

# **NEHRU COLLEGE OF EDUCATION**

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## **TWO YEAR B.Ed. DEGREE PROGRAMME (NON -SEMESTER)**

### **I - YEAR**

## **PEDAGOGY OF BIOLOGICAL SCIENCE – PART 1**

**STUDY MATERIAL BASED ON PONDICHERRY UNIVERSITY SYLLABUS  
(WITH EFFECT FROM 2015-2016)**

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# **FIRST YEAR SYLLABUS**

## **COURSE - 7(IX) PEDAGOGY OF BIOLOGICAL SCIENCE – PART 1**

### **Unit 1: Nature of Science**

Historical background of science – origin its Meaning, Scope, Nature -Science as a dynamic and expanding body of knowledge-Science as an interdisciplinary approach-correlation of science subjects – Science as a process of enquiry and a process of constructing knowledge – Science to the society-Value development- Intellectual, Utilitarian, aesthetic, disciplinary, training in scientific attitude, vocational.

### **Unit 2: Aims and objectives of teaching Biological Science**

Aims of learning Biological Science Objectives of teaching at Secondary school level-Difference between Instructional Objectives and Learning Objectives – Learning objectives-General objectives-Specific objectives based on Bloom's taxonomy – Mastering on Collaborative vs Constructivist Perspectives in planning the lesson plan

### **Unit 3: Curriculum in Biological Science**

Meaning –Curriculum Framework – Curriculum and Syllabus – Principles of curriculum construction – Approaches to curriculum – Development. – Recommendations of National curriculum frame work on science curriculum-Analysis of Biological science syllabi and textbooks of NCERT.

### **Unit 4: Teaching skills**

Teaching Skills – meaning, analytical approach to understand teaching learning process in biological science in terms of teaching skills – relevant teaching skills in teaching of biological science – core teaching skills, meaning, components, observation procedure, writing lesson plan, for the following core

teaching skills –Skill of Introduction – Skill of Explaining – Skill of probing questioning – Skill of demonstration - Skill of reinforcement -Skill of Stimulus Variation. Skill of black board – micro teaching as a technique for acquiring teaching skills – Link lesson practice

### **Unit 5: Learning resources**

**Science Textbook:** Characteristics and evaluation of a good science textbook – use of text book

**Science library:** values, book selection and organizing library work in science.

**Science museum:** importance, essential and desirable item - preparation of museum materials, organization and management.

### **Unit 6: Organizing science related activities**

Science club – Field trips/Excursions – Science Fairs/Exhibitions – Science hobbies – educational values

### **Unit 7: Methods of teaching biological science**

Lecture method, Lecture-cum-Demonstration method.- laboratory method, - Project method, Heuristic approach, – Historical and Biographical approaches- Scientific method-Team-teaching. – Remedial teaching.

### **Unit 8: Facilitating Individual learning strategies**

Individualization of instruction – Programmed Instruction-linear and branching type-Computer Assisted Instruction. – Role of Multimedia in teaching biological science.

### **Unit 9: Lesson plan**

Lesson Planning – Essential features of Lesson Planning – Steps in Lesson Planning –Preparing Lesson Plan –different models/approaches for writing lesson plan - Unit Plan - Steps in Unit Planning

## **Unit 10: Content and pedagogical analysis**

Analyze the content in science books for standard VI to IX from lesson plan point of view and Concretization of concepts – pedagogical analysis of selected concepts for learning.



## UNIT 1

### NATURE OF SCIENCE

#### Background of Science and its Origin

The history of science is the study of the development of science, including both the natural and social sciences (the history of the arts and humanities is termed history of scholarship). Science is a body of empirical, theoretical, and practical knowledge about the natural world, produced by scientists who emphasize the observation, explanation, and prediction of real-world phenomena. Historiography of science, in contrast, studies the methods employed by historians of science.

The English word *scientist* is relatively recent, first coined by William Whewell in the 19th century. Before that, investigators of nature called themselves "natural philosophers". While observations of the natural world have been described since classical antiquity (for example, by Thales and Aristotle), and the scientific method has been employed since the Middle Ages (for example, by Ibn al-Haytham and Roger Bacon), modern science began to develop in the early modern period, and in particular in the scientific revolution of 16th- and 17th-century Europe. Traditionally, historians of science have defined science sufficiently broadly to include those earlier inquiries.

From the 18th through the late 20th century, the history of science, especially of the physical and biological sciences, was often presented as a progressive accumulation of knowledge, in which true theories replaced false beliefs.<sup>[4]</sup> More recent historical interpretations, such as those of Thomas Kuhn, tend to portray the history of science in terms of competing paradigms or conceptual systems within a wider matrix of intellectual, cultural, economic

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and political trends. These interpretations, however, have met with opposition for they also portray the history of science as an incoherent system of incommensurable paradigms, not leading to any actual scientific progress but only to the illusion that it has occurred.

## **Meaning**

Science is the the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment.

## **NATURE AND SCOPE**

Biology has certain characteristics which distinguish it from other spheres of human endeavour. These characteristics define the nature of biology. Humans have always been curious about the world around them. The inquiring and imaginative human mind has responded to the wonder and awe of nature in different ways. One kind of response from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world. This human endeavour is Biology. But Biology is ultimately a social endeavour. Biology is knowledge and knowledge is power. With power can come wisdom and liberation. Or, as sometimes happens unfortunately, power can breed arrogance and domination. Biology has the potential to be beneficial or harmful, emancipative or oppressive. History, particularly of the twentieth century, is full of examples of this dual role of Biology.

In a progressive forward-looking society, Biology can play a truly liberating role, helping people out of the vicious circle of poverty, ignorance and superstition. Biology, tempered with wisdom, is the surest and the only

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way to human welfare. This conviction provides the basic rationale for Biology education.

Science promotes scepticism; scientists are highly sceptic people. Scientists look at everything with suspicion. Every new observation or a new theory is received with a lot of scepticism. It leads to a lot of debate among scientist. A new observation is accepted only when experimental observations have been checked by independent individuals or groups at various places with identical results. Similarly, a new theory is accepted when theoretical calculations have been repeated by other scientists independently with identical results.

Science, and biology in particular, holds several foundational values that should be conveyed to students as they pursue careers as scientists or science teachers. Science is a dynamic, expanding body of knowledge

Science is a dynamic, expanding body of knowledge, covering new domains of experiences. It is a human endeavour to understand the world by building - up conceptual models on the basis of observations and thus arriving at theories, laws and principles. In a progressive society, science can play a truly liberating role, helping people escape from the vicious cycle of poverty, ignorance and superstition. People today are faced with an increasingly fast - changing world where the most important skills are flexibility, innovation and creativity. These different imperatives have to be kept in mind in shaping science education. Good science education is true to the child, true to life and true to the discipline.

As consistent with the stage of cognitive development, science is being taken as core subject in the curriculum at upper primary stage. At this stage, it is a

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gradual transition from environmental studies of the primary stage to the elements of science. It is important to expand the horizon of child gradually and start with things that are within the direct experiences of child. The child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and models and continuing to learn more about the environment and health, including reproductive and sexual health. Scientific concepts are to be arrived at mainly from activities, experiments and surveys. Group activities, discussions with peers and teachers, surveys, organisation of data and their display through exhibitions, etc., in schools and the neighbourhood should be important components of pedagogy.

Science is based on at least four fundamental values:

- Curiosity is good and should be encouraged.
- Knowledge itself is good—it is good to acquire knowledge.
- It is wrong to falsify or fabricate the data on which knowledge is based.
- It is good to keep an open mind (to be willing to examine and consider new evidence and arguments), tempered by a vigilant level of scepticism.

Curiosity is surely the most essential trait a scientist can possess. Curiosity leads to a search for knowledge for its own sake, which is the driving force behind the great majority of scientific discoveries ever made. Acquiring knowledge for curiosity's sake leads naturally to the second value that knowledge is good— not because it may be useful in some pragmatic way, but simply because it increases our store of knowledge about the universe in which we live. Staying open-minded and sceptical is certainly a value and goal for all scientists, provided that one's open-mindedness is reserved for objective evidence, as opposed to subjective opinion.

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Curiosity can be a hard sell because, sadly, many of today's students seem to lack curiosity about the world and universe outside their personal spheres of relevance. Even at the college level, many students appear to have no interest in learning about anything as remote as stellar evolution, photosynthesis, Krebs cycle, the Burgess Shale fossils, hydrothermal vent communities, lateral gene transfer, the bacterial origin of mitochondria, and so on. Yet these topics would not seem remote if they were approached in a creative and spirited manner.

Most investigations in science involve some form of scientific method. It shows creativity of humankind in seeking solution to its problems. The approach used by the scientists in the study of astronomy and ecology is observation and prediction. In microbiology they rely on laboratory experiment focused on cause and effect relationship. This is a glimpse of the process by which science works. The essential elements of this process have been collected in what is known as scientific method.

In science, experimentation and theory building complement each other. Sometimes a new experiment throws up observations which force modification in an existing theory or demand the development of an altogether new theory. At other times, theoretical development in a theory predicts new phenomena which needs to be verified by experiment. This interplay between theory and experiment is a fascinating facet of the scientific process.

Broadly speaking, science is a particular way of looking at nature, which may also be called scientific attitude. One of the most important characteristics of science is that even the most established theories can be modified, or even abandoned, if new experimental results do not fit into the existing theories. This promotes scepticism among scientists. They look at every new observation or theoretical calculation with a healthy dose of

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scepticism and do not accept it till the result has been reproduced by many scientists at various places. Reproducibility is one of the important criteria for a scientific result to be acceptable. It is believed that scientists, in their exploration, employ inquiry and scientific method. The use of scientific method and inquiry in daily life promotes scientific temper and rationality. That is why it has been emphasised that all of us should imbibe the spirit of scientific inquiry in our personal lives. So, science can never belong to a country or region. It belongs to the whole mankind.

### **Science is a dynamic and expanding body of knowledge**

1. Science is the dynamic, ever expanding knowledge, covering every new domain of experiences.
2. Knowledge refers to the product of science, such as the concepts and explanations.
3. Research being carried out in the field of science resulted in developing more knowledge at a faster pace sometimes by replacing old concepts, ideas or principles.

The technological developments that took place in recent times enhanced the acceleration of knowledge.

### **Science as an interdisciplinary approach**

The interrelationships between biology and other different disciplines of science cannot be arguably denied. Every branch of science relates to all other branches of science in certain ways. At last, the study of Biology revolved around morphology of living things and their classifications based on similarities and differences of their characteristics. Presently, biology has expanded our knowledge base about living beings to a molecular level. Researches in biology confirm that living organisms are made of molecules, atoms and organic macromolecules. Also, it justifies that the life processes within the body of a living thing take place due to interactions of particles.

## Correlation of science subjects

### Relation with Chemistry:

- Body of all living organisms is made up of organic and inorganic compounds.
- All the metabolic activities inside the body of living beings involve chemical reactions and chemical changes.
- Genetic materials DNA and RNA are also chemicals.
- Enzymes and hormones produced in the body of living organisms are also exclusively chemicals.
- Acid-base equilibrium in a cell maintains the pH of the protoplasm for proper functioning.
- Molecules move in and out of the cells by diffusion and osmosis.

### Relation with Physics:

- Biological instruments such as microscopes, X-rays, ECG etc. are based on the principles of physics.
- Light induces various effects on living organisms.
- Study on the structure and functioning of human eye require knowledge of optics.
- Physical techniques such as: electron microscopy, X-ray diffraction, fractionation, Chromatography etc. have made possible the study of finer details of cellular and sub-cellular components.

### Relation with Geography:

Distribution of plants and animals vary different geographical factors. e.g. Climate, altitude, temperature, etc.

### Relation with Mathematics and Statistics:

Census of wild animals is based on application of mathematical and statistical

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applications. Such applications are helpful in data compilation and analysis of living organisms.

### **Relation with Sociology:**

Study of human behavior, social relationship and antisocial relationships needs idea of biological science. For example, investigation on criminals and terrorists requires the study of human nervous system and study of glands, hormones, etc. It also requires the knowledge of principles of inheritance, pedigree analysis, etc.

### **Science to the society**

In broad terms, there are two possible goals for engaging the policy process and two primary strategies for achieving those goals. The goals are either to improve policies that affect science (policy for science) or to improve policies that can benefit from scientific understanding (science for policy). Scientists attempt to achieve their goals by either providing information (i.e., educating policy makers about science) or by championing particular policy outcomes (e.g., by using persuasive arguments, political pressure, or positive incentives to achieve particular policy goals).

These goals and strategies for policy engagement can be combined in different ways and they aren't necessarily exclusive: some combine both goals and strategies simultaneously. However, the different goals and strategies confer different risks and opportunities and tensions can arise among those whose goals and strategies differ.

Most scientists recognize that the pursuit of objectivity in research, though perhaps impossible for any human to fully achieve, is a cornerstone of science. Science generates knowledge and understanding by attempting to eliminate potential sources of bias, often through controlled experiments. This pursuit of

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objectivity increases the credibility of scientific advances and expands society's willingness to take up and use the new knowledge and understanding science provides.

### **Intellectual value**

The study of science provide us the opportunity of developing our mental faculties of reasoning, imagination, memory, observation, concentration, analysis, originality and of systematic thinking.

### **Disciplinary value**

Science makes us think seriously 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.

### **Cultural value**

The change in our life-style is due to the inventions of science. The development of culture is the history of science. We can judge the progress of civilization and culture of a nation by its progress in science. Science not only develops our culture but also helps in preserving it.

### **Moral value**

The qualities of honesty of purpose, truth, justice, punctuality, determination, patience, self- control, self-respect, self-confidence and tolerance are automatically developed in man if he follows scientific method in his pursuit of knowledge in science every conclusion depends upon tests and actual observations and not by cheat and deceit.

### **Aesthetic value**

Science is beauty, art, a source of entertainment and a successful means of attaining physical comforts.

### **Social value**

Today's society stands on pillars of scientific techniques and knowledge. All

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our social activities depend upon science. Science is essential for the progress of our society and nation.

### **Vocational value**

Science has opened vast vistas of vocations, because scientific principles and inventions have become so universal and pervasive in our daily life. Scientific inventions have now helped widely all the traditional vocations nowadays like – agriculture, poultry farming and dairy farming. Science has also revolutionized modern vocations like – telephone, radio and television broadcasting etc.

### **Training in scientific attitude**

A scientific attitude is an attitude which will tend to foster scientific achievement. The scientific attitude is indeed closely related to the scientific method, for the attitude gives rise to the method, and the method gives evidence of the attitude. It is this close relationship which has led to the confusion.

Science provides training in scientific attitude through the following characteristic features :

- Curiosity.
- Honesty.
- Open-Mindedness
- Skepticism. ...
- Creativity.



**UNIT - 2**

**AIMS AND OBJECTIVES OF TEACHING  
BIOLOGICAL SCIENCE**

**Aims of learning Biological Science**

The science which deals with the study of living objects is called Biology. Thus the subject involves the studies of all kinds of micro-organisms, plants and animals. Biology is related to mankind ever since the origin of man, therefore this branch of science stands first in order of studies as compared to other branches of science. Ever since the origin of life man is eager to know about various phenomenon of life processes such as health and disease, birth, growth and death. However, man depends on plants and animals for food shelter and clothing which are immediate needs of life, come from Biology.

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 now days it is mostly centralized with the study of agriculture, animal husbandry, health and microbiology and related branches.

**AIMS AND OBJECTIVES OF TEACHING BIOLOGICAL SCIENCE IN  
SECONDARY SCHOOL LEVEL**

Aims of education is to

- ✓ Help students to become responsible democratic citizens of the country.
- ✓ Responsibility of science teachers is not only to teach facts, principles and processes of science,
- ✓ Facilitate students to discharge their social responsibilities and preserve democracy as well.
- ✓ Appreciate how science and technology have developed and are

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affected by many diverse individuals, cultures and societies.

- ✓ Encouraged to appreciate and participate in the responsible use of science and technology for the benefit of society
- ✓ Visualize future of our nation and to become sensitive and responsible citizens.

Science has been developed by people who are part of a group, society or a country, it is expected that their social, psychological, political, economic perceptions could change the course of development of science.

The science education is aimed for the learner to:

- ✓ Acquisition of knowledge and understanding
- ✓ Development of skills
- ✓ Development of scientific attitude
- ✓ Development of thinking abilities
- ✓ Nurturing curiosity
- ✓ Nurturing creativity
- ✓ Nurturing aesthetic sense
- ✓ Assist students in developing models of inquiry and discovery;
- ✓ Guide students in the use of multidisciplinary approach;
- ✓ Recognize and appreciate creative ideas and products of students;
- ✓ Provide rich variety of learning experiences to students;
- ✓ Encourage students to frame questions and browse variety of reading materials; and
- ✓ Express to the students that their ideas have value

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- ✓ Flexible and divergent thinking
- ✓ Decision-making and generating self-confidence;
- ✓ Accepting/rejecting hypothesis;
- ✓ Correlating between various quantities/phenomena;
- ✓ Checking the validity of results;
- ✓ Expressing the task in terms of goal
- ✓ Creating new challenges for life; and
- ✓ Developing positive and cooperative attitude.

### **Difference between Instructional Objectives and Learning Objectives**

#### **Instructional objectives**

An instructional objective is a statement that will describe what the learner will be able to do after completing the instruction. (Kibler, Kegla, Barker, Miles, 1974).

According to Dick and Carey (1990), a performance objective is a detailed description of what students will be able to do when they complete a unit of instruction. It is also referred to as a behavioral objective or an instructional objective.

Robert Mager (1984), in his book *Preparing Instructional Objectives*, describes an objective as "a collection of words and/or pictures and diagrams intended to let others know what you intend for your students to achieve" (pg. 3). An objective does not describe what the instructor will be doing, but instead the

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skills, knowledge, and attitudes that the instructor will be attempting to produce in learners.

- Instructional objectives are specific, measurable, short-term, observable student behaviors. They indicate the desirable knowledge, skills, or attitudes to be gained.
- An instructional objective is the focal point of a lesson plan. Objectives are the foundation upon which you can build lessons and assessments and instruction that you can prove meet your overall course or lesson goals.
- Think of objectives as tools you use to make sure you reach your goals. They are the arrows you shoot towards your target (goal).
- Begin with an understanding of the particular content to which the objectives will relate.
- The purpose of objectives is not to restrict spontaneity or constrain the vision of education in the discipline; but to ensure that learning is focused clearly enough that both students and teacher know what is going on, and so learning can be objectively measured. Different archers have different styles, so do different teachers. Thus, you can shoot your arrows (objectives) many ways. The important thing is that they reach your target (goals) and score that bulls eye!

### **Learning objectives**

Learning objectives are statements that define the expected goal of a curriculum, course, lesson or activity in terms of demonstrable skills or knowledge that will be acquired by a student as a result of instruction.

The Learning objective or objectives that you use can be based on three areas of learning: knowledge, skills and attitudes. Learning objectives define learning

outcomes and focus teaching. They help to clarify, organize and prioritize learning.

### **LEARNING OBJECTIVES**

#### **General objectives-Specific objectives based on Bloom's taxonomy**

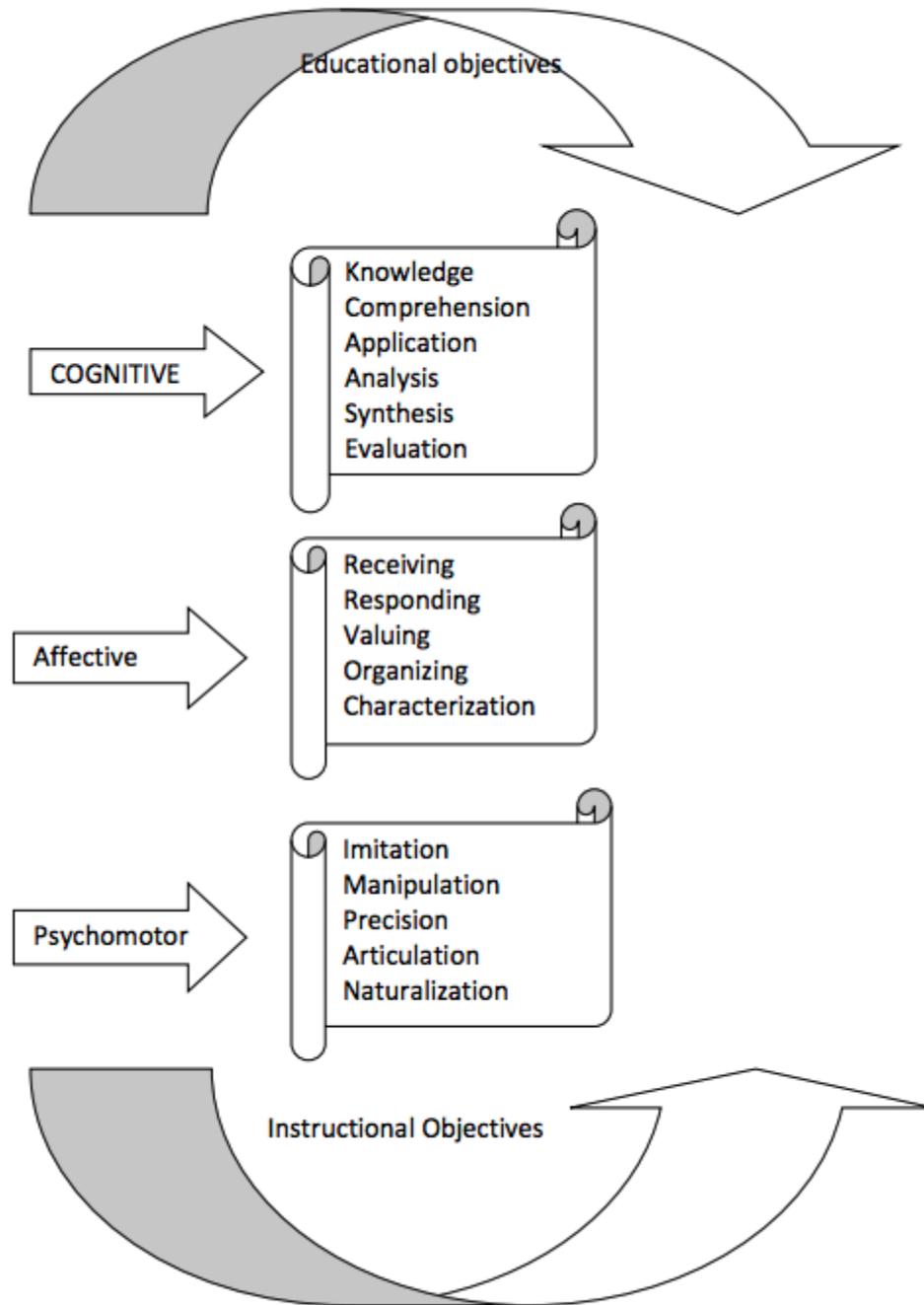
The word taxonomy derived from the Greek word 'taxis' which means systematic classification. Prof. Benjamin S Bloom and his associate, University of Chicago developed and classified the domains of educational objectives. Bloom (1956) presented his taxonomy related to cognitive domain giving emphasis to the hierarchy of cognitive process in attaining knowledge and development of thinking. Later Krathwhol (1964) introduced affective domain and Simpson (1966) developed psychomotor domain. They described the hierarchical development of the three domains of the learner through instruction. This classification objective is known as Blooms taxonomy of educational objectives.

#### **Classification of Blooms taxonomy**

1. Cognitive domain- Knowledge field
2. Affective domain- feeling field
3. Psychomotor domain-doing field

Every educational activity should be planned to develop all this domain of the learner. Hence these three domains are mutually interrelated and interdependent also.

Concept map of Blooms Taxonomy



## Learning objectives

### General Objectives in Cognitive Domain

The cognitive domain deals with the intellectual aspect of cognition. It is concerned with sensation, perception and application of knowledge. The hierarchical development of cognitive domain is discussed below.

#### Knowledge

Acquisition of knowledge is the lowest level in the cognitive domain. It includes the ability of students to recall and remember the information learned in the classrooms. Recall and recognition are the specifications of this instructional objective.

#### Comprehension

It is the second level of cognitive domain. It is the meaningful recall and recognition of the learned content. Here the learner could understand and explain what he learned in the classroom as his own language. Identifying relations, classification of objects, explanations, comparisons, translation etc are the specifications of this level.

#### Application

In third level the learners are able to apply or use the knowledge which is acquired and comprehended during the first two levels. It is the ability to apply the acquired knowledge through instruction in real life situations. Establishing new relationships, formulating hypothesis, predictions are the some specifications of this level.

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## **Analysis**

Analysis is the meaningful breakdown of the materials into its various components and to identify the interrelationship between the elements and find out how they are organized and related. Specification of this level includes the analysis of elements, analysis of relationship, analysis of organizational principles.

## **Synthesis**

Synthesis is the mental ability of the learner to integrate the acquired, comprehended, applied and analyzed knowledge in to a comprehensive whole. It involves the ability to give a new shape or structure to statements or procedures.

## **Evaluation**

This is the highest level of cognitive domain. Students could evaluate an object, person, a theory or a principle if only he is par with all other lower hierarchy in the cognitive domain. It is the ability to judge a value of a material, aspects, methods, principles , theory, philosophy and so forth for a given purposes. At this level s/he could perform personal viewpoint about the information s/he synthesized.

## **General Objectives in Affective Domain**

Affective domain is related with the development of heart and mind of the child. It includes the areas of emotions, feelings, interest, attitude, appreciation and values. The teacher should be given emphasis to correlate the development of cognitive domain with affective domain. A person who studied the Gandhian principles, civic right and duties without developing his affective domain is

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worthless for the country as well as society. Hence the teacher should ensure the development of affective domain in his instructional objectives of the classroom instruction. Bloom and Krathwohl (1964) introduced the following hierarchy for affective domain.

### **Receiving**

In the basic level the learner is sensitized to the existence of a certain phenomena and stimuli. s/he is willing to receive the information whole heartedly by exhibiting awareness on the stimuli and become conscious on particular person, principle, philosophy, incidents etc. For example students are interestingly listening to Gandhian principles.

### **Responding**

Effective reception prepares the learner to respond seriously. As result of receiving some good message from the first hierarchy, the learner tries to respond to the situation positively. For example students show kindness towards elders and weaker people, hold honest behaviour in day to day life situations etc.

### **Valuing**

By responding in good ways, the students set guidelines for their behavior. Accepting values, preference for values, commitment to values are the important behavioural changes in this level. For example students develop positive attitude towards non violent behavior, truthfulness, honesty etc.

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## **Organization**

Student builds a system of value at this level. Value conflict and value crisis are resolved. Through organizing different values students are able to develop their own code of conduct and standard of public life in the society. For example Pupil identifies the inseparability of the values like non violence, truthfulness and tolerance of Indian tradition. They show dislike towards corruption and violence in the country and think against to work.

## **Characterization**

This is the highest level of internalization process. Values are imbibed and forms part of the life style of the individual. For example the non violence value becomes the philosophy of the individual. They will not be ready to compromise on their philosophy at any stage as well as, ready to work for justice even though they are alone their way.

## **General Objective for Psychomotor Domain**

Psychomotor domain deals with the action or performance level. This domain includes muscular action and neuromuscular coordination. Educational objectives of this domain aim to developing proficiency in performing certain acts. Simpson (1966) presented the psychomotor domain as follows.

## **Perception**

Perception is the first level in psychomotor domain. It consist the process of becoming aware of objects, qualities or relation through sense organs.

### **Set**

In this second hierarchy students make preparatory adjustment of readiness for a particular kind of action or experience. Mental as well as physical set for action is performed here.

### **Guided response**

It is the overt behavioural act of a student under the guidance of the teacher. Students initially perform an act which is perceived and set through earlier levels. It includes imitation of teachers, elders, parents, and trial and error activities in attaining writing, reading skill etc. For example; Student imitates the writing style of his teacher to write letter 'A' and repeat many times to learn how to write letter 'A'.

### **Mechanism**

In this level student show progress in performing the act through imitation and trial and error. Student learned to write letter 'A' by imitating his teacher and through trial and error activity. Now s/he can write letter 'A' at his/her will. Here learned response has become habitual. It is a micro analysis in which each step in the mechanism is properly examined and drilled.

### **Complex Overt Response**

In this level the student can perform a complex motor act which required a complex movement pattern. In this hierarchy students attain a high degree of skill and the act can be carried out smoothly and efficiently. In this level students could perform the act without any hesitation. Fine muscular coordination and great deal of ease in performing act are the peculiarity of this level. Here student able to write many word easily and simply within a short

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period of time, ability to run, walk, jump and talk easily are also comes under this category.

### **Adaptation and Originating**

This is the highest level. Here student are adapted with the ability of doing an act which is acquired through above steps. Now spontaneously s/he can perform the act with accuracy. More over s/he is able to originate a new pattern of action or style in doing the activity.

### **General Objectives and Specific Objectives**

As discussed earlier, a classroom instruction needs an effective instructional plan to achieve fruitful result. Classroom coursework are wholly depend on the instructional objectives in the lesson plan. Lesson plan is aims at to develop the cognitive, affective and psychomotor development of the child through teaching the concerned subject. Each domain has its own objective and each objective has its own specific objectives. Specific objectives are written generally in the form of action verb. To understand the writing of instructional objectives and specific objectives see the following example.

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<b>LEARNING OBJECTIVES</b>
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<i>Domain</i>	<i>General objectives</i>	<i>Specific objectives</i>
Cognitive	Knowledge	Recalls, Recognize
	Comprehension	Translation, citing examples, identifies relationships, compares, interprets, detect errors, classifies, explains, discriminate etc
	Application	Applies, analyses, reasons, predict, suggest methods, formulate and test hypothesis, establish relationship, generalize, synthesis, justify, verifies, infers etc
Psychomotor	Skill	Prepare model, tools, project, album etc. Draw cartoon, map, chart, diagram etc Handle instruments appropriately Recording observation Conduct survey and interviews Present data in symbolic form Improvise model Conduct role play Acting in drill and drama Participation in literary and arts work
Affective	Appreciation	Express appreciation on valuable work, rich heritage, social activism etc. Show like and dislike of good and bad deeds prevailing in the society Participate in desirable social welfare programmes
	Interest	Show attention, curiosity, motivation, desires etc Engage in further reading voluntarily Participate in social discussions Visit places of social, historical, political and geographically important. Collect coins, stamps, pictures etc Write articles, poems etc
	Attitude	Develop positive attitude towards values, personalities, organizations; work for social, environmental and human welfare etc. Develop negative attitude towards war, crimes, antisocial activities, extremism, communalism etc



## UNIT 3

### CURRICULUM IN BIOLOGICAL SCIENCE

#### Curriculum – Meaning

Curriculum is a course of study that will enable the learner to acquire specific knowledge and skills.

#### Curriculum framework

A **curriculum framework** is an organized plan or set of standards or learning outcomes that defines the content to be learned in terms of clear, definable standards of what the student should know and be able to do.

#### Curriculum and Syllabus

Here is a table listing the various comparison points of the debate of syllabus vs curriculum:

Comparison Points of Syllabus vs Curriculum	Curriculum	Syllabus
<b>Meaning</b>	A set of guidelines of the different academic contents and chapters that are covered during a program offered by a particular educational institution.	A document that has all the information about different topics or concepts that need to be covered for a particular subject.
<b>Nature</b>	Prescriptive	Descriptive
<b>Structured For</b>	Complete Course	Each Subject Under the Course
<b>Determined By</b>	Administration of College, Institute or School or the Government	Exam Board
<b>Scope</b>	Wide	Narrow
<b>Uniformity</b>	Uniform for all the teachers	Different from one teacher to another
<b>Term Duration</b>	Until the course lasts	A fixed-term, can also be a year

## Principles of Curriculum Construction

### 1. Principle of Child Centeredness.

As modern education is child-centred the curriculum should also be child-centred. It should be based on the child's needs, interests, abilities, aptitude, age level and circumstances. The child should be central figure in any scheme of curriculum construction. In fact, curriculum is meant to bring about the development of the child in the desired direction so that he is able to adjust well in life.

### 2. Principle of Community Centredness.

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.

### 3. Principle of Activity Centredness.

The curriculum should centre round the multifarious activities of pupils. It should provide well selected activities according to the general interests and

## **Pedagogy of Biological Science – Part 1**

developmental stages of children. It should provide constructive, creative and project activities. For small children, play activities should also be provided.!

The purposeful activities both in the class-room and outside the class-room should be provided. It is through a net work of activities that the desired experiences can be provided and consequently desirable behavioural changes can be brought about in children.

### **4. Principle of Variety.**

The curriculum should be broad-based so as to accommodate the needs of varied categories of pupils, so that they are able to take up subjects and participate in activities according their capacities and interests.

The needs of pupils also change from place to place. For example, the pupils in rural areas, urban areas, and hilly areas will have different needs. The needs of boys and girls are also different. So these considerations should be reflected in the curriculum.

### **5. Principle of Co-ordination and Integration.**

Of course, the pupils are to be provided with selected experiences through various subjects and activities but these must be well integrated. Various subjects and activities have to serve the same ultimate purpose, the achievement of the aims of education. The activities and subjects should not be put in after-tight compartments but these should be inter-related and well integrated so as to develop the whole child.

### **6. 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 in view their educational value and the developmental stage of pupils.

### **7. Principle of Creativity.**

The conservation of culture helps to sustain the society. The culture should not be simply transmitted but also enriched. There should be provision in the curriculum to develop the creative powers of the child so that he becomes a contributory member society. Raymont says, “In curriculum that is suited to the needs of today and of the future, there must be definitely creative subjects.”

### **8. Principle of Forward Looking.**

Education is to enable the child to lead a successful social life. So the curriculum should not cater to the present 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.

### **9. Principle of Flexibility.**

In our age, rapid developments are taking place in various fields. Consequently the needs of society are hanging. The content of curriculum cannot be same for all times to come. It should not be static. It must be dynamic and change with

the changing times. It should reflect the latest trends in the field of education and psychology.

### **10. 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.

### **11. Principle of Utility.**

Curriculum should be useful rather than ornamental. It should not only include subjects which owe their place in it to tradition. The curriculum must have practical utility for students. So there should be some provision for technical and vocational education in the curriculum.

The various principles of curriculum construction should be kept in mind. Various regional and national conditions should also be considered. In fact, all considerations which will help in achieving the aims of education should be given due consideration.

## **Approaches to curriculum development**

### **A. Behavioural Approach**

It is based on the Behavioural Principle, goals and objectives are specified, content and activities are also arranged with learning objectives. Learning outcomes are evaluated in terms of goals and objectives set of beginning. Its main aim is to achieve efficiency. Change in behaviour indicates the measure of the accomplishment.

## **B. Managerial Approach**

It became dominant in the 1950's and 1960's. Based on following principle:

**1. General Leader:** He/She sets the policies and priorities, establishes the direction change and innovation and planning and organising curriculum and instruction.

### **2. Instructional Leader**

**3. Curriculum Leader:** He looks at the curriculum changes and innovations as they administer the resources and restructure the school infrastructure.

### **Role of Curriculum Leader:**

1. To help in the development of School's educational goals.
2. To plan curriculum with students, parents, teachers and other stakeholders.
3. To design programs of study by grade levels.
4. To help in the evaluation and selection of textbook.
5. To assist teachers in the implementation of the curriculum.
6. To develop standards for curriculum and instructional evaluation.

## **C. System Approach**

The whole system is approached by system theory. The whole approach represents line-staff relationship of personnel and represent the way, how the decisions are made? It gives the equal importance to all levels: 1. Administration 2. Counselling 3. Curriculum 4. Instruction 5. Evaluation.

## **D. Humanistic Approach**

It is rooted in the progressive philosophy and follows the child centred movements. It considers the formal or planned curriculum and the informal or hidden curriculum. It considers the whole child and believes that in curriculum the total development of the individual is the prime consideration.

### **Recommendations of National curriculum frame work on science curriculum**

There are many responses to the question why science education is so valuable in school curriculum. Science education empowers children by developing in them capabilities to understand and question and think critically. Science makes use of observation, intuition, hypothesizing, experimentation and verification. It helps children observe the world around them, link their cognitive structures with the events and phenomena in their environment, understand the interactions and act as change agents in bringing about behavioral changes in him/her and the society. It enables children to reflect (think) and interact and develop a rational and objective outlook. Science education helps students understand the need for change and progress of the society and manage the same effectively. NCF 2005 looks at science curriculum as an instrument for achieving social change. In order to bring about any qualitative change, science education should undergo a paradigm shift. 18 In this context, NCF 2005 is progressive in its outlook and incorporates linkage of science curriculum with the immediate surroundings of the child and the society at large. It aims at making of learning of science meaningful and relevant for the social needs. NCF recommends that teaching of science has to be recast so that it enables children to examine and analyse every day experiences, acquire methods and processes that will nurture thinking process, curiosity and creativity. Concerns and issues pertaining to environment to be emphasized in every subject and through a wide range of activities involving project work.

### Analysis of Biological science syllabi and textbooks of NCERT

Here biological science syllabi prescribed by various Universities and colleges and the NCERT Biological science text book to be analyzed by using the following steps.

Syllabus-analysis procedure involves the following five steps:

- **Identify specific learning goals to serve as the intellectual basis for the analysis.** This is done before beginning to examine any syllabus materials. The source for appropriate goals can be national standards or benchmark documents such as those mentioned above, state or local standards and syllabus frameworks, or sources like them. To be useful, the goals must be precise in describing the knowledge or skills they intend students to have. If the set of goals is large, a representative sample of them should be selected for purposes of analysis.
- **Make a preliminary inspection of the syllabus materials to see whether they are likely to address the targeted learning goals.** If there appears to be little or no correspondence, the materials can be rejected without further analysis. If the outlook is more positive, go on to a content analysis.
- **Analyze the syllabus materials for alignment between content and the selected learning goals.** The purpose here is to determine, citing evidence from the materials, whether the content in the material matches specific learning goals not just whether the topic headings are similar. At the topic level, alignment is never difficult, since most topics heredity, weather, magnetism, and so forth lack specificity, making them easy to match. If the results of this analysis are positive, then reviewers can take the next step.

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- **Analyze the syllabus materials for alignment between instruction and the selected learning goals.** This involves estimating the degree to which the materials (including their accompanying teacher's guides) reflect what is known generally about student learning and effective teaching and, more important, the degree to which they support student learning of the *specific knowledge and skills for which a content match has been found*. Again, evidence from the materials must be shown.
- **Summarize the relationship between the syllabus materials being evaluated and the selected learning goals.** The summary can take the form of a profile of the selected goals in terms of the content and instruction criteria, or a profile of the criteria in terms of the selected goals. In either case, a statement of strengths and weaknesses should be included. With this information in hand, reviewers can make more knowledgeable adoption decisions and suggest ways for improving the examined materials.



**UNIT – 4**

**TEACHING SKILLS**

**TEACHING SKILLS - MEANING**

Teaching skill is a set of teacher behaviors which are especially effective in bringing about the desired changes in pupils

**Skill of Explaining**

**Meaning**

To present the subject matter in a simplified form before the learners and making it acquirable is known as explanation skill. It involves ability of the teacher to describe logically 'how', 'why' and 'when' concept etc. ... It includes the summary of all the main results of the explanation.

**The components of skill of explaining**

- Clarity
- Continuity
- Relevance to content using beginning and concluding statements
- Covering essential points
- Simple
- Relevant and interesting examples appropriate media
- Use of inducts, deductive approach, it can be functional, causal or sequential

## Pedagogy of Biological Science – Part 1

### Micro – Teaching lesson plan for skill of Explaining

Teacher Activity	Pupil Activity	Components used
Good morning students	Good morning Madam	
Can you see the micro-organism?	Can't madam	
Why?	Because it is very minute living things.	
Good exactly. Could you tell anyone what are the micro-organism?	Bacteria, viruses and fungi, etc.	
Today I am going to teach about Viruses.	Students listen.	
Viruses are microscopic parasites that lack the capacity to thrive and reproduce outside of a host body.	Students listening carefully	Technical words defined, use of appropriate beginning statement.
Name some types of viruses?	I don't know Madam	Testing previous knowledge
Ok let me explain. There are four kinds in viruses. They are as follows : Animal viruses, Plant viruses, Bacterial viruses, <u>Archaeal viruses</u>	Students listen carefully.	Interesting to students, using explaining links, covering

## Pedagogy of Biological Science – Part 1

		essential points.
<p>Characteristics of viruses :</p> <ol style="list-style-type: none"><li>1. Viruses are infectious agents with both living and nonliving characteristics.</li><li>2. Living characteristics of viruses include the ability to reproduce – but only in living host cells – and the ability to mutate.</li><li>3. Nonliving characteristics include the fact that they are not cells, have no cytoplasm or cellular organelles, and carry out no metabolism on their own and therefore must replicate using the host cell's metabolic machinery.</li><li>4. Viruses can infect animals, plants, and even other microorganisms.</li><li>5. Since viruses lack metabolic machinery of their own and are totally dependent on their host cell for replication, they cannot be grown in syn</li></ol>	<p>Students will note important points in their note-books.</p>	<p>Interesting to students, using explaining links, covering essential points.</p>

## Pedagogy of Biological Science – Part 1

<p>Viral diseases that affects human being :</p> <p>smallpox.</p> <p>the common cold and differen types of flu.</p> <p>measles, mumps, rubella, chicken pox, and shingles.</p> <p>hepatitis.</p> <p>herpes and cold sores.</p> <p>polio.</p> <p>rabies.</p> <p>Ebola and Hanta fever.</p> <p>Corona</p>	<p>Students noting important points</p>	<p>Technical words defined, using expalaining links, covering essential points.</p> <p>Use of visual aids.</p>
<p>What is virus?</p>	<p>Viruses are microscopic parasites that lack the capacity to thrive and reproduce outside of a host body.</p>	<p>Testing pupil understanding</p>
<p>What are the types of viruses?</p>	<p>Animal viruses, Plant viruses, Bacterial viruses, <u>Archaeal viruses</u></p>	<p>Testing pupil understanding</p>
<p>Name some viral diseases that affect human being.</p>	<p>smallpox. the common cold and</p>	<p>Testing pupil understanding, use of visual</p>

## Pedagogy of Biological Science – Part 1

	<p>differen types of flu.measles, mumps, rubella, chicken pox, and shingles. hepatitis. herpes and cold sores. polio. rabies. Ebola and Hanta fever Corona</p>	aids.
So, students today we have discussed about virus meaning, types, characteristics and viral diseases.	Students listening carefully	Testing pupil understanding
Pupil-teacher will say 'thank you and will clean the black-board.		

## Pedagogy of Biological Science – Part 1

### OBSERVATION PROCEDURE

Components	Tallies	Rating Scale
Using appropriate beginning statements	I	1 2 3 4 5 6
Using appropriate concluding statements	I	1 2 3 4 5 6
Using explaining links	III	1 2 3 4 5 6
Testing pupils understanding	III	1 2 3 4 5 6
Covering essential points	III	1 2 3 4 5 6
Technical words defined	II	1 2 3 4 5 6
Interesting to students	II	1 2 3 4 5 6
Use of visual techniques	II	1 2 3 4 5 6

#### 7 point scale indicates the following:

0 – Very poor

1 – Poor

2 – Average

3 – Good

4 – Good

5 – Very Good

6 – Excellent

## SKILL OF PROBING QUESTIONING

Questioning is an important teaching skill that a teacher must learn. The teacher should learn to ask suitable, appropriate and meaningful questions. Questioning is definitely a skill. We can very easily answer a question but it is too difficult to ask a question. This questioning skill is considered under three heads namely :

1. Skill type of questions
2. Skill of asking questions
3. Skill of probing questions

### Components

1. Prompting techniques
2. Seeking further information
3. Refocusing
4. Redirection
5. Increasing critical awareness

## Pedagogy of Biological Science – Part 1

### OBSERVATION PROCEDURE

Components	Tallies	Rating Scale
Prompting techniques	I	1 2 3 4 5 6
Seeking further information	II	1 2 3 4 5 6
Refocusing	III	1 2 3 4 5 6
Redirection	II	1 2 3 4 5 6
Increasing critical awareness	II	1 2 3 4 5 6
Simplicity	II	1 2 3 4 5 6
conciseness	III	1 2 3 4 5 6
Relevancy	IV	1 2 3 4 5 6
Specificity	III	1 2 3 4 5 6
Grammatical correctness	II	1 2 3 4 5 6
Clarity and audibility	III	1 2 3 4 5 6

### Skill of Demonstration

#### Meaning

A Demonstration is showing someone else how to do something.

### Components

1. Clear objective
2. Relevant equipments
3. Apparatus handling techniques
4. Techniques in arranging the apparatus
5. Student participation
6. Blackboard usage
7. Giving explanation
8. Visibility
9. Pointing to details
10. Focusing attention
11. Manipulation of various parts
12. Clarity of explanation
13. Sequencing the demonstration
14. Using precautions

## Pedagogy of Biological Science – Part 1

### OBSERVATION PROCEDURE

Components	Tallies	Rating scale
Clear objective	II	1 2 3 4 5 6
Relevant equipments	III	1 2 3 4 5 6
Apparatus handling techniques	III	1 2 3 4 5 6
Techniques in arranging the apparatus	II	1 2 3 4 5 6
Student participation	I	1 2 3 4 5 6
Blackboard usage	III	1 2 3 4 5 6
Giving explanation	III	1 2 3 4 5 6
Visibility	III	1 2 3 4 5 6
Pointing to details	III	1 2 3 4 5 6
Focusing attention	III	1 2 3 4 5 6
Manipulation of various parts	II	1 2 3 4 5 6
Clarity of explanation	I	1 2 3 4 5 6
Sequencing the demonstration	III	1 2 3 4 5 6
Using precautions	II	1 2 3 4 5 6

## Skill Of Reinforcement

### Meaning

Reinforcement is strengthening the connection between a stimulus and a response. ... The negative reinforcement results in unpleasant experiences, which help in weakening the occurrence of undesirable responses or behaviours. The skill of reinforcement can increase the students' involvement in learning in a number of ways.

### Components

- Positive verbal reinforcement
- Positive non-verbal reinforcement
- Negative verbal reinforcement
- Negative non-verbal reinforcement
- Extra verbal reinforces
- Repeating and rephrasing pupils' responses
- Writing pupils answers on the black-board.

### OBSERVATION PROCEDURE

Components	Tallies	Rating scale
Positive verbal reinforcement	II	1 2 3 4 5 6
Positive non-verbal reinforcement	IIII	1 2 3 4 5 6
Negative verbal reinforcement	III	1 2 3 4 5 6
Negative non-verbal	II	1 2 3 4 5 6

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reinforcement		
Extra verbal reinforces	I	1 2 3 4 5 6
Repeating and rephrasing pupils' responses	III	1 2 3 4 5 6
Writing pupils answers on the black-board.	III	1 2 3 4 5 6

### Skill of Black board writing

Blackboard is an important visual aid used by teachers for effective teaching. A teacher makes extensive use of blackboard in his or her daily classroom teaching for working out problems, deriving formulae, proving theorems, drawing figures, constructing geometrical figures and so on. Every teacher should be proficient in the skill of using blackboard. Good blackboard writing leads to the following:

- Clarity in the understanding of concepts
- Reinforcement of the idea which is being verbally presented.
- Conveying a holistic picture of the content.
- Adding variety to the lesson and drawing attention of the pupils to the key concepts.

## Pedagogy of Biological Science – Part 1

### Components and Description of Skill of Blackboard Writing

S.No.	Components	Description of Behaviour
1	Legibility in handwriting	Distinct letters Adequate spacing between letters and words Adequate size for the letters Different sizes for capital and small letters Uniform size for all capital letters Uniform size for all small letters
2	Neatness in blackboard work	Straightness of lines Adequate spacing between the lines Avoiding overwriting Focusing the relevant matter
3	Appropriateness of blackboard work	Continuity in the ideas Brevity and simplicity Drawing attention and focusing

### OBSERVATION PROCEDURE

Components	Tallies	Rating scale
Legibility in handwriting	II	1 2 3 4 5 6
Neatness in blackboard work	III	1 2 3 4 5 6
Appropriateness of blackboard work	III	1 2 3 4 5 6

## Skill of stimulus variation

A teacher uses hand gestures, head and body movements, verbal statements etc in order to draw the attention of her students and to sustain it. The behaviour of the teacher is a stimulus to the pupils. However continued use of stimulus may induce disinterest and inattention on account of so many psychological and physiological factors. The teacher must be skilled in securing and sustaining the attention of her pupils. Stimulus variation deals with a change or variation in the stimuli available in the learner's environment. The teacher should know, when, how and what to change so that her students are attentive. Thus the skill of stimulus variation may be defined as a set of behaviour for bringing about a desirable change in variation in the stimuli which can be used to secure and sustain the student's attention towards classroom activities.

## Components

1. Teacher's movement
2. Gestures
3. Changes in speech pattern
4. Focusing
5. Change in interaction style
6. Pausing
7. Aural-visual Switching
8. Physical involvement of the student

### OBSERVATION PROCEDURE

Components	Tallies	Rating scale
Teacher's movement	II	1 2 3 4 5 6
Gestures	III	1 2 3 4 5 6
Changes in speech pattern	III	1 2 3 4 5 6
Focusing	II	1 2 3 4 5 6
Change in interaction style	I	1 2 3 4 5 6
Pausing	III	1 2 3 4 5 6
Aural-visual Switching	III	1 2 3 4 5 6
Physical involvement of the student	III	1 2 3 4 5 6

### Skill of Introduction

The **skill of introducing** a lesson involves establishing rapport with the learners, capturing their attention and exposing them to the essential contents. In such a situation the primary duty of a teacher is to create a desire for learning among the learners.

#### Components

1. Preliminary attention gaining
2. Use of previous knowledge
3. Use of appropriate device
4. Link with new topic

### OBSERVATION PROCEDURE

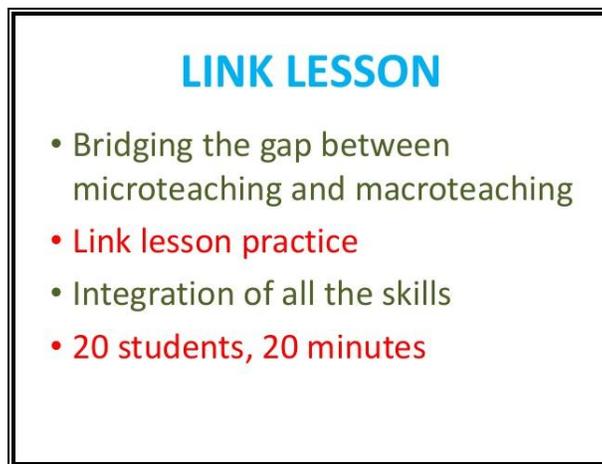
Components	Tallies	Rating scale
Use of previous knowledge	II	1 2 3 4 5 6
Preliminary attention gaining	III	1 2 3 4 5 6
Use of appropriate device	III	1 2 3 4 5 6
Link with new topic	II	1 2 3 4 5 6

### Micro teaching as a technique for acquiring teaching skills

Micro-teaching is a teacher training technique which helps the teacher trainee to master the teaching skills. It requires the teacher trainee 1. to teach a single concept of content 2. using a specified teaching skill 3. for a short time 4. to a very small member of pupils In this way the teacher trainee practices the teaching skill in terms of definable, observable, measurable and controllable form with repeated cycles till he attains mastery in the use of skill. It scales down the complexities of real teaching, as immediate feedback can be sought after each practice session. The modern-day multimedia equipment such as audio–video recording devices has a key role in the learning process. Observing a fellow teacher and using a trial-and-error in own teaching sessions are very common and efficient ways of self-training. But, both of them have their own demerits. On the other hand, microteaching helps in eliminating errors and builds stronger teaching skills for the beginners and senior teachers. Microteaching increases the self-confidence, improves the in-class teaching performances, and develops the classroom management skills.

### Link lesson practice

A deliberate programme of integration of sub skill is called Link Practice or Link Lessons. There are many methods for link practice. One of the methods is that after practicing three sub skills separately, the trainee may combine all the three sub skills in a lesson of ten minutes.



### Analytical approach to understand teaching learning process in biological science in terms of teaching skills

If we look at the table 4.1, it shows the several teaching skills and its components. Against each component we can see the tally marks and the tallies are totalized against each skill. As a result we get a total for each component. The highest total shows one's leading capability on that particular skill. The low scores show one's poor performance on that particular skill. Such a way every teacher can analyze their teaching capacity and also use strategy to improve one's teaching capacity.

## Pedagogy of Biological Science – Part 1

**Table – 4.1**

Teaching skills	Components	Tallies	Total
Skill of Introduction	Preliminary attention gaining	II	10
	Use of previous knowledge	III	
	Link with new topic	IIII	
	Use of appropriate device	I	
Skill of Explaining	Clarity	II	20
	Continuity	III	
	Relevance to content using beginning and concluding statements	IIII	
	Covering essential points	I	
	Simple	II	
	Relevant and interesting examples appropriate media	III	
	Use of inducts, deductive approach, it can be functional, causal or sequential	IIII	
Skill of Stimulus Variation	Teacher's movement	I	23
	Gestures	II	
	Changes in speech pattern	III	
	Focusing	IIII	
	Change in interaction style	IIII	
	Pausing	II	
	Aural-visual Switching	III	
	Physical involvement of the student	IIII	



**UNIT 5**  
**LEARNING RESOURCES**

**Textbook**

It is a framework or guide that helps them to organize their learning. It is helpful to involve students in the process of adapting textbooks. For the learners the textbook is one of the most important sources of contact they have with the language. It is a framework or guide that helps them to organize their learning.

**Characteristics of a good science text-book**

**1. The author:** A good text-book is judged, at face, by the author, his qualification and experience.

**2. Mechanical features of the text-book:**

- (a) The print and paper used and the binding of the text-book should be attractive. It should be hard and durable.
- (b) The printing should be clear, legible and appropriately spaced.
- (c) The book should be well-illustrated with diagrams, sketches and pictures.
- (d) The size of the print, the language and experiments discussed should suit the age of the child and standard of the child.

**3. The subject matter-its nature and organisation:**

- (a) The subject-matter should be developed as far as possible in psychological sequence. Care must be taken of the mental growth and interest of pupils.
- (b) There should be consistency of the subject-matter and the text-book should satisfy the objectives of science teaching.

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- (c) Each chapter should begin with a brief introduction and end with a summary.
- (d) Subject-matter should lead to the inculcation of scientific attitudes, disciplinary and cultural values.
- (e) Each chapter should contain assignments at the end.
- (f) During treatment of subject-matter, numerical examples should find place where necessary.
- (g) Headings and sub-headings are given in bold letters.
- (h) Each text-book should contain detailed Table of Contents and an index.
- (i) The language of the book should be simple, clear, lucid, scientific and precise. The English equivalents of the terms should be always given in brackets.
- (j) The text-book should give suggestions for improving scientific apparatus.
- (k) Examples in the text-book should be given from local environment and from life experience.
- (l) During the treatment of science subject in the text-book, care should be taken to see that it is correlated with other subjects like craft, social environment and physical environment.
- (m) Each text-book should be accompanied by a laboratory manual.

### **Evaluation of Science Textbook**

#### **A. Hunter's Score card**

Score cards and check lists are used to evaluate and select a suitable text book for a course. George hunter has suggested the following score card to evaluate a book.

## Pedagogy of Biological Science – Part 1

### Hunter's score cardpoints

1. Educational rank of the author	-	50
2. Mechanical make up and cost	-	100
3. Psychological soundness	-	300
4. Subject matter	-	250
5. Literary style	-	110
6. Learning exercise	-	140
7. Teacher's help	-	50
Total	=	1,000.

Scores must be given to each of the books by evaluating them on the basis of the above aspects. The book which secures maximum score will be selected as a text book.

### B. Vogel's Criteria of Selection

Another kind of score card, designed to speed up the process of evaluation, is the "spot check" method illustrated by Vogel Louis F known as '**Vogel's Spot Check Evaluation Scale.**' Cited in Thurber and Collete (1964), on this score card, each item has been assigned a maximum value of two points. The value of each item under each head is totalled against the part score. The part scores of each head are then counted and the overall value is written against the space for partial score.

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## VOGEL'S SPOT CHECK TEXT BOOK EVALUATION SCALE

Textbook.....

Author.....

Publisher.....

Copyright year.....

Score.....

### 1. Qualification of author

(See the title page, preface to text book and preface to teachers manual)

1. The author has taught the subject about which he is writing
2. The author holds advanced degree in related fields
3. The author has received assistance from specialists in preparing his manuscript.
4. The author has tried put his material in classroom situations
5. The author's point of view, theory, or philosophy is in harmony with that of my school.

**Partial Score.....**

### II. Organization

(See table of contents, the preface, the section headings through one unit, and the end of one chapter)

1. There is a central theme which correlates the whole textbook. ( )
2. The textbook is organized into units which are based on student interested and probability of use in everyday life. ( )
3. The organization makes use of topics already taught in my school ( )
4. Questions at the end of chapters are graded explicitly in difficulty ( )

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5. Problems at the end of chapters are graded properly ( )

**Partial Score.....**

### III. Content

**(See table of contents, index and five next pages)**

1. The text book contains all the topics necessary for my course. ( )
2. Material from one part of the textbook is cross-reference with similar material in another part of the book. ( )
3. The historical development of science is given some place. ( )
4. Topics dealing with latest advances of science, such as atomic energy are included ( )
5. The social significance of science is stressed. ( )

**Partial Score.....**

### IV. Presentation of material

**(See any five introduction to chapters, or problems)**

1. The inductive approach is used wherever possible in introducing a new topic. ( )
2. The problem solving aspect of scientific method is stressed. ( )
3. The author's style is informal and interesting ( )
4. Unfamiliar scientific terms are set in italics or bold face. ( )
5. Important principles are set in italics or boldface. ( )

**Partial Score.....**

### V. Accuracy

**(Select any five topics in the index and look them up in the text)**

1. All the items I looked up are on the pages indicated in the index. ( )
2. The items I looked up are scientifically correct ( )
3. Technological expressions are avoided ( )

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4. Personification is avoided ( )
5. No ambiguity is apparent. ( )

**Partial Score.....**

### VI. Readability

1. The average number of words per sentence is below 21. ( )
2. Sixty percent of the sentences are simple or compound, as opposed to complex ( )
3. There are at least four personal references per 100 words. ( )
4. There is at least one application for each abstract principle ( )
5. There are not more than 42 affixes per 100 words. ( )

**Partial Score.....**

### VII. Adaptability

**(See table of contents and any five text pages)**

1. The textbook is satisfactory for slow, average and brilliant students. ( )
2. Students with rural and city backgrounds will find the text useful ( )
3. The textbook is arranged so that certain section can readily be omitted. ( )
4. The authors treat controversial subjects impartially ( )
5. In general the text fits my particular community needs. ( )

**Partial Score.....**

### VIII. Teaching aids

**(See end of chapters, appendix, and teacher's manual)**

1. Summaries, questions and problems at the ends of chapters are adequate ( )
2. References for teachers and students are annotated. ( )
3. Appendix materials is pertinent and useful ( )

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4. The teacher's manual is more than an answer book. ( )
5. An annotated up-to-date film list is provided ( )

**Partial Score.....**

### **IX. Illustration** **(See any 10 illustrations)**

1. The illustrations are relatively modern ( )
2. The photographic reproductions are large and clear. ( )
3. The line cuts are well drawn and adequately labeled ( )
4. The figures are tied into the textual material by direct reference. ( )
5. The legends under the illustrations are useful learning devices. ( )

**Partial Score.....**

### **X. Appearance** **(See cover and leaf through the text)**

1. The appearance of the cover is attractive. ( )
2. The size and shape of the textbook would not be a handicap students ( )
3. The placement of the illustrations is pleasing. ( )
4. The design of most pages is open, rather than crowded. ( )
5. The size of the type makes for easy reading. ( )

**Partial Score.....**

### **Uses of a textbook**

Though there are contradicting opinions regarding the use of textbooks for biology teaching and learning, the following points support the use of biology textbooks. A biology textbook is very useful for a teacher in the following ways.

□

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- A textbook is written according to the syllabus and gives the outline of the course, Therefore it helps the teacher to decide about the limits and depth of the content to be presented to the students while teaching. □
- A textbook provides insight to the teacher in planning the lesson, in selecting the problems to be worked out, the methods of teaching to be adopted and the teaching aids to be used. □
- A textbook is written by experienced teachers of biology. By using textbooks, a teacher of biology, especially a beginner, can avail the experience and expertise of the authors. □
- The logical and psychological sequence followed in a textbook helps the teacher in presenting the subject matter in an orderly and systematic sequence. □
- A good textbook presents a variety of worked out examples on each topic.
- This helps the teacher in getting acquainted with different types of problems and the methods to solve them.
- This gives him more self-confidence while teaching. □
- The well-graded exercises provided after every topic in the textbook help the teacher in assigning suitable homework and assignment to the students to suit their intellectual capacity. □
- A textbook saves a lot of time for the teacher as he need not spend time to prepare problems and the solutions as they are readily available in the textbook. □
- A biology textbook provides the teacher with the basic information considered essential in attaining the objectives of biology education and this helps the teacher plan appropriate learning experiences.

### **Book selection and organizing library work in science**

#### **Book selection**

Book selection means to select the appropriate books for a library. It is the professional apex in librarianship. Its objective is to select the right books to

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the right reader at the time. Some principles are followed for book selection. Such as:

- To study clientele and know their general characteristics, special characteristics, cultural and racial elements, their professions and their like and dislikes.
- To be families with subject to present interest, local, national and international.
- To represents all subjects that apply to the communities, needs and interest.
- To give preference local history, literature, culture and heritage.
- To provide books for all organized groups.
- To provide books according to anticipating demands of potential readers.
- To avoid selection of obsolete and out-dated books those have no demands at all.
- To select great works of literature and some books of permanent value whether they are not in demand.
- To maintain impartiality discarding special hobbies or opinion.
- To accepts gifts in controversial or sectarian subjects with great caution.
- To provide books for specialist who work with give benefit to the whole nation. Not to go to build up a 'complete collection' but a 'comprehensive collection, – the books on a subject, the best book of an author and the most useful books of a series.
- To give preference with caution to an inferior book that will be widely read over a superior book that will be dormant on the shelf.

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- To keep abreast of the changing and current thoughts and opinions and give adequate representation to the scientific, social, cultural and intellectual forces that reshaping the modern work.
- To maintain promptness and regularity in selecting new books as far as possible.

### Organizing library work in science

Most libraries have materials arranged in a specified order according to a library classification system, so that items may be located quickly and collections may be browsed efficiently. Some libraries have additional galleries beyond the public ones, where reference materials are stored. These reference stacks may be open to selected members of the public. Others require patrons to submit a "stack request", which is a request for an assistant to retrieve the material from the closed stacks: see List of closed stack libraries (in progress).

Larger libraries are often divided into departments staffed by both paraprofessionals and professional librarians.

- ✓ Circulation (or Access Services) – Handles user accounts and the loaning/returning and shelving of materials.
- ✓ Collection Development – Orders materials and maintains materials budgets.
- ✓ Reference – Staffs a reference desk answering questions from users (using structured reference interviews), instructing users, and developing library programming. Reference may be further broken down by user groups or materials; common collections are children's literature, young adult literature, and genealogy materials.
- ✓ Technical Services – Works behind the scenes cataloging and processing new materials and deaccessioning weeded materials.
- ✓ Stacks Maintenance – Re-shelves materials that have been returned to the library after patron use and shelves materials that have been processed by Technical Services. Stacks Maintenance also shelf reads the

## **Pedagogy of Biological Science – Part 1**

material in the stacks to ensure that it is in the correct library classification order.

Basic tasks in library management include the planning of acquisitions (which materials the library should acquire, by purchase or otherwise), library classification of acquired materials, preservation of materials (especially rare and fragile archival materials such as manuscripts), the deaccessioning of materials, patron borrowing of materials, and developing and administering library computer systems. More long-term issues include the planning of the construction of new libraries or extensions to existing ones, and the development and implementation of outreach services and reading-enhancement services (such as adult literacy and children's programming). Library materials like books, magazines, periodicals, CDs, etc. are managed by Dewey Decimal Classification Theory and modified Dewey Decimal Classification Theory is more practical reliable system for library materials management.

The International Organization for Standardization (ISO) has published several standards regarding the management of libraries through its Technical Committee 46 (TC 46), which is focused on "libraries, documentation and information centers, publishing, archives, records management, museum documentation, indexing and abstracting services, and information science".

### **Values of a Science library**

The prime purpose of a library is to provide access to knowledge and information. To fulfil this mission, libraries preserve a valuable record of culture. Then they pass down this to the coming generations. Therefore, they are an essential link between the past, present and future.

People utilise library resources in their work. They also use library resources to gain information about personal interests. Sometimes, they obtain recreational

## **Pedagogy of Biological Science – Part 1**

materials such as films and novels. Students use libraries to enhance their classroom experiences.

Libraries help the students to develop good reading and study habits. Public officials use libraries for research and public issues. The libraries provide information and services that are essential for learning and progress.

This habit of reading can be developed only if we get into the habit of going to a library regularly, and spending a lot of time there. That is the place that provides just the right atmosphere necessary for studies, and assimilating and retaining all the knowledge taken in. The environment in a library is ideal for the intellectual growth of individuals.

This is the place where one can get unlimited stocks of books on any and every subject that may be of interest or need for an individual. A library is the place where one can spend hours of time fruitfully and filled with interest. One can learn so much by reading books authored by eminent writers and thus become knowledgeable. This is also fruitful to students. Who are poor students they get help from library by taking reference books. Library helps all the students as it helps to get various types of books for projects. After all it helps students to get down monotonousness

### **Science museum**

A science museum is a museum devoted primarily to science. Older science museums tended to concentrate on static displays of objects related to natural history, paleontology, geology, industry and industrial machinery, etc. Modern trends in museology have broadened the range of subject matter and introduced many interactive exhibits. Many if not most modern science museums – which increasingly refer to themselves as science centres or "discovery centres" – also emphasize technology, and are therefore also technology museums.

## **Pedagogy of Biological Science – Part 1**

The mission statements of science centres and modern museums vary, but they are commonly places that make science accessible and encourage the excitement of discovery.

### **Importance of museum**

- Museums collect and preserve our objects and materials of religious, cultural and historical value.
- They are a good source of entertainment.
- These museums help to preserve and promote our cultural heritage.
- Museums are a storehouse of old artefacts, sculptures, objects, history etc.
- Museums help in research and study.
- They are the main attraction for tourist.
- They are a good source of knowledge.

### **Organization and Management of Science Museum**

#### **Organization**

- Proper classification should be followed in the museum.
- Different sections should be allotted for various biological science branches.
- Organisms should be arranged systematically.
- Living organisms should be collected by both teachers and students.
- The teacher should avoid purchase of museum materials as far as possible.
- Inferior quality materials should not be kept in museum.
- The worn out materials and damaged materials should be replaced by new materials.

## **Pedagogy of Biological Science – Part 1**

The roles associated with the management of a museum largely depend on the size of the institution, but every museum has a hierarchy of governance with a Board of Trustees serving at the top. The Director is next in command and works with the Board to establish and fulfill the museum's mission statement and to ensure that the museum is accountable to the public.<sup>[40]</sup> Together, the Board and the Director establish a system of governance that is guided by policies that set standards for the institution. Documents that set these standards include an institutional or strategic plan, institutional code of ethics, bylaws, and collections policy. The American Alliance of Museums (AAM) has also formulated a series of standards and best practices that help guide the management of museums.

### **Essential and desirable item**

#### **Preparation of Museum materials**

Flowers and plants can be dried and preserved. Using the preserved plants, details about structure of plants, flowers, fruits, stems and roots can be taught. Since it is not possible to collect all the parts of the plant at the same time, the parts which are available, should be collected and preserved. Students can use vasculum, plant press, blotting paper, pads and mercuric chloride for collection. When fresh water and marine plants are collected a piece of cotton dipped in the particular water should also be put along with the plant to maintain moisture.

Plants should be collected in summer season so that fungus may not develop on the plant and the plant will dry quickly. The leaves of Vanda and Bryophyllum are very thick. Before preserve these leaves should be put into hot water. Plants can be pressed between two fine sheets and then be transferred to plant press. After two or three days the plant should be kept between news

## **Pedagogy of Biological Science – Part 1**

papers. For the first two weeks the papers should be changed daily. After the plants dried, they need not be changed daily.

The dried plants should not be affected by fungus. For that a mixture of ½ gram mercuric chloride in 100 ml., ethylated spirit to be applied on the plants. Then the plants should be pasted or stitched on a thick paper. The right side lower corner of the paper should contain all details about the plant. The details regarding its name, species, genus, family, class, date of collection, place of collection and the name of student should be written.

### **Preservation of insects**

The next step after collecting insects is to preserve them permanently for future display and study. Insect larvae and soft-bodied and extremely tiny specimens are preserved in liquids. Isopropyl alcohol (70 percent) or equivalent is best. All others are preserved on specially designed insect pins. Large insects are mounted directly on pins, while those too small to be placed on pins are mounted on card points

The wings of butterflies, moths, and dragonflies are spread to make the specimens more attractive and to aid in identification. All other insects should be dried with legs and antennae adjusted in the most lifelike manner possible.

### **Preservation of other animals**

Frogs, tadpoles and frogs eggs are best preserved in 8 % formalin with small amounts of calcium chloride and cobalt nitrate added. (Tadpoles and frogs eggs should never be preserved in alcohol based solutions).

For storage of reptiles it should be used in the proportion of 3 parts 95% alcohol to 1 part water. Alcohol which has been stored in open containers loses its strength rapidly due to evaporation.

## **Pedagogy of Biological Science – Part 1**

In modern collections, salvaged or collected birds may be preserved in a number of ways. The most traditional preparation is a study skin, in which almost all of the body inside the skin is removed and replaced with cotton so that the final result resembles a bird lying on its back with its wings folded.

Skins of larger mammals are opened up, prepared flat and are frequently tanned before permanent storage. Life mounts, in which the skin covers an artificial body in a life-like stance, are prepared for museum dioramas and general displays.

### **Preservation of skeleton and skull**

Prepare a solution of hydrogen peroxide and water. Soak the bones in this solution for up to three days to bleach them. Glue the bones together using clear-drying glue. Spray the skeleton with several thin layers of polyurethane spray.

To preserve an animal skull, start by placing it in a bucket of cold water and laundry detergent for a few days to remove all the flesh. Next, soak the skull in cold water and dish detergent for 2-3 days to remove grease before letting it air dry for several days.

### **Preservation of eggs of Birds**

To preserve the shells of eggs, first take care to clear them of their contents; get a small, fine-pointed common syringe, such as is sold in toy-shops for a penny or twopence, and inject the specimen with water until it comes out quite clean.

### **Preservation of eggs and worms of insects**

Preserve larval stages of insects and other soft-bodied specimens immediately by dropping them directly into a 70 to 90 percent ethyl or isopropyl alcohol

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solution. When collecting in the field, carry a few small vials of preservative fluid to store specimens.



## **UNIT - 6**

### **ORGANIZING SCIENCE RELATED ACTIVITIES**

#### **Science club**

Science Club is an afterschool, mentor-based science program for middle school youth. This program brings graduate student mentors together with small groups of students to conduct fun and engaging scientific investigations.

#### **Aims and Objectives of a Science club**

The aims and objectives of a science club may outline as below.  
To provide proper incentive and inspiration for the pursuit of scientific knowledge in rigorous way by broadening their scientific outlook. To make the students understand the values of time and to help them in the proper utilization to their hours.

- To provide opportunities for bringing school close to the society and to acquaint the people with the services and contribution of the science in their life.
- To develop among the student the spirit and attitude of healthy competition for the individual and social cause. To help the students in imbibing The habit of self-reliance, self-dependence and love for manual work
- To inculcate scientific attitude. To provide opportunity for the development of the constructive, explorative & inventive faculties of the students. To develop training in scientific method of problem solving
- To develop students, inters and participation in the practical application of the knowledge related to different branches of science. To grate interest in scientific facts and events related to one's surroundings.

## **Pedagogy of Biological Science – Part 1**

- To develop interest in scientific hobbies. To encourage individual and group activities. To stimulate active participation and initiative among students in the learning process.
- To develop the creativity and encourage the habit of exploration. To widen the outlook of students, apply the knowledge in life situations.
- To provide opportunity for the development of the constructive, explorative and inventive faculties of the students.
- To create interest in latest inventions and discoveries of science in various fields and to get acquainted with the life history and contributions of great scientists.
- To develop students, interest and participation in the practical application of the knowledge related to different branches of sciences.

### **Organizational Structure :**

The organizational structure of School Science Clubs be as follows-

- ✓ President: Head Master / Head Mistress.
- ✓ Coordinator: One Teacher nominated by Head Master / Head Mistress preferably having Science background.
- ✓ Secretary: One Student from the concerned school.
- ✓ Joint Secretary: One Student from the concerned school.
- ✓ Members : Students from the concerned school.

### **Club activities**

Conducting visual programmes of scientific interest . Improvising and preparing hand-made apparatus. Collecting. Preparation of soaps, ink ,candle matches, toys, bleaching powder, nail polish, chalk etc. Mounting and preserving the specimens.

## **Pedagogy of Biological Science – Part 1**

Rendering school services in health and sanitation through managing a first aid squad. Helping the community by way of demonstration on health and hygiene, improvement of agriculture, eradication of superstitious belief etc.

Publishing school science magazine. Preparing science albums, Preparing still/Working models on science topics .Maintaining a bulletin board for displaying science news .Conducting essay competition on scientific problems.

Arranging science discussions, debate, essay writing, Conducting workshops Conducting science quiz competitions, etc. Arranging the science excursions and visits. Arranging science exhibitions , Film shows and science fairs. Organizing lectures, debates, seminars, symposia etc.

Celebrating the science days . Celebrating birth days of eminent scientist

### **Educational values of Science club**

Science clubs channelize the energies of students and make use of their skills and talents, which satisfy their instincts and urges and helps in their overall personality development

- Through activities of a science club, learning of science become joyful
- The science club caters to freedom for expression, where as the classroom atmosphere leads to conformity and repression
- Students organise thought and translate into action
- Develop a zealous enthusiasm to strive for the cause of scientific enterprise

## Pedagogy of Biological Science – Part 1

- In the classroom everything is done in a formal, artificial and controlled atmosphere. This will never give the child an opportunity for his free fights in the world of science.

### Field trip / Excursion

A field trip or excursion is a journey by a group of people to a place away from their normal environment.

**Some of the below mentioned stages can be a good guide on how to organize and plan a school trip:**

- ✓ Decide where to go and think about places that enhance and reinforce your curriculum goals.
- ✓ Ask your administrator and jot some notes before presenting the idea. Tell her why you want to go, where you want to go, what dates you are thinking of, and what the cost will be.
- ✓ Arrange for transportation and decide how you are going to get the little kids there and back.
- ✓ Decide on where and when you will stop for meals. Some of the common options available are either everyone including children bringing their own lunch, or stopping at a restaurant or café on or off sight.
- ✓ Make a plan and understand the time that each activity takes to perform keeping the interest and attention span of students in mind.
- ✓ Arrange for supervision depending on the number of students going for the trip and number of adults needed in order to handle the children. This also varies depending on the behaviour of age and maturity of the students.
- ✓ Create a permission form that includes all the necessary details about the field trip, like the date, time, venue, pick-up, drop-off, food to be

## **Pedagogy of Biological Science – Part 1**

carried, money to be carried, dress code if any and other such details that is necessary for parents to know before they sign and give their children the permission.

- ✓ Tie in the field trip with the student's curriculum by deciding the kind of assignment and learning that can be done on the trip. This usually requires pre-learning and background reading to be done by the teachers.

### **Educational values / Advantages**

- Students are energized by the excitement and anticipation of leaving the school environment.
- The transportation to and from the museum/site is often a pleasant open-social time.
- Students have the opportunity to see new things and learn about them in a more unstructured way.
- Students have the opportunity to determine what they learn and how they learn it. Said differently, student learning can be interest-driven, not teacher and curriculum driven.
- Students will experience a more holistic, integrated picture of the information that, in the classroom, may have only been presented in a textual and abstract way.
- Museums, and many other kinds of field trips are multi-media experiences; therefore, learning is enriched and reinforced with superimposing sensory and intellectual inputs.
- Most museums are designed to stimulate curiosity and actively engage the visitor, so you have a very professional partner working with you to help your students learn.

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- In some museums you can arrange for your class to meet with a museum educator, often in a private classroom, to facilitate directed learning and/or provide a question-answer session.

### **Science fair / Exhibition**

A science fair is a competitive event, hosted by schools worldwide. Science fairs allow students in elementary, middle and high schools to compete in science and/or technology activities. The goal of a science fair is for students to answer a question based on a hypothesis. Planning to Organize the Science Exhibition

#### **Planning to Organize the Science Exhibition**

- Wide publicity through radio, TV, posters, banners, booklets and newspapers should be given for inviting entries;
- If possible, these guidelines may also be translated in local languages.
- This may also be given on the Internet website(s) of the respective states/union territories and other participating organizations;
- At least two months before, guidelines for the preparation of Exhibits and Models for display should be provided to all schools by the district Organizing Committee.

#### **Screening Committee**

- A district level screening committee needs to be constituted to finalize the selection of entries from the schools/institutions;
- It may consist representatives of District Education Officers and some selected representative institution(s).

## **Pedagogy of Biological Science – Part 1**

- All records about the meeting of the committee should be maintained.
- The selection procedure should lay more emphasis on the quality of the exhibits rather than quantity. It should be ensured that the exhibits are not crude and hazardous.

### **Judges in the Exhibition**

The judges shall be the scientists as per the above mentioned themes. They should be from the research institutes/ laboratories/ universities/colleges level faculties

### **Display the Exhibits and Models in the Exhibition**

- A separate stall for each theme/ sub-theme of the exhibits and models should display;
- Names of the student(s) and guiding teacher(s), name of the school and brief information about the exhibit (may be in two sentences only).

### **Time frame of the Exhibition**

The exhibition could be organized three months before and after of school's examination; and preferably in the months of off rainy season.

### **Planning at the School Level**

The school display sub-themes, date and venue of the district level science exhibition in the school notice board. The school level science exhibition shall be conducted to select the entries for district level participation. To make more competitive, schools may organize science

## **Pedagogy of Biological Science – Part 1**

exhibitions at block/tehsil level and the expenditure could be met by the community contribution.

### **Public-Private Partnership**

Public Sector Undertakings, Industries, and other Non-government Organizations (NGOs) working in the areas (where these science exhibitions are organized) may also be invited to participate as the exhibits displayed by them would be of instructional value for the children and teachers.

### **Expenditure Suggestions**

Financial support provided by the RMSA to respective districts to organize “Science Exhibition” to develop science and technology interest among the youth. Districts are expected to spend the additional expenditure, if any”

- From the district funds, contribution by the research institutes/laboratories/NGOs/communities/individuals are exclusively on travel and boarding of participating students and their teachers and experts.
- Public-private partnership with industrial houses, public sector undertaking, etc. could be explored for publicity and awards.
- Conveyance and boarding charges of the screening committee may be incurred by the District RMSA/District Education Officer (DEO)
- Conveyance of the organizing committee managed by the district RMSA

### **Report Writing**

A formal report of the exhibition shall be prepared within one month after the conclusion of the exhibition. It should include the followings:

## **Pedagogy of Biological Science – Part 1**

- Theme, dates and venue of the exhibition;
- Number of schools (rural and urban) and the number of students/teachers participated;
- Number of entries of the exhibits and models being displayed; under each sub-theme should also be mentioned separately;
- Highlights of the exhibition including participation of other scientific/industrial organizations;
- Criteria for Evaluation of Exhibits and Models by the Panel of judges; and
- Findings and recommendation

### **Follow up of the Science Exhibition**

- The best practices shall be popularized through radio, TV, Internet website, newspapers, periodicals, etc.; and
- A concise booklet shall be published to distribute all schools, scientific research institutions/laboratories, libraries and NGOs,

### **Educational values of science fair**

- Science experiments and innovations offer unique hands on learning opportunities that incorporate STEM (science, technology, engineering and mathematics)
- Integrates many subjects into one project, such as reading, writing, ethics, critical thinking, problem solving, data analysis, computer science, graphic arts, and public speaking.

## **Pedagogy of Biological Science – Part 1**

- Completing a scientific inquiry project provides students personal achievement and confidence
- Science fairs can make science relevant by allowing students to conduct an experiment based on their own interests.
- A science fair project allows students to develop important independent learning skills such as time management, responsibility, organization and communication.

### **Science Hobbies**

#### **Meaning**

Scientific hobbies represent those activities that suit the basic interests and aptitudes of the students. Students never take them as a work but enjoy them like play.

#### **List of scientific hobbies**

- Learn about astronomy
- Build model rockets
- Discover microscopy
- Go bird watching
- Start an aquarium
- Maintaining aquarium, vivarium and science museum.
- Participating in science fair and exhibitions.
- Repair and maintenance of common household articles and gadgets involving scientific knowledge and skills.

## Pedagogy of Biological Science – Part 1

- Listening to Radio broadcast and watching programme on T.V. and Video related to scientific interests.
- Photography, printing and developing of the negatives.
- Providing first aid to the injured and getting acquainted with ordinary medicines of everyday use.
- Preparing articles of daily use such as soaps, tooth powder, inks, polish, varnish etc.
- Preparation of charts, pictures and models related to scientific knowledge.
- Assembling and devising scientific toy.
- Sketching, painting and making diagrams of objects and places of scientific interest.

### **Educational values / Advantages of Science hobbies**

- ✓ Develop scientific attitude
- ✓ Have an employment
- ✓ Training in handling of science equipments.
- ✓ Better work performance
- ✓ Improved health
- ✓ Reduced stress
- ✓ An aid to learning
- ✓ Meeting the psychological needs
- ✓ Good use of leisure time



**UNIT - 7**

**METHODS OF TEACHING BIOLOGICAL SCIENCE**

**Lecture Method**

Lecture method is the most commonly used method of teaching science. It is a teacher- controlled & information centered approach in which the teacher works as a sole-resource in classroom instruction.

**Steps of the lecture method**

(1) Preparation for the lecture:-

This includes silent points like

- (a) appropriate language and manner of presentation according to the nature of students.
- (b) selection of audio-visual aids and instructional materials.
- (c) planning the motivational technique
- (d) anticipating certain difficulties and problem during the lecture.
- (e) finding suitable solution and alternatives to these barriers to a successful lecture.

(2) Introduction to the lecture:-

It should be done briefly and if it is executed poorly, it can initially kill off the enthusiasm of the student.

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(3) Giving the body of the lecture:-

The teacher should have a given cognitive framework upon which he relies to achieve a more logical presentation.

(4) Conclusion of the lecture:-

Following technique can be used to wrap up the lecture.

- (a) summarizing the major points presented.
- (b) forming generalization
- (c) giving implications.

### **Advantages of lecture method**

- (1) It is economical with regard to time.
- (2) It helps in developing the habit of concentration among the students.
- (3) It helps in achieving even high order cognitive objectives ( i.e ) application, analysis, synthesis.
- (4) Lecture method presents the subject matter in a systematic way.
- (5) It develops good audience habits.
- (6) Through this method, new subject matter can easily be introduced.
- (7) It enables linkage between previous knowledge with a new one.

## Disadvantages of lecture method

- (1) Since this is a teacher-centered method so it provides very little scope for student activity.
- (2) Student plays a passive role in this method.
- (3) Individual differences are not taken into consideration.
- (4) It cannot be used for achieving psycho motor objectives.

## LECTURE-CUM-DEMONSTRATION METHOD

It is one of Traditional method. this is also known as Chalk and talk method. Teacher centered method. In this method Teacher is active and learners are passive. the essentials qualities in learning science such as independent thinking, power of observation and reasoning can be developed in this method.

The teacher perform the experiment in the class and goes on explain what he does. here the students see the actual apparatus and operation and help the teacher in demonstrating the experiment. This method works on the principles of concrete to abstract, and learning by doing.

## Criteria of a good lecture demonstration method

- the demonstration should be planned and rehearsed well in advance.
- planning and rehearsing of the experiment is very essential for it gives confidence in the demonstrator. he find out the difficulties involved in the experiment. so that the lesson will go smoothly and systematically.
- the teacher should be clear of the purpose of demonstration. he should know the aims and objectives of the demonstration.

## Pedagogy of Biological Science – Part 1

- demonstration should be the result of the active participation of pupils and teacher. teacher help the students in arranging and fitting and performing the experiment.

### Characteristics of good demonstration

- Visibility
- One major idea at a time
- Clear cut
- Convincing
- Rehearsal
- Supplemented with other teaching aids
- Asking relevant questions
- Neat, clean and tidiness
- Simple and speedy
- To write observation
- Teacher to act as performer
- Sufficient time

### Steps in Lecture-cum-demonstration

**1. Planning and Presentation:** While planning a demonstration the following points should be kept in mind.

- Subject matter
- Lesson planning
- Rehearsal of experiment
- Collection and arrangement of apparatus

**2. Introduction of lesson:** The lesson may be introduced on the following basis

- Student's personal experience
- Student's environment
- Telling story

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- A simple and interesting experiment

**3. Presentation of the subject matter:** The subject should consists of the following things

- The teacher must study the subject matter on broad basis taking into consideration the interest and experience of students
- While demonstration is going on, question should also be asked which help the students to understand the principles
- The teacher should try to illustrate the facts and principles
- Language used by teacher should be simple and clear.

**4. Experimentation :** Demonstration should be properly spaced and striking, clear and convincing

- The demonstration table should have only apparatus
- The experiment should be simple and speedy
- All the apparatus should not be displayed at once

### **5. Blackboard work**

A big blackboard behind the demonstration table is necessary in order to summarize the principles and other matters of demonstration and also to draw necessary diagrams and sketches.

#### **Advantages of Lecture-cum-Demonstration Method**

- Save time and money.
- Student participation.
- Helpful to promote useful discussion.
- More efficient method
- Activity method
- Helpful for teacher

#### **Disadvantages of Lecture-cum-demonstration Method**

- Visibility: Visibility is main problem for a teacher because all the students may not be able to see the details and results of a demonstration

## Pedagogy of Biological Science – Part 1

- Speed of experiment: Either too fast or too slow speed of demonstration sometimes may create trouble
- Ignore individual difference
- This method somehow hinder the development of laboratory skills among the students
- Not useful for developing scientific attitude

### LABORATORY METHOD

The word 'Laboratory' was originally applied to the work-room of a chemist, a place devoted to experimental study in natural sciences. Hence the term Laboratory Method was first widely used in the physical sciences to characterise a teaching procedure that makes use of experimentation with apparatus and materials in order to verify physical laws and other facts.

#### The Method

The Laboratory Method of teaching science has in recent years come to connote a learning situation somewhat in contrast and opposition to the demonstration method. Some experts believe that the Laboratory Method is the one in which there is maximum pupil activity.

The Laboratory Method is a planned learning activity dealing with original or raw data in the solution of problem. It is a procedure involving first hand experiences with materials or facts derived from investigations or experimentation. Of it, the Laboratory Method is not one that may be used exclusively. Used in conjunction with some other techniques, it may be a very effective means of collecting evidence in the solution of problems.

The Laboratory Method is used in many different ways. It is, for the most part, planned on an individual basis. Of course, group laboratory work can be carried on, but it is less satisfactory. Previously laboratory work was done,

separately from class work and there was hardly any correlation between the two. The trend at present is to merge the laboratory and class-room work, making each supplement the other.

If the Laboratory Method is to produce its maximum effectiveness, it must be planned, directed, and controlled by the teacher with just as much care as is used with a demonstration lesson. Under proper guidance and supervision the Laboratory Method can yield much in training for the development of skills and techniques.

### **Techniques of the Laboratory Method**

The technique can be conveniently divided into three parts or steps namely,

- (i) Introductory steps
- (ii) Work Period
- (iii) Culminating activities.

### **Introductory step**

In this step which provides for motivation and orientation, the following factors should be taken into account.

#### **(a) Determination of Laboratory work to be done**

If the teacher has planned this work in advance, then the first step is an explanation of the problem or other work to be done. This may be called presentation. Here is the teacher's opportunity to motivate the students.

But if the work is to be planned co-operatively by the students and the teacher, the first step is to determine by means of class discussion, the nature of the problem or the work to be done.

### **(b) Determination of the Plan of Work.**

The second step is to get clearly in mind what is to be done. This may be set forth by the teacher who gives the necessary directions for both individual and group work. Since this work is likely to take more time than one period as it consists of various activities, written directions in the form of guide sheets, manuals, work-books and so on should be used.

The introductory step thus considers the problem and the objectives of the work as well as of the plan of work to be carried out. After considering the first step, we now discuss the second one-work period.

### **(ii) Work-Period**

The laboratory activity should take the form of a supervised work-period in which groups or individuals have their particular work to do. The students can work individually or collectively on a particular problem or on different problems. Directions must be very specific. The length of the work periods should be determined by the nature of the problems and the objectives. If the laboratory work occupies several days, it may be desirable to have the class meet as group each day, preferably at the beginning of the period for a discussion of the problems, progress and to receive criticisms, suggestions or directions from the teacher.

### **(iii) Culminating Activities**

When the members of a class have completed their laboratory work, the class should meet for discussion and organisation of findings or for presentation of the results of individual work. The following types of activities may be used:

1. Students re-state the problem that the group has been working on and explain its nature and importance.

## Pedagogy of Biological Science – Part 1

2. Review of the plan for solving the problem and organisation of plan for recording the data gathered.
3. Presentation of illustrative material or special contributions by students working on special problems.
4. Where students are working on individual projects, special reports may be given before the group, together with an exhibition of their work.
5. Note-books and written reports may be completed for final record of work.
6. Work of the class may be exhibited and rated by members of the class or by competent judges from outside.
7. Exhibits of various projects may be set up and explained by then- sponsors.
8. Tests or examinations may be used as a means of measuring achievement relative to certain outcomes.

Since it would be impracticable to have too great a variety of culminating activities, those chosen should be adapted to the particular needs of the class, as well as to the time available. Written reports and summaries may be required to assure adequate participation of all the class in the completion of the work.

### Project Method

A project is an educational method where students working individually or in small groups analyze and develop “real-life” problem or tackle a present day theme within a preset time limit, working independently and with the division of tasks clearly defined.

## Steps

From the above example, you can deduce the steps of conducting a project. The steps are

1. Providing a situation
2. Selecting a problem
3. Planning the project
4. Executing
5. Evaluating

## Advantages

- ✓ It helps in developing social norms and social values among the learners.
- ✓ It provides invaluable opportunities for correlation of various elements of the subject matter and for transfer of training or learning.
- ✓ It helps in growing knowledge very effectively as a results of their close cooperation on social participation in the spirit of democracy.

## Disadvantages

- ✓ The project cannot be planned for all subjects and whole subject matter cannot be taught by this strategy.
- ✓ It is not economical from the point of view of time and cost.
- ✓ It is very difficult for a teacher to plan or to execute the projects to the learners and supervise them.

## HEURISTIC METHOD

### Origin

Heuristic Method was propagated by H.E Armstrong, Professor of Chemistry, Imperial College, London. The word 'Heuristic' is derived from the Greek word 'Heurisko' means 'to discover'.

### Definitions

Armstrong: "Heuristic Method is a method of teaching which involves our placing the students as far as possible in the attitude of a discoverer"

West way: "Heuristic method is intended to provide a training in method, knowledge is a secondary consideration all together".

### Principles of Heuristic Method

The Heuristic Method is based on the following principles.

1. Principles of freedom
2. Principles of activity
3. Principles of experience
4. Principles of purposefulness
5. Principles of logical thinking
6. Principles of play-way
7. Principles of individual work

## Steps in Heuristic Method

- ✓ Selection of a problem
- ✓ Formulating hypothesis
- ✓ Collection of data
- ✓ Analyze the data
- ✓ Draw conclusions

## Role of the teacher

- ✓ Well prepared and well equipped
- ✓ Act as a guide and a friend
- ✓ Provide instructions
- ✓ Help to develop values
- ✓ Keeping psychological principles in mind
- ✓ Provide freedom of thought
- ✓ Teacher should encourage the students to approach him time to time and ask questions

## Merit of Heuristic Method

- ✓ Development of scientific attitude
- ✓ Active participation and involvement
- ✓ Psychologically sound
- ✓ Clarity and permanency of the knowledge
- ✓ Cultivation of good habits
- ✓ Providing individualized instruction
- ✓ Good relationship between teacher and taught

## **Pedagogy of Biological Science – Part 1**

- ✓ Reduction in the load of home work
- ✓ Solves problem of indiscipline

### **Demerits of Heuristic Method**

- Not suitable for the elementary classes
- Expects too much from the students
- Expects too much from the teachers
- Obstacle in the path of the progress
- Difficulty in covering the syllabus
- Possibility of faulty outcomes and conclusions
- Not suitable in the existing circumstance because the number of students in a class is too large
- Expensive
- Non availability of suitable text books

### **Historical method**

Historical method is the collection of techniques and guidelines that historians use to research and write histories of the past. Primary sources and other evidence including those from archaeology are used.

**There are three major steps in historical research.**

**They are:**

- Collection of data through primary and secondary sources.
- Criticism of the data, including the internal and external examination.
- presentation of facts in a readable form involving problems of organisation, composition, exposition and interpretation.

## Advantages

- The research is not involved in the situation that is studied
- The researchers do not interact with the subjects of study
- Analysis of historical data may help explain current and future events

## Disadvantages

- Controlling for many of the threats to internal validity is not possible in historical research.
- Many of the threats to internal validity are likely to exist in historical studies.

## Biographical approach

The biographical method is the collection and analysis of an intensive account of a whole life or portion of a life, usually by an in-depth, unstructured interview. The account may be reinforced by semi-structured interviewing or personal documents.

**Biographical criticism** uses details about an author's personal life to analyse the author's works.

- It relies on autobiographies, correspondence, and other primary materials about the author and is a form of historical criticism.
- Critics doing biographical analysis carefully examine incidents in the lives of authors and try to identify events, settings, objects, buildings, people, etc. found in the novels with historical sources.
- The difficulty with this sort of criticism, and reason it has somewhat fallen out of favour, is that fictionalized accounts, even when they may

have been inspired by actual events and people, often suffer a sea change when they are introduced into novels.

### **Advantages and Disadvantages**

#### **Advantages:**

- Arouse interest
- Particularly suited for primary classes
- Made wherever it is possible

#### **Disadvantages:**

- Cannot be adopted as a method of teaching

### **Scientific method**

a method of procedure that has characterized natural science since the 17th century, consisting in systematic observation, measurement, and experiment, and the formulation, testing, and modification of hypotheses.

At the core of biology and other sciences lies a problem-solving approach called the scientific method.

#### **The scientific method has five basic steps, plus one feedback step:**

##### 1. Problem

###### **a. Sensing the problem**

Here a student has to select the problem based on his interest, economy, time and society needs.

## **b. Defining the problem**

A proper and appropriate definition should be given for the problem.

## **c. Analyzing the problem**

By all means a researcher has to analyze the problem background.

## **2. Collection of data**

Researcher has to collect primary and secondary data related to the problem.

## **3. Hypothesis formation**

Based on the data the solution finder frame hypotheses as much as possible.

## **4. Experimentation**

Here the researcher executes the experiment by using all the equipments under controlled situation on involving various variables.

## **5. Principle formation**

Based on the result that you had, the principles has to be formed.

## **Advantages**

- It is based on empirical evidence
- It is proof and verification
- Found by reasoning and observation
- Reliable at finding the truth
- Scientists are impartial

## Pedagogy of Biological Science – Part 1

- Cautious - with theories that are backed up

### Disadvantages

- Nothing has full knowledge of the world
- Senses can deceive us - science only provides us with an incomplete picture of the world
- Scientists can never be completely unbiased
- Science isn't free from error
- No way of knowing what is real - some things could be illusions
- Theories have to sometimes be interpreted e.g. data is interpreted

### Team Teaching

Team teaching involves a group of instructors working purposefully, regularly, and cooperatively to help a group of students of any age learn. Teachers together set goals for a course, design a syllabus, prepare individual lesson plans, teach students, and evaluate the results.

### Characteristics of Team Teaching:

- The team-teaching method is flexible
- In team teaching, teachers need to decide their activities by themselves
- It is a collective responsibility
- In team teaching, the whole responsibility is on all the teachers
- The requirements of pupils, schools and other things also considered
- Teaching and evaluation both done on the co-operative basis

## Types of Team Teaching

Team teaching includes a number of different approaches. Some of the more common are

**Interactive team teaching** – two faculty members present in front of the class simultaneously.

**Rotational format team teaching** – faculty alternate teaching the class. This rotational format has a number of variations depending on the subject matter and the number of faculty involved.

**Participant-observer team teaching** – all participating faculty are present for all the classes, but only one is “teaching” at a time. Roles that the other teachers could play as participating observer(s) are model learner, observer, panel member, or resource (Klein, 1990).

**Team coordination** – faculty arrange and integrate a curriculum so as to maximize learning and connections using paired or linked courses, an integrated cluster of independent courses, or freshman interest groups (McDaniels and Colarulli, 1997). Though not necessarily team teaching per se, this curriculum-level approach to interdisciplinarity can help to achieve some of the expected gains of team teaching.

## Advantages of Team Teaching :

### 1. Low cost:

One can get an efficient form of learning at a very low cost; as such no new resources required to start team teaching.

## **2. Support for teachers:**

Usually, teachers overburdened with the fact that they have to complete the curriculum by the end of the term, even if they have creative ideas to teach students they do not have enough time to plan and impart the same to the students.

Moreover, it can also happen that teachers have ideas but need guidance to develop the skill and impart the same to the students.

Team teaching eliminates such problems and other problems of a similar kind. When teachers collaborate they could play on their strengths and weaknesses and together as a team can make a successful way to teach and learn.

## **3. Closer integration of staff:**

Very often teachers in schools and colleges lack bonding and friendship among themselves. Even worse a competitive environment sees among the teachers.

The main motive of educational institutes is to impart value to students and work as a whole for being efficient knowledge importers. Envy or competition among teachers can harm the Institute and the student's mind.

With team teaching, teachers bound to bond, as frequent discussions and planning make them develop a good relationship. A happy staff can effectively inculcate the vision of the Institute

## **4. Variety of ideas:**

When teachers come together with their teaching style, ideas and expertise come together, if planned perfectly, the mixture of best ideas and styles will put forth many ways out of a single topic. It thus helps in better learning

## **5. Better involvement of students:**

A new method is always appealing; students might wonder what new things they are going to learn. A team of teachers will have various ways and ideas to put forth, which make the students, put on their thinking cap and question 'why' for all things. They will come up with various questions, queries, and ideas.

A dynamic discussion session will increase student's involvement and thus helps in bringing out the best in students

## **6. Mental stimulation to students:**

In traditional lecture only one teacher is teaching, the ideas, thoughts are only one way. Often students forced to accept whatever taught and they do not bother to think the other way around.

Team teaching helps them question the theories and facts. When the students involved it brings out the creativity and the habit of questioning things.

## **7. Breaks traditional lecture boredom:**

Let's be very honest, in lectures, we are often distracted, either chatting with our friends or checking our phones. Or maybe jotting down notes, in all the mentioned cases we are giving divided attention.

An interactive session, debates, help of visual aids and the like evokes interests among students. Team teaching exactly does that.

## **8. Better bonding between student and teacher:**

Humans bond when they interact, it is as simple as that. The bonding is increased when teachers often ask questions and listen to what students have to say. People when heard and appreciated, will ultimately be more engaged.

### **9. Provokes participation / interaction:**

Teachers will often find students who rarely participate in any activity and are aloof, mostly students with a shy personality will not speak much in class. But during team-teaching, a variety of ideas are put forth.

A perfectly planned lecture will provoke even the most notorious and most aloof people to be engaged. Team teaching helps teachers deal with students of all personalities well and get better engagement

### **10. Imparts the lesson of team management:**

When students see the way teachers work in a team, they indirectly get the lesson of team management and the importance of working in a team. Everyone in their career will need to work in teams.

Students get to see how teachers capitalize on each of their strengths how they respect each other's ideas and how as a whole they put the best picture forward. Indirectly, team teaching is helping reduce the extra lecture on team management.

### **11. Develops interpersonal skills and logic of students:**

Students' interaction and logic are improved drastically as they learn to question things and learn how to communicate their ideas effectively.

While in case of a debate, students get to learn how to respect the contradicting ideas, accept them and also tell their thoughts in return.

### **12. Teachers can give individual attention: juggle**

When a teacher is teaching solely, he or she cannot give attention to the students who have a problem learning. The main focus is to make the whole

## **Pedagogy of Biological Science – Part 1**

group of student understanding at the same time. But we all know that all students are different and everyone has their own learning pace.

In team teaching, if one teacher is speaking the other one can solve the queries student raises, without disturbing the whole class.

### **13. Staff development:**

There is no limit to learning, provided if one wishes to, team teaching allows teachers to learn and grow themselves.

Teachers also get a chance to brush up their skills, work up to their fullest potential and along with that their creativity, motivation, and team management skills get a solid boost too.

### **14. Long-term knowledge retention:**

With a dynamic and interactive session students are engaged and they learn better. Knowledge retention is much higher than the traditional learning approach

### **Disadvantages of Team Teaching:**

#### **1. Acceptance of change by teachers:**

Let's face it, we humans dislike change, teachers may not accept the idea of team teaching, they are often rigid and want to stick to the traditional teaching techniques. The idea that they will have to put extra effort and work hard makes them reluctant.

Team teaching can only be effective if teachers are willing and happy to involve in the new form of teaching. A forced approach is bound to fail.

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While traditional teaching has been an attempted and tried technique, likewise it has disadvantages of traditional teaching, especially nowadays the innovation has improved adapting, more fun and intelligence.

### **2. Rigidity in teachers:**

Apart from accepting the change in the form of teaching, teachers often have the rigidity to accept and adjust with other teachers, while working in a team we have to accept others' ideas and drop ours. Teachers should not have an ego and should handle criticism openly.

### **3. Bad team management:**

Internal coordination and good team tempo are extremely important, internal conflict may result in a complete failure.

### **4. Personality conflict:**

People with contradicting personalities must devise a way to work together effectively. A dominating person will overpower other people, a collaborative approach will help everyone grow and devise an effective process of team teaching.

### **5. Inability to complete curriculum:**

While devising creative curriculum & engaging students in an interactive session, the curriculum may fall behind.

Even though creative teaching is necessary, it is also important for completing the course syllabus. This is one of the major challenges faced during team teaching.

### **6. Time for coordination and planning:**

Teachers have to take out time from their busy schedules and sit together to devise the lecture flow and activities that have to be carried out.

Many times you could find them juggling through their work and the time required for planning out the course

### **7. Hard to keep track:**

The sessions at times can get super interactive and teachers will forget the link. The teachers have shared responsibility and have an individual role to play. If anyone of the teachers is absent for some reason then the whole session will be jeopardized.

### **8. Takes time to develop:**

Teachers will have to refer many books and talk to several veteran teachers for designing an effective teaching plan.

It will also involve deep research and planning out activities that will be appealing to students. Thus it takes lots of time and effort before even starting a session.

### **9. Going overboard:**

While being creative and lining up too many activities, it could get way beyond the required amount.

A little stimulation to students' brains will bring the best in them, but if it gets too much they will find it too hard to comprehend. One needs to find the right amount.

### 10. Resistance from students:

Since childhood, students get used to the traditional form of teaching, they like the structure and the repetitiveness of the lectures. Most probably they have devised their ways to make it work, a sudden change in the style of teaching will make them confused and they might resist the change.

Some Students like the basic lecture and then they do their self-study to learn in deep about it. You could find students coming up with specific problems that they find difficult.

Teaching them everything in detail and inculcating activity, debate or different methods to teach the same topic may make them feel that their time is getting wasted.

### 11. Takes time to develop:

This new teaching style is fresh to students as well as teachers. Teachers would not have perfect coordination at the first go, they will have to do many trails for reaching the most effective format. There can be an overlap of ideas among teachers or they could not impart whatever they thought of.

It could also happen that they overestimated or underestimated the time required to complete the planned tasks. If one of the teachers finds it too difficult to carry out and opts out of it then the whole team will be disrupted.

Teachers can also face resistance from the students. Too many ideas and discussions will make the classroom chaotic. Patience from teachers as well as students is required for a successful team-teaching

## 12. The expectation of higher compensation:

If we compare the efforts required for teaching solely with the efforts required to teach in a team, then the later one is undoubtedly much harder and would require deep study, time and planning.

Thus teachers may demand a higher salary. It could ultimately bring financial pressure to the educational institute.

## Remedial teaching

A remedial teaching class is one that is meant to improve a learning skill or rectify a particular problem area in a student. Remedial instruction involves using individualized teaching of students who are experiencing difficulties in specific subject areas

## Characteristics

- tasks,
- time management
- and guidance.

## Remedial program

- Are research-based, using proven teaching methods
- Teach step-by-step without skipping over content
- Are conducted at the student's pace
- Offer regular reviews and practice exercises to reinforce learning and practice applying new knowledge

## **Pedagogy of Biological Science – Part 1**

- Include a way to assess what the student has learned and whether he's ready to move ahead
- Teach your child the material in a different way from the way he was taught the first time around
- Offer small group instruction to provide for more individual attention

### **Advantages**

A remedial activity is one that is meant to improve a learning skill or rectify a problem area. Remedial instruction involves using individualized teaching of students who are experiencing difficulties in specific subject areas. Remedial instruction might be taught individually or in groups and targets academic weaknesses that may hinder learning. Remedial activities teach basic skills that are the foundation for learning a subject in greater detail, and such skills must be learned before students can develop a detailed understanding of the topic of study. The following are the advantages of remedial activities which would help our students to develop their skills they need.

#### **1. Learning Basic Skills**

Students who do not have basic math and reading skills will benefit from attention to remedial activities in the classroom. Using phonics, Dolch words or basic multiplication tables as teaching tools will give students the basic skills they need to advance to a higher academic level.

#### **2. Reinforcement**

Students who have been out of school may benefit from remedial teaching over a week or more to reinforce skills they lost due to extended time away from school. Teachers might use flashcards, games or fun activities involving phonics and basic math to help students get back on the learning path.

### 3. Communication Skills

Students who suffer from speech disorders may have trouble with communication in the classroom. Speech disorders are often developmental and may respond to remedial reading instruction. Teaching reading using phonics and sounding-out activities may help students with communication issues from speech-related problems become more academically proficient.

### 4. Behavior and Motivation

Students who fall behind due to the inability to perform even the most basic tasks in the classroom may develop behavior problems because of their frustration levels. This can also lead to a lack of motivation and the desire to give up altogether. Teaching remedial activities will help students gain general knowledge that can be applied to all subject areas and help reduce feelings of inadequacy that lead to behavior or motivation issues.



## **UNIT 8**

### **FACILITATING INDIVIDUAL LEARNING STRATEGIES**

#### **INDIVIDUALIZATION OF INSTRUCTION**

Individualized instruction focuses on the needs of the individual student. Teaching is specific and targets one need at a time. This teaching method can be used on its own, or it can be part of differentiated teaching. Some students who receive individualized instruction need teachers to help them understand and learn.

#### **Programmed Instruction**

##### **Definition**

Programmed instruction is a method of presenting new subject matters to students in a graded sequence of controlled steps. Students work through the programmed material by themselves at their own speed and after each step test their comprehension by answering an examination question or filling in a diagram.

**Programmed learning**, educational technique characterized by self-paced, self-administered instruction presented in logical sequence and with much repetition of concepts. Programmed learning received its major impetus from the work done in the mid-1950s by the American behavioral psychologist B.F. Skinner and is based on the theory that learning in many areas is best accomplished by small, incremental steps with immediate reinforcement, or reward, for the learner. This technique can be applied through texts, so-called teaching machines, and computer-assisted-instruction. No matter what the medium, two basic types of programming are used: linear, or straight-line programming, and branching programming.

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## Characteristics of Programmed Instructions:

As far as characteristics of programmed instructions, these are as follows:

- ✓ It is not an audio visual device. It is a part of education technology, i.e. instructional technology.
- ✓ It is a method of giving or receiving individualized instructions. It keeps in view their individual differences. The learner moves at his/her own speed.
- ✓ It clearly defines the entering and terminal behavior of the learners.
- ✓ It is not the solution of educational problems. It is a new instructional strategy for the modification of behavior of learner.
- ✓ It is systematic and sequenced.
- ✓ It cannot replace the teacher
- ✓ It provides immediate feedback to the learners.

## Objectives of Programmed Instruction:

The objectives of programmed instruction have been summarized as follows:

- ✓ To help the student in learning by doing.
- ✓ To provide the learners situation so that they can learn at their own pace.
- ✓ To help students learn in the absence of a teacher.
- ✓ To present the content in a controlled manner and in logically related steps.
- ✓ To help students in assessing their own performance themselves by comparing it with the given answers.

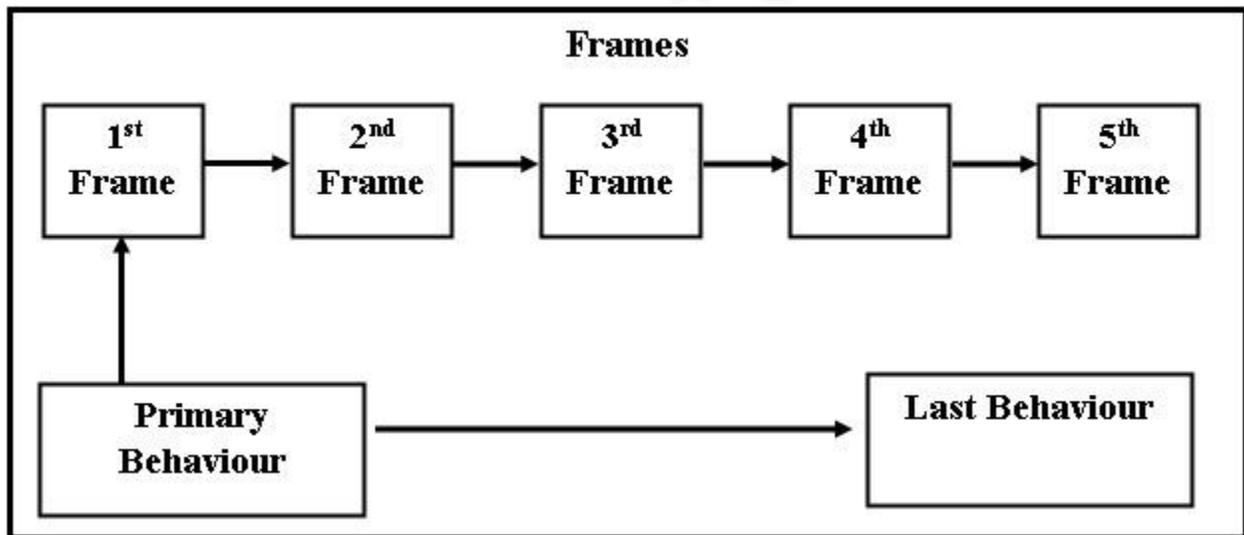
## Types

There are three types of programming.

1. Linear Programming.
2. Branching Programming.

### 1. Linear Programming:

The founder of this programming is B.F. Skinner. It is based on theory of operant conditioning. It tells that “A Certain direction can be given to human behavior”, for this purpose activities is needed to divide in small parts and make their analysis.



**Linear programming is based on five fundamental principles-**

1. Principles of small step.
2. Principle of Active responding.
3. Principle of immediate confirmation.

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4. Principle of self pacing.
5. Principle of student testing.

The assumption behind the linear programming is that student learns better if content is presented in small units, student response if immediately confirmed, results in better learning, student's error create hindrance in learning. Student learns better in Laissez fairy environment.

Frame size in small steps; include only one element of topic at a time. Each step is complete in itself. It can be taught independently and can be measured independently. Frame structure is based on stimulus-response-reinforcement. There are four types of frames. Introductory frames, Teaching frame, practice frames and testing frames.

Responses in linear programming are structured responses and are controlled by programmer and not by learners. Immediate confirmation of correct responses provide reinforcement, wrong responses are ignored.

It is used for secondary level students, used for achieving lower objectives of learning especially for recall and recognition, useful for student of average and below average intelligence can be used in distance education programme.

### **2. Branching programming**

The founder of Branching programming is Norman A Crowder. It is based on configuration theory of learning. It is a problem solving approach. It is stimulus centered approach of learning. It is based on three basic principles :

1. Principle of Exposition
2. Principle of Diagnosis
3. Principle of remediation

# Pedagogy of Biological Science – Part 1

## Assumptions behind this programming are :

- A. Student learns better if he is exposed to whole situation or content.
- B. Student errors help in diagnosis.
- C. Student learns better if remediation is provided side by side.
- D. Student learns better in democratic environment.

Frame size is large. There may be a Para or page in the frame. Frame structure is Exposition- Diagnosis- Remediation types. There are two types of frames- Home page (for teaching and diagnosis) & Wrong pages (for remediation). Responses not rigidly structured and responses are selected by learner and not by the programmer. Confirmation of correct responses provides reinforcement. Wrong responses also help in diagnosis of weaknesses of the learner. Remedy is provided on the basis of diagnosed weaknesses of the learner. Error helps in diagnosis of the weaknesses of learner. More than 20% error rate can be accepted. The purpose of Branching programming is to draw out weak points of learner and provide remedy for recovering those weaknesses.

Branching programming is used for secondary as well as higher classes. Higher objectives can be achieved such as multiple discrimination etc. It is useful for students of above average and high intelligence. It can also be used in Distance education programmes.

## Advantages and Disadvantages of Programmed Instruction

### Advantages of Programmed Instruction

- ✓ Learners will work individually.
  - ✓ Students can proceed at their own pace and at time convenient to them.
- A slow learner is not embarrassed.

## Pedagogy of Biological Science – Part 1

- ✓ This offers a method of teaching project leaders and others in local communities.
- ✓ Those who setup programmed instruction units may be motivated to plan their efforts more deliberately and more thoroughly than with traditional teaching.
- ✓ It may be less complicated to keep materials in current Programmed Instruction unit than it is to update in a textbook.
- ✓ Programmed Materials can be prepared for and adapted to fit almost any local situation related to nationality, economic or cultural variations in a community.
- ✓ Material can be exchanged from country to country and from state to state, giving flexibility and variety to extension offering.

### Disadvantages

- The preparation of Programmed Instruction material is time demanding, many hours are usually required to produce a unit.
- Motivation is necessary for students, whether they're staff members or layman, to complete units of programmed instruction. It may be that job promotion in their own organization would be sufficient enticement. Possibly an item in the individual personnel record would motivate him to complete a unit.
- The extension teacher must keep in touch with their students working on units and let them know he's interested in progress and keeping in touch. This may be difficult to do in some cases, like in case of high rate of competition.

- The technique may be new to the particular students and they may not complete units satisfactorily because they don't adequately understand Programmed Instruction.
- Programmed Instruction done on an individual basis at student's home or offices would likely have to be limited to the linear type. While this could be effective, it may not have the potential that more sophisticated computers would have.
- The problem of teacher motivation, one of the human factors in programmed learning, must be given attention if this method is to succeed.

### **Computer Assisted Instruction(CAI)**

**There are following five kinds of approaches in CAI.**

#### **Kinds of CAI**

##### **1. Drill and practice**

In this mode, the Computer presents to student a series of exercise which he or she attempts by giving some responses, it provides the student feedback on his answers in the form of a Congratulatory message if it is right, or corrective comment if it is wrong. For example CAI packages could be developed on topics like Indus valley civilization, India as a Nation, Human Interaction with environment etc. and students would be allowed to learn through drill and practices.

## 2. Tutorial Mode

In tutorial mode information is presented in small steps followed by a question. The student's response is analyzed by the computer and appropriate feedback is given. Computer programmes in social studies in tutorial mode could be developed and used for providing individualized instruction.

## 3. Simulation Mode

Learning experiences related to real life phenomena are provided to student through this mode. For example, the flow of river from its origin could be very well simulated through computer simulation.

## 4. Discovery Mode

This mode is Inductive approach to learning in which problems are presented and students solve them through trial and error method. The discovery mode is very useful for teaching geographical concepts, principles etc.

## 5. Gaming Mode

In the gaming mode, teaching can be imparted through play way method. This mode is very expressive in the teaching of social studies. Computer based games could be developed in which students assume roles as pioneers, explorers government officials, producers and consumers. Games offer students a number of decision making situations and motivate them to learn many specialized skills.

## Phases of CAI

**There are three phases of CAI based teaching Method.**

### 1. Planning Phase

In this phase target group, Content and appropriate steps are decided. Step by step analysis of content is decided and appropriate measures are taken that which content is delivered by which way of representation. It should be noted here that it is not mandatory to use any teaching method from start to end of content, Teacher can use any method according to need, so in this phase teacher it decide that at which part there is need of CAI method, or whole topic is covered by CAI method.

### 2. Development/Delivery of Content

At this step delivery of content or CAI based instruction is presented by teacher for their targeted student. As the need of subject area Drill and practice, tutorial mode, simulation, gaming or Discovery mode is adopted. As per the mode of presentation content is structured and appropriate evaluation measures are inherited in programme. After completing step by step student get appropriate knowledge in the desired field.

### 3. Consolidation Phase

It is concluding phase where teacher know about the progress of their student, their problem and gives solution for their appropriate modifications.

## Advantages of CAI Method

- The immediate feedback provided by interactive terminals keeps students interacting and eager to keep trying.

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- Weather students are obliged to participate actively. They often remain passive in lecture.
- The Computer will wait patiently for an answer and will not express annoyance with wrong response.
- The graphics facility is a powerful aid in enhancing intuition, especially in giving insight, into mathematical formulae.
- Interactive graphics make it possible to sample many more illustrations than could easily be shown in a text book.
- Mathematical calculations can be done as readily for realistic examples as for artificially simple cases that can be solved analytically.
- Large volume of data can be handled with accuracy and without drudgery.
- The novel technique provides enrichment of a course through added variety.

### **Disadvantages of CAI**

- A programmer cannot cater for every possible response and may give unexpected and unhelpful responses to unusual input.
- A few students are intimidated by the strangeness of a computer terminal.
- Packages can become boring if a student is alone at a terminal for too long. Most packages should run for an hour or so.

- A package will not be appreciated unless it has a perceived goal and will not be considered important unless it is integrated into a course to the extent of being assessed by a teacher.

### **Role of Multimedia in teaching biological science**

#### **Multimedia**

The term “multimedia,” which consists of “multi” – which means integrating many expression methods – and “media” – which implies technical key words such as “computer,” “dialogue,” and “digital,” has changed its meaning through the decades. The term multimedia can be defined as a platform that integrates analogue information in various forms such as text, images, and audio-visual materials to a single digitized data and relays them using several(multi) vehicles (media). It is a system that allows users the use of easy and high-speed information communication networks. As information becomes digitized, all media can now be integrated into one and all the necessary multimedia equipment may be controlled by just one computer system. Multimedia is the exciting combination of computer hardware and software that allows you to integrate video, animation, audio, graphics, and test resources to develop effective presentations on an affordable desktop computer. (Fenrich, 1997).

Multimedia is characterized by the presence of text, pictures, sound, animation and video; some or all of which are organized into some coherent program (Phillips, 1997).

Today's multimedia is a carefully woven combination of text, graphic art, sound, animation, and video elements. Thus, multimedia is an integration of multiple media elements (audio, video,

## **Pedagogy of Biological Science – Part 1**

graphics, text, animation etc.) into one synergetic and symbiotic whole that results in more benefits for the end user than any one of the media element can provide individually.

### **Nature and Characteristics of Multimedia Approach**

- Multimedia approach uses a number of media, devices, and techniques in the teaching learning process.
- Multimedia approach has come out of researches and experiments in educational technology utilized to improve the process of teaching-learning.
- Multimedia approach aims at providing meaningful learning experiences.
- Select the media carefully so that one does not hamper or reduce the effect of the other i.e. each media must complement the other.
- Use media sequentially and judiciously. Then it would be possible to make optimum use of them in a most economical manner.

### **Impact of Multimedia Technology in Teaching of Biological Science**

Shortly after the internet explosion of the 1990s, technology was immediately integrated into the classrooms. Many efforts have been established to help educators realize the benefits of technology and ways of implementing them in the classroom.

Multimedia technology can be used to support and enhance learning. Some examples of technologies used in the education system are video content and digital movie making, laptops, computers, and handheld technologies. New uses of technology, for example, podcasting and tablets are constantly being created. Many students are growing up in a digital age where they have

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constant exposure to a variety of media that is impacting on the way they interact and use information. It is clear that using multimedia in the classroom the students;

- have more fun
- are more enthusiastic
- have increased engagement in learning
- are more interested in learning
- are more self-directed in learning
- have greater self-confidence and self- esteem
- focus on improving performance
- have greater ICT skills
- increase their research skills
- improve problem solving and critical thinking skills
- write more extensively with improved quality
- have increased access to information
- can present information more effectively
- Enjoy learning actively.

Multimedia is changing the way we communicate with each other. The way we send and receive messages is more effectively done and better comprehended. The inclusion of media elements reinforces the message and the delivery, which leads to a better learning rate. The power of multimedia lies in the fact that it is multi-sensory, stimulating the many senses of the audience.

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It is also interactive, enabling the end-users of the application to control the content and flow of information. Children can use technology individually, through computer-assisted instruction, to learn biological science concepts.



**UNIT - 9**

**LESSON PLAN**

**Lesson plan**

A lesson plan is a teacher's daily guide for what students need to learn, how it will be taught, and how learning will be measured. Lesson plans help teachers be more effective in the classroom by providing a detailed outline to follow each class period.

**Essential features of lesson planning**

Some important features of a lesson-plan are as under:

**1. Objectives:**

The entire cognitive objective that is intended to be fulfilled should be listed in the lesson-plan. Objectives should be formulated in terms of changes desired in behaviour of students. Objectives, as we know, have two specifications; the content specification and the competence specification. We have to mention clearly what type of changes we are going to bring in different domains cognitive, affective and psychomotor of students behaviour within a particular type of content.

The objective should be written in specific behavioural terms stating exactly what the learner will be doing, or saying when he demonstrates that he has achieved the aims of an instructional sequence. Walbesser constructing behavioural objectives listed four requirements for the construction of objectives:

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1. Words denoting the stimulus situation which initiates the performance should appear in the description of the objective.
2. An action verb which denotes observable behavior must be contained in the description.
3. A word denoting the object acted upon must be contained in the description.
4. A phrase which indicates the characteristics of the performance that determines its correctness or acceptability must be included in the description of the objectives.

### **2. Content:**

The subject-matter that is intended to be covered should be limited to the prescribed time. The matter must be interesting and it should be related to pupil's previous knowledge. It should be related to daily life situations.

### **3. Methods:**

The most appropriate method is chosen by the teacher. The method chosen should be suitable to the subject-matter to be taught. Suitable teaching aids must also be identified by the teacher. Teacher may also use supplementary aids to make his lesson more effective.

### **4. Evaluation:**

Teacher must evaluate his lesson to find the extent to which he has achieved the aim of his lesson evaluation can be done even by recapitulation of subject-matter through suitable questions.

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**In writing a lesson plan the following points are written down:**

- (i) Date,
- (ii) Period,
- (iii) Class,
- (iv) Duration
- (v) Subject,
- (vi) Topic,
- (vii) General objectives,
- (viii) Specific objectives,
- (ix) Previous knowledge of the students,
- (x) Teaching aids and materials to be used,
- (xi) Introduction,
- (xii) Statement of object,
- (xiii) Presentation,
- (xiv) Generalizations,
- (xv) Recapitulations,
- (xvi) Black-board summary,
- (xvii) Hand-work.

## Steps in Lesson Planning

1. Preparation or Introduction
2. Presentation
3. Comparison or Association
4. Generalization
5. Application
6. Recapitulation

### 1.Preparation

The teacher must prepare the students to receive new knowledge. Knowledge is to be linked with the previous knowledge of the students. Preparation in fact, means the exploration of the pupil's knowledge, which leads to the aim of the lesson. Teacher's skill lies in leading the pupils to see that their knowledge is incomplete and that to conquer lies before them. This can be done:

- By testing of the previous knowledge of pupils and introducing the lesson with an explanation.
- By asking questions that may reveal their ignorance, arouse interest and curiosity to learn the new matter.
- Through the use of chart, maps or pictures.

Through skillful conversation. It should be noted that this step should not in any case take more than five minutes.

## 2. Presentation

Before the presentation of the subject matter, the aim of the lesson should be clearly stated. By this teacher as well as the students are engaged upon a common pursuit.

In the presentation step, the pupils must get some new ideas and pupil should be the active participant in the teaching – learning process. The teacher should try to introduce everything from the learner. A sort of heuristic attitude should prevail the whole teaching. Questioning should form an important device of this step. Other aids should also be used to make the lesson more interesting and comprehensive. Black board summary should be developed along with.

**3. Comparison or Association:** Some examples are given to the students and they are asked to observe carefully and compare them with other set of the examples and facts. This step is important where some definition or some generalization is to be induced from the students.

## 4. Generalization

In this step the aim of the lesson is achieved. This step involves reflective thinking because the whole knowledge learnt in preparation is to be systematized which leads to generalization, formulae, rules etc., through comparison or association. This step completes the enquiry by providing the answer to the problem with which it began. Thus, the students get a new knowledge which is ready for me.

## 5. Application

At this stage, the students make use of the acquired knowledge in familiar and unfamiliar situations. In this way, the new knowledge gained by the pupils will become permanent in the minds of the students and will not fade from

## Pedagogy of Biological Science – Part 1

consciousness soon. 6.Recapitulation : This is the last step. The understanding and comprehension of the subject-matter taught by the teacher can be tested by putting some suitable questions on the topics to the students. This will also help the teacher to find out whether his method of teaching is effective and successful or not.

### PREPARING LESSON PLAN

#### Lesson Plan

Name of the Teacher Trainee : XXXX

Name of the School : XXXX

Subject : Biological Science

Class : IX Standard

Topic : Protozoan Animals

Time : 45 Minutes

Date : XXXX

Teaching Materials : Specimen,Charts, LCD Projector,etc...

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<b>GENERAL OBJECTIVES</b>	<b>SPECIFIC OBJECTIVES</b>
<p>Students will be able to :</p> <ol style="list-style-type: none"><li>1. acquire the knowledge of Protozoan animals.</li><li>2 . understand the Protozoan essential features.</li><li>3. apply the knowledge of Protozoan animals to new and real life situations.</li><li>4 . analyse the facts of Protozoan animals.</li><li>5 . develop the interest to Protozoan animals.</li><li>6. develop the skill of drawing, manipulating, collecting and preserving etc.</li><li>7 . develop scientific attitude and appreciate the nature Protozoan animals.</li></ol>	<p>Students will be able to :</p> <ol style="list-style-type: none"><li>i) Acquire the knowledge of protozoan animals.</li><li>ii) recognize that the Protozoans are single cell microscopic organisms.</li><li>i) develop interest about the locomotion of Protozoan animals by using pseudopodia, cilia and flagella.</li><li>i) analyse the different kinds of reproduction that occurs in Protozoan animals.</li><li>i) understand the binary and multiple fission.</li><li>i) apply the knowledge of biological science to classify the sexual reproduction of protozoan animals – Conjugation.</li></ol>

## Pedagogy of Biological Science – Part 1

Specifications	Content	Learning experience	Evaluation
Motivation:		<p>1)What are the things we see on this earth?</p> <p>Plants,animals,river s and mountains.</p> <p>2)How do you divide them?</p> <p>Living and Non – living.</p> <p>3)What are non – living things?</p> <p>Chair,desk,pen,tabl e,etc.,</p> <p>4)Give examples for living things?</p> <p>Plants,animals,man ,etc.,</p> <p>5)Say some animals name.</p> <p>Tiger,Deer,Elephant ,etc.,</p> <p>6)Do you know the</p>	

## Pedagogy of Biological Science – Part 1

	<p>a)Protozoans are unicellular microscopic organisms.</p>	<p>division of animal kingdom? If yes tell me the divisions?</p> <p>Yes, I know the divisions are:1)Invertebrates 2)Chordates</p> <p>Yes I know</p> <p>7)Do you know about the single cell animals?</p> <p>It has single cell in its body.It has under developed organ system in its body.</p> <p>8)Could you tell me about single cell organisms?</p> <p>All the single cell animals are called as Protozoan animals.</p> <p>Give some examples for single cell</p>	<p>What is protozoa?</p>
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## Pedagogy of Biological Science – Part 1

<p>2. Declaration of the topic:</p> <p>3. Presentation: recognize</p> <p>develop</p>		<p>animals?</p> <p>Amoeba, paramecium, euglena.</p> <p>So today let us study about “Protozoa”</p> <p>A group of single-celled organisms without rigid cell walls. Some, such as amoeba, ingest others cells. The group is polyphyletic - containing organisms which have different evolutionary origins.</p> <p>Pupil listens to the explanation.</p>	
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## Pedagogy of Biological Science – Part 1

	<p>b) Locomotory organs of protozoan animals.</p>	<p>Some of the single celled animals use pseudopodia for locomotion.eg:Amoe ba.</p> <p>Some of the protozoans use cilia for locomotion. Eg.Paramoecium and some of the single celled animals use flagella for locomotion. Eg. Euglena</p> <p>A group of single celled organisms without rigid cell walls.</p> <p>Whenever necessary, amoeba produced pseudopodia, (false leg) with the help of pseudopodia it moves.</p> <p>Pupil observes.</p>	
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## Pedagogy of Biological Science – Part 1

analyze	c) Protozoan animals undergo asexual and sexual mode of reproduction.	<p>Paramecium used cilia and Euglena used flagella for locomotion.</p> <p>Pupils observe.</p> <p>All the protozoans undergo two types of reproduction. They are :</p> <ol style="list-style-type: none"> <li>1) Asexual reproduction.</li> <li>2) Sexual reproduction.</li> </ol>	How does paramecium move from one place to another?
understand	d) Asexual reproduction is two types. Binary fission:	<p>1) Asexual reproduction leads to Binary fission and Multiple fission.</p> <p>Binary fission: A form of asexual reproduction,</p>	What is binary fission?

## Pedagogy of Biological Science – Part 1

		<p>whereby a single celled organisms, such as amoeba, divides into two smaller daughter cells.</p> <p>A form of asexual reproduction, whereby a single celled organisms, such as paramoecium, divides into many smaller daughter cells.</p>	
	<p>Multiple fission:</p>	<p>Pupil listen to the explanation.</p> <p>Multiple fission:</p> <p>A form of asexual reproduction, whereby a single celled organisms, such as</p>	<p>What is multiple fission?</p>

## Pedagogy of Biological Science – Part 1

		<p>paramoecium, divides into many smaller daughter cells.</p> <p>Pupil observe.</p>	
<p>4. Recaptulation:</p>	<p>e) Protozoan animals also undergo sexual reproduction.</p> <p>1) What is protozoa?</p> <p>2) How does amoeba move from one place to another?</p> <p>3) How does paramecium</p>	<p>Fusion of male and female gametes and transformed genetic material and other cell organelles with each other is known as conjugation.</p> <p>Fusion of male and female gametes and produced young ones.</p>	<p>What is conjugation?</p>

## Pedagogy of Biological Science – Part 1

	move from one place to another?  4) What is binary fission?  5) What is multiple fission?  6) In what way conjugation takes place in protozoan animals?		
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### Assignment :

Compare the reproductive mode of protozoan animals with other invertebrate animals.

SIGNATURE OF THE  
STUDENT TEACHER

SIGNATURE OF THE  
GUIDE TEACHER

### Different models/approaches for writing lesson plan

Generally various approaches are used to make a lesson plan. These approaches are Herbartian approach, Unit approach, Evaluation approach, and Project approach.

1. **Herbartian Approach** is based on apperceptive mass theory of learning. All the knowledge and information is to be given from outside by the teacher because the student is considered similar to a clean slate. For the students, if an old knowledge makes a base for new knowledge (his

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previous knowledge or experiences), it may be acquired easily and retained for a longer period.

### Herbart has given five steps:-

- Introduction
- Presentation
- Organisation
- Comparison and
- evaluation.

The main focus is on content presentation.

2. **Unit Approach** of Morrison is based on unit transaction and planning. The Morrison's lesson plan of teaching is cyclic; Morrison has given five steps for his 'cyclephase' of teaching:- Exploration, Presentation, Assimilation, Organisation, and Recitation.
3. **Evaluation Approach of B.S. Bloom in evaluation approach**, education is objective centered not content centered. The focus in this approach is on objective based teaching and testing. It takes into consideration the learning objectives and teaching methods on the basis of the objectives and to assess learning outcomes. Then, a decision can be taken about objectives of learning are achieved or need to provide the revision.
4. **Project approach** originated by Dewey and W.H.Kilpatrick stresses on group activity, social activity, self activity, and related to real life experiences. It is a pre-planned work completed by a person or group in social condition. Due to many reasons, it is not necessary that a lesson plan made by a teacher will be successful at every place and time. Many factors influence lesson planning such as

## Pedagogy of Biological Science – Part 1

- Availability of teaching aids,
- Strength of students in the Class.
- Composition of the Class (Age wise).
- School Location (Area wise)
- The nature of the topic (Medium wise) etc.

**Writing a lesson Plan:** Many written lesson plans are used by practicing teachers. A teacher needs some information about the class, students and their background before to attempt the lesson plan. In general, a Macro Lesson plan is divided into many stages/steps. We had introduced the approaches of lesson planning. Now, one can write a macro lesson plan based on different approaches.

### 1. HERBARTIAN APPROACH

The steps are given below:

1. **General information:** regarding the topic, sub-topic, subject, time, class, and age level of children.
2. **Instructional Objectives** (General Objectives and Specific Objectives): We know that at different grade levels, all subjects have general objectives, and specific objectives are written in behavioural terms. Specific Objectives focuses on the expected outcomes of teaching and the topic in a given time period. These specific objectives also known as instructional objectives, which are observable and measurable. It is required to identify the behavioural objectives and state these objectives in a clear and simple language.
3. **Instructional Aids:** The development of a new lesson plan is based on the standard and knowledge of students. Instructional are used by the teacher to make understand the chapter or topic easily. One picture

## Pedagogy of Biological Science – Part 1

delivers the message of thousand words. Teacher assumes that the previous knowledge of students related to the content can test and teaching will become easy through aids.

4. **Introduction:** in this step topic is introduced mainly through introductory questions or by creating the appropriate situations. New knowledge or information of students is linked with their previous knowledge by assuming and testing.
5. **Presentation:** In presentation the ways of relevant content is presented. A teacher develops the lesson Plan by asking many questions and receiving responses presented by the students'. Students' response helps the teacher for further presentation of the content. The presentation stage is interactive in the real classroom situation. It depends on teachers' communication and teaching skills like questioning, explaining, giving demonstration and providing reinforcement on desirable student behaviour.
6. **Recapitulation:** This step helps the teacher to find out the extent of learning that occurs during instruction. The teacher does this by asking several questions. This stage provides feedback to the teacher about the teaching learning process.
7. **Blackboard summary:** In the classroom during the instruction, the board is used by the teacher to write the teaching points, summary and explanations. Board is used simultaneously when lesson is being delivered in the classroom.
8. **Home Assignment:** At last, in the end of the teaching session, thought provoking, suitable questions or activities must be planned and given to the students. It gives a chance of revision or practice to the students. Home assignment also gives an opportunity to students to assimilate, whatever they have learned.

### 3. EVALUATION APPROACH

The design of lesson plan according to this approach consists of three aspects:

1. Input,
2. Process and
3. Output.

1. **Input:** It contains the identification of objectives in behavioral terms. These are known as Expected Behavioural Outcomes (EBOs). During this the entering behavior of the learners is also identified. With the help of instructional objectives, the sequence of instructional procedure is determined. These objectives are classified into four categories: Knowledge, Understanding, Application and Creativity. These objectives can be transformed in behavioural terms.
2. **Process:** This is an interactive stage when teacher actually communicating with students in the classroom. For effective presentation of the content, teacher has to choose different teaching strategies, audio-visual, and all support materials.
3. **Output:** This aspect of instructional procedure refers to real learning outcomes (RLOs). This is equivalent to terminal behaviour which is measured by using oral and written questions. This aspect is considered for measuring of the desirable change in behaviour of students.

### Unit plan

Unit plans consist of concepts and learning goals that are taught over a period of time and are woven together, often across subject areas. A unit plan lasts two or three weeks (or longer) and includes several standards, skills, and desired outcomes for interconnected learning.

## Components of Unit plan

A unit plan overarches all daily lesson plans with connections among key topics, concepts, skills, and desired outcomes. All the following elements should be considered when developing a unit plan:

- A principal purpose
- Main topic or topics (e.g., World War II, reptiles, double-digit multiplication)
- Concepts (e.g., integrity, the Doppler effect) that unite lessons within the unit
- Essential skills to be developed
- Academic goals and desired outcomes
- Academic standards that directly relate to the subject area or areas
- Cross-curricular connections
- Methods to make the learning relevant throughout the unit
- Big ideas that link to additional big ideas to increase understanding
- Past learning that links to present learning and leads to future learning
- An understanding of students' current knowledge
- Questions to guide thinking each day and from day to day
- Questions based on recurring unit ideas or themes
- Clear expectations for learning of all students
- Vocabulary to study and focus on, with multiple exposures over time to engrain learning
- A determination of appropriate level of proficiency to meet desired outcomes
- Assessments for before, during, and after lessons and the overall unit

### Steps in unit plan

1. Select the overall goals and specific objectives for the unit.
2. State the materials for the unit.
3. Outline or organize the content.
4. Plan and sequence the daily lessons with the appropriate instructional activities.
5. Plan and prepare for ways that students will be evaluated.
6. Gather and prepare the materials needed for instruction.



## **UNIT – 10**

### **CONTENT AND PEDAGOGICAL ANALYSIS**

#### **CONTENT ANALYSIS**

It is a research tool or technique that help to analyze the actual content and it is used to determine the presence of certain words, concepts, theme, phrases, characters, or sentences within texts or sets of texts and to quantify this presence in an objective manner.

By systematically evaluating texts qualitative data can be converted into quantitative data.

#### **Necessity of content analysis**

You have to know what you have before you start doing something with it.

To better serve your customers.

#### **Conducting a content analysis**

To conduct a content analysis on a text, the text is coded, or broken down , into manageable categories on a variety of levels i.e. word, phrase, sentence and then examined using one of content analysis basic methods.

1. Conceptual analysis
2. Relational analysis

#### **The Process of a Content Analysis**

According to Dr. Klaus Krippendorff, six questions must be addressed in every content analysis:

1. Which data are analyzed?
2. How are they defined?
3. What is the population from which they are drawn?
4. What is the content relative to which the data are analyzed?
5. What are the boundaries of the analysis?
6. What is the target of the inferences?

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**Steps of content analysis**

- a) Copy and read through the transcript - make brief notes in the margin when interesting or relevant information is found
- b) Go through the notes made in the margins and list the different types of information found
- c) Read through the list and categorize each item in a way that offers a description of what it is about
- d) Identify whether or not the categories can be linked any way and list them as major categories (or themes) and / or minor categories (or themes)
- e) Compare and contrast the various major and minor categories
- f) If there is more than one transcript, repeat the first five stages again for each transcript
- g) When you have done the above with all of the transcripts, collect all of the categories or themes and examine each in detail and consider if it fits and its relevance
- h) Once all the transcript data is categorized into minor and major categories/themes, review in order to ensure that the information is categorized as it should be.
- i) Review all of the categories and ascertain whether some categories can be merged or if some need to them be sub- categorized
- j) Return to the original transcripts and ensure that all the information that needs to be categorized has been done successfully.

**ANALYZE THE CONTENT IN SCIENCE BOOKS FOR STANDARD VI TO IX FROM LESSON PLAN POINT OF VIEW & CONCRETIZATION OF CONCEPTS :**

While we do content analysis in science text books from lesson plan point of view, we have to consider the following procedure and whether the book possesses those procedures.

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The procedures are as follows :

### **1. Objectives**

For each and every content in a science text book has to possess general and specific objectives without any error in conceptualization and action verbs. So that the learner achieve their goals timely.

### **2. Instructional aids**

For every content and concept proper teaching aids should be coded in the text book. Otherwise teachers may confuse to deliver the content in proper manner. It increases the subjectivity of the content.

### **3. Testing previous knowledge**

In order to remember the concepts, which are studied in previous classes, which are related to the present content, the text book should stated the meaningful questions. If does so, integration of the concepts will occur. Then the conceptualization will be sound among the learners.

### **4. Motivation**

By means of motivating the students proper examples, meaningful questions, proper real life incidents and joyful rhymes should be given in the text books. Through these the students get motivated towards the content.

### **5. Presentation**

Presentation of the content & concept should be availed in the text book as well as in the lesson plan in the following ways:

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- a) Use simple language
- b) Utilize illustrations, examples, real life incidents, etc.
- c) Give exact information relevant to content.
- d) Make proper & psychological sequence of the content.
- e) Usage of diagram to clarify the content.

### **6. Content**

Content should be given in a proper manner in the lesson plan as presented in the text books and from various advanced books, which should be sufficient, sound and short.

### **7. Teacher activities**

Teacher activity should be stated properly in the text books. So that teacher can bring conducive teaching environment.

### **8. Student activities**

The activities to be done by students should be described in the text book for every content. It should be analyzed by the teacher properly. Then only we can seek expected outcomes from the students.

### **9. Generalizations**

While we provide a content and concept in the text book, the similar and related concepts should present in the text books, so that the students able recognize and generalize the content and concepts. So that the students get sound knowledge.

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### 10. Recapitulization

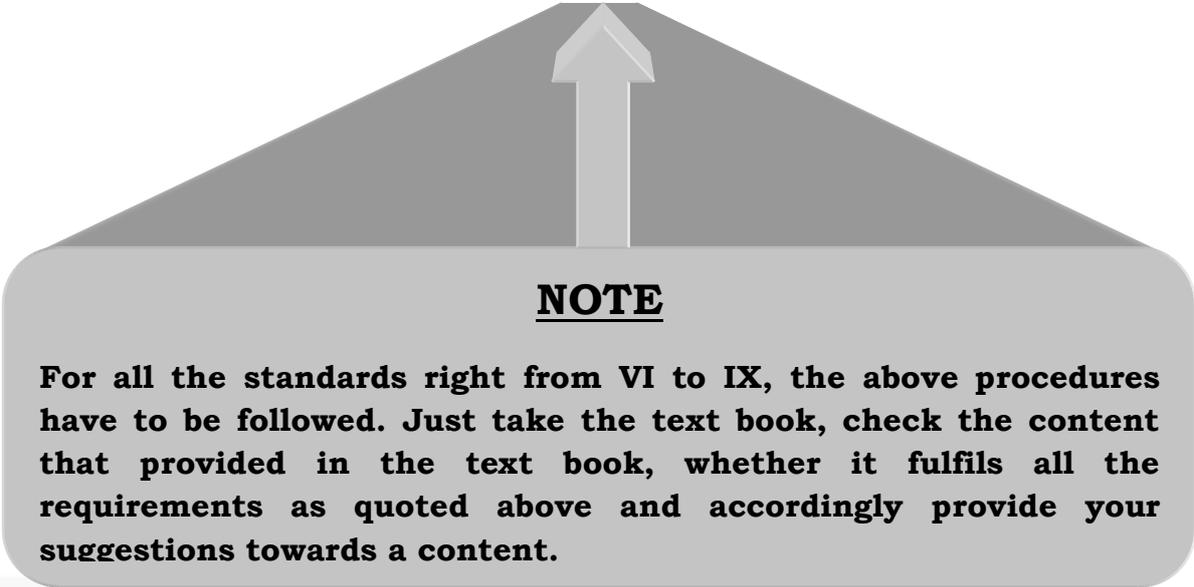
At end of the every concept, gist or summary should be given in the text book in the form of questions or paragraph. So that students will able to recognize whole concepts in easiest way.

### 11. Home assignments

Well planned and designed home assignments should be given for every content and concept given in a text book. So that the students can develop critical and divergent thinking.

### Conclusion

As a teacher or researcher or a student, while we doing content analysis in the science text book, we should consider the above ways and means properly. So that we can rectify more and more errors in the content and then the content will have more objectivity.



### **NOTE**

**For all the standards right from VI to IX, the above procedures have to be followed. Just take the text book, check the content that provided in the text book, whether it fulfils all the requirements as quoted above and accordingly provide your suggestions towards a content.**

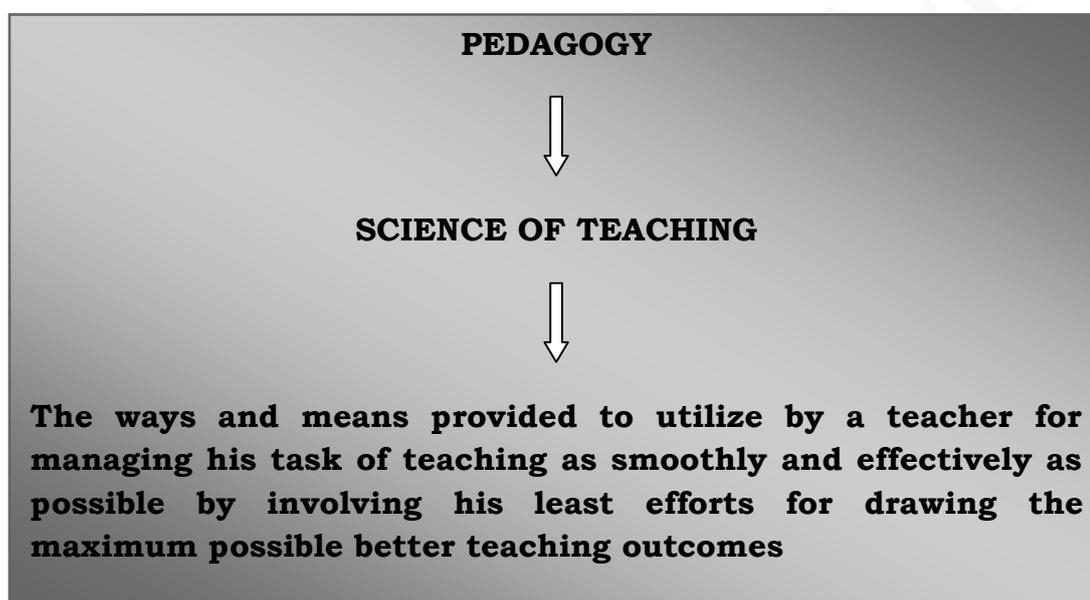
## **PEDAGOGICAL ANALYSIS OF SELECTED CONCEPTS FOR LEARNING**

### **PEDAGOGICAL ANALYSIS**

#### **Introduction**

The word 'Pedagogy' comes from the Greek word "paidagogos" in which 'paida' means "child" and 'agog' means "lead" literally translated "to lead the child".

Pedagogy is the science and art of education specifically instructional theory. It is a master plan that includes a detailed analysis of what is to be done by a teacher .



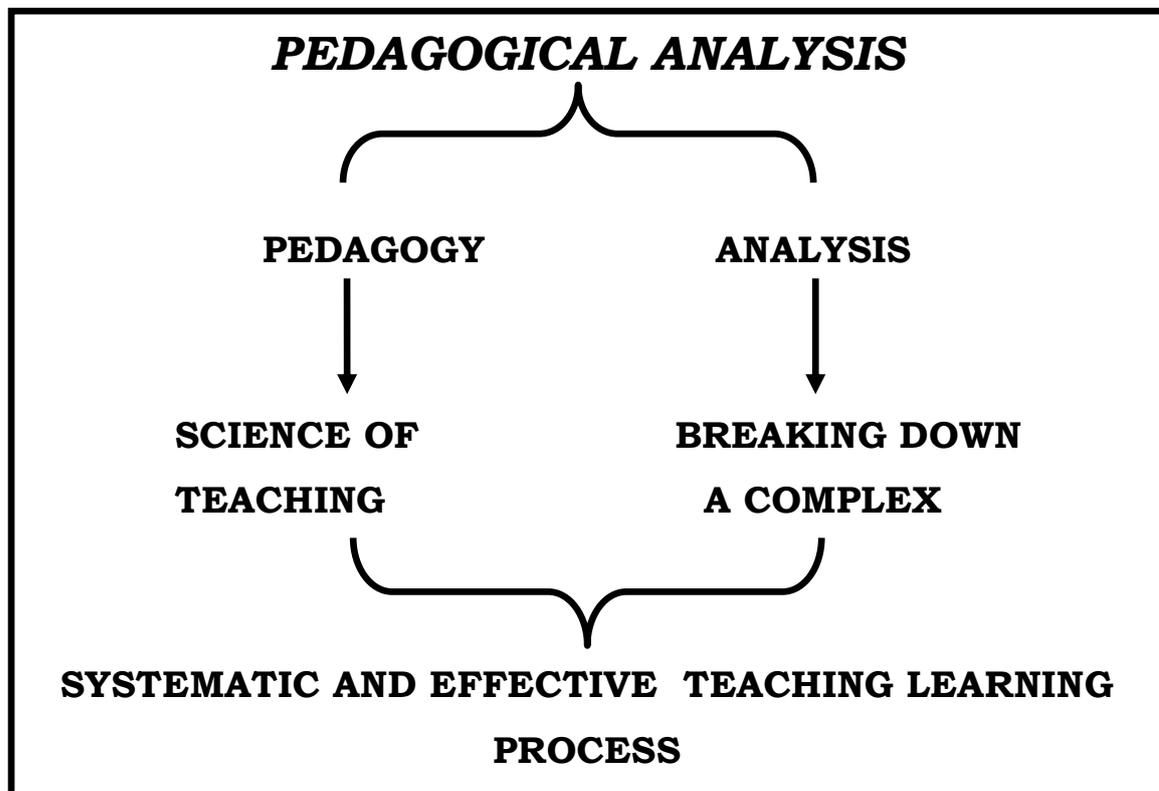
#### **Pedagogy Science of teaching**

- Analysis is a process of breaking or separating a thing into its smaller parts, elements or constituents.
- We can break the contents of the course in a subject into its various constituents – major and minor sections, sub-sections, units and sub-units, major concepts and minor concepts, topics etc. by carrying out a process of content analysis.

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“The analysis of a given content material in any subject any topic carried out well in the spirit of science of teaching is known by the term Pedagogical Analysis of the contents.



## Pillars of Teaching

- Content Analysis
- Framing of Instructional Objectives
- Methods or Techniques
- Appropriate Evaluation Device

### 1. Content Analysis

Content means subject matter of any subject and Analysis means breaking down complex units into smaller sub- units/sub-topics. It is very essential component in pedagogical analysis because in doing so a teacher should have a good knowledge of the maxims of teaching and through knowledge of the content

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## **2. Instructional objectives:**

A teaching process should be effective based upon its instructional objective  
A teacher should consider following points in mind;

- A teacher should have thorough knowledge of the different approaches of behavioral objectives i.e. Bloom's taxonomy, RCEM approach.
- Teacher's approach of formulating instructional objectives into behavioral terms should be learner-centered.
- Teacher should have a good knowledge of the content that's why he can put the subject matter in progressive sequence and should know the domains or levels of teaching-learning.

## **3. Learning methods/techniques/strategies :**

In this the student came into the contact of teacher and subject matter .  
Teacher give knowledge about the content or concept by selecting the methods, techniques or methods which are best of teaching that topic.

A teacher performs the following activities;

- Use of various teaching aids, activities and equipments.
- Selection and use of best teaching method/technique for teaching of science.
- Use of various teaching skills in his teaching.

## **4. Evaluation devices :**

In this we came to know whether the objectives are achieved or not. The outcomes are measured with the help of evaluation devices. So the selection of appropriate evaluation device in the form of oral, written, or practical activities are carried out in relation of the teaching of topic.

### **Steps of pedagogical analysis**

1. Divide the contents of the selected unit into suitable sub-units and arrange the selected sub-units into a number of required periods.
2. Briefly write the essence of the content of the selected sub-unit.

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3. Write appropriate previous knowledge required for the sub-unit.
4. Write appropriate instructional objectives to be selected for the sub-unit.
5. Select the appropriate teaching strategies for the sub-unit according to the following instruction;
  - Write the name of the method applied.
  - Mention the teaching aids required.
  - Briefly illustrate the necessary demonstration and experimentation required.
  - Mention the necessary board work required.
  - Write probing questions related to the sub-unit and provide appropriate answers for them.
  - Prepare a work sheet for the sub-unit.
6. Give suitable examples/illustration for the sub-unit.
7. Prepare a table of specification for the sub-unit. Write atleast six criteria reference test –items each with specific criteria of the sub-unit.

### **Need of Pedagogical Analysis**

- Pedagogical analysis is selection of appropriate objectives and strategies in various instructional situations to assess the level of actual teaching at the end.
- A comprehensive vision of required tasks, strategies for realization of specific goals facilitate
- It also helps the students to understand the concepts, principles and phenomena.
- It involves various logical steps to arrive at logical inference. It states effective teaching. So pedagogical analysis offers enormous potential for improving the delivery of information in all form of education.

### **Elements of effective Teaching**

- Teaching or instructional objectives
- Methods and Learning Materials
- Evaluation Devices
- Content of the Subject

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