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B.Ed.

SEMESTER - II

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Course No. : 205 **Lesson No. : 1-12**

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TEACHING OF BIOLOGICAL SCIENCE

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Bachelor of Education (B.Ed) through Open and Distance Learning (ODL)

Semester –II

(For the examination to held in the year 2025,2026 & 2027)

Methodology of teaching subject-I

Course no. 205 **Title: Teaching of Biological Science**

Credits 4 **Total Marks : 100**

Maximum Marks Internal : 30 **Maximum Marks External :**

Duration of Exam : 3hrs

Objectives: To enable the pupil teachers to :

- Acquaint themselves with the concept of biological science.
- Familiarize themselves with the concept of curriculum, text books and co- curricular activities in biological science
- Prepare a lesson plan .
- Understand some important areas of biological science

Unit -I

Origin and development of biological science. History of biological science.

Aims and values of teaching biological science in secondary school

Behavioural objectives: Meaning and importance of behavioural objectives, steps for preparing behavioural objectives for teaching of biological science.

Unit- II

Curriculum: Meaning, importance and principles of designing a good curriculum for biological science. Concentric, topical and integrated approaches in organising curriculum for biological science.

Textbooks: Meaning importance and role of textbooks in teaching of biological science. Qualities of a good textbook of biological science.

Co-curricular Activities; Meaning, types and importance of co-curricular activities . Steps of organizing co-curricular activities.

Unit -III

Lesson planning: Meaning, importance and principles of writing lesson plans in teaching of biological science.

Steps for preparing a lesson planning through Herbartian and RCEM approach.

Preparing a lesson plan on a topic of biological science.

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Unit -IV

Plant parts and their functions. Classification, Reproduction in plants- concept of asexual and sexual reproduction. Importance of plants as medicine and as source of food, fodder, fuel and oil.

Animal diversity: Classification, Economic significance of animals.

Cell- the basic unit of life, its generalised structure and function, Difference between plant and animal cell.

Sessional work:

Analysis of a unit / chapter in a biological science text book- to identify the concepts, principles and underlying scientific theories.

Note for Paper Setters

The Question paper consists of 9 questions having Q no 1 as Compulsory having four parts spread over the entire Syllabus, with a weightage of 14 marks .The rest of Question paper is divided into four Units and the students are to attend four Questions from these units with the internal choice. The essay type Question carries 14 marks each. Unit IV having the sessional work/field work (section) could also be a part of the theory paper.

Internship/field work Unit IV having the components/activities of the internship are to be to be developed in the form of the Reflective Journal. All the activities under the internship are to be evaluated for credits and hence all the activities are to be showcased by the trainee and are to be fully recorded with the complete certification of its genuineness .

The Theory paper is to have 70 marks (external) . 30 Marks are for the In House activities

Books recommended

- *Gupta ,S.D. & Sharma, D.R.(2002). Teaching of science.Malhotra brothers, Jammu.*
- *Kohli, V.K. (2001). How to teach science.Vivek Publishers,Ambala city.*
- *NCERT. (2013) .Science. Publication Division.NCERT Campus,New Delhi*
- *Sharma, R.C. (1981). Modern Science Teaching.Dhanpat Rai Publishing Co. New Delhi*

TEACHING OF BIOLOGICAL SCIENCE

CONTENTS

LESSON NO.1 UNIT- I

ORIGIN & DEVELOPMENT OF BIOLOGICAL SCIENCE

STRUCTURE

1.1 INTRODUCTION

Biology is the study of life. As humans are living things, they have a natural sense of curiosity and affection towards life and how it has come to be. Biology is a living science, in which changing knowledge continually generates new perspectives and fresh opportunities for productive impact onour society. It is so close to the life of an individual that no teacher ever is without first hand material for the study of biology. Knowledge of biologicalscience ensures a higher standard of living. In this lesson, you will know about the origin, history and the development of biological science.

1.2 OBJECTIVES

After going through this lesson, you shall be able to

- explain the meaning of the biological science,

- describe the origin of biological science,
- discuss about the history of biological science, and
- explore the recent development in the field of biological science.

1.3 ORIGIN AND HISTORY OF BIOLOGICAL SCIENCE

Biological Science is the study of life and living organism. It is also called as 'Biology'. The Greek word 'Bio' means life and 'logos' means study of. In the late 1700, Jean- Baptiste Pierre Antoine de Monet, chevalier de Lamarck coined the term biology. Earlier study of living things was restricted to the pure science like botany and zoology that together comprise the biology but as the time passed new branches evolved, new technologies developed in pure subjects as well as applied fields, which gave rise to a very broad science called biological science. Biological science is an extensive study covering the minute working of chemical substances inside living cells, to the broad scale concepts of ecosystems and global environment changes. It is also concerned with the physical characteristics and behaviours of organisms living today and long ago, how they came into existence, and what relation they possess with each other and their environments, intimate study of details of the human brain, the composition of our genes etc. dealt in biological science. Today, it is also known as Life Science.

The biological science or life science can be defined as "a systematic study of living beings or study of nature". Teaching of biological science deals with providing information about the latest developments in the field of biological sciences all over the world.

Human knowledge of biology began with pre-historic man and his experiences with plants and animals and also through the instincts and efforts to explore the nature. The information was verbally passed on from one generation to another. The history of science, therefore, can be said to have begun with the history of the human existence.

During early period, people knew about medicinal and poisonous plants and knew that a heart-beat meant that someone or some animal was alive. They also had the idea that the conception of babies is in some way connected with sexual reproduction. Records of advances made in the field of medicine as well as some other branches were biological sciences during the early civilization are available.

Anaximander, a Greek philosopher who lived from 611 to 546 BC, is credited with the first written

work on natural science. He said that in the beginningthere was a fish-like creature with scales etc. that arose in and lived in theworld ocean, they moved onto land and became the first humans. Whilst his theories seem very strange when compared to the later work of Charles Darwin, he was the first philosopher to postulate relationships between thevarious animals and human. Many of his exact points concerning the evolution of species and the origins of humanity sound almost comical, but the basic principle and philosophy behind his idea was extremely insightful.

There is much disagreement between historian over the various fragmentary sources and translations, but his thought certainly follows a chain of reasoning. Greek philosophers did not like 'uncaused causes', so Anaximander attempted to explain the origin of life by pointing out that the first human must have come from somewhere, the first real inclusion of human in the history of biology.

- Anaximander noticed that, compared to animals, human took longerto rear and that children could not find food for themselves. Therefore, humans must have originally originated from another species that couldfind food for itself and be completely self-sufficient from a youngage.
- Primitive animals were derived from the moisture evaporated by theheat of the sun and early human resembled a fish.
- The animals swimming in the water were protected by a spiny skin and when they emerged onto the land, this skin split and their behaviours changed to suit the new environment.
- Therefore, fish and men were not created at the same time, but fish were first and gave rise to humanity through this process of change. This explain his first point, namely how could human have arisen ifthe young cannot fend for themselves.

In 570 BC, Xenophone was one of the first people to write about his observation on fossils. He thought that fossils were an indication that therewas water previously in that area. Hippocrates lived from 400 to 300 BC had given a theory that the human body was composed of four elements plus four fluids-Sanguis or blood, produced by heart; yellow bile from liver; blackbile from spleen and phlegm by brain, which corresponded with these.

Aristotle, one of the Plato's pupils, from 343 to 322 BC refined the systemsof animal and plant classification. His classification system included whathe called the "Scala naturae", the 'scale of

nature'. He said that all organisms are arranged in a hierarchy from simplest to complex. By the late 1600s, observations were being made with the first, primitive microscopes. In 1665, Robert Hooke was the first person to see and name cell. He examined cork bark with a primitive microscope and saw little cubicle which he called cells. Leeuwenhoek was the first person to observe sperm cells with his very primitive microscope. He proposed that fertilization occurs when the spermenters the egg, but this could not actually be observed for another 100 years.

In botany, there were considerable efforts in the past. Classification of organisms in India comes from Vedas and Upanishads from 1500 BC to 600 BC. In these books, many technical terms were used to describe plants and their parts both morphologically as well as anatomically. Rotation of crops was practiced and medicinal plants were also collected and studied. Two eminent ancient Indian Ayurvedic physician named Charaka and Susruta contributed to our knowledge of diversity and utility of plants.

Two great Greek philosophers, Hippocrates (460-377 BC) and Aristotle (384-322 BC) studied and classified various living organisms but their classifications were not based on scientific method and reasoning. Theophrastus (370-285 B.C), a disciple of Aristotle classified the plants onthe basis of form and texture and is known as "Father of Botany". His book'Historia Plantarum' deals with 480 plants.

With the decline of the Greek and Roman civilization, there was no significant botanical advancement for more than fourteen centuries. However, there was again awakening of botanical learning in the 16th century when several herbals, especially those of Brunfels, Bock, Fuchs, Turner, Cordus werepublished.

Otto Brunfels, in 16th century, was one of the first among the group of renowned herbalists, who described and illustrated the plants known to thatperiod. They were more interested in the purported medical values and domestic uses of plants. Brunfels produced one of the first illustrated herbals and recognized the perfect and imperfect groups of plants characterized by the presence and absence of flowers respectively. The herbalists as a groupare important for their contribution to the descriptive phases of systematic botany. In the 17th century, two European scientists John Ray (1627-1706)and Francis Willougby (1635-1672) collected many plants and animals and classified them. Ray described 18,000 plants and published between 1686 and 1704 a book "Historia Generalis Plantarum" in three volumes.

Carl Linnaeus (1707-1778), a Swedish naturalist who is also called 'Father of Taxonomy', classified the organisms according to his own system of classification, which is called binomial

system of nomenclature. This system is based on the principle of naming organisms by two words: genus and species. According to him, existing species of plants and animals were the descendants of the previously created species. His 'Systema Naturae' appeared in 1735, 'Genera Plantarum' in 1737 and 'Classes Plantarum' in1738.

Linnnaeus 'Philosophia Botanica' appeared in 1751, which was a revised version of his system, published in 'Classes Plantarum'. His book 'Species Plantarum' was published in 1757,a work in which 1700 species were described and arranged on the basis of sexual system of classification. Hissystem is considered as an artificial system. In 1809, Lamarck published his 'Theory of Evolution'. In 1828, Karl Von Baer published the developmental stages in mammalian eggs. In 1859, Charles Darwin published "The Origin of Species by Means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life", more commonly known as the Origin of Species. Charles Darwin established evolution as a viable theory by articulating its driving force, natural selection as Alfred Russel Wallace is recognized as the co-discoverer of this concept. Darwin theorized that species and breeds developed through the processes of natural selection as well as by artificial selection or selective breeding. Genetic drift was embraced as an additional mechanism of evolutionary development in the modern synthesisof the theory. Biological form and function is created from and is passed on the next generation by genes which are the primary lessons of inheritance wide array of biology and medicine journals

In 1745-1748, John Needham, a naturalist showed that microorganismflourished in various soups that had been exposed to the air. He claimed that there was a life force present in the molecules of all inorganic matter, including air or the oxygen in it that could cause spontaneous generation to occur, thusaccounting for the presence of bacteria in his soups.

In 1865, Gregor Mendel, an Austrian monk, published a paper on genetics that earned him the nickname 'the Father of Modern Genetics'. His work isbased on experiments on sweet pea. He noticed in his garden that some ofthe pea plants were tall while others were short, some has purple flowers while others had white, some had yellow seeds while others had green and some had wrinkled seeds while others had smooth seeds. He developed a theory of genetics that refuted the homunculus idea and enabled people topredict the outcome of a genetic cross if the genes of the parents were known.

In 1870 the process of mitosis, regular cell division by which one cell dividesto make two cells, was observed, and researchers noticed that chromosomes, whose function was not understood,

were moving around in the cell during mitosis so that each daughter cell got an exact set of them. In 1890 the process of meiosis, a special cell division involved in producing egg or sperm was observed. Again, researchers did not yet understand what chromosomeswere, but they did note that as a result of meiosis, each egg or sperm cell formed had half as many chromosomes as the original cell.

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) Biological science is a systematic study of……..

(ii) ……. and…… coined the term biology.

(iii) Carl Linnaeus is known as the……..

(iv) ……..is known as the father of botany.

(v) Charles Darwin gave the theory of ……

1.4 DEVELOPMENT OF BIOLOGICAL SCIENCES

Biology examines the structure, function, growth, origin, evolution and distribution of living things. It classifies and describes organisms, their functions, how species come into existence and the interactions they have with each other and with the natural environment. Four unifying principlesfrom the foundation of modern biology: cell biology, evolution, genetics and homeostasis.

The field within biology are further divided based on the scale at which organisms are studied and the methods used to study them: biochemistry examines the fundamental chemistry of life; molecular biology studies the complex interaction of system of biological molecules; cellular biology examines the basic building block of the life, the cell; physiology examines the physical and chemical functions of the tissues and organ systems of an organism; and ecology examines how various organisms interrelate.

Biology as a separate science was developed in the nineteenth century, as scientists discovered that organisms shared fundamental characteristics. In1870 the process of mitosis, regular cell division by which one cell divides to make two cells, was observed, and researchers noticed that chromosomes,whose function was not understood, were moving around in the cell

duringmitosis so that each daughter cell got an exact set of them. In 1890 the processof meiosis, a special cell division involved in producing eggs or sperm, wasobserved. Again, researchers did not yet understand what chromosomes were, but they did note that as a result of meiosis, each egg or sperm cell formed had half as many chromosomes as the original cell.

Thus, after Mendel's work was rediscovered in 1900, researchers started seeing parallels between his theory of genetics and what the chromosomeswere doing in mitosis and meiosis. Mendel's work was rediscovered in 1900 and people figured out that Mendel's genes were on the chromosomes. In 1940, people finally started fitting the two together. People began to think that the DNA in the chromosomes was the genetic material but because its chemical nature was unknown, a lot of biologists were skeptical about thisidea. In 1953, James Watson, an American and Francis Crick, an Englishman, published a paper in which they proposed a hypothetical structure for DNA and showed how DNA could be the genetic code material and suggested ameans whereby it could replicate itself.

At the beginning of the 20th century, biological research was largely a professional endeavour. Most work was still done in the natural history mode,which emphasized morphological and phylogenetic analysis over experiment- based causal explanations. However, anti-vitalist experimental physiologists and embryologists were increasingly influential. The tremendous success ofexperimental approaches to development, heredity and metabolism in the1900s and 1910s demonstrated the power of experimentation in biology. In the following decades, experimental work replaced natural history as thedominant mode of research.

In the early 20th century, naturalists were faced with increasing pressure to add rigor and preferably, experimentation to their methods, as the newly prominent laboratory based biological disciplines had done. Ecology hasemerged as a combination of biogeography with the biogeochemical cycle concept pioneered by chemists; field biologists developed quantitativemethods such as the quadrat and adopted laboratory instruments and camerafor the field to further set their work apart from traditional natural history. The ecological succession concept, pioneered in the 1900s and 1910s by Henry Chandler Cowles and Frederic Clements, was important in early plant ecology. Ecology became an independent discipline in the 1940s and 1950s after Eugene P.Odum synthesized many of the concepts of ecosystem ecology, placing relationships between groups of organisms at the center of the field.

In the 1960s, as evolutionary theorists explored the possibility of multiple units of selection, ecologists turned to evolutionary approaches. In populationecology, debate over group selection

was brief but vigorous; by 1970, most biologists agreed that natural selection was rarely effective above the level of individual organisms. The evolution of ecosystem, however become alasting research focus.

1900 marked the so-called rediscovery of Mendel: Hugo de Vries, Carl Correns and Erich von Tschermak independently arrived at Mendel's laws. Soon after, cytologists proposed that chromosomes were the hereditary material. Between 1910 to 1915, Hunt Morgan and the "Drosophilists" in his fly lab forged these two ideas-both controversial-into the "Mendelian-Chromosome theory" of heredity. They quantified the phenomenon of genetic linkage and postulated that genes reside on chromosomes like beads on string; they hypothesized crossing over to explain linkage and constructed geneticmaps of the fruit fly Drosophila, which became a widely used model organism.

Hugo de Vries tried to link the new genetics with evolution; building on hiswork with heredity and hybridization, he proposed a theory of mutationism, which was widely accepted in the early 20th century. Lamarckism or the theory of inheritance of acquired characteristics also had many adherents. Darwinism was seen as incompatible with the continuously variables traits which seemed only partially heritable. In 1920-30 the emergence of the population genetics, with the work of Fisher, Haldane and Wright, unifiedthe idea of evolution by natural selection with Mendelian genetics, producingthe modern synthesis. The inheritance of acquired characters was rejected. In the 1960s Hamilton and others developed gene theory approaches to explainaltruism from an evolutionary perspective through kin selection.

By the end of the 19th century, all of the major pathways of drug metabolism had been discovered, along with the outlines of protein and fatty acid metabolism and urea synthesis. In the early decades of the 20th century, theminor components of foods in human nutrition, the vitamins, began to be isolated and synthesized. In the 1920s to 1930s, biochemists- led by Hans Krebs and Carl and Gerty Cori-began to work out many of the central metabolic pathways of life; the citric acid cycle, glycogenesis and the glycolysis. Between 1930s -1950s Lipmann and other established the roleof ATP as the universal carrier of energy in the cell, and mitochondria as thepowerhouse of the cell. Such traditionally biochemical work continued to be very actively pursued throughout the 20th century and into the 21st.

Oswald Avery showed in 1943 that DNA was likely the genetic material of the chromosome, not its protein; the issue was settled decisively with the1952 Hershey-Chase experiment-one of many contributions from so-called phage group centered on biologist Max Delbruck. In

1953, James Watson and Francis Crick suggested that the structure of DNA was a double helix. Watson and Crick noted, "It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism forthe genetic material".

Between 1953 and 1961, there were few known biological sequences-eitherDNA or protein-but an abundance of proposed code systems, a situation made even more complicated by expanding knowledge of the intermediate role ofRNA. Between 1961 and 1966 the work of Nirenberg and Khorana was most important.

The late 1950s to the early 1970s was a period of intense research and institutional expansion for molecular biology, which had only recently becomea coherent discipline. In what organismic biologist E.O.Wilson called "TheMolecular War".

Since the late 19th century, biotechnology in the general sense has been animportant part of biology. With the industrialization of brewing and agriculture, chemists and biologists became aware of the great potential ofhuman controlled biological processes. In particular, fermentation proved a great boon to chemical industries. By the early 1970s, a wide range of biotechnologies were being developed, from drugs like penicillin and steroids to foods like chlorella and single cell protein to gasohol as well as a wide range of hybrid high- yield crops and agricultural technologies, the basis forthe green revolution.

Biotechnology in the modern sense of genetic engineering began in the 1970swith the invention of recombinant DNA techniques. Restriction enzymes were discovered and characterized in the late 1960s, following on the heels of the isolation, then duplication, then synthesis of viral genes. In 1972, Paul Berg produced the first transgenic organism. By the 1980, protein sequencing had already transformed methods of scientific classification of organisms. The development and popularization of the polymerase chainreaction in mid 1980s marked another watershed in the history of modern biotechnology, greatly increasing the ease and speed of genetic analysis.

The Human Genome Project-the largest, most costly single biological study ever undertaken began in 1988 under the leadership of James D.Watson, afterpreliminary work with genetically simpler model organisms such as E.coli, S.cerevisiae and C.elegans. Shotgun sequencing and gene discovery method pioneered by Craig Venter-and fueled by the financial promise of gene patents with Celera Genomics-led to a public-private sequencing competition that ended in compromise the first draft of the human DNA sequence announcedin 2000.

At the beginning of the 21 century, biological sciences converged with previously differentiated

new and classic disciplines like physics into research field like biophysics. Advances were made in analytical chemistry and physics instrumentation including improved sensors, optics, tracers, instrumentation, signal processing, networks, robots, satellites and compute power for data collection, analysis and simulation. These technology advances allowed theoretical and experimental research including internet publication of molecular biochemistry, biological system, and ecosystem science.

Until about 100-150 years ago, bio and religion were intervened in human thought and culture. Since Darwin's time in western culture, science and religion had pretty much gone their one way at a time when new discoveries were constantly being made in science.

Biology is now a standard subject of instruction at schools and universities around the world and over a million papers are published annually in a wide array of biology and medicine journals. Most biological sciences are specialized discipline. Traditionally, they are grouped by the type of organismbeing studied: botany, the study of plants; zoology, the study of animals; and microbiology, the study of microorganisms.

Check your progress-2

Notes : (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) Watson and crick proposed the hypothetical structure of .....

(ii) .....synthesized many of the concepts of ecosystem ecology.

(iii) In year.....Paul Berg produce the first transgenic organism.

(iv) The Human Genome Project was began in 1988 under the leadership of …….

(v) Lamark has given the theory of ……..

(vi) Oswald Avery showed in 1943 that …….was likely the genetic material of the chromosome, not its …….

1.5 LET US SUM UP

Biological science is the study of life and living organisms. Biological science is a massive field of study. Everyone has to start somewhere and studying biology can enlighten your

understanding of the world around you. The study of living things has a rich and exciting history. Jean- Baptiste Pierre Antoine de Monet, chevalier de Lamarck coined the term biology.The biological science is a systematic study of living being or study of nature. Biology as a separate science was developed in the nineteenth century, as scientists discovered that organisms shared fundamental characteristics. Aristotle, one of the Plato's pupils, refined the systems of animals and plant classification. Theophrastus, a disciple of Aristotle classified the plants on the basis of form and texture and is known as "Father of Botany". Darwin theorized that species and breeds developed through the processes of natural selection as well as by artificial selection or selective breeding. Biology is now a standard subjectof instruction at schools and universities around the world and over a million papers are published annually in a wide array of biology and medicine journals

In this lesson, firstly, we have known about the origin of biological science,in second step, we examined the key event in the history of biological studyand in the last step; the lesson has explained the development of biological science and the contribution of different biologist in the field of developmentof biological science.

1.6 LESSON END EXERCISE

1. Explain the term 'biology'.
2. Write a short note on origin of biological science.
3. Write the contribution of biologist in the development of biology.

1.7 SUGGESTED FURTHER READINGS

Bhatnagar, A.B., & Bhatnagar, A.(2008). Teaching of biological science.Meerut: R.Lal book depot

kulsherestha,S.P. (2005). Teaching of biology. Meerut: surya publication

https://www.biologydiscussion.com/biological-sciences/biological-sciences- definition-history-and-objectives/85935

Files.eric.ed.govhttp://shodhganga.inflibnet.ac.in/origin of biology

https://en.wikipedia.org/wiki/History_of_biology

1.8 ANSWERS TO CHECK YOUR PROGRESS

Answers to check your progress - 1

(i) Living thing (ii) Jean-Baptiste Pierre Antoine de Monet, chevalier de Lamarck (iii) Father of taxonomy (iv) Theophrastus (v) Natural Selection

Answers to check your progress - 2

(i) DNA(ii) Eugene P.Odum (iii) 1972 (iv) James D.Watson (v) Inheritance of acquired characteristics (vi) DNA, protein

****

LESSON NO. 2 UNIT -I

AIMS & VALUES OF TEACHING BIOLOGICAL SCIENCE

STRUCTURE

2.1 INTRODUCTION

Biological science is an interpretation of the natural phenomena, biological science plays a very significant role in our everyday life, it becomes an integral part of culture and society. The science, which is related with the study of living things, is known as biology. Biology is related to the humankind ever since the origin of man etc. perhaps it was the elementary need of man to know about the living beings, so that maximum benefits can be drawn out of them. Though biology involves study of life but nowadays it is mostly centralized with the study of different branches of biology. The subject of biological science piques intellectual curiosity, increase awareness of fragile ecosystem and stimulates critical thinking. The aims and values of teaching biological sciences should focus on the importance of appreciating the natural world and protecting planet earth. In this lesson you will learn about the aims of biological science teaching and different values, which we can develop in the students at secondary level through the teaching of biological science.

2.2 OBJECTIVES

After going through this lesson, you shall be able to-

- explain the meaning of aims of biological science,
- highlight the aims of teaching of biological science,
- describe the different values of teaching biological science, and
- discuss the importance of teaching of biological science at secondarylevel

2.3 AIMS OF TEACHING BIOLOGICAL SCIENCE

Meaning- When we start a work on any mission it is essential to think beforeworking towards the motive and purposes of understanding that mission. Without knowledge of the aim, the educator is like a sailor who does not know his destination and the young learner is like rudderless vessel driftinga shore.

Education is imparted for achieving certain ends and goals. Various subjects of the school curriculum are different means to achieve these goals. Biological science aims to make students develop scientific attitude, so that in later life,they can help society make rational choice when confined with various possibilities and challenges.The term aims of teaching of biological sciencestands for the goals, targets or broader purposes that may be fulfilled by theteaching of biological science in the general scheme of education. According to John Dewey, “an aim is a foreseen end which gives direction to certain activity or motivates human behaviour”. Aims are like ideals. Their attainment needs a long term planning. In simple way, we can say that the aim is the general statement of the expected outcome. Their realization is not an easy task so aims are broken into specified objectives to provide definite learning experience for bringing about desirable behavioural change.

Following are the aims of teaching biological science at secondary level

1. Acquisition of knowledge and understanding: An important trait ofhumans is to wonder, observe and interact with the surroundings and look for the meaningful pattern and relation by making and using new tools and build conceptual models to understand the universe. It is important for children to acquire the knowledge of biological science content i.e. concepts and underlying principles as they provide a sound base to explorethe

unknown and build further knowledge, yet these cannot be passed to children directly and understanding cannot be develop by rote learning. It can be done by providing children relevant and age appropriate learning opportunities that allowed them to undergo experimental learning through exploration and interaction with their environment and construct their knowledge. Teachers need to collect such experiences of children to build further knowledge on their previous knowledge. For this, they should engage the children in meaningful discussions.

2. Development of skills: Biological science is about asking questions andfinding answers to them through scientific method and inquiry. The processes that biologists use in it are science processes skills. Biologicalscience is important to all young people for not only to acquire the knowledge associated with it, but also to imbibe its inquiry and processes skill. These skills enable them to develop into adults who are able to take informed and responsible action while engaging and reflecting upon different ideas, opinions, beliefs or values. These are long-lasting; thus,tend to be useful throughout each area of our lives. These skills involve the use of all the sense organs providing hand- to- hand experiences for enjoying and effective learning. When students do experiment in the laboratory, they learn laboratory skill and when they have to work with other students cooperatively sharing the responsibilities. This develops feelings of cooperation in students. These skills are necessary for the students to develop when they study biological science, all these basic skills are important.

3. Development of scientific attitude: Scientific attitude is a composite ofa number of mental processes to react consistently in certain way to a novel situation. These include accuracy, intellectual, honesty, open- mindedness, and looking at true cause and effect relationship. Scientific attitude can be nurtured over a period through the process of relevant learning situations that require creating an open classroom environment encouraging children to perform activities and experiments and reading scientific literature, freely interacting with their surroundings and asking questions. A biological science teacher needs to provide children experiences of a number of scientific activities as base for a thorough understanding of biological science and developing scientific attitude andtemper.

4. Direct experience: Biological science has many applications, both in the natural environment and the environment of health and education. Studying the biological science allows health care workers to understand the living system of the body and to apply the knowledge in direct ways to recover and maintain the physical health of both animal and

human being. Educators rely on biological science to teach the study of life to future generations. Field biologists use biology to understand relationships between living organisms and to notice what is beneficial and what is imbalanced and toxic.

5. Development of thinking abilities: Critical thinking increases learning potential in biological science. It requires deliberate review of the way inwhich activities are carried out, the ideas emerged and the way these can be improved. It is the ability to analyze information and experiences in an objective manner. Reflecting on the processes of thinking does not come readily to young children as it involves abstract thinking as well. Teacher can facilitate this by engaging the children in discussion throughactivities.

6. Nurturing curiosity: When student ask some questions, the teacher shouldnot ignore them. He should try to answer them using the scientific principles. Biological science is nothing but all that happens around us. A learner comes across many questions out of curiosity. Curiosity leads to inculcation of learning to learn aspect of education. Curiosity gets arousedas a result of doubt, perplexity, contradiction, cognitive conflict, lack of clarity etc. a teacher need to create suitable learning situations for this.

7. Nurture creativity: Creative thinking is a novel or innovative way of doing things. Creative thinking enables a learner to explore available alternatives and consequences of action and contributes to decision- making and problem solving. Creativity is the production of relevant and novel product and process. Creativity is doing or seeing the things differently. It cannot be taught, but developed in learners by using planned strategies and techniques. A creative child thinks differently, expresses unending curiosity and possesses divergent thinking ability. Teachers playan important role for nurturing creativity in learners. From pedagogical perspective of biological science inquiry and activity oriented, process based teaching-learning can facilitate in nurturing creativity. The facilitator can play a very important role for nurturing creativity in learners.

8. Nurture aesthetic sense: Aesthetic deals with the creation andappreciation of beauty that gives us happiness. Harmony, order and patternare some of the criteria, which define beauty. A learner of biological science is also concerned with them. She gets motivated to see some pattern in the properties to substances and other things in her surroundings. She appreciates her creation and derives joy when finds that a particular toy works on same scientific pattern that she has already learnt.

9. Development of problem-solving skill: Problem-solving skill means that an individual has learned the skills and acquired relevant information necessary to solve problems that are not only curricular but also related to everyday life. To solve problem in biological science, students must acquire what cognitive psychologists call declarative knowledge, which consists of the body of knowledge and facts needed to working biological science. Simply acquiring knowledge is not sufficient so one must organize this knowledge in such a way that can be retrieved easily to solve problem. Various skills required for problem solving can be enhanced by providing opportunities to students to ask question, think aloud, look for alternative explanations and procedures, isolate and control variables, make models and apply process skills in teaching –learning of science. Students can explore such potentiality while working on the problems; they feel the sense of achievement on getting success and develop self -confidence.

10. Career aims and objectives: The aims and objectives of teaching biological science include introducing students to interesting career fields. Studying biological science prepares you for a job working in either an educational institution or an industry in which you can be directly involved in the research. Also by studying biology, you can become qualified to work for the government in managing such things as environmental research of animals, river system or biological waste.

11. Understanding the nature: The aim of study of biological science to increase the understanding of living beings and to allow you to consider the systems in relationship to the self and other organism in a natural environment. The goal is to be able to test theories developed about living things by utilizing the scientific method and then to apply the new information in a beneficial way. Science fairs and field trips provide opportunities for students to gain on knowledge of their environment.

Check Your Progress-1

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) The realization of aims is not an easy task so aims are broken into.....

(ii) Problem-solving skill means that an individual has learned the skills and ……necessary to solve problem

(iii) The aim of the biological science is Acquisition of…….and……

(iv) According to John Dewey, "an aim is a ……human behaviour".

(v) Aim is the general statement of the …….

2.4 VALUES OF TEACHING BIOLOGICAL SCIENCE

Biological science is very important for the individual benefits and for thedevelopment of the society on the whole. It is very important in our day-to- day lives. Biological science education not only develops knowledge andcompetence in the subject but also helps in developing values of life. Education for human values is an important area that needs to be promoted at all stages of education. Biological science offers many opportunities for value inculcation. Knowledge of biological science prepares the learner to face the challenges of the ever changing modern world. You can inculcate anumber of values in the students through biological science education.

1. Disciplinary value: Biological science helps in the development of personality of an individual. It inculcates the spirit of enquiry, seriousnessand systematic thinking. Biological science brings mental and physical discipline in the life of the individual. Problem solving, decision-making, critical thinking, perseverance and commitment to tasks are some of the mental disciplines, which a student develops by the study of biological science. It brings about total transformation of one's view-point and makes thought process more organized. Biological science makes us think seriously about the environment and helps to observe the real nature of the problem, it helps us to judge all the good and bad points, together with the gain and loss likely to be incurred in the plan of action contemplated. Biological science is the one of the subjects, which promotes motivation and interest in study, concentration and habit ofhard and systematic work. The study of science teaches the student to undertake physical work like practical experiments for long hours in the lab, collection of data, record, analyze and interpret the data and arrive at conclusions. All these activities result in development of self- discipline in students.

2. Intellectual value: The study of biological science provides us the opportunity of developing our mental faculties of reasoning, imagination, divergent thinking, observation, analysis, originality and systematic learning. It makes us aware of our surrounding and ourselves. Biological science gives us the insight which enables us to search the truth and the reality of nature around us and increase our understanding of the complex issue existing around our surrounding. It develops scientific attitude and provides training in scientific methodology. Biological science does not permit us to accept anything, which we cannot prove by actual observation, reasoning and experimentation. Biological science education inculcates the knowledge of facts, the spirit of enquiry, the technique of assumption, and value judgement in the students. It helps in developing scientific attitudes and provides training in scientific methodology. It develops rational thinking in an individual and prepares him to face the challenges of the modern world with a scientific outlook. The queries of all problem and phenomena can be satisfactorily answered only by the wisdom of biological science. A tree does not have any partiality towards a particular person belonging to a caste, region, religion, nation etc. the same intellectual values develop among human being at large.

3. Cultural value: Biological science plays an important role in the civilization of man. From ancient civilization to the present modern world, science has become part and parcel of our everyday life. From time immemorial, man has been trying to maintain and preserve their way of life and standard through the use of science but somehow our way of life has been changing with the passage of time and progress of science. The change in our life-style is due to the inventions of biological science. The development of culture is the history of biological science. Biological science is not only developing our culture but also helps in preserving it. Biological science has aided the growth of our consciousness by developing awareness about the various facts, concepts, customs, and traditions in world. It is an integral part of our cultural treasure. Biological products are useful in protecting our cultural treasure. The knowledge of biological science helps in bringing about a cultural balance between the traditions of the past and the advances of the present, as they are undergoing constant change due to the practical applications of biological science discoveries. The development of our society or culture is totally depends on progress of biological science.

4 Aesthetic value: Biological science is beauty, art, a source of entertainment and a

successful means of physical comforts. Even the study of biological science is a source of great pleasure, when one gets answer to his question about the nature. Ours is a beautiful universe with many unfolding mysteries in it and as a part of this beautiful universe, we should be able to appreciate our mother nature. Nature exhibits an order, which is governed by general laws and thus possesses a beautiful harmony. Biological science recognizes the beauty of nature and makes our lives worth living.

Einstein called it as "the pre-established harmony". We all know that the discovering of such beautiful harmonies is the concern of biological science. A tree waves, a bird flies in blue sky, sun rising and setting is beautiful. Thus, biological science recognizes the beauty of nature, appreciate the nature and make our lives worth living.

5. Vocational value: Biological science is a multi-disciplinary subject and creates a lot of awareness about many aspects of modern development. Biological science has opened vast vistas of vocations because scientific principles and inventions have become so universal and pervasive in our daily life. It has many applications and the students fit better into any vocation as they have a basic knowledge of biological science. Scientific discoveries have helped all the traditional vocation nowadays like- agriculture, aquaculture, sericulture etc. Graduates in biological science may enter teaching, or in industries related to bio-products. It helps individuals to become technically competent and professional in their attitudes. It helps them to become self-sufficient. Hobbies in biological science motivate the students to become creative in their outlook. In every vocation, scientific attitude is required and hence basicscience education is must for every student.

6. Moral value: Biological science as a progress and product based on truth, beauty and goodness. Scientific experimentation is based on truthfulness and honesty. We can say that science is truth. Success in science is purely dependent on the truthfulness. A student working on scientific procedures should inculcate the value like patience, perseverance, truthfulness, honesty and determination. Biological science not only develops scientific thinking skills but also develops moral values in students. Plants kingdom protects human being. Many animals live together. Protecting the other living, togetherness values can be imbibed through biological science. A person who is pursuing science is considered as a seeker of truth. No success is achieved without being truthful. Thus, biological science not only develops scientific thinking skills but also develops moral values in students.

7. Social value: Biological science is of great value of society. It makes a man a good citizen. Biological Science gives impetus to the progress of society by its new thought and ideas. From the very beginning of our civilization, science has played an important role in its development. In fact, the world has become a small social group. Today's society stands on pillar of scientific method and knowledge. All our social activities depend on different sciences. It is essential for the progress of our society and nation. By studying the biological science, we can make our sociallife happy and comfortable by leading a healthy life and by gaining from public welfare activities based on biological science.

8. A better living: The explosion of scientific knowledge has lead to much advancement in the field of science and technology. This made the human being to lead a more peaceful, healthy and happy life. The development in the field of medicine, food nutrition etc. has revolutionized the world. They made this world a happier, safe and pleasurable place to live. The Delor's Commission (1996) of UNESCO in its report entitled, 'Learning- the treasure within', advocates the need to cultivate core universal values like human right, sense of social responsibility, social equity, democratic participation, tolerance, cooperative spirit, creativity, environmental sensitivity, peace, love, truth, non-violence etc. within the learner.

9. Scientific value: The knowledge of science results in the development of scientific attitude like critical observation, open-mindedness, unbiased thinking and judgement. It frees individuals from the superstitious beliefs and improves their rational thinking. Biological science brings the positive change in the attitude of individuals, which improves the life ofthe individuals. It helps in satisfying the basic instincts of curiosity, creativeness, self-assertion, self-expression etc. The development of scientific attitude has a great impact on an individual's psychology that is the way of thinking. Scientific attitudes develop on the basis of laws, principles and theories. Nature is existing by itself, this is the attitude one develops from biological science. The study of biological sciencetrains the students to solve the problems by applying the scientific principles. They approach the problem using a definite scientific procedure called scientific method. With the help of scientific attitude, one can easily solve any problem comfortably. Therefore, it is a necessarythat the students are taught and trained in these scientific methods so that they can attack the problem instead of escaping from it. Once the student is familiar with all the scientific methods, they can solve any type of

problem even in their real life.

10. Creative value: The instinct of biological science is creativity. Creativity is defined as an activity resulting in new products of a definite social value. It is the ability to think, create or do something new or original. It includes a series of actions, which create new ideas, thought and physicalobjects. Biological science is also a product with social value, which is due to creative thinking of many scientists over a period of time. Biological science develops creativity in students. Students learn newconcepts, identify new methods and perform innovative experiments. They observe the processes, conduct experiments successfully and evendevelop the creativity in the learners.

11. Utilitarian value: Biological science has a number of applications in our everyday life. Development of biological science can be related withthe development of human race. The advances in the field of medicine, improvement in the health and hygiene thereby improving the lifespan of human beings, are due to the enormous developments in scientificknowledge. Science has influenced the lives of people so much that todaywe cannot imagine our lives without the involvement of science. Biological science has a major impact in the field of medicine and health, preventing and curing number of diseases. The increased production offood for the ever-increasing population of the world is also a gift of biological science for the survival of man.

It is very important for the students to utilize their time in a proper manner. The knowledge of biology can create interest and motivate the students to use their leisure in an appropriate manner. The leisure time shouldbe used to take up small time projects, or hobbies like collection of specimensof insects or plant etc. Teacher may take the students to nursery or dairy farms to develop the knowledge about the growth and development of plantsand animals. They may also take up science club activities or take part in science fair and make the best use of their time for enhancing their knowledgeof biological science.

Check Your Progress- 2

Note: (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) Utilitarian value is related with our……..

(ii) Creativity is defined as an activity resulting in …….

(iii) Scientific attitude frees individuals from the …….

(iv) Aesthetic value of biological science is related to the….. of nature.

(v) Einstein called the aesthetic value …….

2.5 LET US SUM UP

In this lesson, we have learned about the meaning of the aim in the teaching of biological science at secondary level. The lesson has explained that the aims are the general objectives and to achieve them is a difficult task. Biological science helps the students to develop scientific attitude, so that in later life they can help society make rational choice when confined with various possibilities and challenges. Biological science helps to shape the personality of an individual. Biological science provides us the insight to not to accept anything without prove by actual observation, reasoning and experimentation. Biological science has a major impact in the field of medicine and health, preventing and curing number of diseases. Biological science brings the positive change in the attitude of individuals, which improve the life the individual. Biological science has opened vast vistas of vocations. Biological science aims to help the students to develop scientific attitude, acquisition of the knowledge and understanding so that in later life they can help society make rational choice when confined with various possibilities and challenges. It shapes our personality and makes a human with positive attitude. Then we have discussed about the different values of teaching of biological science like intellectual, moral, scientific attitude, social attitude etc.

2.6 LESSON END EXERCISE

1. What is the meaning of aims?
2. Describe the aims of teaching of biological science at secondary schoollevel.
3. Explain the values of teaching of biological science at secondary school level.

2.7 SUGGESTED FURTHER READINGS

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2.8 ANSWERS TO CHECK YOUR PROGRESS

Answers to check your progress-1

(i) Specific objectives (ii) Acquired relevant information (iii) Knowledge, Understanding (iv) Foreseen and which give direction to certain activities or motivates (v) Expected outcome

Answers to check your progress-2

(i) Everyday life. (ii) New products of a definite social value (iii) Superstitious beliefs and improves their rational thinking (iv) Beauty (v) Thepre-established harmony

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Lesson No.3 Unit I

BEHAVIOURAL OBJECTIVES

STRUCTURE

3.1 INTRODUCTION

Most people would agree that goal of education is learning. Most would alsoagree that education is likely to be more effective if educators are clear aboutwhat it is that they want the learners to learn. Finally, most would agree that if teachers have a clear idea about what learners are expected to learn, they can more easily and more accurately determine how well students learned.

They are helpful to the teacher as well as the learner throughout the learningprocess and are invaluable in the evolution process.

Writing behavioural objectives is a fairly easy task, once the basic are understood. Before actually writing the objectives we should do some researchon it. Once we know what will be required, we can begin to write up to behavioural objectives. In this lesson, you will learn about the meaning, importance and formulation the behavioural objectives.

3.2 OBJECTIVES

After going through this lesson, you shall be able to-

- Explain the meaning of behavioural objectives
- Describe the importance of behavioural objectives
- Explore the behavioural objectives based on the domains.
- Discuss different steps of the behavioural objectives.

3.3 MEANING OF BEHAVIOURAL OBJECTIVES

Education is imparted for achieving certain end and aims. These aims are ideals and their realization is not an easy task. Therefore, they are divided into some definite, functional and workable lessons named behavioural objectives. These objectives are short term, immediate goal that may be achieved in a classroom. They bring the change in learner's behaviour. A behavioural objective also known as the learning objectives or instructional objective is a tool that teachers use to let students know at the beginning of acourse what is expected of them.

Behavioural objectives that are written for students should have a minimum of three components, an explanation of what is expected from them, a performance criteria and an explanation of what constitutes an acceptable amount of knowledge of what was taught during the course. A behavioural objective is a way of describing the objectives of a course in term of what thelearner should be able to do at the end of that course.

According to N.C.E.R.T. in evaluation and examination, "An objective is a point or an end view of something towards which action is directed, a planned change sought through any activity ,which we set out to do".

According to Davis, "Learning objective is a statement of proposed change".

According to B.S.Bloom, "Educational objectives are not only the goals towards which the curriculum is shaped and towards which instruction is guided, but they are also helpful in the specification of evaluation process".

3.4 IMPORTANCE OF BEHAVIOURAL OBJECTIVES

1. Managing learning: Management of learning suggests a more activerole by the student. Students can use objectives to guide their learning effort –choosing appropriate materials, reading selectively etc. Objectives can also be used for self-evaluation, which may direct the student's effort.
2. Planning instruction: Once you have developed behavioural objectives for a course or module of learning, it can become easier to sequence instruction, allot time to topics, assemble materials and organize instructional time. Behavioural objectives can also be used as a guide to developing learning activities, which can engage learners in ways that match the desired behavioural outcomes.
3. Enhancing learning: If the learner has asset of behavioural objectives which provide information about the content to be learned and the way in which he or she will have to demonstrate adequate knowledge, that student can make more appropriate choice about the study method and content emphasis.
4. Facilitating assessments: Learning objectives can facilitate various forms of assessments, which may be formative or summative. Behavioural objectives can form the basis for grading or for determining levels of student achievement. The goal of formative assessment is to gather feedback that can be used by the instructor and the students to guide improvements in the ongoing teaching and learning context. The goal of summative assessment is to measure the level of success or proficiency that has been obtained at the end of a course or instructional module. This can be more effectively accomplished by comparing studentwork with the behavioural objectives.
5. Designing curriculum: To design the curriculum in a particular course, we may begin

with the learning objectives for that course and program outcomes for the program and work backwards. Set of behavioural objectives for one course may be compared with the expected entry behaviour for the next course in the sequence.

6. Producing new insights: The process of clarifying objectives may produce major changes in those who engages in the effort. For example, the instructors who spend time developing behavioral objectives are said to acquire increased understanding about what is a feasible goal.

Check your progress-1

Notes : (a) Answer the questions given below.

(b) compare your answers with those given at the end of this lesson.

(i) Behavioral objective also known as……or…….

(ii) Behavioural objective can be achieved in…… term.

(iii) Behavioural objectives help in designing…….

(iv) Objectives can also be used for……,which may direct the student's effort.

(v) Learning objectives can facilitate various forms of……,which may be

3.5 FORMATION OF BEHAVIOURAL OBJECTIVES

A number of attempts have been made by experts in the field of classification of behavioural objectives. B.S. Bloom has classified the behavioural objectives in the three categories or domains. Beside this categorization, each domain has split up into major categories, which are also hierarchical, interrelated and dependent on each other.

3.5.1 Cognitive domain (Thinking)

The cognitive domain involves knowledge and the development of intellectual skills. This domain is designed to increase an individual's knowledge. This includes recall or recognition of specific facts, procedural patterns and concepts that serve in the development of intellectual abilities and skills. B.S.Bloom and his co-workers have done the classification of this domain in 1956.

Example-

- Given a description of a planet, the learner will be able to identify that planet, as demonstrated verbally or in writing.
- The learner will be able to evaluate the different theories of the origin of life as demonstrated by his ability to compare and discuss verballyor in writing the strength and weakness of each theory.

1. Knowledge : This is defined as remembering of previously learnedmaterial. This is the first and lowest level of the domain. It includes recall and recognition of information such as specific facts, methods, pattern, etc without expecting to use it. Knowledge objective emphasizes what can be described as memory

Example: Students can write a definition of biology.

2. Comprehension : This is defined as the ability to grasp the meaning of material. Comprehension is the level of cognitive ability, someone to be able to understand or comprehend the meaning or concept, situation and the fact. It includes translations, interpretation and extrapolation. This is also related to the use of ideas. It refers to a type of understanding of thematerials message contained in a communication.

   Example: Students can explain the types of cell.

3. Application : It refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws. Behavioural outcomes in this area require a higher level of understanding than those under comprehension. Application is the use of abstractions in particular and concrete situations. Abstractions that can be in the form of general ideas, rules of procedure or method commonly used.

   Example: Students can explain the use of photosynthesis in plants.

4. Analysis : Refers the ability to break down material into its componentparts so that its organizational structural may be understood. This may include the identification of the parts, analysis of the relationships between parts, and recognition of the organizational principles involved behavioural outcomes. Represents a higher intellectual level than comprehension andapplication because they require an understanding of both the content and the structural form of the material

Example: Students can create a diagram of different part of plant.

5. Synthesis : Refers the ability to put parts together to form a new whole, it covers the process of working small parts, elements and so forth and assemble and combine them in such a developing a clear structure before. This may involve the production of a unique communication, a plan of operations or asset of abstract relations. Behavioural outcomes in this area stress creative behaviours, with major emphasis on the formulation of new pattern.

Example: Students can show the different part of a plant in the same diagram.

6. Evaluation : Evaluation is a consideration about the value of materialsand methods for a particular purpose. This refers to the ability to judge the value of material for a given purpose. The judgements are to be based on definite criteria. These may be internal or external criteria. Quantitative and qualitative considerations about the sequel where the material and methods those are used of standard assessment criteria. Behaviour outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgements based on clearly defined criteria.

Example: Students can assess the influence of the greenhouse effect onglobal temperature rise.

Check your progress- 2

Notes : (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) Recall and recognition is the action verb of ……..objective.

(ii) Analysis refers the ability of……the material.

(iii) Comprehension includes……

(iv) ……has classified the behavioural objectives in the three categories or domain

(v) Synthesis refers the ability ……..

(vi) The cognitive domain involves ……of intellectual skills.

3.5.2 AFFECTIVE DOMAIN (EMOTIONS)

The affective domain involves our feelings, emotions, and attitudes. Thesedomains include the manner in which we deals with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations and attitudes. This domain is developed by Krathwal, Bloom and Masia in 1964. Karthwal classify affective objectives into 5 groups. This grouping also is hierarchicalwith the introduction of the lowest level and practice the highest level. The higher rate of objectives in hierarchy, the greater the person's involvement and commitment to that objective.

Example:

- Listen to other with respect.
- Listen for and remember the name of newly introduced people.

1. Receiving : Receiving is the lowest level of the affective domains. It is simply the awareness of feelings and emotions. Receiving may be defined as "Sensitivity to the existence of certain phenomena and stimuli, that is, the willingness to receive them". It involves passively paying attention and being awareness of the existence of certain ideas, material or phenomena.

   Example: Students are willing to listen to the teacher's explanation ofthe concept of uniform rectilinear motion.

2: Responding : This level involves actively participating in the learningprocess. You are not only aware of a stimulus but you react or respond to it in some way. The objective expects students have the desire to do something in reaction to an idea, object or system of values, more than just the introduction alone, in the case students are asked to demonstrate the manner requested. It implies active attending, doing something with or about the phenomenon, and not merely perceiving them.

Example: Students willing to participate actively in extra-curricular activities.

3. Valuing : Valuing implies "perceiving them as having worth or value". Valuing is the ability to see the worth of something and express it. Valuing is concerned with the worth you attach to a particular object, phenomenon, behaviour or piece of information. The objective expects students to understand the value of respect for a belief or a feeling assumption that an idea, object

or a particular way of thinking has value. This level ranges from simple acceptance to the more complex state of commitment. The three sub-categories of this objective are acceptance of value, preferencefor a value and commitment.

Example: Students participate voluntarily in collecting goods to be used to make simple biology experiment equipments.

4. Organizing : The objective expects students were able to organize thethings that show the inter-connectedness between certain values within a system of values and determines which values have higher priority than the value of the other. Organization involves putting together different values, information and ideas then relating them to already held beliefs to bring it into an internally consistent philosophy. It is ability to prioritize one value over another and create a unique value system. The focus of this level is on comparing, relating and assessing values to create that unique value system.

   Example: Students are able to formulate a variety of alternative ways to raise funds and choose the alternative that the public according to its value system to overcome the coastal erosion.

5. Characterizing : This is the highest of the affective domain. It is aboutinternalizing values. The objective expects students were able to show that the practice associated with organizing and integrating the values into a personal value system. It means acting consistently in accordance with the set of values you have internalized and your characterization or philosophy about life. You internalize values and let them control or guideyour behavior. This category is concerned with one's view of the universe and one's philosophy of life.

   Example: Students will show the scientific attitude by mentioning andtesting a hypothesis before accepting it.

Check your progress-3

Notes (a) Answer the questions given below.

(b) compare your answers with those given at the end of this lesson.

(i) The affective domain deals with the……..

(ii) The lowest level of the affective domain is……

(iii) Affective domain is developed by ……..,……..and……..in 1964.

(iv) Characterization is related with the ……values

(v) Receiving may be defined as "……..to the existence of certain ……and……..

3.5.3 Psycho-motor domain (Doing)

Psychomotor domain includes physical movement, coordination and use ofthe motor skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, techniques in execution. Thus psychomotor skills rage from manual tasks such as digging a ditch or washing a car, to more complex tasks such as operating a complex piece of machinery. Simpson was working in this area and R.H. Dave has given the classification under this domain 1969.

Example:

- Maneuvers a car into tight parallel parking spot.
- Operate a computer quickly and accurately

1. Perception : The ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation. Skill of keen observation, sensing a problem and developing self- motivation are the specific objectives under this category.

2. Imitation : The learner observes and then imitates an action. Thesebehaviours may be crude and imperfect. The expectation is that the individual is able to watch and then repeat an action. At this level if students can do it, this behavior is not automatic and errors may occur when students try it. Skill of repeating actions and skill of reflective thinking are the specific objectives under this objective.

Example: Students can position the scale to zero before measurementwith an ammeter.

3. Manipulation : Learning objectives at this level expect students toperform a behavior without visual aid, as the rate of imitation. Performance of an action with written direction but without a visual model or direct observation. Students are given clues in the form of written or verbal instruction and are expected to perform actions are required. The action may be performed crudely or without neuro-muscular coordination at this stage. In this stage difference is that actions are performed with the aid of written and verbal instruction, not visual demonstration. This step involvesthe skill to operate upon with intelligence and manage cleverly are the specific activities.

   Example : Students can turn on a computer by reading the manual andverbal explanations.

4. Precision : Requires performance of some action independent of eitherwritten instructions or a visual model. One is expected to reproduce an action with control and to reduce errors to a minimum. Skill of experimentation, precise movement and neat execution of skills are the activities, which fall under this step. In performing the behaviour less likes to make mistakes, because students can do it correctly.

   Example- Students are able to type data into a database without makingmistakes.

5. Articulation : Learning objectives at this level expects students to demonstrate a series of movements with accurate, correct order and the right speed. It requires display of coordination of a series of related acts by establishing the appropriate sequence and performing the acts accurately, with control as well as with speed and time. Skill of logical thinking, reflective thinking, skill of mind and body are specific objectivesto attain this step.

   Example: Students can use a calculator to do the problems statisticsmoothly.

6. Naturalization : Learning objectives at this level expects students toperform certain movements spontaneously or automatically. For naturalization, High level of proficiency is necessary. The behavior is performed with the least expenditure of energy, become routine, automatic and spontaneous. Students perform the movement without thinking again, how to do and the order. Skill of attaining success and skill of multiple actions are the specific activities under the naturalization.

   Example: Students can operate the program database smoothly.

Check your progress-4

Notes (a) Answer the questions given below.

(b) Compare your answers with those given at the end of this lesson.

(i) Psycho-motor domain is related to the……..

(ii) The highest level of the psycho-motor domain is…….

(iii) ……are the activities of precision.

(iv) ……. and……. has given the classification under this domain.

(v) High level of proficiency is necessary in……..

(vi) The lowest level of psycho-motor domain is……..

3.6 LET US SUM UP

In this lesson, we have learnt about the behavioural objectives- meaning of the behavioural objectives and what is the importance of behavioural objectives for a teacher and a learner in teaching-learning process.

Firstly, we have known about the meaning of behavioural objective. Behavioural objectives are the objectives, which help the teacher what he wants to teach and the student what he should learns.These objectives are specific and can be achieved in short term and they can change a learner's behaviour.These objectives help in a meaningful and purposeful learning.The need of preparing behavioural objectives of teaching of biological science has been emphasized in this lesson. Then the bloom's taxonomy has been discussed under three major domains viz. cognitive, affective and psychomotor. There are six objectives under cognitive domain, and five objectives under affective domain. Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation come under cognitive domain. Receiving, Responding, Valuing, Organizing and Characterizing come under affective domain. The psychomotor domain comprises of the abilities related to the action or manual work. We have also learnt the activities related with theseobjectives. Then we discussed about the role of these objectives that how these objectives are helpful in a classroom. The behavioural objective helps a teacher in managing classroom, in designing curriculum etc.

3.8 LESSON END EXERCISE

1. Explain the meaning of behavioural objectives.
2. Discuss behavioural objectives and their importance.
3. Describe different steps of cognitive domain.
4. Write about the psychomotor domain.
5. Discuss the importance of affective domain.

3.9 SUGGESTED FURTHER READING

Mangal, S.K.(2010) Advance Educational Psychology,PHI private ltd. DelhiSharma and sharma, 'Teaching of Science' Dhanapat Rai snd Sons,Delhi.

Sharma, R.C. & Shukla,C.S., 'Modern Science Teaching' Dhanpat Rai andSons,Delhi

Walia, J.S., 'Educational Psychology' paul publisher, Ludhiyana

www.biologydiscussion.com/biological-science-definition-history-and objectives

www.slideshare.net/mobile/ambreenAftab http://med.fsu.edu/course objectives

www.nzdlorg>gsdlmod

www.biology.cam.ac.uk/undergrads/nst/courses/aims and objectives

3.10 ANSWERS TO CHECK YOUR PROGRESS

Answers to check your progress-1

(i) Learning objectives, behavioural objectives (ii) Short (iii) Curriculum (iv) Self-evolution(v) Assessment

Answers to check your progress-2

(i) Knowledge (ii) break down material into its component parts (iii) Translations, interpretation and extrapolation (iv) B.S.Bloom (v) To put partstogether to form a new whole (vi) Knowledge and the development

Answers to check your progress-3

(i) Emotions (ii) Receiving, Krathwal (iii) Bloom and Masia (iv) Internalize Sensitivity, (v) phenomena and stimuli

Answers to check your progress-4

(i) Doing (ii) Naturalization (iii) Skill of experimentation, precise movement and neat execution of skills (iv) Simpson, R.H. Dave (v) Naturalization (vi)Perception

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LESSON NO. 4 UNIT-II

CURRICULUM

STRUCTURE

4.1 INTRODUCTION

The purpose of this lesson is to introduce you the concept of curriculum so that you can help your students to build up the strengths of balanced learningexperiences. It will provide a range of learning experiences through which students develop the necessary scientific knowledge and understanding , skills and processes, values and attitudes embedded in the 'Life and Living' strand and other strands of science education for personal development and for contributing towards a scientific and technological world. The curriculumwill prepare students for entering tertiary courses , vocational courses or the workforce in various fields of biological science. Practical work and investigations are essential components of the curriculum. It

will enable students to gain personal experience of science through hands-on activities, and to enhance the skills and thinking processes associated with the practice of science. Participation in these activities encourages students to bring scientific thinking to the processes of problem-solving, decision-making and evaluation of evidence. Engaging in scientific investigations enables students to gain an understanding of the nature of science and the limitations of scientific inquiry.

4.2 OBJECTIVES

After going through this lesson, you shall be able to:

- develop the abilities to make scientific inquiries , think scientifically, critically and creatively, and solve problems individually and collaboratively in biology related contexts.
- develop an attitude of responsible citizenship , and a commitment to promote personal and community health.
- develop a curiosity towards the living world , and a respect for all living things and the environment.
- be aware of the social, ethical, economic, environmental and technological implications of biology, and be able to make decisions and judgments on biology – related issues.
- appreciate the relationship between biological science and other disciplines.
- show an interest in the study of biology, appreciate the wonders and complexity of nature.
- identify the pros and cons of the applications of biological knowledge for informed decision-making.
- realise the importance of evidence in supporting, modifying or refuting proposed scientific theories; make careful observations, ask relevant questions, identify problems and formulate hypotheses for investigation.
- plan and conduct scientific investigations individually or collaboratively with appropriate instruments and methods, collect quantitative and qualitative information with accuracy, analyse data and draw conclusions for problem-solving.

- use information technology to process and present scientific information; and communicate ideas and views effectively with others,using the language of science.
- be aware of the dynamic nature of the body of biological knowledge,and appreciate the role of science and technology in understandingthe living world.

4.3 CURRICULUM

4.3.1 Meaning of curriculum

Curriculum is, in the simplest terms, a description of what, why, how and when students should learn. Curriculum is a conceptual plan and dynamic entity to achieve the requirements of the people of a country. It is designedas per the aspirations of the leaders and the people of the society , organized by researches in science education , guided by administrators and implemented by the science teachers in schools. Curriculum needs reviewbecause the subject matter of science and the views of the people are not static. It is more than the process of learning and studying. All the experiences faced by the learner during his/her tenure in the school constitute the curriculum. Science curriculum is a comprehensive concept, which takes into consideration all the possible educational activities . It means all thoselearning experiences that are received by a child through a number of activitiesgoing on inside the school or outside the school in the form of formal or informal education. A comprehensive definition of curriculum is -

"Curriculum is the planned and guided learning experiences and intended outcomes, formulated through systematic reconstruction of knowledge and experience, under the auspices of the school, for the learner's competence. Itis the sum total of all the experiences which have to be provided for the goodof the individual and the society". A curriculum is a plan of learning consistingof two major dimensions, viz. vision and structure. Vision in a curriculum isthe product of a set of assumptions about people and the world at large and takes the form of some conceptualization of reality. A curriculum always contains a set of value-laden assumptions about the purpose of education inour society.

4.3.2 Importance & principles of designing a good curriculum

Importance of designing a Good curriculum

- Demonstrates to pupils that they are part of the diversity of living things.

- Develops pupils' personal values and sense of responsibility with regard to living organisms and their environment.
- Offers an opportunity for informal learning in and about their environment.
- Is intrinsic to pupils' understanding and awareness of decisions related to health and wellbeing – such as healthy eating, personal hygiene, sex education, substance use and abuse.

Principles of designing a good curriculum

Curriculum principles are the values a school believes will give both their pupils and community the best chance of succeeding, and what they know tobe right, given its context.

Some important principles of curriculum organization are:

- The principle of child-centeredness: The curriculum should be able to provide suitable opportunities for fulfilling the various needs of thelearner. It implies that the curriculum should satisfy the physical, emotional and social needs of the learner.

- The principle of utility: Curriculum should help the learners to livea wholesome and fulfilling life. It should provide sufficient opportunities for the academic and social growth of the child. A livingcurriculum has to be developed to meet the demands of the fast challenging realities of the life.
- Principle of variety: The curriculum should not be rigid. It should beflexible to cater to the students , the challenging needs of the learners and society. It should be broad based to satisfy the needs and interestsof the individual learners.
- Principle of balancing: Curriculum should be able to balance the objectives and content, objectives and abilities and objectives and learning experiences.
- Principle of integration: A well planned curriculum should providesuitable experiences to integrate the abilities , aptitudes and interests of learners with different social backgrounds and make them productive citizens of the country.
- Principle of Forward Looking : Education is to enable the child tolead a successful social life. So the curriculum should not cater to thepresent needs of the child alone. The needs of his future life should also be considered. The curriculum should also include knowledge,skills, experiences, influences etc. which will develop in the child abilities and power to make effective adjustments in the later life. ?

- Principles of Conservation : One of the main functions of education is to preserve and transmit our cultural heritage. This is essential for human progress. Culture consists of traditions, customs, attitudes, skills, conduct, values and knowledge. However, the curriculum framers must make a suitable selection of the elements of culture, keeping n view their educational value and the developmental stage of pupils.

    - Principle of Community Centeredness: Though the child's development and growth is the main consideration of curriculum construction, yet his social behaviour is also to be suitably developed, both the individual development and the social development of the child deserve equal attention. He is to live in and for the society.

      Therefore, his needs and desires must be in conformity with the needs and desires of the society in which he is to live. The values, attitudes and skills that are prevailing in the community must be reflected in the curriculum. However, the society is not static. It is dynamic. Its needs and requirements are changing with the rapid developments taking place in all fields. While working for the development, this factor cannot be ignored.

    - Principle of Balance: The curriculum must maintain a balance between subjects and activities, between direct and indirect experiences, between academic and vocational education, between compulsory and optional subjects, between formal and informal education, between individual and social aims of education etc.

Check Your Progress-1

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the lesson.

1) What is the meaning and importance of curriculum in education system?

_____

_____

2) How can we make learning relevant and interesting to students?

_____

_____

4.3.3 Approaches in organizing curriculum for biological science

Concentric approach

Concentric approach involves addition of knowledge from basic to advanced level. In this method the various topics, which are to be introduced, are developed gradually . The general science syllabus gives scope for this way of approach. Here all topics are taught in all classes, the difference being only in the depth of the content matter. As the child grows the subject also grows in ever widening concentric circles.

This system becomes highly successful if one teacher handles the subject continuously in different years. If different teachers handle the subject in different classes, there will be the danger of too much repetition and the subject loses its freshness and power of appeal.

The concentric approach, often called spiral, is a way of organizing a curriculum by laying out basic concepts, covering other related material, and then circling back around to the basic concept and filling in more complexity and depth. It differs from the topical approach, in which all relevant material is covered in linear fashion and concepts are not revisited, and the functional approach, which emphasizes skill building and avoidstheoretical background.

This is a system of organizing a course rather than a method of teaching. It is, therefore, better to call it concentric system or approach. It implies widening of knowledge just as concentric circles go on extending and widening. It is a system of arrangement of subject matter. In this method the study of the topic is spread over a number of years. It is based on the principle that subject cannot be given an exhaustive treatment at the first stage. To begin with, a simple presentation of the subject is given and further knowledge is imparted in following years. Thus beginning from a nucleus the circles ofknowledge go on widening year after year and hence the name concentric method.

Procedure : A topic is divided into a number of portions which are then allotted to different classes. The criterion for allotment of a particular portion of the course to a particular class is the difficulty of portion and power of comprehension of students in the age group. Thus it is mainly concernedwith year to year teaching but its influence can also be exercised in day-to- day teaching Knowledge being given today should follow from knowledgegiven yesterday and should lead to teaching on following day.

Merits of Concentric Method :

- This method of organization of subject matter is decidedly superior to that in which one topic is taken up in particular class and an effort ismade to deal with all aspects of the topic in that particular class.
- It provides a framework from course which is of real value to students.o The system is most successful when the teaching is in hand of one teacher because then he can preserve continuity in the teaching and keeps his expanding circle concentric.
- It provides opportunity for revision of work already covered in a previous class and carrying out new work. o It enables the teacher to cover a portion according to receptivity of learner.
- Since the same topic is learnt over many years so its impressions are more lasting.
- It does not allow teaching to become dull because every year a new interest can be given to the topic. Every year there are new problemsto solve and new difficulties to overcome.

Limitations of concentric approach

For the success of this approach we require really capable teacher. If a teacher becomes over ambitious and exhausts all the possible interesting illustrationsin there introductory year then the subject loses its power of freshness andappeal and nothing is left to create interest in the topic in subsequent years.

In case the topic is too short or too long then also the method is not found to be useful. A too long portion makes the topic dull and a too short portion fails to leave any permanent and lasting impression on the mind of the pupil.

Topical Approach

This is simplest of all approaches, based on the importance the topics are selected and placed in a systematic order. Topics, which are relevant to day –to-day life and today's world, are included in the subjects of higher classes. They may not provide the continuity of the knowledge. Sometimes, this may lead to defective syllabus due to imbalance, lack of sequence and lack of coherence in the curriculum. In this approach, topics of immediate interests to the pupils are selected carefully and lessons are developed in an interestingway.

Merits of Topical Approach

- This approach provides an action plan for dealing with vast material in a logical and rational way. It helps the pupils to understand the facts of their developmental setting.
- This approach can be adapted according to the age ability and aptitudeof the children.
- It imparts a sense of purpose to the pupils because of the total perception attempted.
- This approach enables the teacher to control the subject matter and adapt it to the varying needs of the children

Limitations of Topical Approach

- It destroys the continuity of subject matter.
- Since many aspects involved in a topic may be beyond the cognitive competencies of pupils in lower classes a complete study of the topicwill not be possible.
- Lack of efficient teachers for proper selection of topics.

Integrated Approach

In this approach, importance is given to all the content and teaching is carried out in an integrated manner. It tries to inspire the pupils to have a coherent view of science by establishing the numerous links between the various branches of science. In India, the integrated approach for science teaching iswidely used.

It provide epistemological progress, allowing the establishment of connections and interrelations between disciplines in a synthesizing and integratingmanner.

- facilitate reciprocal exchanges between contents, methods, techniques,and language.
- involve the construction of conceptual and practical broader schemata that are more flexible and transferable, the development of paradigms, and epistemological constructs.
- allow new complex problem solving situations, through integrative and synthesizing approaches.
- provide solutions to concrete, real problems that consider phenomenaand processes in their totality; they approach problems in a holisticmanner making thus possible the premises for the development of logical and systemic thinking.
- provide a unified, synthesized, integrated knowledge about the processes and

phenomena investigated in a systemic manner.

- can lead to the creation of new specialized language .
- provide explanatory structures for broad areas of science.
- can lead to the formation of new, border disciplines, called transdisciplines.
- represent a strategy to boost the capacity of active and responsible involvement in learning approaches and innovative and creativecapacities.

4.4 LET US SUM UP

Curriculum is a pathway through which students travel during a course of study. It is a formal plan of educational experiences and activities offered to a learner under the guidance of an Educational Institution and not a "Time Table". It is dynamic and related to aims and objectives.

- It develop inquiring minds and curiosity about science and the naturalworld
- It acquire knowledge, conceptual understanding and skills to solveproblems and make informed decisions in scientific and other contexts
- It develop skills of scientific inquiry to design and carry out scientificinvestigations and evaluate scientific evidence to draw conclusions
- It communicate scientific ideas, arguments and practical experiencesaccurately in a variety of ways.

Curriculum is based on the principles that

- The learner should be an active contributor to the educational process .
- Learning should closely relate to understanding and solving real life problems .
- Learner's current knowledge and experience are critical in newlearning situations and need to be taken into account
- Learners should be given the opportunity and support to use self direction in their learning.

Organization of curriculum is based on a number of approaches to providequality of education to all students.

4.5 LESSON END EXERCISE

1. What do we consider necessary in curriculum for children to learn?

2. Which domain of objectives is not being evaluated through our present system of examination?

3. What are the different approaches used in organizing science curriculum?

4.6 SUGGESTED READINGS

Green, T.L. :The teaching of biology in Tropical Secondary Schools

National Council for Curriculum and Assessment (2007) Guidelines for Teachers of Students with General Learning Disabilities. Dublin: NCCA.

The Teaching Council (2011). Initial Teacher Education: Criteria andGuidelines for Programme. Providers. Maynooth: The Teaching Council.

4.7 ANSWERS TO CHECK YOUR PROGRESS

1. Curriculum is a conceptual plan and dynamic entity to achieve the requirements of the people of a country. It is designed as per the aspirations of the leaders and the people of the society , organized by researches in science education , guided by administrators and implemented by the science teachers in schools.

   Importance of curriculum

   - It reflects latest trends in education.
   - Provide suitable knowledge.
   - Provide suitable activities and experiences.
   - Achievement of educational aims.

2. To make learning relevant and interesting to students, following principles should be followed while framing curriculum

   - Principle of creativity.
   - Principle of variety.
   - Principle of activity centeredness.
   - Principle of balancing.
   - Principle of integration.

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LESSON NO. 5 UNIT-II

TEXT BOOKS

STRUCTURE

5.1 INTRODUCTION

The purpose of this lesson is to introduce you the concept of text books because these are helping in attaining the school curriculum and the foundation on which the course is built up. Textbooks stated as the heart of educational enterprise. In case of developing countries where other instructional material are not available, the role of text book is vital. It will provide scientific knowledge to students and develop scientific interest and attitude among them. It will help the teachers to individualize instructions in the sense that teacher may permit each student to read it his/her own rate of comprehension. The textbook is a book used as a standard source of information for formalstudy of a subject and an instrument for teaching and learning. It should beregarded as one of the many sources teachers can draw upon in creating an effective lesson and may offer a framework of guidance and orientation.

In an education system, a textbook is one of the important tools for curricular transaction.

Textbooks play a pivotal role in the whole scheme of education. Science is a subject in which the knowledge is widening day by day, therefore, in order to keep in touch with the latest trends in it and to keep the knowledge updated, books are essential. In our country, at many places, a textbook is the only accessible and affordable resource material. Thus, textbooks are considered to be one of the primary instruments of science education.

5.2 OBJECTIVES

After going through this lesson, you shall be able to:

- develop the abilities to make scientific inquiries, think scientifically, critically and creatively solve various problems in science,
- appreciate the importance of a science text book,
- understand the need of a science textbook,
- describe the characteristics features of a science textbook,
- evaluate a science textbook prior to classroom teaching,
- select the most appropriate science textbook and recommend it to others,
- ensure uniformity of good standard,
- provide both confirmation and sustenance,
- get essential knowledge at one place and promote learning, and
- solve exercises, activities and prepare in advance for better learning.

5.3 TEXT BOOKS

5.3.1 Meaning of Text books

Textbook is frequently the most important teaching tool because it can determine not only what will be taught but also how it will be taught. Although television, computer, internet and other new media are rivaling printed materials of communication, textbook remain major sources in school and colleges. Among various instructional aids, books are presumably the most important because it is used in formal as well as in informal situations of instruction and also in situation of self study. A text book is an instrument of instruction that facilitates the teaching –learning

process. The science text- book should aim at aiding the pupils in the development of their personalities, in developing open mindedness, developing appreciation and understanding of nature and not merely stuffing their minds with facts. Text books are important tool in the hand of a teacher. It helps student to how and what they learn to achieve some definite goals. When we make a text we should give importance to its content organization literary style, vocabulary, mechanicalmakeup and authorship.

- It provides a syllabus for the course because the authors of the syllabus have made decisions about what will be learned and in what order.
- It provides security for the students because they have a kind of a road map of the course: they know what to expect and they know what is expected from them.
- It provides a syllabus for the course because the authors of the syllabus have made decisions about what will be learned and in what order.
- It provides a set of visuals, activities, readings, etc., and so saves the teacher time in finding or developing such materials.
- It provides teachers with a basis for assessing students' learning. Some textbooks include tests or evaluation tools.
- It may include supporting materials (teacher's guide, CD, worksheets, and video.)
    - It provides consistency within a program across a given level, if all teachers use the same textbook. If textbooks follow a sequence, as within a series, it provides consistency between levels.

5.3.2 Importance and role of text books in teaching of biological science:

Since science plays a very crucial role in the day to day life of an individual, it is, therefore, essential that students should have a sound foundation in the subject. This will enable the students to have a clear understanding of the various phenomena occurring in nature. Thus, it becomes very essential that a science textbook covers all the important aspects of nature and conveys the information in a very simple manner so that even an average student can comprehend the content.

Needs of having a science textbook can be listed as below:

- Textbooks supply facts and develop the appreciation and understandingof concepts and

principles.

- A textbook preserves and stores knowledge and wisdom.
- Textbooks guide the students in learning.
- Textbooks reflect and establish standards.
- Textbooks help to realize the basic curricular objective of differentstages.
- Textbooks provide an opportunity to the students to reflect and evaluate.
- Textbooks generate educational interaction between a teacher and a student.

Role of textbooks: Help the pupils:

Science text books help the students to sort out their problems in particularconcept and act as an accessible guide for them. The pupil make use of the textbooks to prepare himself in advance for learning in the classroom , revisesand reinforces the classroom learning , make assignments and prepare forthe examination.

Help the teacher:

The text book provides useful guidelines along which the teacher can plan his/her day to day teaching. It serve as a reference book for teachers to provide suggestions and suggest activities related to the content matter.

Provide logical and comprehensive material:

A good textbook provides material in a systematic and comprehensive form.It sets a standard to be achieved by pupils. It gives the beginner a grasp of new matter. It also gives direction to students for further studies.

Provide a base from which both the teacher and the pupil may start and continue to work:

Textbooks provide the common ground which both the student and teacher may explore together. Also it focus attention on the same issues, event, sequences and circumstances and serve well as rallying points.

Ensure uniformity of good standard:

The textbook provides a highway for carrying good practices to all students. The text book furnishes a common basis on which to master the process of reading, analyzing, outlining and summarizing. It, thus, furnishes a commonlaboratory in which students develop study skills.

Check Your Progress

Note: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the lesson.

1) Why textbooks should involve exercises at the end of the lesson?

_____

_____

2) How textbooks are helpful for both teachers and students?

_____

_____

3) Why is a science textbook an essential resource for a science teacher?

_____

_____

5.3.3 Qualities of a good textbook of biological science:

A science text book is good one if it contain both physical and academic features.

Physical features:

1. Size of the book
   - It is suitable for all learners.
   - It is convenient in handling and carrying.
2. Printing of the books
   - The printing is neat and clean.
   - It is free from any type of errors.
   - The spacing between the words, lines and paragraph is even and satisfactory.
   - There are sufficient margins on all sides of the page.
3. Font size used in text books
   - The font size used in the book is suitable for the age group.
   - It does not strain the eye sight of the pupils.
   - Different type size is used for title, text and captions.

4. Paper used in text books

- It is reasonably of fine quality.
- It is adequately thick and smooth.

5. Binding of textbooks

- The binding of the book is sufficiently strong.
- The sides of the book are properly trimmed.
- The cover page of the book is durable.

6. Price of textbooks

The price of the textbook is reasonable. It suits the pockets ofmajority of the parents.

Academic aspect of the book:

From the academic point of view, a good textbook has the following features:

1. Thematic content of thebook

- The subject matter is according to the mental level of the learners.
- It is capable of sustaining interest of the student.
- It provides new information to the learners.

2. Organization of the content and its presentation:

- The subject matter is divide into convenient units.
- Length of each lesson suits the learners.
- The reading material is graded in order of difficulty.
- The style of presentation is simple and clear.
- The title of each lesson is brief meaningful and suitable.

3. Textual language

- The textual language is according to the mental level oflearners.
- The language used is correct.
- It is appropriate to the situation or context.

4. Illustrations used intextbooks

- Abstract concept of the book is clarified with the help of pictures and diagrams.
- The pictures used in the books are well drawn.
- Variety of applications are involved in text books.
- Pictures are realistic and properly distributed in the textbook.

5. Textual exercises in book

- Every lesson is followed by exercises.
- Instructions to do exercises are clear.
- The exercises for each lesson are purposeful and adequate.

Textbook Evaluation Criteria:

Textbooks are evaluated according to the following criteria:

- Practical Considerations
- Layout and Design
- Activities
- Skills
- Language Type
- Subject and Content
- Miscellaneous

- Practical Considerations:

1. Is the price of the textbook reasonable?
2. Is the textbook easily accessible?
3. Is the textbook a recent publication ?
4. Do a teacher's guide, workbook, and audiotapes accompany the textbook?
5. Are the author's views on language and methodology comparable to the user's ?

- Layout and Design:

6. Does the textbook include a detailed overview of the functions, structures and vocabulary that will be taught in each unit?
7. Is the layout and design appropriate and clear?
8. Is the textbook organized effectively ?
9. Is an adequate vocabulary list or glossary included ?
10. Are adequate review sections and exercises included ?

- Activities:

14. Does the textbook provide a balance of activities ?
15. Do the activities encourage sufficient communicative and meaningfulpractice ?
16. Do the activities incorporate individual, pair and group work ?
17. Are the grammar points and vocabulary items introduced in motivatingand realistic contexts ?

18. Do the activities promote creative, original and independent responses?

19. Are the tasks conducive to the internalization of newly introduced language ?

20. Can the textbook's activities be modified or supplemented easily?

- Skills

21. Does the textbook highlight and practice natural pronunciation ?

22. Is the practice of individual skills integrated into the practice of otherskills ?

- Language type

23. Is the language used in the textbook authentic ?

24. Is the language used at the right level of students ability ?

25. Is the progression of grammer points and vocabulary items appropriate?

- Subject and Content

26. Is the subject and content of the textbook relevant to students needs?

27. Is the subject and content of the textbook generally realistic ?

28. Is the subject and content of the textbook interesting, challenging andmotivating?

Advantages of textbooks:

- Textbooks are especially helpful for beginning teachers. The material to be covered and the design of each lesson are carefully spelled outin detail.
- Textbooks provide organized units of work. A textbook gives you all the plans and lessons you need to cover a topic in some detail.
- A textbook series provides you with a balanced, chronological presentation of information.
- Textbooks are a detailed sequence of teaching procedures that tell you what to do and when to do it. There are no surprises—everything is carefully spelled out.
- Textbooks provide administrators and teachers with a complete program. The series is typically based on the latest research and teaching strategies.
- Good textbooks are excellent teaching aids. They are a resource for both teachers and students.

Disadvantages of textbooks:

- A textbook is only as good as the teacher who uses it. Sometimes, teachers over-rely on textbooks and don't consider other aids or othermaterials for the classroom.
- Textbooks are too contrived and artificial in their presentation of thetarget language.

5.4 LET US SUM UP

The textbook plays an important role in teaching and learning. It represents a useful resource for both teachers as well as learners. Text books are the most widely used of all instructional

materials. Now a day's text book has become a course of study. A set of unit plans and a learning guide as well. A text book should really design for the pupils rather than the teacher. Text book should stimulate reflective thinking and cultivate in students the scientific attitude. Science text books help the students to sort out their problems in particular concept and act as an accessible guide for them.

A good text book should have following qualities

1. Content
2. Organization
3. Literary style vocabulary
4. Illustrations
5. Teaching aids
6. Mechanical make up and appearance
7. Authorship

5.5 LESSON END EXERCISE

1. What objectives should be kept in mind while designing the textbooks?
2. What is the importance of textbooks in education system?
3. What are the qualities of textbooks of biological science?

5.6 SUGGESTED FURTHER READINGS

Cimer, A. (2011). What makes biology Learning difficult and effective . Educational Research and Reviews, 7(3),61-71.

Cunningsworth, A. 1995.Choosing Your Course book. Oxford: Heinemann.

National CurriculumFrameWork (2005) National Council of EducationalResearch and Training: New Delhi

Reuven, L. & Sofia, P. (2010). High school students difficulties in biology concept. Journal of Biological Education, 26(3), 215-323.

Roseman, J. E. , Stern, L., & Koppal ,M. (2010). A method for analyzing the coherence of high school biology textbooks. Journal of Research in ScienceTeaching, 47(1),86-92.

5.7 ANSWERS TO CHECK YOUR PROGRESS

1. Textbooks should include exercises at the end of the lesson to develop the abilities among the students so that they make scientific inquiries, think scientifically, critically and creatively about the concept.
2. Science text books help the students to sort out their problems in particular concept and act as an accessible guide for them. The pupil make use of the textbooks to prepare himself in advance for learning in the classroom, revises and reinforces the classroom learning, makeassignments and prepare for the examination.
3. The text book also provides useful guidelines along which the teachercan plan his/her teaching. It serve as a reference book for teachers to provide suggestions and suggest activities related to the content matter.

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LESSON NO.6 UNIT –II

CO-CURRICULAR ACTIVITIES

STRUCTURE

6.1 INTRODUCTION

Along with good teaching, a teacher has to undertake a number of activities in a school such as administration and organization, guidance, counseling, and so on and so forth. If a

teacher teaches all the time, however effective and excellent a teacher may be, the atmosphere of the School will become monotonous. Apart from this, he will not be performing other functions thathe/she is expected to perform. He/she performs a variety of roles since theyare essential for promoting all-round development of students One of the roles that he/she performs is the organization of co-curricular activities. Inthis unit, we will discuss the importance of these activities, how to organizethem, what principles have to be kept in mind, which objectives are to be achieved and what the role of a teacher is.

Let us first understand the place of co-curricular activities. They are by no means new. They are as old as organized education itself. A number of activities which we perform today in the name of co-curricular activities existed in schools even in ancient times, for example, music, debate, drama,athletics, etc.

In between they were somewhat ignored and neglected, with more importance being given to Academics. It was soon realized that some objectives of education cannot be achieved by Academics alone. A pure academician develops a lop-sided personality, and all-round Development remains a far off dream. All-round development means mental, physical, Psychological, spiritual and vocational development. Can we achieve this all-round development by following mere teaching-learning procedures? The answeris certainly 'no'.

Today's school is giving attention to a child's health, hygiene, sanitation and safety. In addition, recreational activities are being increasingly and intelligently designed and promoted for the purpose of wholesome physical development, good citizenship, character education, Manners and courtesy. The development of worthy emotions and feelings, heightened Inspirationsand wholesome aspirations are also provided in schools.

Outside school or classroorn activities are equally as important as those Insideclassroom, as they supplement curricular activities .In simpler words we cansay that the true aims of education can be fully realized by introducing co- curricular activities at every stage of education. Do you agree?

Nowadays co-curricular activities have been accepted as an integral part ofscience curriculum because they provide scope for developing skills, a sense of cooperation, team spirit and self discipline, which are important for a citizento function in a democracy. All this is possible only through students' participation in co-curricular activities. Hence the need for co-curricular activities is increasingly felt in schools. They are an integral part of the activities of a school as its curricular work and therefore their proper Organization needs much care and thought.

6.2 OBJECTIVES

After going through this lesson, you shall be able to:

- define the concept of co-curricular activities;
- discuss the different types of co-curricular activities;
- explain the need and importance of co-curricular activities;
- explain principles underlying organization and administration of co-curricular activities;
- enumerate the difficulties faced in organizing co-curricular activities;
- suggest measures to overcome such difficulties; and assess yourselfas to whether you possess the required skills for organizing various co-curricular activities.

6.3 NEED FOR CO-CURRICULAR ACTIVITIES

6.3.1 Concept of Co-curricular Activities

Before discussing the importance and need of co-curricular activities, let usbe clear about the concept of co-curricular activities.

Four decades ago it was comparatively easy to define co-curricular activities because all of them were organized and promoted largely by students themselves, with relatively little assistance from teachers and administrators. Equipments were meager, little official recognition was given and no credit was allowed for participation. These activities were really extracurricular.

Today, it is difficult to define co-curricular activities because all teachers have some definite responsibilities for their organization; many full time professional teachers are employed, school rooms, time, equipment and materials are provided; their relationships with regular curricular activitiesare regarded as vital; credit for participation is allowed and recognition is also given.

In short, we can say that according to modem education thinkers, curriculum is not only teaching and learning in classroom. It also includes work in library, laboratory and workshop and numerous informal contacts, between teacherand pupils in these places. In these informal contacts there are many activities. one of which is co-curricular activities. It is a part of

curriculum of the institution.

6.3.2 Types of Co-curricular Activities

Co-curricular activities are categorized under six headings:

- Literary Activities
- Aesthetic and Cultural Development Activities
- Civic Development Activities
- Social Welfare Activities o Leisure Time Activities o Excursion Activities

In the following chart you will find different activities under the main heading

LITERARY ACTIVITIES	Debates and discussion on biological topics, biology club, lectures by prominent biologist, biology Magazine, Dramatics of biological phenomenas Story Writing on life of scientists, Seminar on various biological phenomenas
AESTHETIC AND CULTURAL DEVELOPMENT	Music, Dancing, Drawing, Painting Sculpture, Dramatics, Fancy Dress, Folk Dance, Folk Songs, Variety Programme on different biological phenomenas of life.
CIVIC DEVELOPMENT ACTIVITIES	Celebrating scientific days, environment day, AIDS day, Health day etc.
SOCIAL WELFARE ACTIVITIES	Rendering school service in health & sanitation, community service in realm of public health, rendering first aid to the needy etc.
LEISURE TIME ACTIVITIES	Collecting specimens, preparing models, charts, making improvised apparatus diagrams etc.
EXCURSION ACTIVITIES	Visit to science museum , places of biological interest, Exhibitions of science books, Films show on biological topics etc.

6.3.3 Need and Importance of Co-curricular Activities

Looking at the list of various types of activities, the question will arise in your mind is how do these activities help us in achieving the objectives of education. Also what is the need and importance of these activities? Let us first discuss the advantages. Curricular activities have a number of values like educational value, development of social spirit, character training education for leadership, worthy use of leisure time or recreational value, team spirit, development of civic virtue, improved discipline, aesthetic development and development of cultural values. Let us discuss them one by one.

Educational Value

These activities have great "educational" potential. All classroom teachingis theoretical.

Practical knowledge can be imparted through co-curricular activities.

- Excursions and tours provide firsthand experience and reinforce classroom knowledge
- Language and expression improves through debates and recitations of biological concerns.
- Science magazines teach students the art of experimentation.
- Celebration of scientific functions develops scientific qualities in students.
- Science Projects provide direct learning opportunities.

Psychological Value

These activities as the name suggests meet the psychological needs of the students, mainly with reference to social demands of the pupils. They help in expressing personal behaviour and provide a vehicle for creative thinking

a) These Activities act as Agent for Sublimation of the Instincts

Co-curricular activities are a means of channelizing students' instincts into healthy and fruitful channels e.g. instinct of curiosity can be fruitfully channelized by preparing models & improvising apparatus.

b) Emotional 'Health

A student is a bundle of innate urges or drives. It is natural for him/her to becurious, to show

off, to master, to be loyal and to be sympathetic. Co-curricular activities provide valuable opportunities in which these drives may be capitalized for educational benefit. But fortunately or unfortunately, they may not come up to the required expectation e.g. some students who are backward in studies develop inferiority complex and find school life disgusting andcan get emotionally unbalanced. Such activities provide a means of emotional adjustment for students.

c) To Increase the Interest ofStudents

A student who gives his time and effort to his school is, therefore, more interested in it, because of his contributions

d) Recognition of Individual Differences

By providing a number of co-curricular activities, we can ensure the expression of potential capacities of each individual e.g. scientific writing, public speaking on biological topics, dramatics on environmental concerns,paintings on environmental issues, organization of ADIS day etc. which provide scientific training in different aspects of personality of students. Theseactivities, thus, cater to aptitude, interests and abilities of students and sometimes act as a determining factor for the choice of future vocation.

Development of Social Value

By 'participating in group activities, students learn good manners and develop a sense of cooperation. Membership in a biological club, student council ofscience, dramatic cast requires co-operation. Students learn to appreciate therelationship of an individual to the social group. Through team activities, students learn social cooperation. They develop group spirit,'we' - feeling,belongingness, unity and ability to be co-operative.

Development of Civic Value

In group activities students learn the value of doing one's duty. For example, students' experimentations in schools provides an excellent training in shouldering responsibilities. These activities train the students for good citizenship. Co-curricular activities offer many opportunities for thedevelopment of self-discipline. They develop in students a spirit of tolerationof others' views, healthy exchange of ideas, fellow feeling and accepting victory and defeat with grace.

Secondly, the school is a miniature society and the activities of the schoolshould have direct

relations with the activities of the society. Qualities like initiative and leadership are not always developed in a classroom. In the laboratories, students get opportunities to develop leadership qualities like initiative, decision-making, judgement, tolerance etc. These qualities are required for a scientific society. Many girls and boys have little practice in controlling themselves and in directing their own affairs. They have not developed the ability to do these things. As a result, when they are placed in settings that demand self-direction, they are lost. Co-curricular activities provide numerous situations in which students may gradually get increasing responsibilities for their own direction. The settings for developing these carry-over values must be definitely provided. A school must be a workshop in democracy.

Recreational Value

Lack of ability and training in proper utilization of one's leisure time is one of the major defects in our present system of education. By providing and organizing various activities, we provide wholesome opportunities to ourstudents, rather than to spend their spare time in undesirable activities e.g. Movies, TV, idle talk etc. Hobbies developed at the secondary school stage become lifelong habits eg. Preparing certain things of common use as ink, soap, phenyl etc.

We can conclude by saying that co-curricular activities cater to the development of a child's entire personality, draw out the latent powers of children of different temperaments, supplement academic work, develop scientific thinking and scientific attitude. Without these activities studentswould be mere book-worms.

Check Your Progress

Notes: a) Write your answers in the space given below.

b) Compare your answers with those given at the end of the unit.

1. Which of the following statements are true?

i. Co-curricular activities are part and parcel of school organization.

ii.	Co-curricular activities are as old as organized education itself.
iii.	These activities are not appropriate media to achieve aims of education.
iv.	Excursion provides firsthand experience.
v.	Co-curricular activities provide opportunities for better understanding of our environment

2. Find out the type of co-curricular activity to which each of the following belongs:

Exhibition of science books, preparing models ,charts on biological topics, Fancy Dress on environmental issues, rendering first aid to the needy, Recitation of Poems on environmental issues, Celebration of health day or environment day.

6.4 ORGANISATION OF CO-CURRICULAR ACTIVITIES IN SCHOOL

By now we are clear about various types of co-curricular activities and howthese activities help in achieving the manifold goals of education. A questionmay arise in your mind. "Can I organize activities in my school though I am not a specialized teacher in any activity?"

Yes, you can, If you do not have any specialization in any activity, do not worry, you can develop skill and abilities for organizing activities, if you arekeen about it.

When we think about organizing co-curricular activities, the nature of the activity, involvement of students, teachers, parents and community as wellas objectives of a particular activity must be thought of. Secondly, we haveto remember that it is a joint activity and joint effort of many people. The learning experiences of the students are improved when the organizer of co- curricular activities utilizes the talents and energies of all optimally. A better climate for learning is established and finally, school community relationshipis always improved.

6.4.1 Organization of co-curricular activities

In this section, we are going to discuss organization of co-curricular activitiesin a school, what are the points to be kept in mind and what role a teacher hasto play. If we want to make any programme successful, we must look after its organization. Without organization, objectives cannot be achieved. Moreover, resources are wasted, planning and

organization help in makingactivities successful. What are the points to be kept in mind for planning andorganization of activities?

For organizing the following points need to be considered:

- Students should feel the need for activities and should demand them.
- Activities should be selected keeping in view students' interests. Thereare a number of activities and there are also differences in students' interests and liking. An activity should be selected in such a way that all students are able to participate i.e. there should be maximum involvement. More and more students should be involved. Activities should be such that all students are able to participate.
- A teacher should help students plan and organize co-curricular activities. The ultimate planning and implementation should be doneby students.
- Activities should be organized during school hours but some activities like tours, excursion, scientific fairs etc. can be organized on holidays.
- Minute details of activities should be worked out for the success of the programme.
- Activities selected should be economical i.e. they should not place unnecessary financial burden on the school or parents.
- Activities having educational value should be selected. The selectedactivities should support and enhance classroom learning.
- Activities selected should be such that they provide opportunity to students to learn and also to become self-reliant.

- Activities should not be imposed on students. They have to be selectedby students themselves.
- Students should meet and discuss such aspects as the venue, date andresources available.
- Objectives of activities should be made clear.
- Various sub-committees should be formed e.g.

1) Stage committee	2) Decoration committee
3) Seating arrangement	4) Reception committee
5) Invitation committee	6) Overall organization

- Work has to be allotted to various committees depending upon abilitiesof persons.
- Activities should be supported by teachers, principal, parents, community members and management.
- The rules and regulations regarding activities should be mentioned well in advance to the students.
- The best participants are to be identified.
- Activities should be planned year wise so that they find place in schoolcalendar, and that parents know their dates in advance.
- Expenditure on activities should be borne by the school only. Only in unavoidable circumstances should students be charged.
- Records should be kept of the activities.

In order to make co-curricular activities successful, what should be the contribution of a school?

The school should provide necessary facilities and infrastructure. The school should provide necessary facilities and infrastructure, and a dark room to show T.V. or films. It should provide necessary equipment and allocate proper time for various activities. It should also provide required apparatus and provide financial help. Apart from all these. it should reduce the workload ofteachers in charge of co-curricular activities.

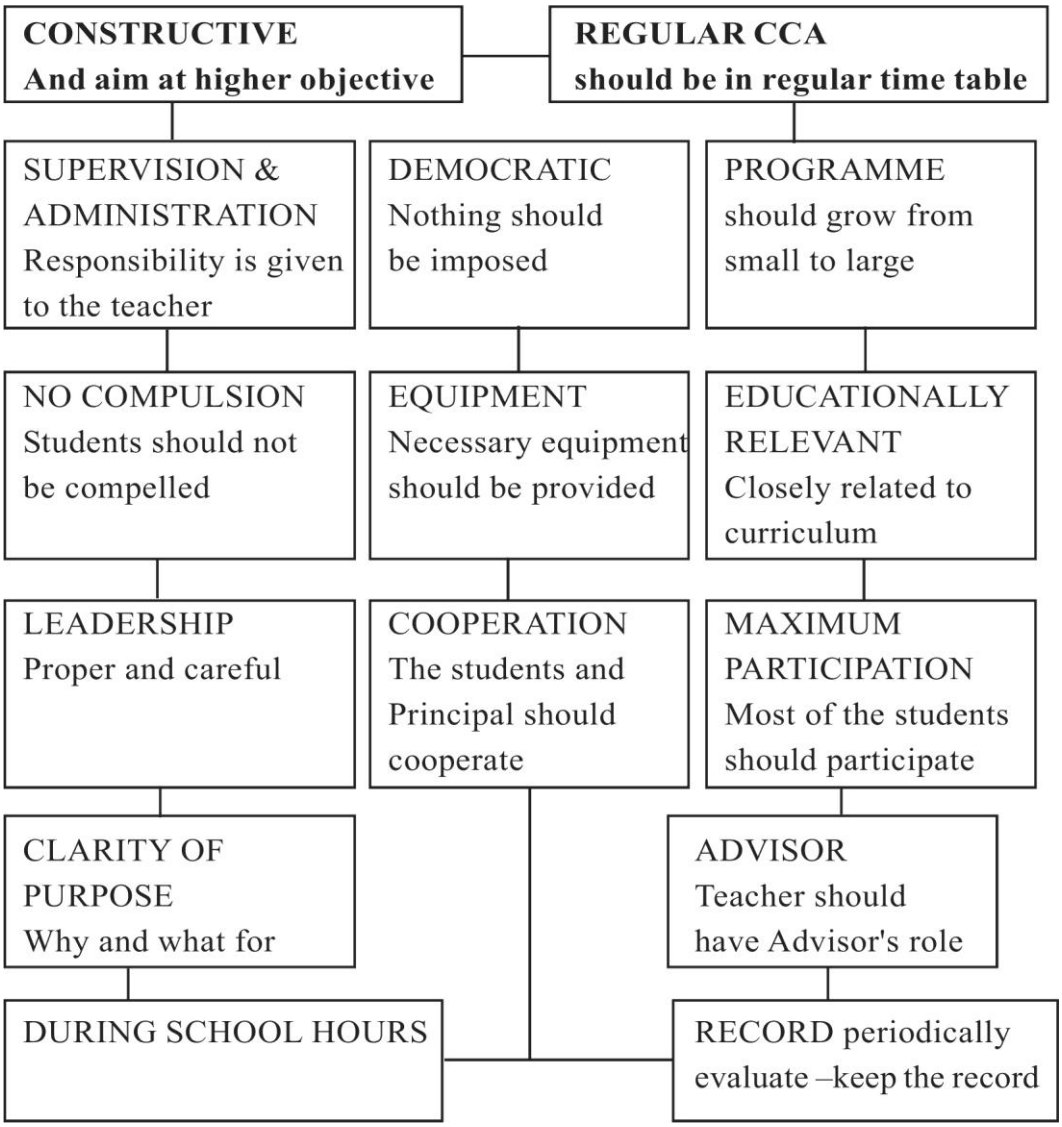
Principles Underlying Organization of Co-curricular Activities

The Fig.6.1 below summarizes the main principles which need to be kept inmind while organizing these activities.

- Select activities that are closely related to science curriculum. They should be educationally relevant.
- The selected activities should be constructive and should aim at development of higher level objectives, which are not attainable through regular classroom teaching e.g, novelty and originality, skillfor experimentation, discussion etc.
- Co-curricular activities should have place within school timings so that all can participate.
- As far as possible all students should participate in one or other activity going on in the school.
- The Atmosphere has to be democratic : more suggestions and ideas can be incorporated in democratic atmosphere so nothing is imposedon students.
- Leadership should be proper and careful : every time the sameperson should not get a chance to lead. Leadership should be rotational and maximum number of students should get opportunity to conductan activity.
- Administration and supervision : the responsibility for organizing and arranging the programme should be placed on students, while teachers can supervise and facilitate.
- Regularity : co-curricular activities should be organized regularly
  i.e. they should have a place in school time-table.
- Advisor : the teacher should have an advisory role and should notimpose his her

will on students.

- Programme should grow from small to large gradually. Initially theremay be a few items and a few students but gradually the programme should widen with maximum number of students being. involved.
- Equipment: necessary equipment should be provided well in time tostudents for practice and organization
- A record of each programme should be maintained. Teachers shouldenter the details in a special co-curricular register



6.4.2 Role of a science Teacher in Organizing Co-curricular Activities in School As a Planner]

The teacher must be a good planner and should plan out all the activities to be performed in a year, preferably in form of a chart.

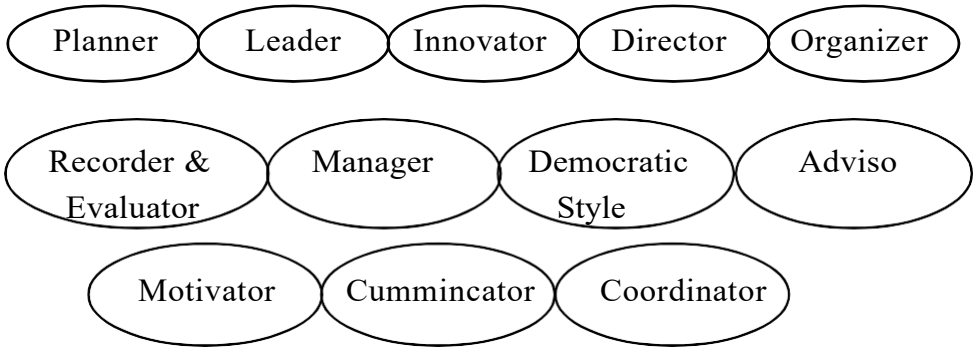


Fig. 6. 2 : Role of a science Teacher in Organizing Co-curricular ActivitiesAs a Leader

The teacher should give the student opportunity to exhibit their leadershipqualities and , this opportunity should be given in rotation.

As an Innovator

In order to break monotony of activities, a teacher should try to introduce some novelty (new programme) gradually.

As a Director

As a director teacher should see that the programmes selected by the studentsare constructive. The programmes or activities should be scrutinized for theireducational relevance.

As an Organiser

The planned activities should be implemented through a strong organizer.The teacher should supervise activities of students for effective programmes.

As a Recorder and Evaluator

A teacher has to keep a record of all activities undertaken in the academic year. The record must consist of names of participants and winners. The programme should be evaluated periodically.

As a Manager

The teacher has to be an effective manager in order to plan, organize, co- ordinate, direct,

record, evaluate and control activities.

As a Decision Maker

As far as possible a teacher should use democratic methods for taking decisions regarding organization of activities. Care should, however, be taken that style of decision-making is democratic.

As an Advisor

The role of a teacher is to advise students as and when it is required. Teachershould not impose upon and compel students to accept his/her ideas.

As a Motivator

At times, students are reluctant to participate in some co-curricular activities. In such circumstances, the teacher must motivate them to participate in suchactivities.

As a Communicator

The teacher should be able to communicate well regarding the programme and its objectives very clearly and well in advance.

As a Coordinator

The teacher has to co-ordinate resources, time and activities. He/she shouldalso co-ordinate effectively amongst students, colleagues, principal, management and community in order to have an effective programme.

When a teacher organizes any activity, he/ she should not think that everything will always be smooth. Many difficulties may arise at organization and planning stage as well as at performing stage. Sometimes there is financialcrisis; equipment is not in order, electricity has failed, the time is short and place is not suitable. Like these there are many problems which prove to be hurdles. But a teacher should not lose hope. He/she should try to solve the problems.

There will always be financial problems. Fund be low and activities more.? Every activity needs some finance.

Without finance also activities can be organized. A teacher should select suchactivities, which do not require any finances e.g. debate on environmentalissues quiz, fancy dress, role play, jokes, monoacting, songs etc. An scienceexhibition can be arranged. Students can be asked to

bring items to exhibition and at the end of the exhibition they can take them back. A teacher should be competent and resourceful to manage activities, even without finances

6.4.3 Difficulties Faced in Organizing Co-curricular Activities

Difficulties faced by students

Students do not take active interest in co-curricular activities because:

- Provision for these activities in schools is not adequate to meet all the needs of all the students.
- Activities are not given a place in school time-table, during school hours. These are either Bxed before or after school hours and many students do not participate in them because it is neither convenient nor compulsory for them to do so.
- Sometimes students feel that these activities interfere with their studies. Therefore, whenever they are organized, students participate in them unwillingly.
- These activities are not assessed in the examinations. No extra credit is given for them. At present one passes an examination without participating in these activities.
- Teachers are not competent to organize a sufficient number of activities. There is hardly any trained staff to inspire students to participate in these activities.
- Students are not economically well off to bear the extra expenses involved in participating in these activities.
- Many students work and learn, they do not have sufficient time for these activities.
- Heavy homework is assigned to students. So they do not find time to participate in these activities, though they are interested.
- Some students are not familiar with the importance of these activities due to lack of proper guidance.
- Students are too shy to participate in these activities. Some students do not know their hidden potentialities.

Problems faced by the teachers

- Teachers expect extra allowance for organizing these activities.
- They lack knowledge and training to organize such activities.

- Few teachers realize that the aim of education is the development ofthe total personality of children. They assess students only on the basis of their performance in examination and consider these activities assuperfluous.

Thus we have discussed the problems faced by the students and by the teachers. The question is can we solve these problems? How?

One should remember that these problems are not permanent in nature. Theycan be solved by using various techniques and foresight.

6.4.4 How to Overcome these Difficulties?

- As far as possible, these activities should be accommodated in the time-table during regular school hours. This will enable all students to take part in these activities and also give more importance to these activities.
- A wide variety of activities should be planned in order to meet the different needs of a large number of students.
    - Activities having educational value should get greater attention e.g. literary activities like debates, elocution contests, composing poems on scientific and environmental issues.
    - 'Activities should be selected according to the economic means of theschool aid needs of the students. Activities thus differ from school to school. Different activities are required for rural and urban schools and for primary and secondary sections.
    - Students should be motivated to participate in activities by asking them to choose activities of their interest.
    - Aims and function of each activity should be well defined. Each activity should have its objectives which should be made clear to the participants.
    - A system of rewards should be instituted for best performance. Some prizes, merit, certificates, shields, running trophies etc. would motivatestudents to participate.
    - While allowances may not given to teachers for organizing these activities, the principal can reduce their workload !through proper allocation of duties.
    - Unnecessary expenditure is to be avoided.
    - Work done should be properly recorded and periodical evaluation ofthe activities is

also done. And on the basis of the evaluation, problems can be sorted out and modifications in the programme are thought of.

- Regular time should be devoted to these activities in the time-table.
- Some credit, either in the form of less teaching periods or in the formof extra payment must be given to teachers.

6.5 LET US SUM UP

The school can be made a dynamic or multi-dimensional affair, if suitable curricular and co-curricular activities are organized in a school in which each student participates, contributes his maximum and prepares himself for becoming a good citizen of the society. Co-curricular activities should be organized in such a manner that students utilize their energy and school facilities are used in optimum way. Activities should be suchhat they help in achieving goals of education, make students enthusiastic, develop leadershipqualities, develop sociability and enhance their learning ability. Activitiesshould be designed keeping in view the objectives co-curricular activities. We have described only a few important co-curricular activities here. The organization of these activities is equally important and every effort shouldbe made to introduce as many activities as financially and administratively possible in the school.One cannot think of a school without co-curricular activities. Assembly, games, competitions. programmes, publications, exhibitions, and other activities bring students together, unite them, develop in them the 'we' - feeling and help them to make their own contribution for the betterment of the school.

6.6 LESSON END EXERCISE

1. List a few activities, which according to you, are literary activities.
2. What co-curricular activities would you like to introduce in your school? How will you organize them to develop scientific attitude among the students.
3. Analyze your function as a teacher of co-curricular activities and list the various activities, skills which you use and classify them into various categories of co-curricular activities.

6.7 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1994): Educational Administration, Management andSupervision, Principles and Practices, New Delhi.

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Safaya, R.N. and Shaida B.D. (1969): School Administration and Organisation, Dhanpat Rai & Sons, Jullundhar.

6.8 ANSWERS TO CHECK YOUR PROGRESS

1. a) True, b) True, c) False, d) True, e) True.

2. Exhibition of science books - Excursion Activities Preparing models, charts on biological topics - Leisure Time Activity Fancy Dress on environmental Issues - Cultural Development Activity Rendering first aid to the needy - Social welfare activity Recitation of Poems on environmental issues - Literary Activity Celebration of environmental day health day - Civic Development Activity

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LESSON NO.7 UNIT –III

LESSON PLANNING

STRUCTURE

7.1 INTRODUCTION

The introduction process is of vital importance because it is through the process of instruction that many social studies objectives are achieved. The question of "what" to teach always prcedes "how" to teach it. A good instructional process is one that enables the teacher and pupils to achieve predetermined objectives by selecting appropriate teaching-learning strategies. In this unit a careful discussion on lesson plan and unit plan is presented. When you decide what the instructional objective are, the sequence, of learning activities and how those activities are to be introduced, experienced and integrated, you make your own teaching sequences. A lesson plan or aunit plan kill emerge depending upon the magnitude of your effort. Lesson plans or a unit plan kill emerge depending upon the magnitude of your effort. Lesson plans or unit plans based on materials other than those found in textbooks (instructional inputs) often reflect a high order of creativity.

According to the Lester B Stand "Lesson Plan is actually a plan of the action. It therefore

include the working philosophy of the teacher, his knowledge of philosophy, his information about and understating of his pupils, his comprehension of the objectives of education, his knowledge of the material to be taught, and his ability to utilize effective methods."

Helpful as it may be, the lesson plan is never what it is so often called, "the teachers indispensable aid". When it is thought of indispensable, it has unsuped the teacher's place and whether he knows it or not, he is subordinated to a bit of machinery. Often of course the lesson plan become a more protective device against what teachers constitutionally fear almost as much as silence chaos. Our problem is that we mistake an ordinary method for order itself just as we often confuse the challenges of real learning with disorder.

And where do we start: where the students are there is no other place a great of nonsense of talked about raising the students to our level non sense become it, generally means standing on same height of knowledge and culture and exhorting them to climb up there with us. but why should they? They, usually,have no interest in doing it and so we have to take the whip to them like thedrayman with the kitten. If the lash is biting enough theymany struggle up but most of time they will not stay. In that case we have achieved only the appearance of education.

7.2 OBJECTIVES

Aftrer giving through this lesson, you shall be able to :

- define lesson plan,
- explain salient features and importance of lesson plan.
- plan a unit plan from prescribed syllabus and
- discuss the importance of year planning

7.3 MEANING OF LESSON PLANNING-

A lesson plan is not a blue print that one has to adhere to at all costs. It is rather a guide, an index of sequence of the class room activities, a list of important teaching points : suggestions for procedures that may be followedduring the period. The teacher may and should modify the plan or change any part of it whenever necessary ."

In literature one come across many definitions of " Lesson Plan " Like a blueprint, a creative piece of art , a plan or guide for action in the near future, a systematic and elastic approach to the development of scientific concept andskills are employed by the teacher to realize both the general and specific objectives of teaching and education in a democratic society.

A lesson plan does not exits in vacuum. It takes into consideration all the major variable which influence the teaching learning process in the classroomviz, school philosophy, the nature of the students, availability of rich education experiences of instruction in over crowed classrooms and the intelligent andwell informed supervision available in a permissible atmosphere etc.

Hence we can say that a lesson plan is a teacher's own guide to control the teaching learning process under the conditions he find him self in. It is no wonder then that there are as many lesson plans as there are teachers on single topic. It hardly matters if they are either short or long ones.

We can then emphatically say there is no such thing as the IDEAL LESSONPLAN . Secondly lesson plan is for the personal use of teacher and thirdly itis as good as he can make it. Lastly, teachers should be helped to frame better lesson plans which provide productive thought and action among students.

7.4 IMPORTANCE OF LESSON PLANNING

1. Lesson planning help to present the material in logical, systematic and effective way keeping in mind the mutual development of those for whom the lesson is being planned.

2. Lesson Plan helps in obtaining the adequate sampling of subject matterto be taught and the instructional objectives to be achieved.

3. Lesson plan helps in achieving the economy of time, effort and even money resources. This ultimately leads to the maximum of education development with minimum of resources including cost factor.

4. A good teacher intends to insure first class instruction. Hence a good teacher avoids frustrating and embarrassing situation and experience in the conduct of his lesson. He is thus able to anticipate not only his but also his pupils likely difficulties such as more concretization of abstract terms facts and concepts prior preparation of a list of teaching, developingand testing questions, ready for use at the most appropriatetime, arranging fully tested instructional material (apparatus, experiments, chemicals and films etc.) in

advance and suggesting library references for guiding students reading in the library etc. Thisleads to maximum use of the teaching time available because the mostthings which help the teaching learning process, have been provided for in advance for likely use in the future

5. Lesson plan reveals teacher's personality. A lesson plan suggest its own alternatives in term of manner of class organization, choice of instructional and illustrative materials and other specific objective to be achieved without suffering any loss in standards. Different and varied ways, thus, become available to achieve the particular specific objective the lesson.

6. By preparing a lesson plan, a teacher gets an opportunity to experimentwith his own ideas. This leads him to discover unaided or under controlled guidance, the alternative lines of action in the light of his students background experiences, capacities and past attainments which provide him the growing points for self-improvement and professional growth. He thus, learns to improve his professional effectiveness through well thought out and carefully conducted self- improvement and professional growth. He, thus, learns to improve his professional effectiveness through well thought out and carefully conducted self activityin which trial and error only plays a nominal role.

7. When the teacher is towards finishing the lesson, it helps the teacherto know the extent to which the objectives of the lesson were achieved, which in future, leads to self evaluation and consequent improvement later on.

8. More over, it also helps the teacher to clarify the objectives and teaching learning procedures.

9. Preparing a lesson plan stimulate the teacher to think and work in anorganized manner.

10. Lesson planning establishes a proper correlation between the old andnew lesson.

11. It provides guidance to the teacher as to what, when and how he shouldteach.

12. Lesson planning compels the teacher to think about and use teachingaids

13. It helps the teachers to choose the best teaching method

14. Proper care is taken to take into consideration the level and the previous knowledge to the students.

15. It develops self confidence in the teacher.

16. Lesson plan brings definiteness and regularity in the thinking of theteacher.

17. Lesson planning inspires the teacher to improve the further lesson.

18. Lesson Plan fosters self confidence, persistence, security and individual pride in one's work. This further reduces fatigue, fear and even strain.

Characteristics of a good lesson plan

1. A good lesson plan should make the objectives of teaching lesson veryclear to the teacher.
2. It should help the teacher in systematic presentation of subject matter, in arranging sequential and appropriate teaching activities, in deciding the questions to be asked and the likely problems which may arise during the lesson.
3. It helps the teacher to decide motivational techniques and teaching aids.
4. A good plan should be flexible.
5. It should always be written
6. It works as a guide line for content, activities ,aids etc.

7.5 PRINCIPLES OF LESSON PLANNING

R. Schorling in Student Teaching suggests the following principles and stepsin planning a good lesson plan.

1. Select the most appropriate aims.
2. Provide the illustrative materials available.
3. Include crucial questions.
4. Consider the level of the ability and interests of the pupils.
5. Consult courses of study and grade requirement.
6. Select the best procedures.
7. Tie the lesson with previous ones.
8. Take into consideration the knowledge already possessed by pupils.
9. Include an appropriate assignment.

10. Consider supplementary materials in making the assignment.

11. Emphasise the main points of interest.

12. Give a logical order to activities that would lead towards a realizationof the aim of the lesson.

13. Provide for adequate summaries.

14. Make the plan flexible enough to allow the teacher to leave it temporarily and follow pupil interests.

15. Budget the time devoted to phases of the lesson.

16. Provide a means for evaluating the results of the lesson and the teaching.

Limitations of lesson Planning :-

1. Lesson Planning traps or entangles the teacher. In traditional instructional colleges, there is no mention of flexibility. Thus the teacher finds himselfhelpless in new situations.

2. Some times lesson plan obstructs the independence of teacher

3. Sometimes simple matters become complicated. The teaching processbecomes more difficult.

4. In lesson planning, more time is required to plan the lesson.

7.6 LET US SUM UP

1. The teacher should have full control or mastery over the subject matterand related subjects of the topic which he is about to teach.

2. The teacher should have a knowledge of psychology of the children and should plan his teaching work according to the psychology of the children.

3. He should have knowledge of sociological and philosophical bases of education. He should select teaching methods with the help of psychology and philosophy. He should also have full knowledge of teaching objectives.

4. He should keep in mind the individual differences while preparing lesson plan.

5. Prior to preparing the plan, the available material should be kept in mind. The teaching and instructional aids related to the topic should be planned before hand and the teacher should have full knowledge about the aids.

6. The plan should be prepared according to the time duration of the period in which the topic has to be finished.

7. The teacher should have the information about the previous knowledgeof the students before preparing the plan.

8. The various parts of the lesson should be well co-ordinated

9. The lesson plan should be based on the nature of the subject matter.

7.7 LESSON END EXERCISE

1. Explain the meaning of lesson planning.

2. Discuss the importance of lesson planning.

3. What are the principles of lesson planning.

7.8 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1994): Educational Administration, Management andSupervision, Principles and Practices, New Delhi.

Aggarwal, J.C. (1967): Educational Administration, School Organisation andSupervision, Arya Book Depot, New Delhi.

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LESSON NO. 8 UNIT- III

STEPS FOR PREPARING A LESSON

STRUCTURE

8.1 INTRODUCTION

All of us aware of the importance of planning in our life. All kinds of activities require planning. Planning for any purposeful activity shows results. In addition, planning leads to shared understanding and acceptance of clear and attainable goals. In teaching-learning process planning of instructional activities enhances students performance. Planning can give both teachersand students a sense of direction.

8.2 OBJECTIVES

After going through this lesson, you shall be able to :

- describe various steps involved in Herbartian approach, and
- explain RCEM approach of lesson planning.

8.3 HERBARTIAN APPROACH

Pual Monroe remarks, Herbart's method consists in a given series of steps, determined not by the character of the material but by the way in which the human mind acts.

German Philosopher and educationist John Fredrick Herbart (1776-1841) developed a psychological procedure in the field of lesson planning. He and his disciples Ziller, Ryan and others gave five formal steps for preparing lesson plans. This approach is the result of `Classical Human Organization'.

Theoretical Base

- This approach is totally subject matter centered. Much emphasis is laid on the `presentation of subject matter', no care for interest, aptitude, need and association of the students.
- Knowledge from outside Herbartian approaches is based on the principle that the entire knowledge is provided to the pupils from the outside. So, now knowledge should be associated with similar facts previously acquired.

FIVE STEPS OF HERBARTIAN TEACHING

Five Steps of Herbartian Teaching	1)	(a) Preparation (b) Statement of Aim
	2)	Presentation
	3)	Comparison/Associatio
	4)	Generalisation
	5)	Application

1) Presentation (Introductory Step/Introduction Motivation)

It prepares the minds of students to acquire new knowledge. During this step, the teacher tries to arouse curiosity in the students by asking the questions based on knowledge previously acquired. Here we can quote, J. Welto.

`To know where the pupils are and where they should try to be, are the first two essentials of good teaching.'

Statement of Aim

This is a part of the first step. Here, the teacher announces the day's lesson and writes the topic's name on the black-board in clear concise and known words. The statement should be brief like `today, we shall study plantcells and its organelles'.

Appropriate Particulars are Included in this Step

Pupil- Teacher's Roll No ……. Date……..... Class ……... Average Age of Pupils……. Subject……..... Duration of Period…… Topic……

General Aids: (Like Chalkboard, Duster, Coloured Chalk and Pointer).Instructional Material……..

General Objectives…….Specific Objectives…….

Previous Knowledge Testing……..Announcement of Aims……

1) Presentation

The practical part of the lesson begins with presentation, where lesson is developed with the co-operation of pupils. Here, teacher divides the lessonin different sections/units to impart new knowledge in proper sequence andalso keeps in mind the level of students.

Appropriate devices for presenting the subject matter effectively:

- Description - Demonstration
- Exposition - Explanation
- Illustration - Narration
- Questioning - Sensory Aids

Presentation

Matter	Method	Blackboard Summary

Comparison Association

In fact, association or comparison is a part of presentation step. The teacher should try to

take help of comparison or association between previous knowledge and new knowledge, for stabilizing the new knowledge in the minds of pupils.

Generalization

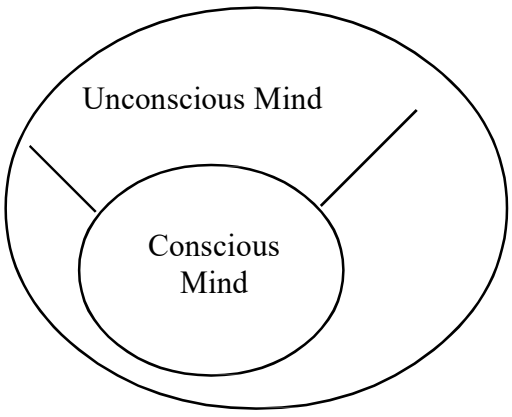
Herbart termed this step as comparisons, contracts and association lead to generalization. As far as possible, this step develops the reflective thinking in the pupils and now they can draw out the conclusions themselves and can use them in the various practical situations of life.

Application

This is the last step of Herbartian teaching approach. The teacher asks the recapitulatory questions to test the validity of the generalization developed by the pupils. In this way the knowledge acquired by the pupils will last long.

Merits of Herbartian Lesson Planning

It is psychological and logical because it follows the principle of learning which describes- first, thoughts come to unconscious mind, then go to conscious mind and again go to the unconscious mind. This process indicates a close relationship between previous knowledge and new knowledge of pupils.



Herbart termed this Mental Process as a perception:

- This approach can be used for all subjects.
- The new knowledge acquired will last longer because it is based on previous knowledge of pupils.
- The reflective thinking is developed among the students.

- Inductive and deductive methods both are used in this approach.
- This approach teaches how to use the newly acquired knowledge in new situations.

Demerits of Herbartian Lesson Planning:

- It is not applicable to all lessons. Through this approach, only knowledge lessons can be taught, not skill lessons.
- It confines to memory level only.
- Very much emphasis on the presentation step.
- No flexibility in the lesson plan.
- No care for pupil's interest, needs and aptitudes.
- No place for individual differences.
- No consideration for learning conditions.
- No opportunity to students for self- motivation and initiation becausethe pupils have to do only that activity, which they are told to do.

8.4 RCEM APPROACH

Under NCERT, four regional colleges of education were founded at Ajmer, Bhopal, Bhubaneswar and Mysore in 1962. Their main aim was to train theteachers of their states (regions). Indian educationists at Regional College ofEducation, Mysore (RCEM) developed RCEM approach to lesson planning.The key person who contributed a lot in RCEM approach was Dr. P.N. Dube.

The basis of RCEM approach is Bloom's taxonomy of objectives. In RCEMapproach there are 4 categories of cognitive objectives in place of six categories as given by Dr. Bloom. The format of lesson plan according to this approach consists of three aspects:

1. Input

It includes identification of objectives which are known as Expected Behavioural Outcomes (EBO's) of children. The four categories of objective namely knowledge, understanding, application and creativity are then writtenin behavioural terms of the child by using seventeen mental abilities. Theseseventeen mental abilities are as given below:

The RCEM Taxonomy of Objectives	Mental Abilities
1. Knowledge	a) Recall b) Recognize
2. Understanding	a) Seeing Relationship b) Cite example c) Discriminate d) Classify e) Interpret
3. Application	a) Reason Out b) Formulate Hypothesis c) Establish Hypothesis d) Infer e) Predict

A few examples of writing objectives in behavioral terms are:

1. The student is able to recall the meaning and definition of ecology.

(Knowledge)

2. The student is able to cite example of various kinds of Pollution.

(Understanding)

3. The student is able to infer about the various levels of management.

(Application)

4. The student is able to create a model showing the process of rain waterharvesting.

(Creativity)

2. Process

The process aspect implies the interaction of teacher and students teachingstrategy and tactics, techniques of motivation and audio-visual aids etc.

3. Output

This outcome aspect implies the actual behavioural changes amongst students.These changes are called as Real Learning Outcomes (RLO's). various measuring devices like Review Questions are employed to evaluate the actuallearning outcomes.

THE FORMAT OF LESSON PLAN ACCORDING TO RCEM APPROACH

Input (Instruction) Expected Behaviour Outcomes	Process Communication Strategy (Learning Experiences)		Output (Evaluation) Real Learning Outcomes

Merits of RCEMApproach

1. More suitable to our schools, as it has been developed in our country.
2. Use of mental processes in place of action words while writing the instructional objectives.
3. The focus on the process, not on product while writing objectives.
4. Evaluation task is quite simple and objective.

Demerits of RCEM Approach

1. Time consuming approach.
2. Suitable to cognitive objectives only, no dealing with affective and psychomotor objectives.
3. The whole learning of human being cannot be explained fully throughonly 17 mental abilities.
4. This approach is an improvement over the prevailingpractices of lessonplanning.

8.5 LET US SUM UP

We have discussed the Herbartian approach and RCEM approach of teaching. Lesson planning is very essential as it helps the teacher conduct his/her lesson in an orderly fashion and it allows students to know what they are going to be learning and how it fits into the course syllabus. Lesson plan is a written description of education process in which it shown what, when, where and with which method learners should learn and how they should be assessed.

8.6 LESSON END EXERCISE

1. Discuss in detail various steps of Herbartian lesson planning.
2. What are the major features of RCEM approach ?
3. What are the salient features of Herbartian lesson planning.
4. Discuss merits and demerits of RCEM approach ?
5. What are the difference between the Herbartian and RCEM approach?

8.7 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1994): Educational Administration, Management andSupervision, Principles and Practices, New Delhi.

Aggarwal, J.C. (1967): Educational Administration, School Organisation andSupervision, Arya Book Depot, New Delhi.

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LESSON NO. 9 UNIT- III

PREPARING OF LESSON PLAN

(Based on RCEM Approach & Constructivism Approach)

STRUCTURE

9.1 INTRODUCTION

All of us are aware of the importance of planning in our life. All kinds of activities require planning. Planning for any purposeful activitiy showsresults. In addition, planning leads to shared understanding and acceptance of clear and attainable goals. In teaching-learning process planning of instructional activities enhances student performance. Planning can give bothteachers and students a sense of direction

9.2 OBJECTIVES

After going through this lesson, you shall be able to :

- describe various steps involved in Herbartian approach.
- organise constructivist classroom activities, and
- prepare lesson plan based on the principles of Constructivism.

9.3 LESSON PLAN BASED ON RCEM APPROACH Topic: Structure of Plant Cell Class: VIII General Objectives:

1. To develop scientific attitude among students.

2. To develop skill of reasoning & observation.
3. To create interest of students in science.
4. To make them familiar with the use of science in everyday life.

Content: Components of Plant Cell and function of each cell component(organelle).

Specific Objectives:

1. KNOWLEDGE: To acquire knowledge of different components of plantcell.
2. UNDERSTANDING: To develop understanding of the need of eachcomponent in a plant cell.
3. APPLICATION: To apply the knowledge & understanding gained insolving unfamiliar problems related to structure of plant cell.

Specific Teaching Aid: Chart showing structure of plant cell and an evaluationchart.

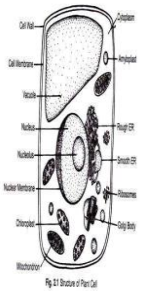
P.K. Assumed: It is assumed that students know that all living organisms are made up of one or more cells

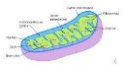
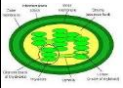
Introduction:

P.T,'s Activity	Student's Response
1. P.T. will draw the diagram of amoeba on the board and ask the students to name that organism. 2. Is it unicellular or multicellular organism? 3. Name some multicellular organism.	1.This is Amoeba 2. It is a unicellular organism. 3. Plants, Animals, Human Beings etc.
4. What are the lower levels of organization in a multicellular organism. 5.Name the different types of cells in multicellular organisms.	4. Lower levels of organization are Cells→ Tissues→Organs →Organ System 5. Cheek cells, Nerve cells, Muscle cells, White blood cells, Red blood cells.
6. What are the different components of a plant cell.	6. -

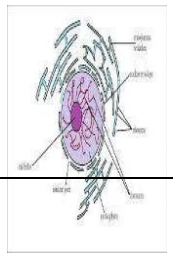
Announcement of the Topic: P.T. will announce the topic by saying "Wellstudents today we will study the different components of a plant cell"

Presentation of the Topic: P.T. will use question answer technique to developthe lesson with active participation of students.

Expected Behavioral	P.T.'s Activity	Student's Activity	Blackboard Work	Learning Aid	Real Learning
Recall that cells have cell membrane, cytoplasm &nucleus	P.T. will show a chart (structure of plant cell) P.T. will show different organelles suspended in cytoplasm and explain their structure & function.	Students will observe chart carefully and answer the main components of cell are Cell membrane, cytoplasm &nucleus.	Components of Plant Cell: 1. Cell Membrane 2. Cytoplasm 3. Nucleus	A chart showing the structure of plants cell 	Names of various components of plant cell
Recall that skin protects our internal body organs.	a) P.T. will the skin and ask what is importance skin for man. P.T. will show the membrane the chart explain its living and elastic nature P.T. will ask the students main duties of gatekeeper.	Skin protects the different organs of the body. Students will observe and list carefully. The gatekeeper allows only the known familiar persons to enter the house.	CELL MEMBRANE • Living & Elastic • Semi permeable	Chart with cell membrane labeled on it	Cell membrane is semi permeable and elastic in nature

Recognize that cell membrane permits only selective materials to enter the cell.	a) P.T. will state that the cell membrane is also semi permeable and controls the entry and exit of selective material. b) P.T. will show the jelly and ask what is the nature of this material. P.T. will take a pin and press it into jelly. Now answer,	Students will write the functions of cell membrane in their notebooks. Students will respond that pin remains in the same position	• Control entry and exit of selective materials The jelly like		What is the function of cell membrane
mitochondria produces energy required by cell to perform various activities	Now tell me the different organelles suspended in cytoplasm. (i) P.T. will show mitochondria on the chart and ask what is the shape of this organelle. Where is the energy/food produced in a house.	Mitochondria ,VacuolesChloroplast, Endoplasmic Reticulum		mitochondrion 	What is the role of cytoplasm in a cell. Why is mitochondria called powerhouse of a cell.
Recall the process of photosynthesis in a chloroplast	P.T.will ask why are the leaves green in colour? P.T. will show the shape and colour of chloroplast	Students will carefully observe.			What performs the function of photosynthesis in plants.

Reason that vacuoles are chief organelles for storage &excretion of wastes.	iii) PT will ask which organelle will forms a major part of the cell? What is the function of the sac?(bag)?	Major part of the plant cell is occupied by plant cell vacuole.			Why do cells have large vacuoles.

	Now, answer what is the function of sac like structure in the plant cell?				
Predict that endoplasmic reticulum transports materials from cytoplasm to nucleus	(iv) P.T. will ask where is endoplasmic reticulum present in a plant cell? P.T. will ask "Why do we need means of transport"				role of endoplasmic reticulum.
Recognize that nucleus is the control centre of a cell.	P.T. will ask which component is present in the centre of a cell? What is the control centre of the human body? Now answer why is nucleus called the brain of the cell.	control centre of the human body.			Why is nucleus called brain of the cell.

Evaluation: Match the following

COMPONENT	FUNCTION
1) Mitochondria	Brain of Cell
2) Chloroplast	Power House of the Cell
3) Nucleus	Kitchen House of the Cell
4) Endoplasmic Reticulum	Store house of the Cell
5) Vacuole	Middle man of Cell

Home Work: Draw a neat & well labeled diagram of a plant cell.

Reference: Science Textbook Class VIII.

9.4 LESSON PLAN BASED ON CONSTRUCTIVIST APPROACH

Class IX Biological Science

Topic: Experiment to show that Oxygen is released during Photosynthesis

Learning points:

1) All green plants prepare food by photosynthesis
2) Photosynthesis requires CO_2, water and chlorophyll
3) During the process of photosynthesis, oxygen is released
4) Setting up an experiment that show oxygen is released during photosynthesis.
5) Observe the release of O_2 in the form of bubbles
6) The release of O_2

Learning Outcomes: can be proved with the help of an experiment.

After the experiment, the students will be able to:

1. Recall the term 'Photosynthesis'
2. List the factors necessary for photosynthesis
3. Identify the products of photosynthesis
4. Construct an experiment to show that O_2 is released during photosynthesis
5. Observe that O_2 is released in the form of bubbles
6. Evaluate that the gas released during photosynthesis is O_2

Management of Learners:

- The students are divided into 5 groups of 5 students each
- One student from each group is chosen as leader of the group
- Students are given instruction on what they have to do
- The leader of the group writes down the observation done by the group

Learning resources:

The following are the materials required for the experiment. Each group isprovided with a set of these materials to conduct the experiment.

- Water
- Hydrilla plant
- Glass funnel
- Test tube
- Pond water

Evidence for learning:

1. Observation recorded by the students in data sheet
2. Questions answered by the students while the experiment is being conducted and during the 'elaborate' stage of the lesson
3. Observation by the teacher during each stage of the lesson

1. Engage:(5 Minutes)

Teacher greets the students

Teacher asks a few questions related to the process of photosynthesis tounderstand the previous knowledge of the students

4. Why plants are called autotrophs?
5. What is photosynthesis?
6. What are the essential requirements for photosynthesis?
7. Which gas is released during photosynthesis?

Students are divided into groups of four. All groups are supplied with material to setup the experiment.Students are instructed on how torecord observation on data sheet

2. Explore : (20 Minutes)

8. Students are shown how to set up the apparatus to prove that O is released during

photosynthesis.

9. Students have to observe and count the number of bubbles released atan interval of 8 minutes.
10. Students will try to set up the experiment
11. Ask students to note down the initial level of water in the test tube
12. Students are asked to observe the release of bubbles and note down the no. of bubbles in the interval of 3 minutes
13. Students note the no. of bubbles released during this process
14. Students note down the final level of water in the test tube

3. Explain :(5 Minutes)

Teacher ask the leader of each group about their observations Each leader gives observation of their group on:
The initial level of water in the test tube.

The no of bubbles released at an interval of 3 min, the first level of water in the inverted test tube.

4. EXPAND : (5 Minutes)

In this stage teacher asks a few questions to expandstudents' knowledge. The questions are formed in such a way to make students think deeper into the content. The knowledge gained can be applied in various similar situations

The questions are:

15. Why hydrilla plants are used in this experiment?

Ans : They are aquatic plants & can do photosynthesis inside the water

16. Why pond water is used?

Ans: It is a source of carbonates as it contains dissolve CO

2

17. If a pinch of baking soda is added to the water in experimental setup, what will happen?

Ans: More bubbles may be released due to increase in the rate of photosynthesis

18. Instead of pond water, if distilled or boiled water is used, what will happen?

Ans: Distilled water lacks dissolved CO_2 thus rate of photosynthesis will decrease or no photosynthesis takes place.

19. How can we confirm the collected gas in the test tube is O_2 ?

Ans: A glowing splinter when introduced into the test tube containing gas, O_2 will glow bright.

5 Evaluate

The teacher evaluates the data collected by the students and discuss theshortcomings of the students

9.5 LET US SUM UP

In this lesson, RCEM approach of lesson plan is explained with help of example. The importance of constructivism in the field of education has been elaborated. A suggestive example of constructivist based lesson plan was presented. The term remedial teaching in a broader sense is explained as teaching which is developmental in its scope. It is based upon careful diagnosis of defects and in general to the needs and interest of pupils.

9.6 LESSON END EXERCISE

1. Prepare a lesson plan on any topic of your choice based on RCEM approach.
2. Prepare a lesson plan on any topic of your choice based on constructivist approach.
3. Explain the role of instructional material and teacher in Remedial Teaching.

9.7 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1994): Educational Administration, Management andSupervision,

Principles and Practices, New Delhi.

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LESSON NO. 10 UNIT-IV

PLANT PARTS AND THEIR FUNCTIONS, CLASSIFICATIONS

STRUCTURE

10.1 INTRODUCTION

Basic parts of most all plants are roots, stems, leaves, flowers, fruits, and seeds. The

roots help provide support by anchoring the plant and absorbing water and nutrients needed for growth. They can also store sugars and carbohydrates that the plant uses to carry out other functions.

10.2 OBJECTIVE

After going through this lesson, you shall able to:

- explain the two main types of root system,
- describe the modification of stem,
- analyse the structure of leaf, and
- elucidate the functions of plants parts.

10.3 MORPHOLOGY OF ROOT

There are two main types of root systems tap root system and adventitiousroot system.

In plants, having tap root system, the radical develops into primary root. Itgrows vertically into the soil and becomes the main root or tap root. Tap root system is characteristic of dicotyledonous plants.

Roots which arise from any part of the plant other than the radicle are called adventitious roots. Fibrous root system is a type of adventitious roots. Fibrous root system is a type of adventitious root system. It is most common in monocots.

Root consists of 4 major zones-root cap, meristematic zone, zone of cell elongation and maturation zone.

The cap like structure made up of thin walled cells that covers the root apex is the root cap. The root cap (also known as calyptras) made of dead cells, protects the young growing cells of the apical region.

Meristematic zone is present just above the root cap. It is made up of compactly arranged small, thin dense protoplasm and meristematic cells having dense protoplasm and large nucleus. The cells of meristematic regionare in active state of division and so this is the main growing region of theroot.

The region of cell elongation is present above the meristematic zone. Thecells of this zone

elongate rapidly resulting in increase in the length of theroot. The external cells of the region possess the power of absorption of waterand mineral salts from the soil.

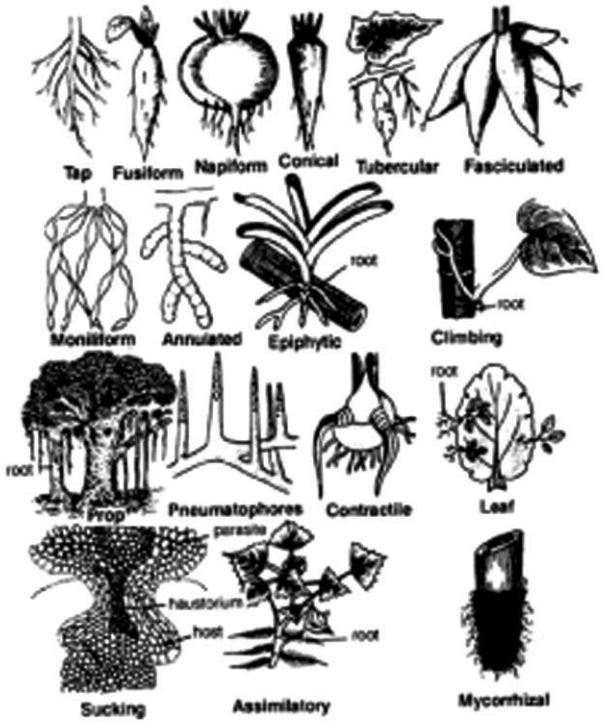
Above the cell elongation zone, is present the cell maturation zone. Secondarygrowth takes place in this region. Unicellular and ephemeral root hairs areformed from the epidermal cells in the zone. Root hair region is called piliferous zone.

10.3.1 Modification of Root

Tap roots are modified into – fleshy roots, nodulated roots, pneumatophoresand root buttres..

Fleshy roots: Root becomes swollen and fleshy for storage. Fleshy root maybe conical.

Nodulated roots: Roots develop numerous small or large irregular swellingscalled root nodules or trubercles, e.g leguminous plant.



Kinds of root.

Respiratory roots (pneumatophores): Erect roots negatively geotropic, usually club shaped which protrude some distance above substratum. They have minute proes called pneumathodes for intake of oxygen.

Root buttress: Horizontal tuft of roots arising from the base of tap root andtrunk for extra support e.g. rubber tree.

Some adventitious roots modify to provide mechanical support like prop root. Stilt root and climber root. Prop roots arise from braches of plants and enterthe soil, to provide support in huge trees, e.g. Ficus benghalenisis. Stilt roots are aerial, obliquely growing roots formed from the nodes of lower most portion of the stem and fix firmly to the soil.

10.4 MORPHOLOGY OF STEM

The aerial part of plant that develops from plumule and bears leaves, flowers.fruits, etc.

Modifications of stem are of three types-underground, aerial and subaerial. These three types show further modifications.

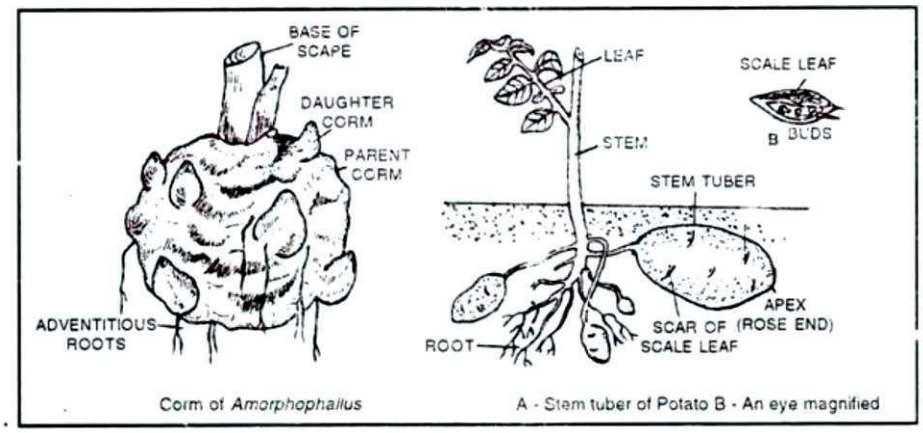
Modified underground stems are of following types:

Stem tuber: Branch of main stem which possesses axillary buds or eyes, and swells due to food storage, e.g., Solanum tuberosum.

Rhizome: A perennial fleshy underground stem having nodes and internodes,e.g., ginger.

Corm: A subspherical, branched stem growing vertically inside soil, possessesadventitious roots at base of nodes, axillary buds in axil of scale leaves, e.g.,Colocasia,Gladiolous.

Bulb: Highly reduced disc like stem with numerous fleshy scaly leaves covering a central terminal bud, adventitious roots arise from the under surface.e.g.:Allium



Aerial Modifications are of following types:-

Stem tendril: Fine, sensitive thread like sensitive structures which can coilaround a support, e.g., Cucurbita.

Phylloclades: Flattended (e.g., Opuntia) or cylindrical (e.g.) Casuarina, Euphorbia royleane) green, fleshy structures which bear in place nodes and internodes and help to perform photosynthetic funcation of leaves.

Cladodes (Cladophylls): Green stems of limited growth generally one ortwo internodes long and perform the funcation of photosyntheses, e.g., Asparagus (one internode long).

Thorns:- Stiff, hard pointed structures that perform defensive functions and check transpiration, e.g., citrus, Duranta.

Thalamus: Flower is a specialized reproductive shoot which possesses highly condensed axis called thalamus or torus. Thalamus bears four types of floral organs (sepals, petals, stamens and carpets), each from their own nodes.

Subaerial modifications are following four types:

Runner: Green, above ground horizontal branches which develop at the bases of erect shoots which are called crowns, e.g., Cynodon dactylon.

Stolons: Elongated horizontal growing underground stems that give rise tobranches which come out of the soil. The lower portion of nodes give rise toroots, e.g., Fragaria (strawberry) Jasminum (jasmine,) Coloccasia, etc.

Sucker:- Formed from the nodes of underground stem. Stem and sucker both grow horizontally under the soil but sucker comes up obliquely in the form of leafy shoot, e.g., Chrysanthemum.

Offset: One internode long, short and thickened special horizontal branches, that develop a tuft or rosette of leaves at nodes. Adventitious roots develop from below the rosette, e.g., Pistia, Eichhornia (water hyacinth).

10.5 MORPHOLOGY OF LEAF

A leaf consists of three parts- leaf base, petiole and lamina.

Leaf base (=hypopodium) is the lower most part of the leaf and is joined tothe node of the stem. It may by pulvinus, sheathing, decurrent or amplexicaul. In pulvinus leaves, leaf base in swollen and leaf is easy to pluck due to weak attachment with stem, e.g., mango, pea, gram, banyan, etc. In some plants,

leaf base consists of small appendages on both sides, these are called stipules. Mainly stipules perform the function of protection of leaves.

Petiole (= Mesopodium) is a cylindrical or subcylindrical smooth or grooved stalk of the leaf which connects the lamina with the stem. Leaf having petiole is called petiolate and when it is absent, it is called sessile.

Lamina (=epipodium) or leaf blade is green flattened part of leaf performing the important functions of photosynthesis, transpiration and respiration. Depending upon the incision of lamina, leaves can be simple (smooth or incised margins, incisions not deep upto midrib) or compound (incisions reachmidrib dividing leaf into leaflets).

The arrangement of veins and veinlets on the lamina of a leaf is called venation. In parallel venation the veins run parallel to each other. Generallyfound in monocot and rarely in some dicot leaves, e.g., Eryngium, Calpophyllum, etc. In reticulate venation the main vein by forming a numberof branches gives rise to a net like structure in the leaf. It is generally found in dicots and rarely in monocots, e.g., Similax, Alocasia, Dioscorea, etc.

Phyllotaxy is the arrangement of leaves on the true stem and its branches. Itfacilitates the leaves to obtain maximum light for photosynthesis. It may beof a types:

Alternative (spiral) arrangement: Only one leaf is borne on a node and the leaves of the adjacent nodes roughly lie towards the opposite side, e.g. shoeflower.

Opposite arrangement: Each node gives rise to two leaves, arranged opposite to each other, e.g., Cal;otropes.

Whorled: More than two leaves are formed from each node, which arearranged in a whorl, e.g., Alstonia, Nerium, Vangueria, etc.

10.5.1 Modifications of Leaf

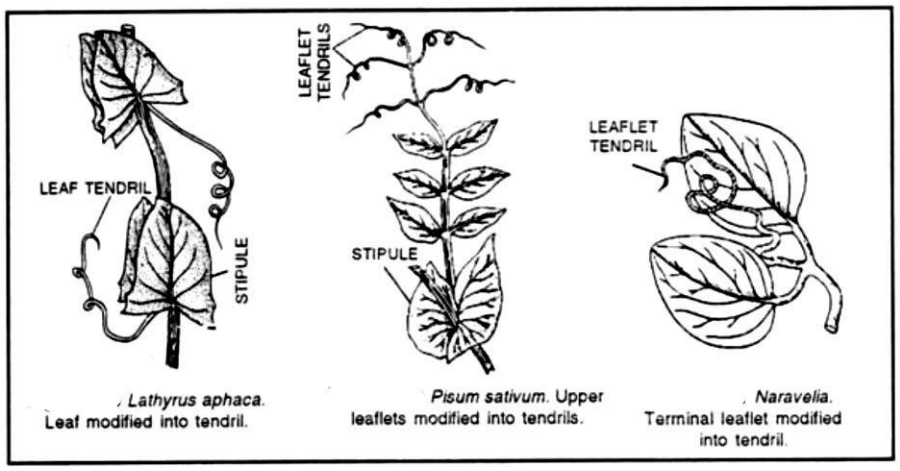
Leaf shows following types of modifications.

Leaf tendrils: Help in climbing. The leaf parts which get modified into tendril, are stipule (e.g. Smilax), petiole (e.g., Clematis), leaflets (e.g.,Gloriosa),rachis (e.g., Lens) or whole leaf (e.g., Lathyrus).

Leaf spines: Protect the plant from grazing animals and reduce transpiration.Stipules may

also get modified into spines, e.g., Zizyphus.

Phyllodes (Phyllodia): Petiole modify into leaf like structures, e.g.,Parkinsonia aculenta, Acacia auriculiformis.



Lathyrus aphaca. Leaf modified into tendril.

Pisum sativum. Upper leaflets modified into tendrils.

Naravelia. Terminal leaflet modified into tendril.

Leaf bladders: Leaf is modified into bladders e.g., Utricularia (bladderwort).

Leaf pitcher: Lamina is modified to form a large pitcher, e.g., Nepenthes(insectivorous), Dischidia (non-insectivorous).

Succulent leaves: Fleshy or swollen leaves that help to store water, mucilageor food materials e.g., Aloe, Agave, Bryophyllum, Portulaca.

Leaf hooks: Leaflets modified into stiff claw like curved hooks. Help plantin climbing e.g., Doxantha unguis-cati.

10.6 INFLORESCENCE

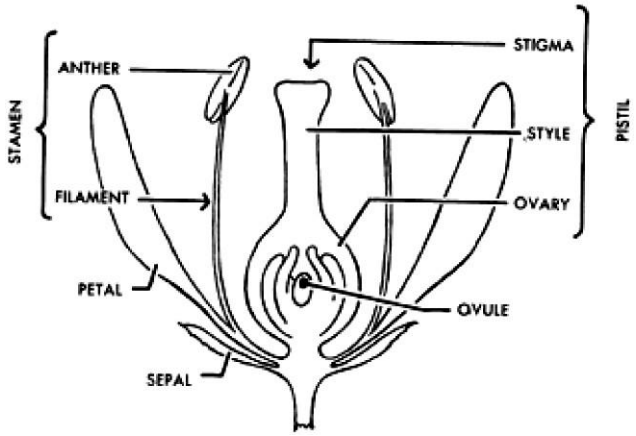
A flower is a modified shoot wherein the shoot apical meristem changes to floral meristem. Internodes do not elongate and the axis gets condensed. Theapex produces different kinds of floral appendages laterally at successive nodes instead of leaves. When a shoot tip transforms into a flower, it is always solitary. The arrangement of flowers on the floral axis is termed as inflorescence. Depending on whether the apex gets converted into a flower or continues to grow, two major types of inflorescences are defined-racemose and cymose. In racemose type of inflorescences the main axis continues to grow, the flowers are borene laterally in an acropetal succession.

In cymose type of inflorescence the main axis terminates in a flower, henceis limited in growth. The flowers are born in a basipetal order

10.7 FLOWER

- Flower is a modified condensed shoot of limited growth which bears floral leaves that carry on sexual reproduction and give rise to seeds and fruits. Pedicel is the stalk of flower. In case of solitary flower, itsstalk is termed as peduncle. The tip of the pedicel is called thalamus or torus or receptacle. Thalamus is formed by the condensation of intermodes of the floral axis.
- Actionomorphic flowers can be cut into t6wo equal parts in anyplane

  e.g. Solamum. Zygomorphic flowers can be cut into two equal parts in only one plane e.g. pisum. Asymmetric flowers cannot be cut into two equal parts in any plane e.g. canna.
- A flower possessing superior ovary is known as hypogynous while a flowers possesiing inferior ovary is epigynous. A perigynous flower possesses subinferrior ovary. In pentamerous flower each whoral especially calyx and corolla possess 5 members. In trimerous and tetramerous flower each possess 3 and 4 members respectively.
- Calyx is the outermost whorl composed of sepals. Flower can be plyspalous or amosepalous. Corolla is the second whorl consisting ofpetals. Flower can be apetalous or gamopetalous.
    - The mode of arrangement of sepals or petals or tepals in a flower bud is called aestivation. When these units are not overlapping it is valvateaestivation. When of the total number of units, one is completely out, one is completely in and the rest are in and out it is imbricate aestivation. In descending imbricate or vexillary aestivation the standard petal is large and overlaps the two wing petals which in turnoverlap the keel petal. When of the total number units, two are completely out, two are completely in and the rest are in and out, it isquincuncial aestivation.



1. Ovary can be described as :-

   - The swollen place of the overy where the ovules are attached is called placenta. Arrangement of placentae in an ovule is called placentation.It can be:

     Marginal : Placenta on central suture ub moinocarpellary ovary e.g.pea.

     Basal : Single placenta on floor of monoloular oarary, eg.g Ranunculus.

     Axile : Placenta along axis, radial septa present e.g.HibiscusFree central : Placenta along axis, no radial septa, e.g. DianthusParietal: Placenta on inner wall of ovary, e.g. Brassica

10.8 FRUIT

- True fruits develop only from the ovary and other floral part do not take part in its development
- Fruits developing from other parts are false fruits. Parthenocarpie fruitsor seedless fruits, are fruits which are formed without fertilisaation
  e.g. banana.
- Mature wall of the ovary after ripening is called pericarp. It consistsof epicarp, mesocarp and endocarp.

10.9 SEED

- Morphologically, seed is the integumented, mature, megasporangium which is developed from fertilized ovule and contains an embroyo. In bitegmic ovules outer, thick hard,

leathery seed coat is called testa and the inner thin, papery layer is called tegmen.

- With the help of a stalk called funicle, a seed is attached to the fruit wall and the point of attachment is called hilum. Raphe is the part of funicle that is fused with the seed wall. Chalaza is that region from which the seed coats originate. Micropyle is a small opening or pore, present adjacent the hilum. Kernel is obtained by removing the seed coat and it mainly consists of the embroyo. The embryo consists ofan axis or tigellum to which are attached one or two seed leaves or cotyledons. In most monocots and some dicot seeds, the food reserve remains in the endosperm.
- There is one seed cotyledon, in monocots and two cotyledons, in dicots. In some seeds called perispermic seeds below seed coat a very thin membrane is found over kernel called perisperm. In monocots, the outer covering of endosperm separates the embryo by a protein layer called aleurone layer. In monocotyledonous seed cotyledon is shield-shaped scutellum. 2-4 protective layers are found over plumule which are called coleoptiles. Such protective layers over radical are called coleorhizae.

Check Your Progress -1

Note: a) Answer the question given below

b) Compare your answers with those given at the end of the lesson

Q.1 In a Cymose inflorescence the main axis

(a) has unlimited growth

(b) bears a solitary flower

(c) has unlimited growth but lateral branches end in flowers.

(d) terminates in a flowers.

Q.2 Stomata in grass leaf are

(a) heart shaped (b) kidney shaped

(c) oval shaped (d) dumb-bell shaped

Q.3 Age of a tree can be estimated by

(a) number of annual rings

(b) diameter of its heartwood

(c) its height and girth

(d) biomass.

Q.4 Bat pollinated plants are known as

(a) ornithophilous

(b) chiropterophilous

(c) entomophilous

(d) malacophilous.

Q.5 Entry of pollen tube through micropyle is termed as

(a) misogamy

(b) porogamy

(c) syngamy

(d) chalazogamy.

Q.6 Female gametophyte is also called as

(a) embryo sac

(b) ovary

(c) endosperm

(d) microspore mother cell.

Q.7 Synergids are

(a) haploid

(b) diploid

(c) triploid

(d) tetraploid.

10.10 LET US SUM UP

Flowering plants exhibit enormous variation in shape, size, structure, mode of nutrition, life span, habit and habitat. They have well developed root and shoot systems. Roots system is either tap root or fibrous. Generally, dicotyledonous plants have tap roots while monocotyledonous plants have fibrous roots. The roots in some plants get modified of storage of food , mechanical support and respiration. The shoot, system is differentiated into stem. Leaves, flowers and fruits. The morphological features of stems like the presence of nodes and internodes, muliticellular hair and positively phototropic nature help to differentiate the steams from roots, Stems also getmodified to perform diverse functions such as storage off food, vegetative propagation and protection under different conditions. Leaf is a lateral outgrowth of stem developed exogeneously at the node. These are green in colour to perform the function of photosynthesis. Leaves exhibit marked variations in their shape, size, margin, apex and extent of incisions of leaf blade. Like other parts of plants, the leaves also get modified into other structures such as tendrils, spines for climbing and protection respectively.

10.11 LESSON END EXERCISE

Q.1 What is meant by modification of roots? What type of modification ofroot is found in the.

a) Banyan tree b) Turnip c) Mangrove trees

Q.2 Describe modifications of stem with suitable examples.

Q.3 What is a flower? Describe the parts of a typical angiosperm flower.

Q.4 How do the various leaf modifications help plants?

10.12 SUGGESTED FURTHER READINGS

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10.13 ANSWERS TO CHECK YOUR PROGRESS

1-d, 2-d, 3-a, 4 –b, 5-b, 6-a, 7-a

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LESSON NO. 11 UNIT-IV

REPRODUCTION IN PLANTS

STRUCTURE

11.1 INTRODUCTION

Plant reproduction is the process by which plants generate new individuals, or offspring. Reproduction is either sexual or asexual. Sexual reproduction is the formation of offspring by the fusion of gametes . Asexual

reproduction is the formation of offspring without the fusion of gametes. Sexual reproduction results in offspring genetically different from the parents. Asexual offspring are genetically identical except for mutation. In higher plants, offspring are packaged in a protective seed, which can be long lived and can disperse the offspring some distance from the parents. In flowering plants (angiosperms), the seed itself is contained inside a fruit, which may protect the developing seeds and aid in their dispersal.

11.2 OBJECTIVE

- define of asexual reproduction,
- differentiate between male and female reproducation organs of plants,
- describe the economic importance of plants, and
- explain animal diversity with classification.

11.3 REPRODUCTION PLANTS

Reproduction : is defined as a biological process in which an organism given rise to young once similar to itself. The offspring grow, mature and in tum produce new offspring. Thus there is a cycle of birth, growth and death. Reproduction is essential for the continuation of the line of succession and maintenance of a particular species in the biosphere. The reproduction methods are broadly categorized into 2 types namely – asexual reproduction and sexual reproduction.

11.4 CONCEPT OF ASEXUAL REPRODUCTION IN PLANTS

Is the production of offspring by a single parent without the formation and fusion of gametes. The young one receives all its genes from one parent, so are identical. Multiplication occurs rapidly and only mitotic division occurs. It is common in single celled organisms of plants and animals.

Various type of asexual reproductions are as follows:

(i) Fission: It is the division of the parent body into two or more daughter

individuals identical to the parent. It is of two types.

(a) Binary fission: (b) Multiple fusion

(ii) Budding : Formation of a daughter individual from a small projection, the bud, arising on the parent body is called budding. Budding occurs in some protozoans and certain lower animals such as sponges coelenterates annelids yeast and tunicates.

(iii) Strobilisation: In this series of ring like transverse constricaion are developed. Organism looks like a pile of minute saucers. The segmented body is called a strobila.

(iv) Fragmentation: In this the parent body breaks into two or more fragments Each fragment develops into an organism.

(v) Gemmae: These are specialized structures which are green, multicellular, asexual buds, which develop in a small receptacles called gemma cups located on the thalli.

(vi) Regeneration: Regeneration is the formation of the whole body of an organism from a small fragment or the replacement of the lost part .

(vii) Spore formation: spores are propagules which geminate to produce new individuals. There are several kinds of spores. These are zoospores, sporangiospores, chlamydospores, oidia, conidia.

(viii) Vegetative propagation: It the formation of new plants from vegetative units such as buds, tubers, rhizomes, etc. these vegetative units are called as vegetative propagules. While in animals and other simple organisms the term asexual is used unambiguously, in plants, the term vegetative propagation is frequently used.

11.5 CONCEPT OF SEXUAL REPRODUCTION IN PLANTS

Sexual reproduction is the formation of new individuals through the meiotic gamete formation and their subsequent fusion during fertilisation. It is alsocalled amphimixis.

A typical flower has 4 whorls of floral leaves viz., sepals (calyx,) petals (corolla,) stamens (androecium) and carpels (gynoecium). The last two represent reproductive structures of flowers.

Male Reproductive Organ

A stamen is the male reproductive structure of angiosperms. It consists of an anther and a filament.

The anther is bilobed and the lobe encloses 4 pollen sacs or microsporangia. Each pollen sac contains a number of pollen grains. The four pollen sacs in adithecous anther appear to lie in the four corners of an anther thus a typical anther is tetrasporangiate while monothecous anther is bisporangiate.

A microsporangium or future pollen sac is a cylindrical sac which appears circular in transverse section. It consists of two parts, outer wall and centralhomogeneous sporogenous tissue. Microsporangial wall has four types oflayers.

Epidermis: One cell thick and protective in function.

Endothecium: Second wall layer. Usually single layered. Cells have a cellulose thickening with a little pectin and lignin in some cases. It helps in anther dehiscence.

Middle layers: The number of middle layer ranges from 1-6. The middle layers degenerate at the maturity of the anther.

Tapetum: This is the innermost layer of anther wall which surrounds the sporogenous tissue. Tapetal cells are nutritive. They are multinucleated andpolyploid. In these cells the Ubisch bodies are present which help in the ornamentation of microspore wall. A compound sporopollenin is sectreted by Ubisch bodies which is deposited in the exine of microspore wall.

The formation and differentiation of microspore is called microsporogenesis. The pollen mother cells (PMCs) divide meiotically each forming generallytetrahedral tetrads.

Female Reproductive Organ

The gynoecium represents the female reproductive part of the flower. The gynoecium may consist of a single pistil (monocarellary) or may have more than one pistil (multicarpellary). When there are more than one, the pistils may be fused together (syncarpous) or may be free (apocarpous).

A pistil has a terminal terminal terminal receptive disc-like stigma, a stalk-like style and basal swollen ovule bearing part called ovary.

Inside the ovary is the ovarian cavity (with one or more locules) and parenchymatous cushion

called placenta. Arising from the placenta are themegasporangia, commonly called ovules.

Ovule is an integumented megasporangium found in spermatophytes which develops into seed after slender stalk called funicle. The point of attachment of the body of the ovule with the funicle is known as hilum.

In inverted ovule, the poart of funicle remains attached beyond the hilum alongside of the body of the ovule forming a sort of ridge called raphe.

Each ovule has one or two protective envelopes called integuments. Integuments encircle the ovule except at the tip where a small opening called the micropyle is organised. Opposite thee micropylar end, is the chalaza,representing the basal part of the ovule.

Enclosed within the integuments is a mass of cells called the nucellus. Cells of the nucellus have abundant reserve food materials. Located in the nucellus is the embryo sac or female gametophyte. An ovule generally has a single embryo sac formed from a megaspore through reduction division.

The process of formation of megaspores from the megaspore mother cell is megasporogenesis. Ovules generally differentiate a single megaspore mothercell (MMC) in the micropylar region of the nucellus.

The megaspore mother cell undergoes meiosis to form four haploid megaspores.

Pollination

The term pollination refers to the process of transfer of pollen grains from anther of the stamen to the receptive stigma of the carpel of the same or genetically different flowers of the same species.

Pollination is the prerequisite for fertilisation. Pollination is of two types: self pollination and cross pollination.

Self pollination involves the transfer of pollen grains from the anthers of a flower to the stigma of the same flower or genetically similar flower.

Accordingly, self pollination is of two types, autogamy and geitonogamy.

Autogamy is a type of self pollination in which an intersexual or perfect flower is pollinated by its own pollen, i.e., it involves the transference of pollen grains from anther to stigma of the same flower.

Geitonogamy is the transfer of pollen grains from the anther to the stigma ofdifferent flowers present in the same inflorescence or in the same plant. Geitonogamy is genetically equivalent to self pollination but ecologically itis cross pollination.

11.6 IMPORTANCE OF PLANTS AS MEDICINE, FOOD,FODDER, FUEL AND OIL

FIBRE AND FIBRE PLANTS

1. COIR

- Botanical Name :- Cocos nucifera L.
- Part used :- Mesocarp, fibre.

❖ Uses:

- Floor convering, rope, packaging material.
- Rubberized coir is used for making cushion.
- Coir yarn is used for making fenders which are attached to ships and boats for preventing Collision and shock.

- Hard boards made up of Cocomut husk shorts and coir dust are durable, smooth, insect proof and water repellant.
- Coir waste has been recently used in the manufacture of coiroliteby incorporating with resins.

2. COTTON

- Botanical Name:- Gossypium orboreum Linn, G.hirsutum Linn.,
- Part Used:- surface fibre, (Epidermal cellsl of seed coat.

❖ Uses:-

- Lint fibre is used for clothing household and industrial articles.
- Industrial articles include cellulose, plastic, stuffing cushion,pillow, mattresses, absorbent cotton, nonabsorbent cotton etc.

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3. FLAX :-

- Botanical Name:- Linum usitatissimum L.
- Part Used:- Stem fibre.

❖ Uses:

- Flax fibre is stronger than cotton and linen.
- The fibre quality is very good. It is durable, strong, glossy.
- Manufacture of strong cordage.
- Cheap and rough textile e.g. blankets, carpets.
- Galicha, mat mattresses.
- Fine fabrica like Linso – fabric.
- Straw board, parchment paper, cigarette paper and writing paperetc.

4. HEMP:-

- Botanical name:- Cannabis sativa Linn.
- Part Uses:- Bast fibre obtained from secondary phloem.

❖ Uses:

- Manufacture of Tarpaulin, carpet yarn, fine cordage, Sail cloth etc.
- Green fibre used as substitute for jute.
- Loose fibre is used for caulking boats, engines pumps etx.

5. JUTE:-

- Botanical Name :- Corchorus capsularis L,. C. olitorius L.
- Part Used: Bast fibre.

❖ Uses:

- It is an important textile fibre second to cotton.

- Yarn of the fibre is used to make fabrics, coarse sacking, package material.
- Filling material ropes.
- Cloth made for purpose of upholstery, Linoleum Tapestry etc.

6. PINE APPLE:-

- Botanical Name:- Ananses comosus (Linn) Perr.
- Plant part used: Leaf fibre.

❖ Uses:

- Ropes, fishing net, strings are made from it.
- Pina; a delicate fabric of the phillippines is made from this fibre.
- Waste after extraction of fibre is used for paper making.

7. SUNN HEMP :-

- Botanical Name:- Crotolaria juncea L.
- Part Used:- Bast fibre.

❖ Uses:

- Cordage fibre and used is making ropes, cords, cordages etc,
- Sunhemp is used for making fishing nets and marine cordage. It isresistant to deterioratin in water.
- It is used for namufacture of sell-cloth, sacking, matting, rope solesof shoes, canvas etc.
- Spices And Condiments
- ASAFOETIDA
- Botanical name:- Ferula asafetida
- Plant Part used: Gum Resin of the plant.

❖ Uses:

- The gum resin is used as spice is culinary preparation.

- It is carminative, digestive, diuretic, laxative.
- It is medicinal properties also.

8. BLACK PAPPER

- Botanical name:- Piper nigrum L.
- Part Used: White pepper and black paper both are piper nigrum.Fully mature unripe dried fruits are black paper while ripe berries are stemmed then dried to get white pepper (Sheetal mirchi).

❖ Uses:

- Mdeicinally in Malaria, hemorrhoids/dyspepsia etc.
- Essential preservative of meat or perishable food.
- Flavoring Agent.
- Oil of peper is used in flavouring Sausages.
- Black pepper is used in culinary seasoning.
- Essential ingredient of many food stuffs.

9. CAPSICUM

- Botanical name:- Capsicum annum Linn.

Capsicum frutescent L.

- Plant part uses:- Dried or green fruits.

❖ Uses:

- Annum is also known as simla mirch. And C, frutescence as Red Pepper or paprika.
- Dry or green chilies are extensively used as speces and seasoning.
- Peprika. Is rich in vitamin ‘C’ and appetizer.

10. CARDAMOM

- Botanical Name:- Aframomus melagueta (Roscoe.) K. Sohum.
- Use :- Seeds used for flavouring sauce, beer, wine perfumery etc.

11. CINNAMON:-

- Botanical name:- Cinnamomum zeylenicum Blume
- Plant part used :- Dried inner bark of stem obtained by removingcork and cortical parenchyma.

❖ Uses:

- Bark is extensively used as spice or condiment in the form of small pieces or in Garam Masala.
- Cinnamon oil (from bark) in used in confectionary, pharmaceutical,soap etc.
- Bark is carminative, astringent and stimulant.
- Bark oil is medicinal.

12. CLOVE

- Botanical name:- Eugenia caryophyllus (Speregal) Bullock atHarrison.
- Plant part used:- Dry Buds.

❖ Uses:

- Very aromatic spice with a fine flavor imparting warming properties.
- Culinary spice in both sweet and savoury dishes.
- It is used in Pickles, gravy, baked food, cake, pudding, syrups etc.

13. CORIANDER :-

- Botanical name:- Coriandrum sativum Linn.
- Plants part used:- Dried ripened seeds or fruits. Fresh leaves arealso used in Indian curries.

❖ Uses:

- Dried fruits are used in curry is in powder from .
- Dhaniya power is also used in Pickels, sausages, curries, chutneyas.
- It is used to flavor spirits particularly green.
- It used as medicine as well.

14. CUMIN:-

- Botanical Name:- Cuminum Cyminum L.
- Plant part used:- Dried fruit & seed.

❖ Uses:

- A very important ingredient of curry and curry powder.
- It is carminative, stimulant and is used in medicines as well.
- It is used for seasoning soups and stews.

15. GINGER:-

- Botanical Name :- Zingiber officinale Linn.
- Plant Part Name:- Rhizome.

❖ Uses:

- Raw ginger has a pleasant smell and is in food items tea etc. Dry ginger is used as a spice in garam masala, curry powder etc,
- Rhizome is carminative, stimulant and aromatic used as medicinealso in cold, cough etc.
- Ginger oil is a flavored, spice in bakery and confetionary

16. FENNEL

- Botanical Name:- Foeniculum vulgare Mill.
- Plant Part uses:- Dried ripe fruit & Seed.

❖ Uses:

- Fruits used for flavoring dishes.
- Fruits are also used as masticatory after having lunch or dinner orin paan.
- Fruits are carminative, stimulant and aromatic with medicinal value.

17. FENUGREEK:-

- Botanical Name:- Trigonella foenum-graceum L.
- Plant part used:- Seed and leaves.

❖ Uses:

- It is used as spice and for flavouring food.
- Seeds contain steroidal substance diosgenin.
- In Egypt, Ethiopiea, Arab, Etc. Fenugreek is an ingredient of bread,hulba, Abisha etc.

18. SAFFRON :-

- Botanical Name : Cfrocus sativas Linn.
- Part used: Dried Stigma of crocus sativus.

❖ Uses:

- Apart from flavouring and colouring properties it has extraordinarymedicinal value also.
- Mostly used in exotic dishes like sweets. Biryani etc.
- It is effective medicine with ghee for diabetes.

19. TEJPAT

- Botanical Name:- 1. Cinnamomum tamala Nees and eberum.

  2. Cinnamoumum obtusifolium nees.

- Part Uses: Evergreen, Leaves of tree

❖ Uses:

- Leaves used as spice mainly.
- As a clarifier in dyeing with myaobalans
- In Kashmir, as a substitute of Betel or Paan.

20. TURMERIC

- Botanical name:- Curcuma longa Linn.
- Plant part used:- Dried, boiled, cleaned, polished rhizome.

❖ Uses:

- Food, flavourent and adjunct.
- Also used as stimulant, Carminative, expectorant etc.
- Used as cosmetic for beautifying skin problems.

21. MEDICINAL PLANTS

- ATROPA
- Botanical Name:- Atropa belladonna Linn.
- Plants part Used:- Leaves and Roots.

❖ Uses:

- The drug obtained from leaves is very much powerful and containsalkaloids like atropine, homatropine and scopolamine etc.

♦ CAMPHOR

- Botanical name:- Cinnamomum camphora Nees & Eberm.
- Plant part used:- Leaves, flowers, tender parts etc.

❖ Uses:

- Externally applied for bruises, Sprain, inflammation

- It is Sedative, antispasmodic and anthelmintic
- It is good for cold and diarrhea

♦ CINCHONA

- Botanical Name:- Cinchona sp.
- Plant part used:- Bark

❖ Uses:

- The bark has alkaloid like quine, quinidine, cinchonine etc. used in malay fever as antipyretic.
- It is also used in hey fever, whooping cough, septic fever, pneumonia, acute nasal trouble etc.

♦ DHATURA

- Botanical name:- Datura alba
- Plant part used:- Seed, Root, Leaves
- Seeds given in elephantiasis, discharge from ear.
- Extract of leaves or seed oil is given in rheumatic swellings, pains,boils and tumors.
- Roots are boiled and used with butter in insanity.

♦ EUCALYPTUS

- Botanical name:- Eucalypt6us citriodora Hook
- Plant part used: Leaves

❖ Uses:

- Essential oil extracted from leaves have antiseptic, stimulant, anthelmintic properties.
- It increases flow of saliva, gastric and intestinal juice resulting inappetite increase and digestion.

- It increases heart beat and lower arterial tension.

♦ ISAPGOL

- Botanical name:- Plantago ovate Forsk.
- Plant Parts used:- Fruit, husk or seed coat.

❖ Uses:

- It is used in chronic constipation, gastrointestinal or genitor-urinaltract problems.
- Seed and seedcoat contain a mucilage.
- It acts as cooling, diuretic, expectorant.

♦ PEPPERMINT

- Botanical name:- Mentha piperata Linn.
- Plant part used:- Volatile oil of plant.

❖ Uses:

- The volatile oil obtained from the plant is used as antiseptic, carminative and stimulant.
- It is used for nausea, flatulence, vomiting and sickness.
- It is used locally for headaches.

♦ BEVERAGES

♦ NON-ALCOHOLIC BEVERAGES:-

♦ COCOA

- Botanical name:- The broma Cacoa L.
- Plant Part used:- Seeds

❖ Uses:

- Cocoa is used largely in choclolate industry.
- Cacao shell is used as a filler for thermosetting resins in the plasticindustry.

- Cacao butter is pale yellow, brittle and solid. It is used in production of chocolate, confectionary, cosmetics, medicines etc.

♦ COFFEE

- Botinical name:- Coffee Arabica L.
- Plant part used: Seeds

❖ Uses:

- It is uses as non-alcoholic beverage
- Roasted and grinded beans are used, which re bitter in taste.
- It has characteristic arouma and stimulating character.
- It is also used as medicine.

♦ MATE

- Botanical name:- Ilex paraguariensis St. Hill.
- Plant part Used:- leaves.

❖ Uses:

- In argentina it is taken as tea and is called "Yerba-mate". It is anon-alcoholic beverge.

♦ Tea

- Botanical name:- Camellia sinensis (Linn.) O. Kuntize
- Plant Part used: Top leaves.

❖ Uses:

- Dried, cured and fermented leaves are used as non-alcoholic beverage.
- In India Assam and Darjeeling tea are commercially used.

♦ ALCOHOLIC BEVERAGES

♦ BEER

- Botanical name:- Pennisetum typhoidicum

- Plant part used :- Pearl millet grain.

❖ Uses:

- It is light fermented malt beverage which is brewed by bottom fermentation at low temperature. Beer is made from many grains like rivce, rye, barely, maize etc.

♦ BRANDY

- It is distillate obtained from the fermented juice or wine of fruitsdistilled at 87? C. The alcohol ranges varies from 60 to 70%.

♦ GIN

- Botanical Name:- Juniperus communis
- Plants part used:- Juniper berry + flavor.

❖ Uses:

- Gin includes flavorus from various plants like anise, caraway seeds, limes cardamom, licorice, angelica root, orange peel, bitter almondsetc.

♦ RUM

- Botanicial name:- Saccharum officinalis
- Plant part Used:- Fermened sugar syrup, sugar molasses etc.

❖ Uses:

- Rum is the alcoholic beverage, a by-product of distillation and fermentation of molasses, syrup of sugarcane. It has 40% alcohol.

♦ WHISKY

- Botanical name:- Thiticum, avena, Hardeum etc.
- Plant part used : Grains

❖ Uses:

- Wisky is the beverage made by distilling fermented grains like wheat, barley, oats,

corn rye etc.

- Scotch is a type of whisky made by malted or unmalted barley with a special flavor.
- In USA whiskey is made from maize or rye.

♦ WINES

- Botanical name:- Vitis vinifera
- Plant part used :- Juice of fruits or grapes.

❖ Uses:

- Wine is made from different varieties of grapes after fermentation.
- Dry wine, fortifies wine, Red Wine, Sweet Wines, Sparkling wine.

♦ VODKA

- It is used produced on multi-column distillation system f5rom fermented mash of gains and 87?C. It is treated with activated carbon or charcoal. It contains 60-80% alcohol.

♦ NON-WOOD PRODUCTS

♦ DYES

♦ C AMLA

- Botanical name: Emblica officinalis Gaertn.
- Plant part used: Fruit

❖ Uses:

- Dried fruit is used as dye after boiling is water and yields bluish black colour called abnusi and is used to dye hari.

♦ ARUSA

- Botanical name:- Justicia adhatoda L.
- Plant Part used :- Leaves

❖ Uses:

- Yellow dye is obtained from leaves by boiling in water. Where combined with indigo the dye becomes dark-blue green.

♦ CARCUMA

- Botanical name:- Curcuma longa L.
- Plant part used:- Rhizome

❖ Uses:

- Yields yellow dye
- When added to alkali turns red and is known as kumkum .

♦ DHAK

- Botanical name:- Butea monosp0erma Kuntze.
- Plants part used:- Flower

❖ Uses:

- Flowers yield a yellow dye called tesu.

♦ DHAI

- Botanical name:- Woodfordia floribunda Salisb.
- Plant Part used :- Flower.

❖ Uses:

- Red flowers and leaves yield yellow dye used is dyeing silk.

♦ GENDA

- Botanical name:- tagetes erecta linn.
- Plant part used: Folwers.

❖ Uses:

- Flowers yields yellow dye.

♦ HARR

- Botanical name:- Terminalia chebula Retz.
- Plant part used:- Rind of dried fruit.

❖ Uses:

- Fruit of chebulic myrobalans is black and used to dye and tan .
- Galls of leaves with alum yield permanent yellow dye.

♦ KAMEL

- Botanical name:- Mallotus phillipinensis muell.
- Plant part used :- Ripe fruit,

❖ Uses:

- Ripe fruit covered with a powder yielding yellow dye or orange dye used in dyeing silk and wool.

♦ KHAIR

- Botanical name: Acacia catechu wild
- Plant part used:- Red heart wood.

❖ Uses:

- Kattha is obtained used in paan and medicine.

♦ NAGARMOTHA

- Botanical name:- Mariscus cyperinus
- Plant part used:- Root.

❖ Uses:

- Roots yield dye used to dye cloths.

♦ ROSE LICHEN

- Botanical name: Parmelia kamschadalis Ach.

- Plant part used: Thallus.

❖ Uses:

- Lichen is used in dyes and calico printing of cloth in rose color.

♦ RUBBER

♦ PARA RUBBER

- Bitanical Name: Hevea brasiliensis Muell-arg.
- Plant part used: Latex

❖ Uses:

- Rubber is used to make structural materials, soft comfortable. Materials, elastic, conductors, shock absorbers. Etc.
- It is used in making mountings for motors and other machinery, gasket, transport materials, transleucent materials, sports goods, paints tyres etc.
- It is also used in pharmaceutical industries.

♦ GUAYULE

• Botanical name:- Parthenium argentatum Gray

• Plant part used:- Rubber is accumulated in both tops of the plants.,plants are harvested to get it.

❖ Uses:

• It is low quality rubber in comparison to para Rubber.

• It is used for making floor covering, rugs, rubber, backs, gloves, hotwater bottles, ice caps etc.

♦ C-GUM :-

- Gums are found naturally as cementing substances between cells

  i.e. middle lamella or decomposition products of cellulose. The process of disintegrating internal tissue is called gummosis. Gums are colloidal in nature. They are water soluble but insoluble in alcohol or oils. Gums exude naturally

from stem, root or leaves due to wounds or burns. Commercial gums are in the form of dried exudation.

❖ Uses:

- Gums are used as adhesives in printing and finishing textiles, candy industry, in medicine, as sizing agent for paper and food industry. Most common and useful gums are Gum Arabic, gum tragacanth and Karyana gum.

♦ GUM- ARABIC

- Botanical Name : Acacia Senegal willd.
- Plant part used:- Gum from bark of trees.

❖ Uses:

- Used as office glue
- In food industry
- As thickener of sweets, jellies and chewing gum .

♦ GUAR GUM

- Botanical Name:- Cyamopsis tetragonolobus Taub.
- Plant Part used: Gum from seeds of cluster bean.

❖ Uses:

- Emulsifier in salad
- As stabilizer in ice cream .

♦ Some Important Gum producing plants

1.	Lobut bean gum	Ceratonia siliqua	Cealpiniaceae	Stabilizer of food products, paper
2.	Karaya Gum	Sterculia urens	Stereuliaceae	Substitite for gum tragacenth used in
3.	Agar agar	Gracilaria sp.	Rhodophyeae (Red algae)	In casein paints, Mucilage, polish,

- D. RESIN

  - There are oxidative products of essential oils, secreted in definite cavities or passages, typically derived from stems or roots as exudates due to incision, bruising, chipping etc.

Resins may be of three types:-

A. Hard resin. Little amount of essential oil, solid, transparent brittle noodour or taste, non-volatile, poor conductor of electricity, burn in air with smoky flame.

Hard resins are of follow types:

1. Copals: No oil, yield hard elastic varnish used in out door work

2. Amber: It is fossil resin found along the shores of Baltic sea. It was obtained from Pinus succinifera. It is used to make mouth piece of pipes, Holder of cigar and to increase elasticity of rayonfibers.

3. Dammar: Dammar is obtained from the members ofDipterocarpaceae. It is abundantly found in Malaya in Sumtra. Thechief Genera producing dammar are shorea robusta , vateriaindica,.

4. Lacquer: It is the natural varnish obtained from Rhus verniciflua

. the tree is native of Chine. It is cultivated in Japan.

B. OLEORESIN:

The oil content is more in addition to resin. More or less liquid in naturewith distinct aroma and flavor such as.

1. Canada Balsam: it is obtained from abies balsamea of Canada and North United states. The resin is collected on elongated blisterson the bark and only small amounts are obtained. It is yellowish or greenish substances usually used as a mounting medium while making permanent slides.

2. Terpentine: It is obtained from coniferous trees. It is viscous honey like soft and brittle solid. It is secreted and accumulated in ducts near cambium and exudes naturally as soft, sticky substance.

C. GUM RESIN: It is a mixture of true gum and resin combining the characters of both. The contain small quanitity of essential oil and large of colouring substance.

1. Asafoetide: The cortex of thick fleshy roots exudes milky juice during rainy season. The root is cut and dried in the shade. The gum resin is collected on the surface in the form of tears. It has powerful odour and bitter arid taste due to sulphur compounds of essential oil.
2. Galbanum :- The gumresin is extracted from lower part of stem. It is used as medicine. It has tenacious aromatic odour.
3. Opopanax: A member of family Burseraceae used in perfumery. It is also used as medicine.
4. Bdellium :- Also known as guggulu used in perfumery, Hawan samagri and as medicine also.
5. Bisabal myrrh : Also known as Sweet myrrh. A member of family Burseraceae, this is a myrrh of antiquity and is used in incese, perfumes and embalmin.
6. Ammaniaceum : It exudes a milk latex from the stem and flowering branches as tears, which are collected and used as medicine in circulatory stimulant. It is also used in perfume industry.

11.7 ANIMAL DIVERSITY

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 describedspecies.

11.7.1 Basis of Classifcation

Inspite of differences in structure and form of different animals. there are fundamental features common to various individuals in relation to the arrangement of cells, body symmetry, nature of coelom, patterns of digestive, circulatory or reproductive systems. These freatures are used as the basis ofanimal classification and some of them are discussed here.

(i) Levels of Organisation

Though all members of Animalia are multicellular, all of them do not exhibitthe same pattern of

organisation of cells. For example, in sponges, the cellsare arranged as loose cell aggregates, i.e., they exhibit cellular level of organisation. Some division of labour (activities) occur among the cells. In coelenterates, the arrangement of cells is more complex. Here the cells performing the same function are arranged into tissues, hence is organ level is exhibited by members of Play helminthes and other higher phyla where tissues are grouped together to form organs, each specialised for a particular function. In animals like Annelids. Arthropods, Molluscs, Echinoderms andchordates, organs have associated to form functional systems, each systemconcerned with a specific physiological function. The pattern is called organsystem level of organization. Organ systems in different groups of animals exhibit various patterns of complexities. For example, the digestive system in Platyhelminthes has only a single opening to the outside of the body thatserves as both mouth and anus, and is hence called incomplete. A complete digestive system has two openings, mouth and anus. Similarly, the circulatory system may be of two types:

(a) open type in which the blood is pumped out of the heart and the cells and tissues are directly bathed in it or

(b) closed type in which the blood is circulated through a series of vesselsof varying diameters (arteries, veins and capillaries).

(ii) Symmetry

Animals can be categorised on the basis of their symmetry. Sponges are mostly asymmetrical, i.e., any plane that passes through the centre does not dividethem into equal halves. When any plane passing through the central axis of the body divides the organism into two identical halves, it is called redial symmetry. Coelenterates, ctenophores and echinoderms have this kind ofbody plan (Figure 4.1a). Animals like annelids, arthropods, etc., where the body can be divided into identical left and right halves in only one plane, exhibit bilateral symmetry (Figure 4.1b).

(iii) Diploblastic and Triploblastic Organisation

Animals in which the cells are arranged in two embryonic layers, an external ectoderm and an internal endoderm, are called diploblastic animals, e.g., coelenterates. An undifferentiated layer, mesoglea, is present in between the ectoderm and the (Figure 4.2a). Those animals in which the developing embryo has a third germinal layer, mesoderm, in between the ectoderm and endoderm, are called triploblastic animals (platyhelminthes to chordates,Figure 4.2b).

(iv) Coelom

Presence or absence of a cavity between the body wall and the gut wall is very important in classification. The body cavity, which is lined by mesoderm is called coelom. Animals possessing coelom are called coelomates, e.g.,annelids, mollusks, arthropods, (Figure 4.3a.). In some animals, the body cavity is not lined by mesoderm, instead, the mesoderm is present as scattered pouches in between the ectoderm and endoderm. Such a body cavity is called pseudocoelom and the animals possessing them are called pseudocoeiomates,
e.g. aschelminthes (Figure 4.3b). The animals in which the body cavity is absent are called acoelomates, e.g., platyhelminthes (Figure 4.3c).

(v) Segmentation

In some animals, the body is externally and internally divided into segments with a serial repetition of at least some organs. For example, in earthworm, the body shows this pattern called metameric segmentation and the phenomenon is known as metamerism.

(vi) Notochord

Notochord is a mesodermally derived rod-like structure formed on the dorsal side during embryonic development in some animals.Animals with notochordare called chordates and those animals which do not form this structure are called non-chordates, e.g., porifera to echinoderms.

Check Your Progress-1

Note: a) Answer the question given below

b) Compare your answers with those given at the end of the lesson

Q.1 From which part of the coconut, coir is obtained?

(a) Epicarp (b) pericarp

(c) Mesocarp (d) Endocarp

Q.2 The cloves which are used in food preparation are

(a) seeds (b) leaves

(c) flower buds (d) stem tips.

Q.3 Female gametophyte is also called as

(a) embryo sac (b) ovary

(c) endosperm (d) microspore mother cell.

Q.4 Synergids are

(a) haploid (b) diploid

(c) triploid (d) tetraploid.

11.8 ECONOMIC SIGNIFICANCE OF ANIMAL

The economic significance of animal as follow .

1. Food: The livestock provides food items such as Milk, Meat and Eggs for human consumption. India is number one milk producer in the world. It is producing about 176.34 million tones of milk in a year (2017-18). Similarly it is producing about 95.22 billions of eggs, 7.70 million tonnes of meat in a year. The value of output of livestock sector at current prices was Rs 9,17,910 crores at current prices during 2016-17 which is about 31.25% of the value of output from agriculturaland allied sector. At constant prices the value of output from livestockwas about 31.11% of the value of the output from total agriculture and allied sector. During the financial year 2017-18, the total fish production in India is estimated at 12.61 Million Metric tonnes.

2. Fibre and skins: The livestock also contributes to the production of wool, hair, hides, and pelts. Leather is the most important product which has a very high export potential. India is producing about 41.5 million Kg of wool per annum during 2017-18.

3. Draft: Bullocks are the back bone of Indian agriculture. Despite lotof advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are savinga lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks. In situations like hilly terrains mules and ponies

serve as the only alternative to transport goods. Similarly, the army has to depend upon these animals to transport various items in high areas of high altitude.

4. Dung and other animal waste materials: Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement (dung).

5. Storage: Livestock are considered as 'moving banks' because oftheir potentiality to dispose off during emergencies. They serve as capital and in cases of landless agricultural labourers many time it is the only capital resource they possess. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

6. Weed control: Livestock are also used as Biological control ofbrush, plants and weeds.

7. Cultural: Livestock offer security to the owners and also add to their self esteem especially when they are owning prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc.

8. Sports / recreation: People also use the animals like cocks, rams, bulls etc for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu)are quite common during festive seasons.

9. Companion animals: Dogs are known for their faithfulness andare being used as companions since time immemorial. When the nuclear families are increasing in number and the old parents are forced to lead solitary life the dogs, cats are providing the needed company to the latter thus making them lead a comfortable life.

11.9 LET US SUM UP

Plant reproduction is the production of new offspring in plants, which can be accomplished by sexual or asexual reproduction. ... Asexual reproduction produces new individuals without the fusion of gametes, genetically identical to the parent plants and each other, except when mutations occur.

11.10 LESSON END EXERCISE

1. Describe the reproduction in plants
2. Explain the importance of plants
3. Discuss the economic significance of animal.

11.11 SUGGESTED FURTHER READINGS

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11.12 ANSWER TO CHECK YOUR PROGRESS

1-C, 2-C

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LESSON NO. 12 UNIT-IV

CELL - THE BASIC UNIT OF LIFE

STRUCTURE

12.1 INTRODUCTION

When you look around, you see both living and non-living things. You musthave wondered and asked yourself – 'what is it that makes an organism livingor what it is that an inanimate thing does not have which a living things has'?The answer to this is the presence of the basic unit of life-the cell in all livingorganisms.

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.

12.2 OBJECTIVES

After reading this lesson, you shall be able to:

- explain the generalized structure of cell,
- describe the cell theory,
- differentiate between plants cell and animal cell, and
- enumerate the functions of cell organelles.

12.3 CELL- THE BASIC UNIT OF LIFE

Unicellular organisms are capable of (i) independent existence and (ii) performing the essential functions of life. Anything less than a complete structure of a cell does not ensure independent living. Hence, cell is the fundamental structural and functional unit of all living organisms.

Anton Von leeuwenhoek first saw and described a live cell. Robert Brown later discovered the nucleus. The invention of the microscope and its improvement leading to the electron microscope revealed all the structuraldetails of the cell.

12.3.1 Cell Theory

In 1838 Malthias Schleiden, a German botanist, examined a large number ofplants and observed that all plants are composed of different kinds of cellswhich form the tissues of the plant. At about the same time, At about the

same time, TheodoreSchwann (1839), a British Zoologist, studied, differenttypes of animal cells and reported that cell had thin outer layer which is today known as the plasma membrane. He also concluded, based on his studieson plant tissues, that the presence of cell wall is a unique character of the plant of animals and plants are composed of cell and products of cell.

Schleiden and Schwann together formulated the cell theory. This theory however, did not explained as how new cells were formed. Rudolf Virchow(1855) first explained that cells divided and new cells are formed from pre- existing cell (Omins cellula-e cellula). He modified the hypothesis of Schleiden and Schwann to give the cell theory a final shape. Cell theory asunderstood today is:

(i) all living organisms are composed of cells and products of cells.

(ii) all cell arise from pre-existing cells.

12.4 GENERALISED STRUCTURE OF CELL.

The cells in an onion peel and/ or human cheek cells under the microscope. Let us recollect their structure. The onion cell which is a typical plant cell, has a distinct cell wall as its outer boundary and just within it is the cell membrane. The cells of the humam cheek have an outer membrane as the delimiting structure of the cell. Inside each cell is dense membrane bound structure called nucleus. This nucleus contains the chromosomes which is turn contain the genetic material, DNA. Cells that have membrane bound nuclei are called eukaryotic whereas cell that lack a membrane bount nucleus are prokaryotic. In both prokaryotic and eukaryotic cell, a semi-fluid matrixcalled cytoplasm occupies the volumn ofl the cell. The cytoplasm is the mainarena of cellular activities in both plant and animal cells. Various chemical reactions occur in it to keep the cell in the 'living state.'

Beside the nucleus, the eukaryotic cells have other membrane bound distinctstructures called organelles like the endoplasmic reticulum (ER), the golgi comples, lysosomes, mitochondria, microbodies and vacuoles. The prokaryotic cells lack such membrane bound organelles.

Ribosomes are non-membrane bound organelles found in all cell both eukaryotic as well as prokaryotic. Within the cell, ribosomes are found notonly in the cytoplasm but also within the two organielles chloroplasts (in plants) and mitochondria and on rough ER.

Animal cells contain another non-membrane bound organelle called centriolewhich helps in cell division.

Cells differ greatly in size, shape and activities.

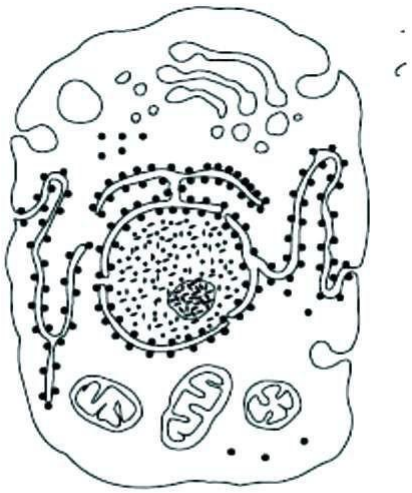
12.4.1 Prokaryotic Cell

The Prokaryotic cells are represented by bacteria, blue, green algae, my coplasma and PPLO (Pleuro Pneumonia like Organisms). They are generally smaller and multiply more rapidly than the eukaryotic cells . They may verygreatly in shape and size. The four basic shapes of bacteria are bacill us (rodlike), occus (spherical), vibrio (comma shaped and spirillum (spiral).

The organization of the prokaryotic cell is fundamentally similar even thoughprokaryotes exhibit it is wide variety of shapes and functions. All prokaryoteshave a cell wall surrounding the cell membrane. The Fluid matrix filling thecell is the cytoplasm. There is no well-defined nucleus. The genetic materialis basically naked, not envolped by a nuclear membrane. In addition to the genomic DNA (the single chromosome/circular DNA), many bacteria havesmall circular DNA are called plasmids. The plasmid DNA confers certain unique phenotypic characters to such bacteria. One such character is resistacneto antibiotics. In higher classes you will learn that this plasmid DNA is usedo monitor bacterial transformation with foreign DNA. Nuclear membrane isfound is eukaryotes. No organelles, like the ones in eukaryotes, are found inprokaryotic cells except for ribosomes. Prokaryotes have something unique in the form of inclusions. A specialized differentiated form of cell membrane called mesosome is the characteristic of prokaryotes. They are essentially infoldings of cell membrane.

12.4.2 Eukaryotic Cell

The eukaryotes include all the protists, plants, animals and fungi. Incukaryotic cells there is an extensive compartmentalization of cytoplasmthrough the



A typical eukaryotic cell
(10-20 μm)

Figure 8.2 Diagram showing eukaryotic cell organisms

presence of membrane boundorganelles. Eukaryotic cells possess an organized nucleus with a nuclear envelope. In addition, eukaryotic cells have a variety of complex locomotory andcytoskeletal structures. The irgeneticmaterial is organized into chromosomes.

Alleuka ryotic cells are not identical. Plant animal cells are different as the former possess cells are different as the former possess cell walls, plastids and a large central vacuole which are absent in animalcells. On the other hand, animal cells havecentrioles which are absent in almost all plant cell.

12.4.3 Difference between Prokaryotic and Eukaryotic Cell

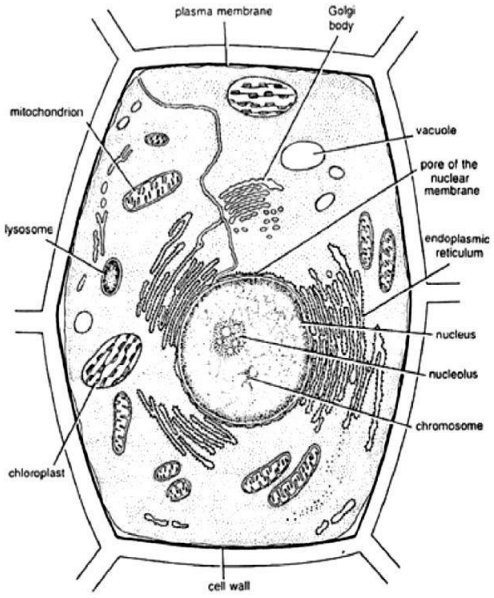
Prokaryotic Cell	Eukaryotic Cell
1. Cell is usually small	1. The cell is comparatively larger (10-100mm) (0.1-2.0 mm.)
2. Cell is bounded by a cell wall, muramic acid	2. Cell may or may not posses cell well which Possesses Animal Cell lack cell wall while those of plantsand fungi have cell wall. Plants cell walls are cellulosic whereas fungal cell walls arechitinous.
3. An organized nucleus is absent is found	3. An organized nucleus is present. It is Instead a nucleoid differentiated into nuclear envelope chromatin and nucleoplasm.

4. DNA is naked , that is, without histones. Proteubs, Nuclear DNA is linear while extra Nuclear DNA is circular.	4. Nuclear DNA is associated with histone an Association with DNA is Usually circular.
5. The amount of DNA remains life cycle.	5 The amount of DNA shows a regular. same throughout the alrternation between diploid and halploid stages.
6. Transcription and translation cytoplasm.	6. Transcription occurs in the nucleus occur in the while translation takes place in the cytoplasm.
7. Cell organelles like ER, Golgi apparatus, Centrioles apparatus). are absent	7. ER, mitochondria, Golgi apparatus and mitochondria, lysosomes or their equivalents are present lysosomes and all the eukaryotic cells. Centrioles are(centrosome, central Usually present in animal cells.
8. Ribosomes are of 70S type.	8. Ribosomes are of 80S Type.

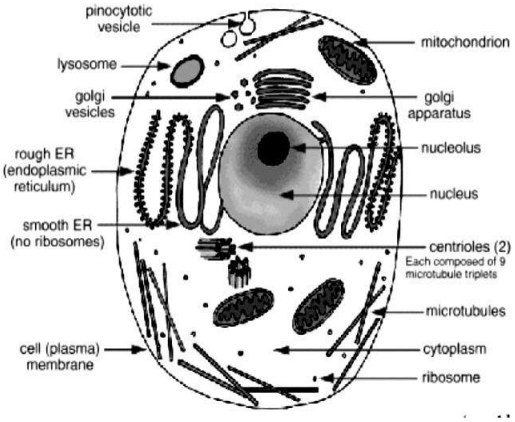
12.5 DIFFERENCE BETWEEN PLANT CELL AND ANIMAL CELL

	Plant Cell		Animal Cell
1	A plant cell has a rigid cell on the Outside	1.	A cell wall is absent (Schwann, 1838). Cell is enclosed by plasma membrane.
2.	It cannot change its shape.	2.	An animal cell can often change its shape.
3	Plastids are found in plant cells.	3.	Plastids are usually absent.
4.	A Mature plant cell contains a large Central vacuole.	4.	An animal cell often possesses many small Vacuoles.
5.	Mitochondria are comparatively fewer	5.	Mitochondria are generally more numerous.

6. Centrioles are usually absent plants.	6. Centrioles are found in animal except in lower cells.
7. Spindle formed during nuclear Is amphiastral	7. Spindle formed during nuclear division is anastral. division
8. Golgi apparatus consists of a distinct or unconnected dictyosomes.	8. Golgi apparatus is either localizednumber of or consists of a wall connectingunits called single Complex.
9. Reserve food is generally starch and fat.	9. Reserve food is usually glycogen fat
10. Adjacent cells may be through. a number of junctions.	10. Adjacent cells are connected connected through plasmodesmata



Ultrastructure of a plant cell covered by cell wall.



Check Your Progress -1

Note: a) Answer the questions given below

b) Compare your answers with those given at the end of the lesson

Q.1 Which of the following is seen only in prokaryotic cells?

(a) Dictyosome (b) Ribosome

(c) Mesosome (d) Endoplasmic reticulum

Q.2 Cell wall shows

(a) complete permeability (b) semi permeability

(c) differential permeability. (d) Impermeability

Q.3 Cell theory in not applicable for a

a) Bacteria b) Fungus

c) Algae d) Virus

Q.4 A mature plants are contain a large

a) Plasma membrane b) Vacuole

c) Centriole d) None of the above

12.5.1 Cell Components:-

(i) Cell envelope:-

Most prokaryotic cells, particularly the bacterial cells have a chemically complex cell envelope. The cell envelope consists of a tightly bound three layeared structure i.e, the outermost glycocalyx followed by the cell wall and then the plasma membrane.

Glycocalyx is a sticky, gelationous layer that is present outside the cell wall to form an additional surface layers. When this layer is firmly attached to thesurface of the cell, it is called a capsule. If it is loosely distributed around thecell, the glycocalyx is called a slime layer.

A special membranous structure the mesosome is present which is formed by the extensions of plasma membrane into the cell.

Bacterial cells may be motile or non-motile. If motile they have thin filamentous extensions from their cell wall called flagella. A flagellum hasthree basic parts filament, hook and basal body. Pili are longer, fewer and thicker tubular outgrowths which develop the reponse to F* or fertility factor in Gram-ve bacteria. Fimbriae are formed in large

numbers. They help in attaching bacteria to solid surfaces or host tissues.

(ii) Cell Wall :-

Bacterial cell wall is made up of peptidoglycan (murein or mucopeptide) while fungal cell wall consists mainly or fungal cellulose or chitin. The plant cell wall is composed of a variety or polysaccharides, lipids, proteins andminerals.

There layers can be distinguished in a cell wall: middle lamella, primary cell wall and secondary cell wall. Occasionally a tertiary cell wall may be present.

(iii) Plasma membrane :-

The plasma membrane (PM) or plasmalemma forms the outermost boundary of cytoplasm which separates it from the extracellular environment and controls the entrance and exit of molecules and icons and thus helps to maintain the difference in ion concentration of the cytoplasm and the surroundings.

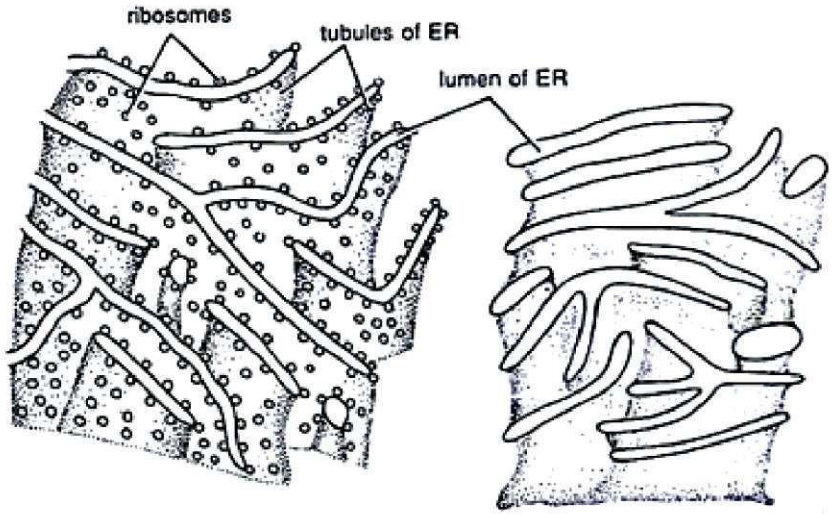
Several types of models have been put forward to explain the sturucture of abiomembrane. The most accepted model is fluid mosaic model. Fluid mosaic model of plasma membrane was given by Singer and Nicoloson in 1972. According to this model, lipid molecules in the membrane are arranged in the form of a bimolecular layer so that their hydrophilic polar heads constitute the outer and inner surface, while hydrophobic tails are buried in the membrane.

Cytoplasm is a jelly-like semi-fluid general mass of protoplasm excluding the nucleus but including all other components-cytoplasmic matrix, cell organelles and cell inclusions.

12.5.2 Cell Organelles and their Function.

(i) Endoplasmic reticulum (ER)

1. It was discovered and name by Porter in 1945.
2. ER is a complicated and interconnected system of membrane lined channels that run through cytoplasm.
3. ER divides the intercellular space into two distinct compartments, i.e.luminal (inside ER) and extra luminal (cytoplasm) compartments.
4. ER exists in three forms : Cisternae, vesicles (oval sacs called as microsomes) and tubules.



Structure of endoplasmic reticulum. A, Rough ER; B, Smooth ER.

Types of Endoplasmic Reticulum

a) Smooth ER (SER) Smooth ER has smooth membranes due to absenceof ribosome.

b) Rough ER (RER) Appears rough due to presence of number ofribosome's of Membrane

Function of SER

1. Detoxification

2. Storage of glycogen, fat and sterol.

3. Lipid synthesis

4. Gives rise to sphaerosomes.

Function of RER

1. Provides surface for ribosome attachment and protein synthesis. .

2. Forms SER by loosing ribosomes.

3. Modification and packaging of newly formed protein.

4. Helps to formation of lysosomes.

(ii) Golgi Complex :-

Camillo Golgi, first observed Golgi bodies in the form of a network in nerve cells of a network in nerve cells of barn owl and cat.

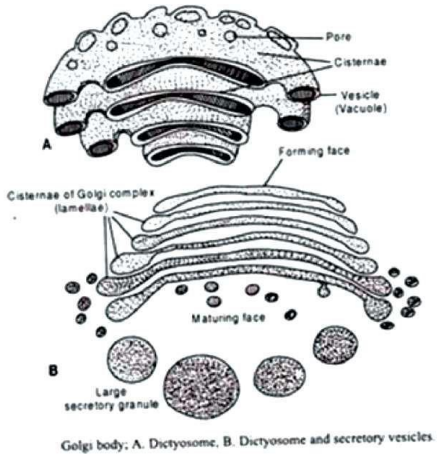
Gogi bodies are present in all eukaryotic cells except in male gametes of bryophytes and pteridophytes, mammalian RBCs, sieve tubes of plants andin cells of fungi.

Golgi body is a complex cytoplasmic structure made up of smooth membrane saccules and other

forms which takes part in membrane formation, secretion and production of complex biochemicals.

Functions :-

1. Packaging and storage of materials.
2. Secretion of different substances like gum, mucilage and hormones of endocrine glands.



Golgi body; A. Dictyosome, B. Dictyosome and secretory vesicles.

3. Acrosome formation during spermatogenesis.
4. Glycosylation of proteins and lipids of form glycoproteins and glycolipids.

(iii) Lysosomes :-

Lysosomes first reported by Christian de duve are single membrane bound,small vesicular organelles, containging hydrolytic enzymes.

Lysosmes are present in all animal cells except RBCs.

They are also called as suicidal bags owing to the presence of large number of digestive enzymes or acid hydrolases in them.

In Plant and fungi, vacuoles take over the function of lysosomes.

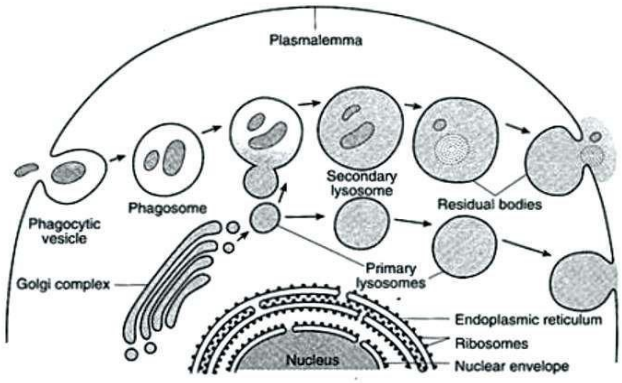


Diagram showing the origin and different phases of lysosomes

Functions:-

1. Lysosomes help in digestion of usuful substances for cell's use i.e. intracellular digestion.
2. Harmful (unwanted) material like pathogens, toxic material are disposed off by lysosomes. Thus lysosomes are also called disposal bags or disposal units.
3. They are recycling centres of cell and help in renewal of worm out cells and organelles.

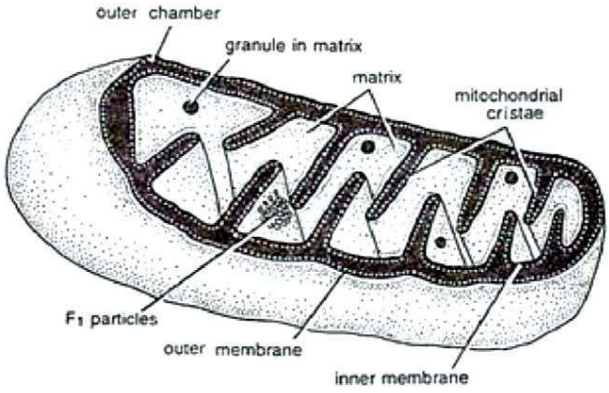
(iv) Mitochondria :-

Mitochondria are cell organelles of aerobic eukaryotes which take part inoxidative phosphorylation and kreb's cycle of aerobic respiration.

They are called power houses of cell because they are major centres of releaseof energy in aerobic respiration.

They were first observed by Kolliker, but the term mitochondria was given by Benda.

Mitochondria are absent in prokaryotes and anaerobic eukaryotes. Mitochondria are secondarily lost in the red blood corpuscles of mammals.



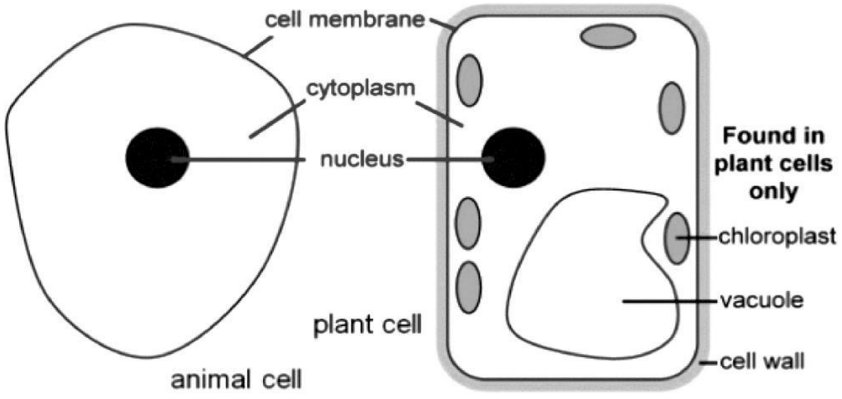
Structure of mitochondrion as seen in electron microscope (Diagrammatic).

(v) Vacuoles :-

Vacuoles are non-cytoplasmic areas present inside the cytoplasm.

There are surrounded by single membrane called tonoplast. They are formed by expansion and pinching off from endoplasmic reticulum.

They are small in animal cell and large in fungal and plant cells. Vacuoles may be of our types, depending upon its contents and functions.



(vi) Plastids :-

The term plastid was introduced by E. Haeckel in 1866.

With the exception of some protists, plastids are restricted to plants only.

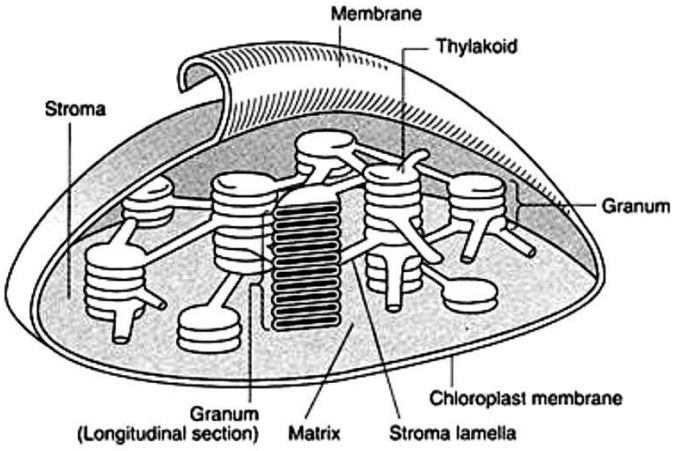
Plastids are semi-autonomous organelles having DNA and double membrane envelope which store or synthesise various types of organic compounds.

Plastids develop from colourless precursors called proplastids which havethe ability to divide and differentiate into various types of plastids. The maintypes is chloroplasts.

The number of chloroplasts in a cell varies from species to species but remainfixed to a particular species e.g. one in Ulothrix, photosynthetic leaf has 20-40 chloroplasts.

Similarly the shape and size of chloroplast also differs with species. It may

be cup b shaped in ribbon- like in spirogyra, discshaped and oval in higherplants.



Three dimensional figure of a chloroplast

Functions:-

1. Energy Transduction:- Chloroplasts have unique ability to trap solar energy and transform in into chemical energy, which is essential for all living organisms to support their life activities.
2. Photosynthesis:- Chloroplasts are the centers of photosynthesis or formation of organic compounds from inorganic raw materials.
3. Consumption of CO_2 $_2$

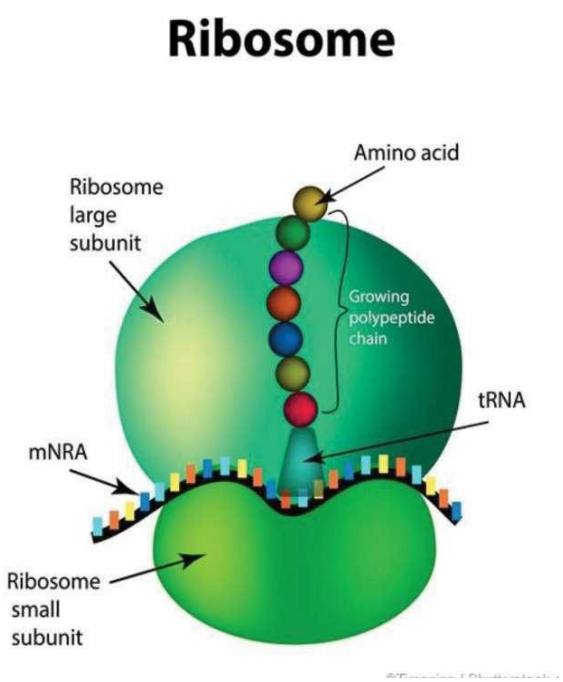
:- They Pick up carbon dioxide and use the same in photosynthesis. Thus, keep the; percentage of carbon dioxide balance in the atomosphere as it is being constantly added through respiration and combustion.

(vii) Ribosomes :-

Ribosomes are submicroscopic, naked (without membrane) ribonucleoprotein(RNP) protoplasmic

The ribosomes are subspherical in outline and consists of two unequal subunits.

On the basis of sedimentation coefficient of Svedberg unit ribosomes are oftwo types- 80S ribosomes and 70S ribosomes



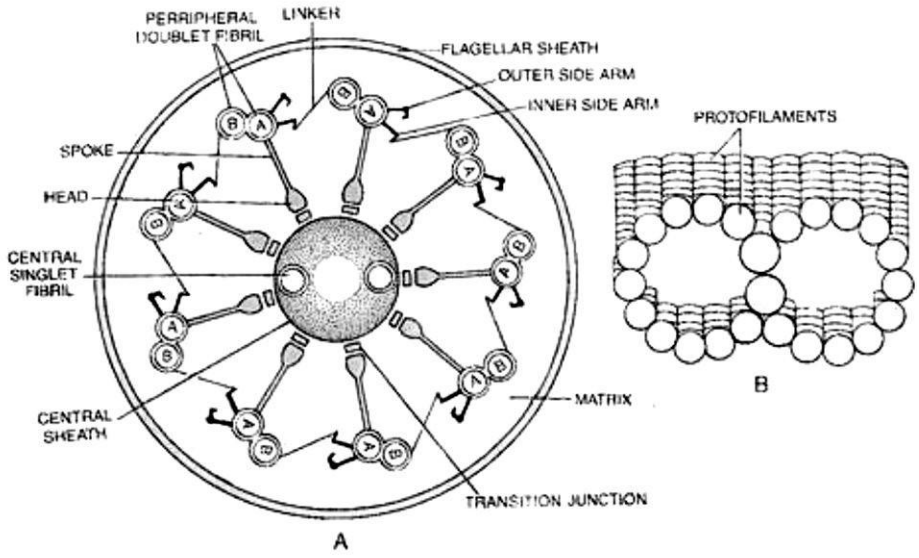
Function :-

1. Ribosomes are the sites for polypeptide or protein synthesis, hence called as protein factories of cell.
2. Structural proteins are produced by free cytoplasmic ribosomes whilethose attached to ER synthesise globular proteins.

(viii) Cilia and Flagella :-

The cilia and flagella are microscopic, contractile and filamentous processesof the cytoplasm.

They have a fibrillar or microtubular composition. Their core called theaxoneme usually has nine doublets ofl radially arranged peripheral microtubules, and a pair of centrally located microtubules.



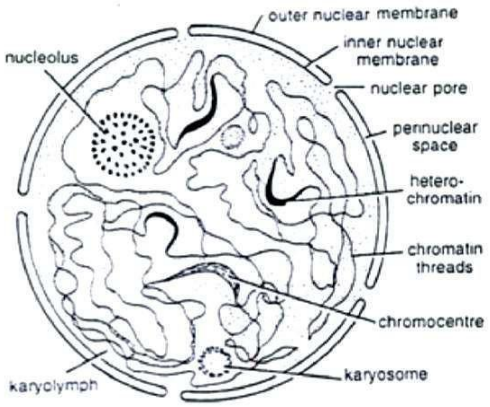
A, ultrastructure of flagellum in cross-section. B, doublet fibril without arms.

Functions :-

1. Both are capable of producing a current in fluid medium for locomotionand passage of substances, and act as sensory organs of the cell.

(ix) Nucleus

Nucleus is a specialized double membrane bound protoplasmic body whichcontains all the genetic information for controlling cellular metabolism and inheritance. It is one of the most important and the largest cytoplasmic organelle, present in all eukaryotic cells except mature RBC and mature sieve cells of vascular plants. It is well organized in eukaryotes but in prokaryoticcells it is of primitive nature called prokaryon or nucleoid.



Ultrastructure of a nucleus (Diagrammatic).

Check Your Progress - 2

Note: a) Answer the questions given below

b) Compare your answers with those given at the end of the lesson

Q.1 Which of these organelles does not ribosomes?

I. Rough endoplasmic reticulum. II. Chloroplast

III. Golgi apparatus IV. Mitochondria

(a) I and II (b) I and IV only

(c) IV only (d) III only

Q.2 Which of the following organelles is called suicidal bag of cell?

(a) Lysosome (b) Mitochondria

(c) Peroxisome (d) Glycocalyx

Q.3 Endoplasmic reticulum is in continuation with

(a) Golgi body (b) nuclear wall

(c) Mitochondria (d) cell wall.

Q.4 Nucleolus is the site for the synthesis of

(a) Ribosome (b) Mrna

(c) TRNA (d) DNA

12.6 LET US SUM UP

A cell is a mass of cytoplasm that is bound externally by a cell membrane . Usually microscopic in size, cells are the smallest structural units of living matter and compose all living things. Most cells have one or more nuclei and other organelles that carry out a variety of tasks. Some singlecells are complete organisms, such as a bacterium or yeast . Others are specialized building blocks of multicellular organisms , such as plants and animals .

12.7 LESSON END EXERCISE

1. What are the characteristics of prokaryotic cells?
2. Cell is the basic unit of life. Discuss in brief.
3. Describe the structure of the following with the help of labelled diagrams.
   (i) Mitochondria (ii) Nucleus
4. Differentiate between plants cell and animal cell with the help of diagram ?

12.8 SUGGESTED FURTHER READINGS

Aggarwal, J.C. (1994): Educational Administration, Management andSupervision, Principles and Practices, New Delhi.

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12.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress-1 1-c, 2-a, 3-d, 4 –b Check Your Progress-2 1-a, 2-a, 3-b, 4-a

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