



# **PEDAGOGY OF**

# **BIOLOGICAL SCIENCE**



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## UNIT - 1

### INTRODUCTION TO SCIENCE

1. What is the meaning of science? Write a short note on functions of science ?

**A. Meaning of Science:** The term "Science" has been derived from Latin word "Scientia" Which means all that one should know. The nearest German equivalent for the English word science is Wissen Schaft which includes systematic study in various disciplines including history philosophy.

1. Science is a study of natural phenomena
2. Science is a body of knowledge on observation, experimentation and Inference.
3. Science as ordered knowledge of Natural phenomena  
- W.C.Dampler.

#### Functions of science:

The following are the functions of science

✦ To predict on phenomena in nature ✦ To explain things and events around us ✦ To create scientific culture ✦ To produce empirical knowledge

2. Write a note on the characteristics of science describe the scope of science.

**Ans : Nature and Characteristics of science:**

1. Science is a system. It is a system of knowledge where so many facts are related together.
2. Science is a body of respond knowledge
3. It is self-corrective in nature
4. Science Formulates Law.
5. Science is based on critical discrimination. It is objective and Impartial.
6. It is objective in nature. Science does not depend on subject attitudes like feeling, temperament, bias etc.
7. Science is both product and process.

**Scope of science:** The word Biology has the origin of Greek word "Bios Logos" - A discourse on life. The study of life and nature is called Biology.

2)

3

The first phase of development of biology started in 384 - 322 BC with the work of Aristotle and the 2nd phase starts is the period of (1890-1929) with the work of Darwin the third phase occurred in USA during 1929-1957. The fourth phase in Biology education in India was started with the recommendation of Indian education commission.

The scope of science is Infinite ✦ Botany is the complete study of plants and uses of plants for various purposes. ✦ Zoology is the study of sociology and psychology of animals.

3. Explain the structure of science?

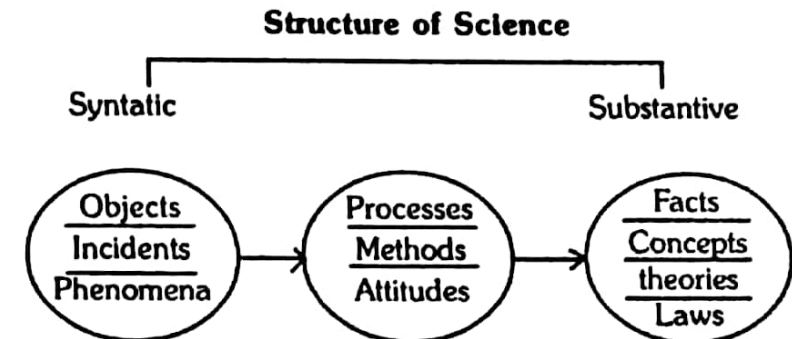
**Ans: Structure of Science:** Joseph J. Schwab and Philip. H.Phenics (1964) described the structure of science based on its processes and products.

Structure of science is built on two parts they are:

(a) Substantive Structure (b) Syntactic structure

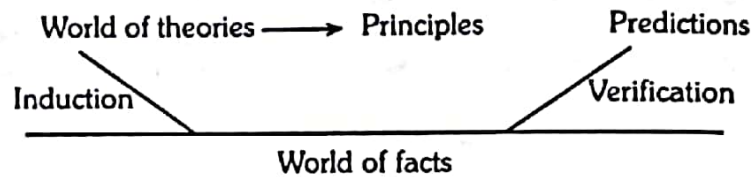
**Substantive Structure:** Science as product is explained by the substantive structure. Scientists by using various methods and processes, obtain facts. Principles, concepts and theories about nature. So according to the substantive structure, the structure of science consists of various theories, facts etc.

**Syntactic structure:** It is concerned with the process of scientific in quiry i.e means by which the scientific knowledge is acquired and verified methods through which the new knowledge is developed



**James Conant's concept about the structure of science:** He believes that world is divided into (a) world of facts

and (b) world of theories. Scientist enters from world of facts into world of theories by inductive reasoning.



Conant's structure of science

According to James science is a dynamic subject and there is no end for it.

#### 4. Explain the branches of science:

**Ans :** The branches of science are commonly divided into given Major groups.

**Natural Sciences:** The study of natural phenomena (Including Fundamental forces and biological life)

**Formal Sciences:** The study of mathematics and logic which use an a priori, as opposed to factual.

**Social Sciences:** The study of human behavior and societies.

#### Some of the Branches of science:

S.No	Branch of Science	Field of Study
1.	Botany	Structure of plants, growth etc.
2.	Zoology	Structure of various animals habits etc.
3.	Anatomy	Structure/frame work of various Living organisms, functioning etc.
4.	Microbiology	Bacteria, Virus etc.
5.	Biotechnology	Matter related to genes hybrid seeds, production of drugs etc.
6.	Ornithology	Birds their ways of living, Migration etc.

#### 5. Trace the history of science from the ancient period to the modern period?

**Ans : Ancient civilization:** The Egyptians Invented many tools and techniques as early as 3000 B.C. They learned some physiology and surgery while embalming their dead.

The Chinese civilization developed a little later than the Egyptian and Babylonian cultures. The Chinese developed and made advances in medicine in addition to astronomy and chemistry.

The Greeks left the largest heritage of science of all the ancient peoples. Aristotle was the Famous biologist in this period. The Romans were mainly interested in applied science.

**Development of science in India:** India made developments in the field of medicine, agriculture till about 600 A.D. Later in between (750AD to 1000AD) Buddhism discouraged further development of life sciences.

**The middle age:** great advance occurred in biology during the 1700's. In 1757 the Swiss physiologist Albert Van haller developed systematic physiology by organizing what biologists has learned about circulation embryology and nervous system. In 1858 Charles R. Darwin Presented to biology Ideas the concept of orderly, gradual changes or evaluation.

In the mid 1800's Gregory mendal discovered the basic laws of heredity that laid the foundations for the science genetics. In 1928 Alexander Fleming discovered penicillin. By the Late 20th century new fields like genomics and prote omics were reversing this trend.

## UNIT - 2

### AIMS AND VALUES OF BIOLOGICAL SCIENCE

1. Discuss the various aims of teaching biological sciences in school?

Ans : Aims of BIOLOGY:

1. Every student has to know certain fundamental principles of Biology. Some of them are cell is a unit of life. Living things are identified by their properties. Genes are the basic Genetic material of heredity. Chromogeny, speciation, phylogeny etc.

2. Nature is big classroom, which opens to various wonders of life. To make life comfortable every person has to make contact with the nature, and should fit in the process of nature. He should not become an obstacle for the various processes in natural phenomena. For this he should have clear understanding about the components of nature and the importance is maintaining ecological balance.

3. The knowledge of health and hygiene principles are essential for every person to lead a healthy life. Knowledge of plants and animal products make lives comfortable in health aspects and economic aspects. For this purpose every student should be educated how to use principles of biology in everyday life.

4. **Health and Hygiene:** Health is wealth. Everybody should recognise it. To improve the conditions of health everybody requires some knowledge of principles of health and hygiene.

5. **To improve standards of living:** If we are able to utilize the natural resources properly or if we achieve sustainable development, standards of living are improved and at the same time environment is protected. The concept about sustainable development should be known through the study of biology.

6. **Individual and social development :** If we develop in health aspects individual development takes place. If he develops

in economic aspects also, society also develops. Biology provides knowledge of various small scale industries like semi culture, aquaculture, and agriculture. If people know more about these fields individual and social development take place.

7. **To develop critical attitude and develop scientific reasoning :** Science gives explanations about the scientific phenomena, which develops scientific reasoning, many ideas are developed through observation. An increase in knowledge of biology increases critical attitude also.

8. **To develop awareness about environmental issues :** Man is a part of environment and affects environment. He has the responsibility of taking care about the agent influences man in various aspects. So he should be aware of some environmental issue, and play a key role in maintaining environment in a proper manner.

9. **To develop skills :** Every Biology student should have basic skills in drawings, observation and experimentation, as they are required for further developments in biology.

10. **To identify the creative abilities of children and to direct them in proper channels :** It is the prime responsibility of every teacher, to direct the creative channels of the student into proper channels.

11. **To develop the ability of students in framing generalizations :** To develop theoretical concepts students should be giving training framing generalizations.

2. Describe the values of Teaching Biology Science ?

Ans : Values of Teaching Biology Science : Values of biology can be taken as Aims of Teaching Biology. That is why we say values are the sources for selecting aims of teaching life sciences.

The popularity of a subject depends on the values of it. The subject which is most related to daily life situations, develop more rapidly than the others. Science is one of those subjects created out of humanistic activities and useful to man. In olden days science was a less promising subject and the average students are given science to study, slowly the research in science started

and its applications came into use. Then people recognised the importance of it. Now science has become one of the compulsory subjects in the curriculum up to school education. Today's children are living in the science age influenced by science more than by any other human activity.

"The dominating feature of the contemporary world is the intense cultivation of science on large scale and its application meet the country's requirements." - The scientific policy Resolution (1958) of the Government of India.

There are multifarious values of learning science. As a part of it, biology achieving all these values.

**1. Intellectual Value** The prime value of every education is the intellectual development of individual. Through the study of biology also pupils develop thinking, reasoning, observation interpretation etc. All these are the characteristic features of intellectuals.

**2. Utilitarian Value** The term Biology is now termed as life sciences, as it is closely associated with the knowledge of life activities. This itself shows how the knowledge of biology is useful to mankind. Biology is influencing human activities through various branches of it.

**3. Vocational Value** Most of the students opt for science with a view that they will get an employment easily because science is an open seesaw for a number of professions. Biology also provides such opportunities to its students. They can get vocations in different fields - like teaching, medicine, agricultural forms, *recherche* laboratories forest departments, curators in museums and zoos, health departments.

**4. Cultural Value** Science has played an important role in determining the culture, and civilization of a country from time to time. It affects our way of thinking and way of living.

**5. Aesthetic value** Biology is the study of nature. Everything in nature is beautiful. So the subject has aesthetic value.

**6. Moral Value** Truth, goodness, beauty' are the three qualities for a morally high person. Through the study of biology

if one can develop truth and sense of beauty the we must say science (biology) is having moral value.

**7. Psychological Value** The study of biology is having psychological values. As it provides opportunities to satisfy the creative instincts, curiosity, spirit of observation and enquiry etc., students talents and psychological needs are well satisfied, as the subject requires experimentation where all these values developed.

**8. Inspirational value** Life histories of scientists provide excellent opportunities to develop inspiration to know more about biology. Louis Pasteur, his number of discoveries to serve mankind, Charles Darwin's thirst of observing, nature, his contributions inspite of his ill health-all these are sources of inspiration to develop interest in the subject.

**9. Training in scientific method** : Biology is mainly bases on observation and experimentation. These two activities should be done in a systematic manner to find out facts in nature.

**10. Habits** : As the subject is learnt through experiments, students develop the habits of tolerance, persistence, critical observation, faithful in recording results, self confidence etc.

**3. What competencies are required for biological science teacher?**

**Ans** : The essential competencies requires by a biological science teacher are :

**Instructional competencies of Biological science teachers:**

✦ Plan the content of a lesson ✦ Determines student interest and needs ✦ Plans the summary of a lesson ✦ Effectively motivates students ✦ Effectively determines students needs ✦ Effectively evaluates students ✦ Demonstrate concern for the student.

**Competencies related to program planning, development and evaluation:** ✦ Visioning planning ✦ Develop and writing general objectives for the program ✦ Effectively manages, maintains and improves laboratories.

**Professionalism competencies required science teachers.**

✦ Keep up to date through reading professional literature

✦ Maintain ethical standards expected of a professional educator

**4. Elaborate the correlation of biological science with other school subjects.**

**Correlation of biology with other school subjects.**

**1. Biology with physics :** Various phenomena in plants and animals can be presented by using physics principles only. To explain certain instruments like photometer, stethoscope and B.P apparatus physical science knowledge is required they work on physics principals.

**2. Biology with chemistry :** Most of the concepts in physiology are closely related to chemistry. Chemistry and biology are much inter-dependent up on each other.

**3. Biology with mathematics :** Proportions and sizes of animals and plant are explained by using mathematical units genetics is one of the branches of biology which is presented with the help of statistical calculations.

**4. Biology with social studies :** Knowledge of biology improves social conditions of the people. Knowledge of principles of health and hygiene improves surroundings there by improves the social conditions.

**5. Biology with craft :** Agriculture as a craft and as a branch of biology explains the relation between these two subjects.

**6. Biology with fine arts :** Drawing is of immense importance in the study of biology.

**7. Biology with language :** Language is very essential that the science students should be able to express their ideas precisely in clear and correct language.

**UNIT - 3**  
**OBJECTIVES OF TEACHING**  
**BIOLOGICAL SCIENCE**

**1. What is the meaning of objectives? Write the importance of objectives?**

**Ans : Meaning of objectives:**

The aims of education which can be achieved in a school are called as objectives. An objective is a part of an aim. Objectives are immediate attainable goals. Objectives make a teaching programme meaningful. They indicate the behavioral changes in the pupil after completion of instruction.

**\*Objective as an end towards which a school sponsored activity is directed - Good, C.V**

**Objectives of Teaching Biology:**

✦ Providing advanced information. ✦ Providing practical knowledge of the content ✦ stimulating the spirit of Investigation and Invention. ✦ Developing the problem solving capacities.

**Characteristics of objectives:** ✦ Measurable ✦ they should be content oriented ✦ They should be able to test ✦ According to student's abilities.

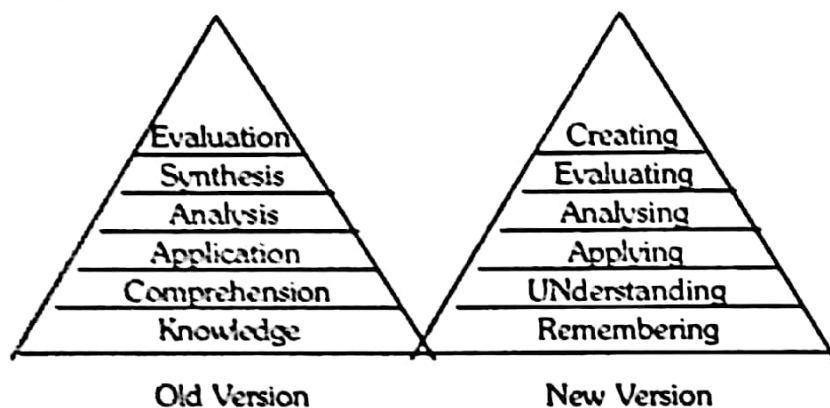
**Importance of Objectives:** The objectives are important because ✦ Helps in modifying the goals ✦ Guide student's learning ✦ Help the teacher in Instructional planning ✦ They enable construction and usage o valid and reliable tools for evaluating student achievement of the objectives ✦ They help the teachers to identify the goals that they want to include in the curriculum.

**2. Write about revised blooms taxonomy of educational objectives?**

**Ans :** The original Bloom's taxonomy was revised in 1990 by Lorin Anderson and it was published in 2001.

**Terminology changes:** Bloom's six major categories were changed from noun to verb forms. Additionally the lowest level of the original, knowledge was renamed and became remembering. Comprehension and synthesis were retitled to understanding and

creating. In an effort to minimize the confusion, comparison images appear below.



**The new terms are defined as :**

✦ **Remembering:** Retrieving recognizing, and recalling relevant knowledge from long-term memory.

✦ **Understanding:** constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying summarizing, inferring, comparing and explaining.

✦ **Applying:** Carrying out or using a procedure through executing, or implementing.

✦ **Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure of purpose through differentiating, organizing, and attributing.

✦ **Evaluating:** Making judgments based on criteria and standards through checking and critiquing.

✦ **Creating:** putting elements together to form a coherent or functional whole; recognizing elements into a new pattern or structure through generating, planning, or producing.

**Structural changes:** Structural changes seem dramatic at first, yet are quite logical when closely examined Bloom's original cognitive taxonomy was a one dimensional form. With the addition of products, the Revised Bloom's Taxonomy takes the form of a two-dimensional table. One of the dimensions identifies

the knowledge Dimension (or the kind of knowledge to be learned). While the second identifies the cognitive process dimension (or the process used to learn). As represented on the grid below, the intersection of the knowledge and cognitive process categories from twenty-four separate cells as represented on the "Taxonomy Table".

**Emphasis:** In the old taxonomy the six categories receives more emphasis where as in the revised taxonomy the 19 cognitive processes with in the six categories receives major emphasis.

**Revised Taxonomy Structural Details:** The most notable change in the revised taxonomy is the move from one dimension to two dimensions. Instructional objectives are usually formulated in terms of a verb-noun relationship. Thus, Statements of objectives typically consists of (a) some subjects matter content (i.e, noun or noun phrase) and (b) a description of what is to be done with or to that content (i.e, verb or verb phrase). The verb or verb phrase describes the cognitive process involved. In the OT, The knowledge category embodied both noun and verb aspects. The noun or subjects matter aspects was specified in the knowledge's extensive subcategories. The verb aspect or cognitive process was included in the definition given to knowledge in that the learner was expected to be able to recall or recognize knowledge. This brought unidimensionality to the framework at the cost of the knowledge category that was dual in nature (Krathwohl). The revised Taxonomy separates the noun and verb components of the original knowledge category into two separate dimensions, the Knowledge Dimension (Noun aspect) and the Cognitive Process Dimension (verb aspect).

**A) Factual knowledge:** The basic elements that students must know to be acquainted with a discipline or solve problems in it.

Aa. Knowledge of terminology

Bb. Knowledge of specific details and elements

**B) Conceptual Knowledge:** The interrelationships among the basic elements within a larger structure that enable them to function together

Ba. Knowledge of classifications and categories

Bb. Knowledge of principles and generalizations

Bc. Knowledge of theories models and structures

**C) Procedural Knowledge:** How to do something, methods of inquiry and criteria for using skills, algorithms, techniques and methods.

Ca. Knowledge of subject's specific skills and algorithms.

Cb. Knowledge of subject's specific techniques and methods

Cc. Knowledge of criteria for determining when to use appropriate procedures.

**D) Meta cognitive Knowledge :** Knowledge of cognitive is general as well as awareness and Knowledge of ones own cognition

Da. Strategic Knowledge

Db. Knowledge about cognitive tasks including appropriate contextual and conditional Knowledge.

Dc. Self- Knowledge.

**1. Knowledge Dimension:** As has been mentioned above the RT has taken into consideration the new developments in Cognitive and educational psychology. Thus, the Knowledge dimension in the RT includes four instead of three categories. Three of them include the substance of the Knowledge subcategories in the OT. But they were reorganized and renamed to use the terminology and to recognise the distinctions of cognitive psychology that developed since the publications of the OT.

The fourth new category, Metacognitive Knowledge provides a distinction that was not recognized at the time the OT was developed. Metacognitive Knowledge involves knowledge about cognition in general as well as awareness of and knowledge about one's own cognition (Pint rich 2002).

**2) Pedagogic Significance of Metacognitive:** Meta cognitive knowledge of learning strategies enables students to perform better and learn more. Students who know about the different kinds of strategies for learning, thinking, and problem solving will be more likely to use them. Students who know their

own strengths and weaknesses can adjust their own cognition and thinking to be more adaptive to diverse tasks and thus, facilitate learning. It is noteworthy that meta cognitive knowledge seems to be related to the transfer of learning that is the ability to use knowledge gained in one setting or situation in another (Branford et al. 1990)

Authors of the RT used Favell's classification of Meta cognition (1979) knowledge of strategy task and person variables. In the RT this classifications was represented in terms of three types of Meta cognitive knowledge

a) Strategic knowledge: student's knowledge of general strategies for learning and thinking.

b) Knowledge about cognitive tasks including appropriate contextual and conditional knowledge and

c) Self-knowledge.

Although there are many definitions and models of metacognition an important distinction is one between (a) knowledge of cognition and (b) the processes involving the monitoring control and regulation of cognition. The basic distinction between Meta cognitive knowledge and metacognitive control or self regulatory process parallel the two dimensions in the two dimensional Taxonomy Table. Metacognitive control and self-regulatory processes are cognitive processes that learners use to monitor, control and regulate their cognition and learning. As such, they fit under the six cognitive process categories and specific cognitive processes in the RT. These processes are well represented in task a such as checking, planning, and generating. Accordingly, on the Knowledge dimension, Metacognitive knowledge categories refer only to knowledge of cognitive strategies, not the actual use of those strategies

**3) Cognitive Process Dimension:** With reference to the Cognitive Process Dimension the number of categories in the OT was retained (i.e. six) but with significant changes. Three categories were renamed, the order of two was interchanged and those category names retained were changed to verb form to fit the way they are used in instructional objectives. Knowledge was renamed Remember, Comprehension was renamed Understand

and Synthesis was re-titled Create Application, Analysis and Evaluation were retained, but in their verb forms as Apply, Analyze, and Evaluate. All the original subcategories were replaced with gerunds and called "Cognitive Processes".

In addition the order of synthesis create and Evaluation, evaluate was interchanged. Anderson et al. indicated that "induction" (involved in creating) is a more complex process than deduction. Deduction involves breaking a whole into subparts, evaluating them and determining whether criteria are met. Induction on the other hand involves finding things that could fit together, judging their appropriateness. And assembling them to best meet criteria." This is supported by Ormell who stated that "Synthesis implies more than ... mere assembly. It implies ... [ that the bits ] form an organic unity and clearly this cannot be achieved without... awareness of what will fill together, i.e. of prior imaginative evaluation".

In the RT the cognitive process categories no longer form a cumulative hierarchy. The framework remains a kind of hierarchy in the sense that the six major categories of the Cognitive Process Dimension are presumed to be ordered in terms of increasing complexity with Remember being less complex than understanding, which is less complex than Apply and so on. However unlike the OT, the six categories are allowed to overlap on a scale of judge complexity. As Krathwohl points out the categories are allowed to overlap on another. This is most clearly evident in the category understand. Because its scope has been considerably broadened over Comprehend in the OT, some cognitive process associated with Understand (Eg: Explaining) are more cognitively complex than at least one of the cognitive process associated with apply (Eg:Executing).

**Table 3.2: Structure of the Cognitive Process Dimension in the RT**

**1.0 Remember:** Retrieving relevant knowledge from long-term memory

1.1 Recognizing 1.2 Recalling

**2.0 Understand:** Determining the meaning for instructional messages. Including oral and graphic communication

2.1 Interpreting 2.2 exemplifying 2.3 Classifying 2.4 Summarizing 2.5 Inferring 2.6 Comparing 2.7 Explaining

**3.0 Apply:** Carrying out or using a procedure in a given situation.

3.1 Executing 3.2 Implementing

**4.0 Analyze:** Breaking material into constituent parts and detecting how the parts relate to one another and to an overall structure of purpose.

4.1 Differentiating 4.2 Organizing 4.3 Attributing

**5.0 Evaluate:** Making judgment based on criteria and standards.

5.1 Checking 5.2 Critiquing

**6.0 Create:** Putting elements together to form a novel coherent whole or make an original product.

6.1 Generating 6.2 Planning 6.3 Producing

It is not worthy that whereas the six categories in the OT were given far more attention than the subcategories, in the RT the 19 cognitive process table 2 within the six cognitive processes receive the major emphasis.

The move from one dimension to two dimensions in the RT has led to another notable change in the structure of the taxonomy i.e. the formation of the Two Dimensional Taxonomy Table (Table 3). This table is the analytical tool of the revised taxonomy. The TT reflects a dual perspective on learning and cognition. Having two dimensions to guide the process of stating objectives and instruction.

### The Cognitive Process Dimension:

The Knowledge Dimension	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual Knowledge						
B. Conceptual Knowledge						
C. Procedural Knowledge						
D. Meta Cognitive Knowledge						

The TT emphasizes the need for assessment practices to extend beyond discrete bits of knowledge and individual cognitive processes to focus on more complex aspects of learning and thinking. The cognitive process dimension calls our attention to the need to find ways of validly and reliably assessing higher-order and metacognitive processes. Knowledge of cognitive strategies, cognitive tasks, and self not only requires different ways of thinking about assessment, but in the latter case reintroduces the need to engage in affective assessment (Airasian and Miranda).

**3. Write a short note on Instruction all objectives and specifications ? Give the example of Instructional objectives and specifications**

**Ans : Instructional Objectives** Instructional Objectives form the core of an instructional procedure. The instructional objectives are developed and set before an instruction is planned and delivered and delivered. These objectives help in identifying the expected behavioral outcomes of the learners through that particular instruction. The instructional objectives are the terminal results of the learning stated in terms of changes observed in the learner's behavior.

The instructional objectives are developed based on the following factors:

✦ The age and the maturity of the learner ✦ The physiological and psychological parameters ✦ The previous learning experiences ✦ The availability of resources for imparting education.

### Important Characteristics of Instructional Objectives

✦ Instructional objectives are the statements of student's terminal behavior the change in their behavior which is a result of learning

✦ Instructional objectives indicate the outcomes of teaching learning process.

✦ Instructional objectives are the skills that are imparted to the learner through the content.

✦ Instructional objectives indicate the end result of learning.

**Specifications** These are specific learning outcomes of teaching learning process. They denote the learning outcome of the pupils and indicate how far an objective is achieved in a classroom situation. Specific learning outcomes are the observable, measurable behavior changes in the learner and help in better communication between the teacher and the learner. Specifications are an important tool in lesson planning. Specifications are required to develop course material, teaching strategy and evaluate the learning outcomes.

### Important Characteristics of Specifications

✦ Specifications are precise and unambiguous statements.

✦ Specifications are observable are observable and measurable and are stated in terms of their action verbs.

✦ Specifications are simple and feasible learning outcomes, which are attainable in a stipulated time and class allotted in a school.

### Instructional Objectives & Specifications Teaching Biological Science

The Instructional Objectives & Specifications for Teaching Biological Science are as follows:

✦ **Objective Knowledge:** the pupil acquires the knowledge of Biological terms, concepts, Facts, processes etc.

**Specifications**

**The pupil Recalls:**

The terms, concepts, facts and processes.

Recognizes the terms, facts concepts, processes etc.,

✦ **Objective Understanding:** the pupil understands the biological terms, concepts, facts and processes.

**Specifications**

The pupil translates the data:

✦ Illustrates with examples

✦ Identifies the relationships of various concepts and processes

✦ Compares the concepts and processes

✦ Classifies the groups

✦ Distinguishes between different closely related processes

✦ Explains the concepts and

✦ Interprets the biological data, concepts, processes, floral diagrams and formulae, charts and models.

✦ **Objective Application:** the pupil applies the knowledge of biology to new and real life situations.

**Specifications**

The pupil-analyses the problem:

✦ Predicts the hypothesis

✦ Suggests possible methods

✦ Gives reasons for various phenomena

✦ Establishes the cause and effects,

✦ Draws inferences for biological problems

✦ **Objective Skills:** the pupil develops skills like: drawing, manipulating, collecting and preserving, dissecting, observing and reporting skills.

**Specifications**

The pupil develops skill of drawing: the pupil

✦ Draws neat and well labeled diagrams

✦ Draws with a sense of proportion

✦ Draws accurately and appropriately

**Specification**

The pupil develops the skill of manipulation: the pupil

✦ Handles the apparatus carefully

✦ Arranges them systematically

✦ Observes the readings precisely

✦ Develops improvised apparatus

**Specifications**

The pupil develops the skill of preserving the specimens.

The pupil

✦ Identifies the particular specimen

✦ Collects the specimen carefully

✦ Mounts the specimen using relevant procedures.

✦ Preserves the specimen following the appropriate technique.

**Specification**

The pupil develops the skill of dissecting: the pupil

✦ Selects the material for dissection

✦ Fixes the specimen appropriately

✦ Handles the instruments with precision

✦ Dissects carefully

✦ Displays the relevant parts

**Specification**

The pupil develops skill of observation: the pupil

✦ Distinguishes between the different parts of the specimen.

✦ Identifies various parts of the specimen.

✦ Notices the relevant parts carefully.

✦ Reads an instrument accurately.

✦ Detects errors in the experimental setup

**Specification**

The pupil develops the skill of reporting:

✦ Uses appropriate the skill of reporting:

- ✦ Organizes the thoughts systematically
- ✦ Puts forth the opinions in a clear perspective.

**Objective Interest:** the pupil develops interest in the study of plants and animals.

**Specification**

The pupil develops interest in

- ✦ Collecting and preserving plant and animal specimens
- ✦ Observing natural phenomena
- ✦ Reading books, magazines and journals of Biology
- ✦ Visiting places of nature like forests, zoos, botanical gardens and museums.
- ✦ Participating in biological science activities in school

**Objective Scientific Attitude:** the pupil develops scientific attitudes

**Specification**

The pupil develops

- ✦ Curiosity to know the biological concepts
- ✦ Honesty of expression
- ✦ Appropriate reasoning
- ✦ Critical thinking
- ✦ Unbiased judgement

**Objective Appreciation:** the pupil develops appreciation of nature and its utility to the human beings.

**Specification:**

The pupil appreciates the knowledge of Biology, the role played by biology in human improvement and realizes the significance of the study of biology. The pupil appreciates the

- ✦ Wonderful nature
- ✦ Importance of plants and animals
- ✦ Need of microorganisms and their use in our daily life
- ✦ Utility of biology to human beings
- ✦ Ecological balance

- ✦ The role of biology in enhancing the welfare of mankind.

**Recommendations of Commissions & Policies on Aims & Objectives of Science Teaching**

The Ministry of Education published the proceedings of the All India Seminar on the Teaching of Science in 1956. The aims and objectives of teaching science at different stages as recommended by the Taradevi Committee are:

**Primary School Level**

i) Arousing and maintaining interest in nature and in the physical and social environment, arousing love for nature and the habit of nature and its sources.

ii) Developing the habit of observation, exploration, classification and systematic way of thinking.

iii) Developing the child's powers of manipulative, creative and inventive faculties.

**✦ Middle School (Junior High School Level)**

i) Acquisition of a kind of information concerning nature and science, which may also serve as the basis for later general science course.

ii) Developing the ability to reach generalizations and to apply them for solving everyday problems.

iii) Understanding the impact of science on our way of life.

**✦ High School and Higher Secondary Level**

i) To familiarize the pupil with the world in which they live and to make him understand the impact of science on society so as to enable him to adjust himself in his environment.

ii) To acquaint him with the scientific method and to enable him to develop scientific attitude.

iii) To give the pupil a historical perspective, so that he may understand the evolution of scientific development.

4. Explain the academics standards mentioned in the school biological science text book published by government of Andhra Pradesh

S.No.	Academic Standard	Explanation
1.	Conceptual understanding	children are able to explain, cite examples, give reasons and explain the process of given concepts in the text book
2.	Asking questions and making hypothesis	children are able to ask questions to understand, to clarify the concepts and to participate in discussions
3.	experimentation and field Investigation	to understand given concepts in the text book children are able to do experiments on their own
4.	Information skills and projects	children are able to collect Information and analyses systematically
5.	Communication through drawing, model making	children are able to explain their conceptual understanding by drawing figures and making models
6.	Appreciation and aesthetic sense, values	children are able to appreciate man power and nature, and have aesthetic sense towards nature
7.	Application to daily life, concern to bio diversity	children are able to utilize scientific concept to face their daily life situations.

## UNIT - 4

### METHODS AND TECHNIQUES OF TEACHING BIOLOGICAL SCIENCE

#### 1. Enumerate Teaching

**Ans : Meaning of Microteaching :** 'Micro' means small and 'Teaching' means teaching situation. 'Micro teaching' is a scaled down teaching situation in which a teacher teaches a small unit to a group of 5 to 10 pupils for a reduced period of 5 to 10 minutes. It is scaled down in terms of class size and class time. This technique provides micro-conditions for the teachers. Such conditions offer a helpful setting for an experienced or inexperienced teacher to acquire new teaching skills and to refine the old ones the short lesson is recorded on the audio or the video tape and trainee gets to hear and see himself immediately after the lesson, Microteaching is a new design for teacher training and very effective technique for classroom instructions as it is working on some important aspects like taking into consideration the behavior pattern of the students, It also provides trainees with information about their performance immediately after completing their lesson.

#### Definitions of Microteaching

+ **Allen, D.W. (1996)** "Microteaching is a scaled down teaching encounter in class size and class time"

+ **Clift (1976)** "A teacher training procedure which reduces the teaching situation to a simpler and more controlled encounter achieved by limiting the practice teaching to a specific skill and reducing teaching time and class time".

#### Features of Microteaching Micro teaching is a:

+ **Real Teaching:** microteaching is real teaching. However, it focuses on developing teaching skills.

+ **Scaled down Teaching:** all the aspects of classroom teaching is scaled down-class size, duration of period of five to ten minutes, size of the topic and teaching skill.

✦ **Individualized Device:** it is the highly individualized training device.

✦ **Provision of feedback:** It provides a very good feedback for trainee's performance.

✦ **Preparation Device:** It is an effective device to prepare efficient teachers.

**Concept of Microteaching** Introduction of modern concepts in teaching has led to a considerable change in classroom teaching. Emphasis has been given to new practices in science teaching so that the academic performance of the students is raised and the affectivity of the teaching learning situations is improved.

Utilization of innovative teaching methods and strategies form an effective part of the teacher training programme. Teaching is not just a single skill and does not follow only a single method or approach of teaching. The teacher-training programmes simultaneously aid in the development of different teaching skills in the student trainees along with the development of innovative techniques of classroom teaching. The innovative practice of Microteaching is dealt at length in this chapter.

Microteaching is an organized practice teaching. The goal is to give instructors confidence, support, and feedback by letting them try out among friends and colleagues a short slice of what they plan to do with their students. Ideally, microteaching sessions take place before the first day of class, and are videotaped for review individually with an experienced teaching consultant. Microteaching is a quick, efficient, proven, and fun way to help teachers get off to a strong start.

**Principles of Microteaching** In micro teaching setting. The teacher educator demonstrates a particular skill. The act of the teacher educator is known as "modeling". The student teacher observes the model and plans a micro lesson on the demonstrated skill.

The major principles involved in Microteaching are:

✦ Principle of practice and drill ✦ Reinforcement ✦ Principle of experimentation ✦ Evaluation principle ✦ Precise supervision ✦ Continuity ✦ Capability principle ✦ Motivation principle ✦

Realistic goals ✦ One element of modifiable behavior ✦ Spaced distributive recalls

### Procedure

Usually six-eight student teachers from the same or similar courses participate in a single microteaching session. The teacher educator serves as a facilitator. While one person takes his or her turn as teacher, everyone else plays the roles of students. It is the job of these acting pupils to ask and answer questions realistically. It is the job of the acting teacher to involve his or her "class" actively in this way.

Such a teaching scenario typically runs for five to ten minutes. When completed, the trainee conducting the class has a moment or two to react to his or her own teaching. Then all the peers join to discuss about the session taught. They provide a feedback and suggest the things that the trainee teacher might follow to improve the teaching in the future.

### Microteaching cycle:

Before starting microteaching it is essential to motivate the trainee teachers with the philosophy and technique of the microteaching method. A particular skill is defined to student teacher in terms of teaching behaviours the objectives. The teacher trainees are supposed to acquire these behaviors.

### The following steps are involved in the Microteaching:

**Lesson Planning:** Once the skill to be developed is identified, the first step is to plan a micro-lesson based on the identified skill. The plan for the lesson has to design in the usual manner. The student teacher plans a short lesson in which he/she can use the demonstrated skill.

**Practicing the teaching skills:** The lesson planned for teaching the specific skill has to be presented in front of the audience that comprises of a selected number of the classmates. The rest of the classmates and skills are shown or written material provided to demonstrate the teachers, use of particular skill in microteaching or in a normal classroom situation.

**Obtaining the Feedback:** After the teaching session, sometime is given for the feedback from the audience as well as

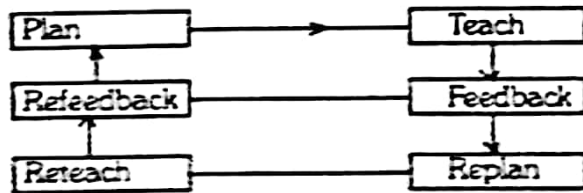
from the supervisor. The supervisor attempts to make reinforcing comments about instances of effective use of the skills and draw student's attention to other situations where the skill could have been exercised. Video recording could also be done so that the candidate could see and tell what the weak and strong points and know if there is a scope for self-improvisation.

**Re-planning:** The suggestions and views obtained from the feedback session could be incorporated in the lesson and the lesson should be re-planned. The weak points should be identified and efforts should be directed to develop the appropriate skills. In the light of the feedback i.e., the supervisor's comments the student teacher re plans the lesson in order to use the skill more effectively.

**Re-teach session:** After improving the lesson by incorporating all the necessary instructions in the lesson, the lesson has to be again presented in front of the same audience.

**Re-feedback session:** The teacher will again obtain the feedback from the audience and if the expected level of performance is not obtained then the same cycle is repeated to achieve the desired results.

The 'teach-reteach' (4-8steps) may be repeated till an adequate level of skill acquisition takes place. The exact teach-reteach cycle of microteaching can be represented as follows: the Microteaching cycle can be represented as follows:



**Advantages of Microteaching**

- ◆ It helps in increasing the teaching efficiency of pre-service well as in-service teachers.
- ◆ It can be presented in a simulation situation mimicking the classroom conditions.
- ◆ Teaching skills could be learnt and practiced by this method effectively.

**Limitations of Microteaching**

- ◆ There is a tendency to reduce the creative thinking of the teachers for preparation of the classes.
- ◆ The applications to new teaching techniques are limited.
- ◆ For the successful implementation of this method well competent and well-trained teachers are required.
- ◆ Alone the technique is not very effective, it should accompany by various other teaching techniques for effective teaching.

**Micro teaching lesson plan**

Skill: Introduction of the Topic

Name: \_\_\_\_\_ Topic: \_\_\_\_\_  
 Class: \_\_\_\_\_ Skill: \_\_\_\_\_  
 Subject: \_\_\_\_\_ Date: \_\_\_\_\_

Content Analysis	Teacher's Activity	Pupil's Activity
Announcement of the topic		

**Micro Teaching lesson plan**

Skill: Black Board work

Name: \_\_\_\_\_ Topic: \_\_\_\_\_  
 Class: \_\_\_\_\_ Skill: \_\_\_\_\_  
 Subject: \_\_\_\_\_ Date: \_\_\_\_\_

Content Analysis	Teacher's Activity	Pupil's Activity	Black Board Work

2. What do you mean by lecture method? How do you justify the present day context?

Ans : **Lecture Method:** It is the oldest teaching method

given by philosophy of Idealism. The lecture method refers to the teaching procedure involved in the clarification or explanation to the students of some major idea.

This method lays importance to the presentation of content.

**"The lecture is a pedagogical method where by the teacher formally delivers a carefully planned expository address on some particular topic or problem".**

- James Michel Lee

**Steps in the Lecture Method:** 1. Wide reading of the subject to be delivered through lecture. 2. Preparing the synopsis. 3. Preparing sufficient teaching aids, selecting suitable experiments 4. It should be started with brief introduction 5. It should be made live with humorous jokes occasionally 6. Important points should be written on the black board. 7. It should be ended with brief summary 8. Teacher can ask questions as a follow up activity

**Merits:** + Teachers work simplified + Economical-no need of library or laboratory.

**Demerits:** + Skills will not be developed + There is a lot of spoon-feeding

**Occasions to choose lecture:**

+ To explain the historical aspect of the subject + To review the lesson + At the end of the lesson

**3. Describe the Lecture-cum-Demonstration method**

**Ans : Lecture Cum Demonstration method:** This method is mainly based on the principle "learning by observation" In this method the merits of both lecture and demonstration are combined.

It is the combination of two methods. It is based on the merits of lecture and demonstration methods.

**Purpose of a lecture cum demonstration method:**

Lecture cum demonstration method is used in the following situations

+ Explanation of the concepts + Provide a problem  
+ Problem solving + Verify the facts + Develop the scientific skills  
+ Economize the time

**Demonstrations are used to:** + Introduce a lesson  
+ Explain the concepts + Demonstrate the processes + Solve the problems + Apply the principles + Summarize the topic  
**Steps in a Lecture Cum Demonstration method:**

**Planning:** The teacher formulates the objectives of teaching, identifies the concepts to be explained, the questions to be asked.

**Introduction of the lesson:** The teacher introduces the lesson by motivating the students.

**Presentation of the content:** The dissemination of the knowledge mainly depends on the presentation of the subject matter.

**Role of a teacher:** The teacher has an important role in this method. The teacher should possess knowledge of both the theoretical and practical skills in science.

**Advantages:**

+ It involves active students participation in the teaching learning process + This method is economical in saving the time and money + This method caters to the needs of individual students

**Disadvantages:** + Students do not work individually and they will not get first hand experience + The concept of learning by doing has no place in this method.

**4. Discuss the laboratory method.**

**Ans :** Laboratory method is a planned activity dealing with original or raw data in the solution of problems. It is a procedure involving first hand experiences with materials or facts derived from investigations or experimentation.

According to John Dewey the Laboratory method is an excellent vehicle for instruction.

Dr. Mangal described this method in the following words "students are encouraged to derive the laws and principles of science themselves actually performing the experiments".

It is mostly planned on an individual basis. But it can also be carried out in small groups.

**Objectives of laboratory method:** + To develop manipulative skills + To develop the skills of handling the apparatus + To train the students in scientific data + To develop scientific attitude + To develop the skill of experimentation

**Important principles of the laboratory method.**

+ The aims and objectives of the experiments should be clearly defined + The teacher and the students should be motivated to conduct the experiments with interest + The data should be recorded systematically and evaluated by the teacher + The teacher may modify some procedures to bring innovation and creativity into the process of experimentation.

**Methods of conducting the practical laboratory work**

Some common Methods of Grouping are :

**Group Method:** In this method the class is divided into small groups to carry out the experiments.

**Part Method:** This method is used when the experiment is very lengthy and is not possible to be conducted at a stretch.

**Role of a Teacher:** The teacher has an important role in this method. They develop the practical skills and scientific attitudes in the students

**Advantages:** + It develops manipulative skills + It gives training in scientific method + It develops the spirit of discovery + It solves the problem of indiscipline.

**Limitations:**

+ It is time-consuming + It is an expensive method + It demands intelligent and creative teachers

**5. Explain the scientific method (Inductive and Deductive approaches) of teaching biological sciences?**

**Ans :** The Important scientific methods are

1. Inductive approach
2. Deductive approach

**Inductive Approach:** The Inductive approach of teaching begins with a consideration of particular example, from the examination of which a general rule, definition or formula is established. For example : root modifications.

In this approach students are actively engaged in thinking for themselves and can have the joy of having discovered for themselves a rule, a generalization etc. It follows the principle "proceed from the particular to the general".

**Steps In Inductive Approach:**

+ Sense the problem + Arriving at a suitable solution  
+ Analyze the problem + Verify the solution + organize the Information

**The Inductive Approach Enables students to:**

+ Develop Interest in science  
+ Recognize the importance of science  
+ Enhance scientific knowledge and skills.

**Merits:** + Develops self-confidence and self-dependence

+ Develops scientific attitude + A logical method on learning by doing.

**Demerits:** + It is time consuming + It cannot be applied to all the topics of science

**Deductive Approach:**

While teaching science, to introduce a rule or generalization this approach can also be used. Here teacher gives general rule or formula and apply it to particular examples. This type of learning is having better results.

**Steps in Deductive Approach:** + Understanding the problem + Collecting Information + Reviewing the principles and generalizations + Proving concluding + Verifying the solutions

**Merits:** + It saves the time + It provides a get ready material  
+ It is suitable for primary classes.

**Demerits :** + It only encourages memorization of facts.  
+ Thinking will not be promoted + Self confidence is not encouraged.

**6. Explain the project method?**

**Ans :** Project method has its origin from the American Philosopher's Philosophy, which is popularly known as Pragmatism. John Dewey, who believes strongly in practical training for life, advocated this method. It is the outcome of his

philosophy. It is also a worthy expression of the practical genius of the American People. We must attribute to it something of the 'life is real, life is earnest'.

### What is an educational project?

'A problematic act carried to completion in its natural setting.'  
- Stevenson

'A project is a whole hearted purposeful activity proceeding in a social environment'.  
- Kilpatrick

'A project is a unit of activity in which pupils are made responsible for planning and purposing'.  
- Parker

### Main Characteristics of a Project

✦ Project is a purposeful activity. ✦ Real life activity. ✦ An activity in a social setting. ✦ Problem centered activity. ✦ An activity in a natural setting.

### Principles of the method :

**1. Principle of Purpose :** Before doing a thing pupils should know the purpose of it. It motivates learning. The more the use, the more the motivation to the students to do work.

**2. Principle of Activity :** Pupils love activity. The instincts of curiosity, construction, pugnacity, and working in groups make them active in nature. Therefore such opportunities should be provided to make them active and learn things by doing. Physical as well as mental activities are to be provided to them.

**3. Principle of Experience :** Experience is the best teacher. The children learn new facts and information through experience.

**4. Principle of Social Experience:** By providing work, some opportunity should be provided to learn social behavior.

**5. Principle of Reality:** To make education meaningful, experiences which are related to real life situation, should be provided. In project method real life situations are presented in the life of the school.

**6. Principle of Freedom :** The desire for an activity must be spontaneous and not forced by the teacher. He must be given freedom to choose an activity, and to do that activity

according to his interests, needs and capacities. The project method follows the principle.

**7. Principle of Utility :** Knowledge is worth while only when it is useful and practical. The project method develops various attitudes and values, which are of great significance from the practical point of view.

**Different types of Projects** W.H. Kilpatrick mentions four types of projects

**1. Producer type:** In this type of project, students are aimed at constructing an article or material. For example, constructing a working model of lung and constructing a garden.

**2. Consumer type:** Here by doing the project students get direct or vicarious experience. For example, playing a drama and learning stories.

**3. Problem type:** In this type students take up a problem and find out solutions. For example, why some diseases spread seasonally and can we grow a water plant on land?

**4. Drill type:** Pupils are aimed at attaining a certain degree of skill in a reaction. For example, drawing diagrams in science and getting perfection in exercise.

Thus the project involves all types of activity mental and manipulative.

### Steps Involved In a project

**1. Providing a situation:** The teacher creates a situation in which students feel the presence of the problem. The situation should preferably be social ones, the solution of which will result in genuine satisfaction to the individuals working them out.

**2. Choosing and Purposing :** Purposing is very important. It is the centre around which a project moves. This purpose must be acceptable to all the students of a class. The students themselves should choose the project. The teacher should not be in a hurry to choose project, sometimes the children may choose unwise or may want to do something that is like to prove a failure. The project which will have the most educative value and good value for all.

**3. Planning of the Project :** Careful planning leads to

better results. To get maximum benefit out of the project, it must be planned properly by the pupils, under the guidance of the teacher.

**4. Executing :** The teacher should help the students to divide the work and distribute it among them according to their interests and abilities. Every child should contribute actively towards the execution of the project. This step is really the longest step in the project and requires a great deal of patience on the part of the teacher and effort on the part of the pupils.

**5. Evaluation :** The students review the project and find out the mistakes if any. The pupils learn to criticize their own work and see if they can do it better or not.

**6. Recording :** They should write a complete record of all the work done by children in the project book. This should contain the details-how the situation was created, how they selected, planned and how it was done and finally criticism of their work. This record is useful for the future reference.

#### **Essentials of good project**

**1. Time:** Projects should be related directly to the lesson and vocational interest. Projects should suit the age of the students.

**2. Usefulness:** The work done through project should be useful to the students in their lives.

**3. Interesting:** The project should be neither too simple nor too difficult. Youth are interested to do tasks, which are challenging in nature.

**4. Economical:** Project should not tax the pocket of the students. It should be economical.

**5. Rich in experience:** The project selected should be capable of correlating different subjects and practical activities of life.

**6. Cooperativeness:** Project should be the result of cooperative efforts of all the students of the group and the teachers.

#### **Example for this method**

##### **The study of the importance of Nutritious Food**

##### **Step1. Creating situations**

To make students aware of the value of nutritious food, the teacher can take students to near by hospital and ask the students to interview the patients (who are suffering from lack of nutritious food) and doctors. With the talk with the patients and doctors, students notice the importance of food to some extent, and they will get some doubts regarding the food items having nutritious value.

##### **Step2. Choosing the problem**

After returning from the hospital, students ask the teacher about their doubts. By clarifying their doubts, teacher raises the point that everybody should know something about the nutritious value of various food items. So the students take this as their project work and they are interested to enquire information about it.

##### **Step3. Planning the problem**

Then all the students sit together and plan the things to be done to prepare the project report. They discuss the procedures to be adopted to get information, persons to be consulted, experiments to be conducted and expense of the project etc. Teacher helps the students by giving guidance in selecting procedure and selecting resources of information.

##### **Step4. Execution of project**

Here the teacher according to their interests and capabilities assigns students duties. Students distribute work in the following way:

a. Some students will go to the shops and fast food centers and note the details of different food items and their nutritious values given on the bottles and packets.

b. Some students will get information a physician about the values of different items, and the importance of proteins and vitamins to our body.

c. Some students will refer books and collect information.

d. Some students will discuss the issue with experts in this field.

e. Some students study experimentally the contents of different food items.

Like this students distribute their work and collect information from different sources.

### **Step 5. Evaluation**

After completing their work, every student checks his work whether the work done by him is satisfactory or not, relevant to the project or not and correct or not. This type of self-evaluation provides best training for learning.

### **Step 6. Report**

By organizing all the information collected by students a detailed report will be prepared about the "importance of nutritious food in maintaining health" and nutritious values of different food items. In this report the procedure they followed at each and every step will also be given clearly.

Thus by completing a project, they get the knowledge of different subjects also.

1. They will get some knowledge about human physiology by knowing the processes that will go on in the body due to lack of sufficient nutritious food.

2. Botany - they will know different plant products and their importance.

3. Economics - cost and price of food items

4. Chemistry - Chemical combination of food items.

### **Role of the Teacher**

1. The role of the teacher in this project method is neither a director nor a dictator. Teacher should assist at every step of this method.

2. The teacher must be on the lookout of discovering their interests, tastes, aptitudes, and needs, thereby he will provide situation to the students to select the problem.

3. The teacher has to act as a friend and a guide.

4. The teacher should see that the pupils do not lose their interest.

5. Planning and execution should be under the guidance of the teacher.

6. The relation of the teacher with students is closer in the project method.

7. The teacher must stimulate the shy students to put their best.

8. The teacher must see that the project is carried on in a democratic way.

9. The teacher should have adequate knowledge of the project.

### **Merits**

1. It follows the laws of learning.

2. It gives freedom to the pupils. This freedom provides the child to learn to improvise, to invent, to experiment, and to acquire knowledge in all possible ways.

3. This method upholds the dignity of labour and makes the pupils to have a respect for the workers of the world.

### **Limitations**

1. A teacher finds it difficult to guide the project in such a way that the proper development of the different subjects takes place.

2. Some teachers may think that project method means that the children are to make models and engage themselves in hard work.

3. Textbooks and materials written on the lines of project method are not available.

4. It absorbs a lot of time with the resultant quantity of knowledge suffers.

**Application:** This method is suitable for teaching primary and lower middle classes and unsuitable for high and higher secondary classes. The problem of expenditure can be easily solved by taking a project in which earning is possible. All the

problems of insufficient, superficial and disorganized knowledge will be solved if provision is made for the ordinary class teaching.

**7. What is the meaning of objectives? Write the importance of objectives?**

**Ans : Meaning of objectives:** The aims of education which can be achieved in a school are called as objectives. An objective is a part of an aim. Objectives are immediate attainable goals. Objectives make a teaching program meaningful. They indicate the behavioral changes in the pupil after completion of instruction.

**"Objective as an end towards which a school sponsored activity is directed - Good, C.V**

**Objectives of Teaching Biology:** + Providing advanced information. + Providing practical knowledge of the content + Stimulating the spirit of Investigation and Invention

**Characteristics of objectives:**

+ Measurable + they should be content oriented + They should be able to test + According to student's abilities.

**Importance of Objectives:**

The objectives are important because

+ Helps in modifying the goals + Guide student's learning + Help the teacher in instructional planning + They enable construction and usage of valid and reliable tools for evaluating student achievement of the objectives + They help the teachers to identify the goals that they want to include in the curriculum.

**8. Write about revised Blooms taxonomy of educational objectives?**

**Ans :** The original Bloom's taxonomy was revised in 1990 by Lorin Anderson and it was published in 2001.

**Terminology changes:** Bloom's six major categories were changed from noun to verb forms. Additionally the lowest level of the original, knowledge was renamed and became remembering. Comprehension and synthesis were retitled to understanding and creating. In an effort to minimize the confusion, comparison images appear below.

## UNIT - 5

### PLANNING FOR TEACHING BIOLOGICAL SCIENCE

**1. What do you mean by year plan ? How do you prepare it ?**

**Year Plan:** The subject to be presented through out the year is prepared in the form of syllabus. The portion of syllabus, which is to be completed in every month, should be planned and this is known as "year plan". It should be done before starting the academic year.

**Procedure of preparing year plan:**

1. The whole syllabus should be divided into certain workable portions called units. 2. The objectives to be achieved through each unit should be selected. 3. The content to be presented in each unit should be collected. 4. Then the total time allotted to the subject should be calculated. 5. Time required for each unit and the activities to be taken in each unit should be decided.

**Factors to be considered for teaching biology:**

1. Objectives to be achieved through the teaching of biology in a year. 2. Time required for each unit. 3. Total number of working days available. 4. List of holidays. 5. Local holidays, optional holidays dates required for conducting exams, casual leaves of teacher. These are to be deleted from the total number of working days and with the remaining days the work of the subject should be adjusted.

**Proforma of Year Plan**

Class : ..... Subject : ..... Year : .....

Total periods obtained : ..... Name of the Teacher .....

Month	Unit	Periods	Resources	Activities to be organized (According to C.C.E.)

**Year Plan (C.C.E. Model Annual Plan - IX class)**

Month	Unit	Periods	Resources	Activities to be organized (C.C.E)
June	Cell its structure and functions	10		
June/July	Plant tissues	11		
July	Animal tissues	11		
August	Plasma Membrane	10		
Sept.	Diversity Inliving Organisms	11		
October	Sense Organs	13		
Nov.	Animal behaviour	09		
December	Challenges In improving agricultural products	10		
January	Adaptation in different eco-systems	10		
February	Soil Pollution	11		
March	Bio-geo-Chemical cycles	10		

**Advantages:** + To finish the syllabus in time + Teacher can arrange activities according to the time availability + It is very useful to the teacher as the scheme of the year is very clear

**2. Define unit? Explain the steps in unit planning/ lesson plan.**

**Ans : Unit plan (or) lesson plan :**

The planning for a unit is known as unit plan. A unit may have several lessons a unit also includes the procedure of presentation of the subject matter that means the unit is not only a block of content but also a method in it self

**"Unit is as large a block of related subject matter as can be overviewed by the learner" - Preston**

**"A unit is an out line of carefully selected subject matter. Which has been Isolated because of its relationship to pupils needs and interests - Samford**

**Characteristics of a good unit:** 1. The aims should be clear and well defined 2. It should consider the previous experiences of the students 3. It should keep in view the needs, capabilities and interests of the students 4. It should have similar type of content

**Steps Involved in developing a unit:**

**1. Preparation:** By knowing the overall idea of a unit by the teacher, pupils are motivated.

**2. Knowing the previous experiences:** The second step that should follow motivation is testing the previous knowledge of the students.

**3. Presentation:** This step provides new experiences to the students

**4. Organization of the learning:** Students should be provided opportunities to organize their learning.

**5. Summarization:** At the end of the unit, the entire unit is summarized in a systematic order to bring all the learning together.

**6. Review and drill:** For this review of the unit or reteaching of main points, drilling for difficult points should be done

**7. Evaluation:** This last step is meant to check the achievement levels of the students

**Advantages:**

✦ It creates Interest and curiosity in the learners ✦ It is based on aims and objectives of teaching ✦ It develops the content knowledge in the teacher

**Disadvantages:**

✦ Evaluation is difficult to do at lower stages  
✦ It requires committed and hard working teachers

**C.C.E Model unit plan**

**Class :**                      **Subject :**                      **No.of Periods**  
**Name of the Unit :**

Period	Concept	Teaching Strategies	TLM	Evlauation/ C.C.E.

**3. Explain the Herbartian and constructivist approach**

**Ans : Herbartian Lesson Plan :** The Herbartian steps of approach in the preparation of lesson plan are one of the most frequently used methods in most of the teacher education institutions. The major contribution of the Herbartian movement was the class lesson plan suitable for any class size or organization. The lesson plan reflected a conceptualization of education that placed an emphasis on order and planning, which were necessary to fit the requirements of large classes. According to Herbart, the best method of instruction is to present material that is related to a previous interest of the student. Herbart's theory denies the existence of faculties and emphasizes the unique role of subject matter in the development of mental and moral abilities

John Fredrik Herbart a German philosopher and a great educationist divided teaching units into five steps. His approach is based on a perceptive mass theory of learning and greatly influenced by classical Human Organization theory. Although the previous knowledge of the students is taken into consideration, the other aspects such as their abilities, attitudes, and values are not considered. But still this the method of approach that is widely used in teaching of various school subjects.

Herbart(1776-1841) combined Enlightenment ideas of reason with the growing faith in systematic approaches, planning, and organization

**The Herbartian Lesson Plan-Steps**

✦ Remind students of knowledge already learnt  
✦ Present new materials  
✦ Compare new materials to prior knowledge  
✦ Generalize a central idea  
✦ Apply the new knowledge to some other situation.

✦ Find the effectiveness of teaching through recapitulation

This approach employs six steps, which are generally called as the Herbartian steps of lesson planning. They are as follows:

**1. Preparation or Introduction** The student should be in a position to acquire the new knowledge that is imparted to him/her. For this purpose, the teacher should acquaint himself or herself with the previous knowledge of the student so that they can correlate the new knowledge with the earlier knowledge. This helps in bridging the gap and leads a student towards the aim of the lesson. A teacher can do this:

✦ By analyzing the previous knowledge of the student of the student and introducing the new lesson by explaining its aims and objectives.

✦ By asking relevant questions that exposes their ignorance and arouses interest and curiosity to learn more and something new.

✦ By using different types of teaching aids such as charts, maps or pictures.

✦ Through skillful conversation.

The teacher should keep in mind that this step should be short and concise and the duration of this step should not exceed five minutes.

*How can a teacher start the lesson?*

✦ By asking two or three interesting questions. ✦ With help of aids that is pictures, charts or models. ✦ By asking questions from the content-matter previously taught. ✦ By discussing a situation and illustrating it. ✦ With the help of a relevant story.

**2. Presentation** Presentation of content-matter should be preceded with the mention of aim of the lesson. Once the aim of the lesson is made clear to the students of the classroom, both the students and the teacher have a common focal point to concentrate and that is to reach the objective of the lesson. This is the step where there is equal participation of students and the teacher in the teaching learning process. A sort of heuristic attitude prevails during the whole teaching process. Questioning becomes one of the most important devices that is used in this method. Use of other teaching aids can enhance the interest of the students towards the lesson and it can be made comprehensive. Development of blackboard summary is also necessary.

**3. Comparison or abstraction** Some illustrations are given to the students and they are asked to compare them from other illustrations or facts. This is one of the important steps, which compels a student to draw a generalization or a definition based on the results of the comparison or abstraction.

**4. Generalization or definition** This step is as a result of the reflective thinking of the students. The knowledge gained in the earlier steps is used in this step to draw generalizations.

**5. Application** This is the step where students use the acquired knowledge in favorable and unfavorable situations. The validity of the generalization is determined, whether it is permanent or temporary. The generalization stays in the minds of the students and do not leave their consciousness soon.

#### Forms of application

- ✦ Solving problems.                      Preparing some models.
- ✦ Writing an essay or an article.      Doing some practical work.
- ✦ Drawing maps or charts.              Setting of new type tests.

**6. Recapitulation** This is last step. Putting some suitable questions on the topic to the students can test the understanding and comprehension of the subject matter taught by the teacher. This will also help the teacher to find out whether his method of teaching is effective and successful or not.

#### Merits of Herbartian lesson plan

**The following are the advantages of the Herbartian lesson planning approach:**

- ✦ It follows logical and psychological aspects and therefore incorporates the basic principle of learning.
- ✦ It is an easy and simple approach of lesson planning.
- ✦ Content-matter is given utmost importance.
- ✦ It employs deductive thinking in learning.
- ✦ It is the method that can be used to teach any subject of the school science subjects social studies, and languages.

**Demerits of Herbartian Lesson Plan** Although the Herbartian lesson plan is the most widely used approach in lesson planning, it has some demerits. They are as follows:

- ✦ It mainly emphasizes on the content-matter.
- ✦ It confines teaching only to memory level.
- ✦ It ignores the attitudes, and requirements of the students.

**Constructivist Approaches** Constructivism is an epistemology, a learning or meaning making theory, which offers an explanation of the nature of knowledge and how human beings learn. It maintains that individuals create or construct their own new understandings or knowledge through the interactions of what they already know and believe and ideas, events and activities with they come in contact (Canella & Reiff, 1994; Richardson, 1977).

Constructivist learning is based on student's active participation where they are "constructing" Their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new situation and integrating the new knowledge and experience, applying these to new situation and integrating the new knowledge with pre-existing intellectual constructs.

**Characteristics of constructivist learning and teaching** Honebein (1996) describes seven goals for the design of constructivist learning environments:

1. Provide experience with the knowledge construction process.
2. Provide experience in and appreciation for multiple perspectives.

3. Embed learning in realistic and relevant contexts.
4. Encourage ownership and voice in the learning process.

**Lesson Planning in constructivist's Approach** The various types of constructivist's Approach lesson plans are developed by the many of the scholars. They are 4E's, 5E's, 7E's, 9E's etc., models. The lesson plan was developed using constructivist's 5E's model of planning the lesson. The Biological Science Curriculum Study (BSCS), a team whose Principal Investigator is Roger Bybee developed an instructional model for constructivism, called the five "E's". The following steps were considered for planning the lesson.

Step 1: Planning for Engage

Step 2: planning of Student Exploration

Step 3: Planning for Explain

Step 4: Planning for Elaborate

Step 5: Planning for Evaluation

#### **Teachers Activity**

**1. Engage:** Capture the students' attention, stimulate their thinking and help them access prior knowledge.

**2. Explore:** Give student's time to think, plan, investigate and organize collected information.

**3. Explain:** Involve students in an analysis of their explorations. Use reflective activities to clarify and modify their understanding.

**4. Elaborate:** Give students the opportunity to expand and solidify their understanding of the concept and/or apply it to a real-world situation.

**5. Evaluate:** Evaluate through the lesson. On-going process will be both instructor and learner to check for understanding.

**Planning and Learning Cycle** The above lesson planning "5Es" model was adoption from the Biological Science Curriculum Study (BSCS) and Teacher Activity model from e MINTS Staff Revised October 16,2008 was used focusing on a concept, helping learners to construct meaning and encouraging them to expand understanding of that fundamental meaning.

#### **4. Classify the learning experiences**

**Ans :** Learning Experiences is Interaction between the learner and the content and not a part of syllabus or mere activity.

**Classification of learning Experiences:** All the learning experiences that the man beings derive are mainly from three sources namely

1. Direct sensory contact which involves doing
2. Pictures or some other forms of representation of object (Indirect) Involve observing.
3. Oral or printed words which Involve symbolizing

Edgar dale in his 'cone of Experience classifies all the learning experiences, which can be utilized for classroom teaching.

**1. Direct, purposeful experience:** These experiences are not only direct but are also purposeful

**2. Vicarious experience or contrived experience:** Some of the teaching aids are substitutes of real objects

**3. Indirect Experience:** All the visual and audiovisual aids provide indirect experience

**4. Symbolic Experience:** It encourages abstract thinking

**Methods for developing learning Experiences:** There are two methods for developing learning experience

**1. The contrast method:** Here the teacher divides the students into two groups Experimental group and control group

**2. The Identification method:** Here the teacher puts himself in the position of the person, who has understood the content and tries to reveal his behaviour in that position.

#### **Sources of learning Experiences:**

+ Home + Society + Peer group + School + Mass media

#### **Characteristics of good learning experiences:**

+ Effective + Meaningful + Economical + Related to the content

**5. Write about the planning ICT Applications in learning biology**

**Ans** ICT is a diverse set of technological tools and resources used to communicate and to create, disseminate, store and manage information.

ICT refers to a technology employed in the form of tools element and application support which helps in the collection, storage, retrieval transmission, manipulation and dissemination of Information as accurately efficiently as possible for the purpose of enriching the knowledge and develop communication, decision - making as well as problem solving ability of the user.

**Essential conditions for ICT Integration:**

1. Shared vision
2. Standards and curriculum
3. Required policies
4. Access to ICT hardware, software and other resources
5. Trained personnel
6. Technical assistance
7. Appropriate teaching and assessment approaches

**Approaches to Integrate ICT in learning Biology:**

1. Directed approaches/models
2. Constructivist approaches/models