwork experiences had enabled them to enhance theirinformation gathering skill.55.56% of the student felt that fieldwork experiences had enabled them to enhance theirdata analysis skill.88.89% of the students felt that fieldwork experiences had enabled them to enhance theircommunication skill.88.89% of the student felt that fieldwork experiences had enabled them to enhance theirdata recording skill. 75% of the students felt that fieldwork experiences had enabled them to enhance theirmeasuring and sampling skill. (ix) 69.44% of the students felt that fieldwork experiences had enabled them to enhance their advanced scientific methods skill. 91.67% of the students felt that fieldwork experiences had enabled them to enhance their Safety skill.

(B) Finding related to Academic Benefits of Field work: All students felt that fieldwork was an effective way to learn human physiology as it helps to put theory into practice, provides hands-on experience, facilitates more effective learning, allowsone to gain confidence to perform practicalsand facilitates learning about the practical aspects of the subject.

(C) **Finding related to reaction of student towards field work:**In terms of reaction of students towards the statement i.e. “Field work helped me to develop key learning skills” 66.67 %, 13.89 %, and 19.44 % of them reacted agree, no response and disagree. The intensity index of 2.53 shows favourable reaction of the students towards the statement in developing the learning skills. In terms of the reaction of students’ towards the statement i.e. “Field work encouraged me to take responsibility for my own learning” 75 %, 11.11 %, and 13.89 % of them reacted agree, no response and disagree. The intensity index of 2.64 shows favourable reaction of the students as it encouraged them in taking responsibilities for their

own learning.In terms of reaction of students' towards the statement i.e. "Field work allowed me to study topics in depth" 77.78 %, 11.11 %, and 11.11 % of them reacted agree, no response and disagree. The intensity index of 2.67 shows favourable reaction of the students in developing habits to study any topic in depth.In terms of reaction of students' towards the statement i.e. "Field work allowed to develop more relaxed social contact with teacher; 88.89%" 2.78 % and 2.92 % of them reacted agree, no response and disagree. The intensity Index of 2.92 shows favourable reaction of the students towards free flow communication among students and teacher.In terms of reaction of student's towards the statement i.e. "Field work encouraged of my teamwork skills" 86.11 %, 2.78% and 2.83% of them reacted agree, no response and disagree. The intensity index of 2.83 shows favourable reaction of the students in developing skill of teamwork and teamspirit.In terms of reaction of students' towards the statement i.e. "Field work developed my curiosity about the human physiology" 88.89 %, 5.56 %, and 5.56 % of them reacted agree, no response and Disagree. The Intensity Index of 2.83 shows favourable reaction of the students in developing skill of curiosity about human physiology.In terms of reaction of student's towards the statement i.e. "Field work hadbeen undertaken at inappropriate times of the academic year" 25 %, 58.33 % and 16.67 % of them reacted agree, no response and Disagree. The intensity index of 1.67 shows neutral reaction of the students towards the arrangement of field work in the academic calendar. In terms of reaction of student's towards the statement i.e. "Field work had been of inappropriate length" 63.89 %, 22.22 %, and 13.89 % of them reacted agree, no response and Disagree. The intensity index of 2.42 shows the negative reaction related to the duration of field work and time management.In terms of reaction of student's towards the statement i.e. "Field work had been financially expensive" 36.11 %, 41.67 %, and 22.22 % of them reacted agree, no response and Disagree. The intensity index of 1.94shows their neutral reaction towards the statement.In terms of reaction of student's towards the statement i.e. "Field work involved too much travel and not enough activity" 30.56 %, 55.56 % and 13.89 % of them reacted agree, no response and Disagree. The intensity index of 1.72 showstheir neutral reaction towards the statement. The overall intensity index of 2.41 showed the positive reaction of students towards the field work.

Conclusion

It is clear from this research that there are a wide variety of things that students can learn from their fieldwork experience. These vary in range from the very practical ability to use equipment and the development of identification skills, through gaining a wider experience of the environment as a whole and thus being able to relate theory to practice, to the

accumulation of intellectual and personal skills. It is clear that the full ranges of the advantages of fieldwork are multifarious in nature. It would seem that fieldwork provides a very valuable learning experience. The findings of the present study also showed that the fieldwork to provide practical experience to Biology students in human physiology was effective in terms of the skill acquisition of students and their positive reaction towards the field work.

In conclusion, fieldwork provides students with a wide range of benefits that are difficult to quantify and measure. For all those involved with fieldwork it would seem that the benefits far outweigh the costs of running these courses. Therefore, it is strongly recommend that fieldwork should be given importance place in the school time-table for the practical subjects like Biology.

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