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TAMIL NADU TEACHERS EDUCATION UNIVERSITY  
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Course Material for B.Ed. (First Year)  
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Course: 7(a) PEDAGOGY OF PHYSICAL SCIENCE  
(Part- I Methodology)

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## **UNIT – I-AIMS AND OBJECTIVES OF TEACHING PHYSICAL SCIENCE**

### **Objectives:**

After the completion of the unit, the learners will be able to:

1. Describe the nature and scope of physical science.
2. Explain the aims and objectives of teaching physical science.
3. Identify the need and significance of teaching physical science.
4. Discuss the values of teaching physical science.

### **Introduction**

Physical Science is the concerted human effort to understand, or to understand better, the history of the natural world and how the natural world works with observable physical evidence as the basis of that understanding. It is done through observation of natural phenomena, and or through experimentation that tries to stimulate natural processes under controlled conditions.

### **MEANING OF PHYSICAL SCIENCE**

A branch of science (a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe.)

Physical science is the study of matter and energy. That covers a lot of territory because matter refers to all the stuff that exists in the universe. It includes everything you can see and many things that you cannot see, including the air around you. Energy is also universal. It's what gives matter the ability to move and change. Electricity, heat and light are some of the forms that energy can take.

### **NATURE OF PHYSICAL SCIENCE**

The nature and scope of physical science can very well be explained with the help of the following attributes. In other words, they constitute science and contribute greatly to its existence and new inventions. They are:

1. Systematic and understandable
2. Accuracy
3. Validity
4. Subject to change
5. Durability
6. Unable to provide complete answers to all the questions
7. Mixture of logic and imagination

### **SCOPE OF PHYSICAL SCIENCE**

1. Anything that is outside the boundaries of senses of human beings is outside the limits of science. In other words, the scope of physical science includes everything within the realm of the senses of human beings.
2. Physical science deals with the natural world, the realm of nature, matter and energy.
3. Physical science is not limited to only what is observable.

### **AIMS AND OBJECTIVES OF TEACHING PHYSICAL SCIENCE IN SCHOOLS**

#### **AIMS OF TEACHING PHYSICAL SCIENCE IN SCHOOLS**

- To know about the facts and principles of science and its applications, consistent with the stage of cognitive development.
- To acquire the skills and understand the methods of processes that lead to generation and validation of scientific knowledge.
- To develop a historical and developmental perspective of science.
- To relate science education to environment, local as well as global and appreciate the issues at the interface of science, technology and society.
- To acquire the requisite theoretical knowledge and practical technological skills to enter the world of work.
- To nurture the natural curiosity, aesthetic sense and creativity in science and technology.
- To imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment.
- To cultivate scientific temper, objectivity and critical thinking.

## **OBJECTIVES OF TEACHING PHYSICAL SCIENCE IN SCHOOLS**

### **To develop the power of observation.**

Pupil at this stage are curious to know about all things, they come into contact with. It is therefore necessary to develop and train their power of observation.

### **To make them know the relationship between physical and social environment.**

Students at this age group come into contact with the natural and social environment. They should be therefore trained to know about the relationship and the various benefits that are derived from nature.

### **To develop good character**

It is necessary to develop certain qualities of character in the pupils of this age group and also to bring about the changes in their behavior.

To develop a habit of personal, family and society cleanliness

To help them know the utility of science in life

To develop scientific outlook

To develop practical outlook

To develop the skill of manipulation

## **NEED AND SIGNIFICANCE OF TEACHING PHYSICAL SCIENCE**

Science is one of the human activities that man has created to gratify certain human needs and desires. The search of truth became the dominant motive in the prosecution of science. The teaching of science imparts training in the scientific method and develops scientific attitude which are very valuable and at the same time are transferable to other situations in life. The rapid advancement of science and technology and increasing need for scientist and technologies have made it all the more important to provide for science based education in the schools. Science has now become a compulsory subject in the school curriculum because of its multifarious value to the individuals as well as the society.

## **Physics as a Science**

Physics, in everyday terms, is the science of matter and its motion; the science that deals with concepts such as force, energy, mass, and charge for example. More accurately, it is the general analysis of nature, conducted in order to understand how the world around us behaves.

In one form or another, physics is one of the oldest academic disciplines, and possibly the oldest through its modern subfield of astronomy. Sometimes synonymous with philosophy, chemistry and even certain branches of mathematics and biology during the last two millennia, physics emerged as a modern science in the 16th century and is now generally distinct from these other disciplines; although the boundaries between physics and all these other subjects still remain difficult to define.

Generally seen as an important subject, advances in physics often translate to the technological sector, and sometimes resonate with the other sciences, and even mathematics and philosophy. For example, advances in the understanding of electromagnetism lead to the widespread use of electrically driven devices (televisions, computers, home appliances etc.); advances in thermodynamics led to the development of motorized transport; and advances in mechanics led to the development of the calculus, quantum chemistry, and the use of instruments like the electron microscope in microbiology.

Today, physics is a broad and highly developed subject that is, for practical reasons, split into several general subfields. In addition to this, it can also be divided into two conceptually different branches: theoretical and experimental physics; the former dealing with the development of new theories, and the latter dealing with the experimental testing of these new, or existing, theories. Despite many important discoveries during the last four centuries, many significant questions about nature still remain unanswered, and many areas of the subject are still highly active.

Physics is the discipline devoted to understanding nature in a very general sense: the fundamental characteristic of physics is that it aims to gain knowledge, and hopefully understanding, of the general properties of world around us. As an example, we can consider asking the following question on the nature of the Universe itself: how many dimensions do we need? Given that we know the Universe to consist of four dimensions (three spacedimensions, and one timedimension),

we can also ask why the universe picked those particular numbers: why not have four space dimensions? The fact that a choice was made out of a possibility of many means that questions like these fall under the scope of physics. Other general properties of nature include the existence of mass (as in Newton's laws of motion), charge (as in Maxwell's equations), and spin (in Quantum mechanics), amongst others.

### **Chemistry as a Science**

Chemistry is the science concerned with the composition, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. Chemistry is the study of interactions of chemical substances with one another and energy. Chemistry is the science concerned with the composition, structure, and properties of matter, as well as the changes it undergoes during chemical reactions. Historically, modern chemistry evolved out of alchemy following the chemical revolution. Chemistry is a physical science related to studies of various atoms, molecules, crystals and other aggregates of matter whether in isolation or combination, which incorporates the concepts of energy and entropy in relation to the spontaneity of chemical processes.

Disciplines within chemistry are traditionally grouped by the type of matter being studied or the kind of study. These include inorganic chemistry, the study of inorganic matter; organic chemistry, the study of organic matter; biochemistry, the study of substances found in biological organisms; physical chemistry, the energy related studies of chemical systems at macro, molecular and submolecular scales; analytical chemistry, the analysis of material samples to gain an understanding of their chemical composition and structure. Many more specialized disciplines have emerged in recent years, e.g. neurochemistry the chemical study of the nervous system.

Chemistry is the scientific study of interaction of chemical substances that are constituted of atoms or the subatomic particles: protons, electrons and neutrons. Atoms combine to produce molecules or crystals. Chemistry is often called "the central science" because it connects the other natural sciences, such as astronomy, physics, material science, biology, and geology. The genesis of chemistry can be traced to certain practices, known as alchemy, which had been practiced for several millennia in various parts of the world, particularly the Middle East.

The structure of objects we commonly use and the properties of the matter we commonly interact with, are a consequence of the properties of chemical substances and their interactions. For example, steel is harder than iron because its atoms are bound together in a more rigid crystalline lattice; wood burns or undergoes rapid oxidation because it can react spontaneously with oxygen in a chemical reaction above a certain temperature; sugar and salt dissolve in water because their molecular/ionic properties are such that dissolution is preferred under the ambient conditions. The transformations that are studied in chemistry are a result of interaction either between different chemical substances or between matter and energy. Traditional chemistry involves study of interactions between substances in a chemistry laboratory using various forms of laboratory glassware.

## **VALUES OF TEACHING PHYSICAL SCIENCE**

### **Intellectual Value**

Physical Science helps pupils to think of problem, and follow the method of inquiry. During the process they think at every stage. Science sharpens our intellect and lead us to critical observation and reasoning.

### **Utilitarian Value**

We are living in an age of science and technology. Physical Science has entered in our life and daily activities. All our activities are controlled and fashioned by it. There is a vast storehouse of natural power such as wind, waterfall, heat of the sun, etc. which science shows how it is useful for us. Science has revealed from nature almost all the hidden treasures. It restores eyes to the blind, hearing to the deaf, legs to the lame, even life to the dead. So it is very essential to have some elementary knowledge of science for becoming a full member in the society.

### **Vocational Value**

Knowledge of science forms the basis for many vocational studies like medicine, engineering, agriculture or any other profession. Further the study of science forms the basis for many hobbies like bee keeping, radio servicing, photography, etc.

### **Cultural Value**

Science has aided the growth of consciousness by making us more aware of the universe we live in. Through the practical application of scientific discovery our civilization is undergoing constant change which in turn brings about situations that threatens the well-being of the future generations. Scientists take an active part in the vital issues of the country so as to bring about consideration and integration of scientific development and our cultural heritage.

### **Moral Value**

Science has more moral value. It is the search for truth in a faithful manner. When a scientific theory has religious and philosophic or any other kind of human interest, it no longer remains disintegrated passion for the truth. It teaches the pupil to be intellectually honest and truthful.

### **Aesthetic Value**

Aesthetic sense is the most important consideration with all scientific men for it meets one of the deepest needs of human nature which manifests itself as the desire for beauty. To a man of science, practical application is just a by-product of his autonomous activity. The search for universal laws and comprehensive theories undoubtedly the manifestation of the aesthetic motive is very apparent and the satisfaction they get from it seems to be indistinguishable from those of an artist.

### **Conclusion**

There are as many preconceptions and misconceptions about science. Science is not a finished enterprise and many things in science are still need to discover. Science offers solution to the problems. The application of science can offer solution to some of the problems where as it can also cause some problems.

**Questions for Discussion and Reflection:**

1. Describe the nature and scope of physical science.
2. Explain the aims and objectives of teaching physical science.
3. Examine the need and significance of teaching physical science.
4. Critically evaluate the values of teaching physical science.

## **UNIT-2: PLANNING FOR INSTRUCTION**

### **Objectives**

After completing the unit, the student teacher is able to

1. define unit plan
2. understand taxonomy of educational objectives
3. plan to design a unit plan
4. construct lesson plan
5. write a model lesson plan
6. describe the guidelines of effective test
7. develop skill on constructing test items
8. develop interest in writing a lesson plan
9. develop an attitude on constructing different test items

### **INTRODUCTION**

A lesson is defined as a subdivision of the unit wherein a concept is at the centre. A lesson plan is a plan showing the teaching points, specification to be achieved, organization of learning activities in detail and the actual test items to which students are to be exposed. It is confined only to one period, and the content, is presented in the form of teaching points and is realized in a psychological and logical sequence. The word objective is an end view of the possible achievement in terms of what a student is to be able to do when the whole educational system is directed towards educational aims. Formulation of objectives in any subject is an educational necessity. Evaluation is an important step in almost any writing process, since we are constantly making value judgments as we write. When we write an "academic evaluation," however, this type of value judgment is the *focus* of our writing. In the words of Kothari commission [1966] Evaluation is a continuous process, it forms an integral part of the total system of education and is intimately related to educational objectives. We judge or decide that something is good or bad, satisfactory or unsatisfactory, average or above average on the basis of information we have and the values we use in making the decisions.

### **SETTING LESSON GOALS**

A lesson is defined as a sub-division of the unit wherein a concept is at the centre. A lesson-plan is a plan showing the teaching points, specification to be achieved, organization of learning activities in detail and the actual test items to which students are to be exposed. It is confined only to one period, and the content, is presented in the form of teaching points and is realized in a psychological and logical sequence.

Lesson-plan forces consideration of goals and objectives of the selection of subject matter, the selection of procedures, the plan of activities and the preparation and tests of progress. Lesson-plan involves looking ahead and planning a series of activities, all of which progress definitely towards the modification of pupil's attitudes, habits, information and abilities in desirable directions. Without this kind of planning, accepts by a miracle there can be no steady progress and no definite outcome of teaching and learning procedures.

Planning is an essential activity for the effective teacher. The form of the plan may change according to the educational purpose of the planner. It helps the teacher to be systematic and orderly. It encourages good organization of subject matter and activities. Good planning helps the teacher to delimit the field in which he is teaching. It encourages a proper consideration of the learning process and definite choice of appropriate learning procedures. It also encourages continuity in the teaching process.

## **DESIGNING A UNIT PLAN**

A unit should be viewed as a whole. You should be thoroughly familiar with the content before you make any attempt to write out the successive steps.

- **Objectives with Specifications:** The second step is to find out the objectives with specifications that can be realized through the content analysis.
- **Content Analysis:** In unit planning emphasis is placed on analyzing its content into terms, contents, facts, situations, processes, generalizations, conclusions, principles, laws, relationships, etc. In the language units, it should be analyzed into new words, new phrases, idioms, facts, figures of speech, central idea, concepts, proverbs, word-building, etc.

This analysis helps the teacher to have a thorough knowledge of the subject matter. It would help him to teach with a full awareness of the depth of the subject matter. The teacher, again, enters the class with full confidence since he has mastery over the subject matter. Again, because of the content analysis the teacher will not be likely to miss any point while teaching the subject.

- **Learning Activities:** The third step is to organize those activities that will best achieve the specifications. Keeping individual differences and the psychology of the pupils in view, the content, specifications, and the learning activities should be planned in the unit plan.
- **Testing Procedures:** This is the fourth and the last step in the unit plan. Here, the types of evaluation tools and techniques are mentioned through which the teacher would get evidence of the achievements of objectives on the part of the pupils.

The planning for a unit is known as the Unit Plan. When should the teacher prepare the unit plan before the year plan has been prepared or after it? Unless he has a thorough knowledge of each

of the units of a subject, he cannot prepare the year plan. So, in a way, the unit plan should be prepared first. But, again, while preparing the unit plan, the availability of the period cannot be lost sight of. This is possible only if the year plan is ready. The year plan should therefore be ready before one starts preparing the unit plan. A teacher, who is experienced and competent enough in the subject matter, should prepare the year plan, keeping in mind the in's and out's of the units of the subject.

## **DESIGNING A LESSON – PLAN**

There are certain essentials which must be observed before drawing up lesson-plans. The teacher must have mastery of and adequate training in the subject matter and activities from which the master has been selected for a certain lesson.

The teacher ought to possess knowledge of children from direct contact with them and from a study of child psychology. He must have a deep understanding of the principles of learning so that he can plan the learning activities on these principles.

Awareness of the various principles and techniques of teaching is essential for successful lesson plan. Awareness of individual differences in the class is another useful pre-requisite. It is essential in planning to know as accurately as possible that knowledge of the topic, the pupils already possess.

### **Steps Involved in Lesson – Planning**

Herbart , J.F (1776-1841) suggested six formal steps for the development of a lesson plan.

- Preparation or introduction
- Presentation
- Comparison or Association
- Generalisation
- Application
- Recaptulation

### **Preparation:**

The teacher must prepare the minds of students to receive new knowledge. This knowledge is to be linked with the previous knowledge of the students. Preparation means the exploration of the pupil's knowledge which leads to the aim of the lesson. Teacher's skill lies in creating the interest, the children seem to have in the particular subject. Many teachers are faced with the difficulty of introducing the topic in a class. This can be done:

- By testing the previous knowledge of pupils, The teacher may introduce the lesson with an explanation.

- By asking questions that may reveal their ignorance, arouse interest and curiosity to learn the new matter.
- By presenting a demonstration, the teacher can lead the students to a discussion.

Teaching will be effective and pleasant when there is a desire to learn. The teacher should be in a position to create the proper atmosphere in the class room. This is an essential step in the teaching process. But it should be noted that this step should be brief and to the point and should not in any case absorb more than five minutes.

**Presentation:**

Before the presentation of the subject matter, the objectives of the lesson should be clearly stated. In the presentation step, the pupil must get some new ideas and knowledge. Both the teacher and the pupil should be the active participants in the teaching learning process. The teacher should try to elicit everything from the students by suitable questioning. There should not be monologue but there should be a dialogue. Questioning should be from an important device of this step. Other aids should also be used to make the lesson more interesting and comprehensive. Blackboard summary should be developed along with as the lesson proceeds ahead.

**Comparison or association:**

Some examples are given to the students and they are asked to observe carefully and compare them with other set of examples and facts. Sometimes the facts learned in the present lesson may be associated with facts learned in previous classes. Comparison helps the pupils to fix the new facts in mind.

**Generalization:**

This step involves reflective thinking because the whole knowledge learnt in presentation is to be systematized which leads to generalization, formulae, laws etc, through comparison.

**Application:**

At this stage, the students make use of the acquired knowledge in familiar and unfamiliar situations. At the same time, it tests the validity of the generalizations arrived at by the pupils. In this way, the new knowledge gained by pupils will become permanent in the minds of the students.

**Review and assignments:**

A lesson without review is an incomplete one. The principle purpose of this step is to make the presentation more effective. It helps the pupils to come to some conclusion with reference to the wider significance of the problem.

An attempt is made to ask students to tell back or reproduce what he has learnt. The students learn how to express themselves and how to reproduce the material learnt.

Assignment of some work is essential for the consolidation of knowledge. This is the last step in the teaching act. The understanding and comprehension of the subject matter taught by the teacher can be tested by putting some suitable questions on the topic to the students. This will also help the teacher to find out whether the method of teaching has been effective and successful.

These are the essential steps in teaching all types of lessons. This type of lesson plan will depend upon the nature of topic to be taught and the method of teaching.

## **BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES**

**Bloom's Taxonomy** is a classification of learning objectives within education proposed in 1956 by a committee of educators chaired by Benjamin Bloom who also edited the first volume of the standard text, *Taxonomy of educational objectives: the classification of educational goals*. It is a matter of fact that the meanings of terms like “to understand”, “to analyze”, “to respond” as understood by the framers of a curriculum may differ when they are interpreted by an evaluator. Again, two evaluations or two teachers may interpret the various terms in their own way if the precise meaning of these terms is not communicated to them in the same way.

### **The most important purposes of taxonomy are:**

- a. To establish the accuracy of a communication regarding the objectives of education.
- b. To reduce the vagueness arising out of such loosely defined terms and concepts as “to know”, “to reason”, “understanding”, “interest”, etc., and to understand the relationship among them.
- c. To become a means of more precise communication system in the field of education.
- d. To establish a common understanding about a hierarchical classification of objectives.
- e. To become a means of understanding the sequence and organization of human development and
- f. To be a great help in clearly defining and meaningfully evaluating the educational standards of school taxonomies have been divided into three domains – cognitive, affective and psychomotor. A student's development is always studied under these three categories.

## **COGNITIVE DOMAIN**

The **cognitive domain** (Bloom, 1956) includes those objectives which deal with thinking, knowing and problem solving. It includes those objectives which deal with recall or recognition of knowledge and the development of intellectual abilities and skills.

**Example:** To understand the steps under this domain, let us take an example of “how to open a jam bottle?”. A jam bottle can be opened by just warming the metallic lid part, keeping it inverted into a dish of warm water and unscrewing it. How did we get this idea? Knowledge about the expansion of materials due to heat forms the basic step. Then we should understand that metals expand to a greater extent than glass. We apply this knowledge to open it, we can analyze similar situations like open a pen and synthesize our ideas and come to a general conclusion as to how a lid can be opened. Finally we have to judge whether our conclusion is correct or not. So we evaluate the merits of this procedure. Evaluation, thus, is the highest step in this domain. **Knowledge:** Knowledge is defined as

the recalling, remembering of previously learned material. It represents the lowest level of learning outcomes in the cognitive domain.

**Comprehension** : Comprehension is the objectives, behaviors or responses which represent an understanding of the literal message contained in a communication. The communication may be in oral or written form, in verbal or symbolic form. It is the largest general class of intellectual abilities and skills emphasized in schools and colleges.

**Application** : Application is the ability to use the previously learned material in new situation and the learning outcomes in this area requires a higher level of understanding.

**Analysis** : Analysis emphasizes the breakdown of the material into its constituent parts and of the way they are organized. Learning outcomes represent a higher intellectual level.

**Synthesis** : Synthesis refers to the ability to put together elements and parts of material so as to form a new whole.

**Evaluation** : Evaluation is defined as the making of judgements about the value, for some purpose of ideas, works, solutions, methods, material etc.

It involves the use of criteria as well as standards for appraising the extent to which particulars are accurate, effective, economical or satisfying. The judgements may be either quantitative or qualitative and the criteria may be either those determined by the student or those which are given to him. Judgment in terms of internal evidence means the evaluation of a communication from such evidence as logical accuracy, consistency and other internal criteria. Judgment in terms of external criteria means the evaluation of material with reference to the selected or remembered criteria. Example: The faculty member evaluates the students' knowledge by giving the project.

## **AFFECTIVE DOMAIN**

The **affective domain** (Krathwohl, Bloom, Masia, 1973) describes learning objectives that emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent, values, and emotional sets or biases.

Example: To understand the steps under this category let us consider a situation where children get addicted to see TV always. The first step is that they have seen a qualities of character and conscience. We found a large number of such objectives in the literature expressed as interests, attitudes, appreciations program and received pleasure out of it. In other words they have received a sensation. The second step is that they try to repeat it as they get some response from the parents encouraging them to see some educational programs. Now, they are conditioned and would like to

see T.V. always without doing their homework. Parents will set up a value and the children are to value the best one. So values are organized and this will become his habit or characterized activity.

**Receiving:** Receiving is the awareness of a situation giving opportunity to the learner to be conscious of something, willingness to receive the stimulus, without avoiding the situation, controlled and selected attention to the situation.

**Responding:** Active participation on the part of the learners. Attends and reacts to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).

**Valuing:** Values are accepted only when we realize the worthiness. The individual should pursue by giving first preference for a particular activity of value. Children should commit themselves and work for that particular value.

**Organization:** Organization is the building up of organized system of values. Conflicts between different values are resolved and inter-relationships are established.

**Characterization:** Characterization is the highest level of affective domain. Through the training given in other steps, the child organizes values internally, sets up a structure or pattern and follows it. Thus it becomes his characterization.

### **PSYCHOMOTOR DOMAIN :**

Psychomotor domain deals with manual and motor skills. A boy perceives his friend going on a bicycle. He buys a bicycle and tries to imitate the movements to learn the skill of cycling. At the first instant his movements may not be precise. He may do unwanted movements. Slowly his movements become perfect and precise. Now he will try to combine or articulate this action with other actions, namely, applying brake, turning, giving signals etc. Finally his actions will be conditioned and it becomes his naturalized habit.

**Perceiving :** Perceiving is the skill of keen observation, skill of sensing a problem and skill of developing self motivation.

**Imitating :** Imitating is the skill of repeating the actions and skill of reflective thinking.

**Manipulation of act:** Manipulation of act includes differentiating among various movements and selecting the proper one..

**Precision :** Precision in reproducing a given act includes accuracy, proportion and exactness in performance.

**Articulation :** Articulation among different acts includes co-ordination sequence and harmony among acts.

**Naturalization :** Naturalization is the pupil skill that he attains its higher level of proficiency in performing and act with the least expenditure of psychic energy. The act becomes so automatic that it is attended to unconsciously.

## **STRUCTURE OF A FOUR FOLD LESSON PLAN**

### **Content**

The teacher elicit the content to be taught to the students in the classroom . The students develop skills in terms of cognitive, affective and psychomotor domain after attending the teaching session of this content.

### **Specification of Behavioural Outcomes**

Specification of behavioural outcomes helps us to state the instructional objectives of various school subjects. These objectives, however, are too vague for the teacher. They should be specific and must be expressed in behaviors terms. Vague, general objectives often do not offer an adequate enough direction to the teacher. As a result, he cannot prepare and organize appropriate learning activities for his pupils. Hence the need for specifications. We have also discussed that the term specifications mean specific objectives or behavioural objectives. The statement of a specification contains an action verb. The statement of specification should be in the form of the students achievement and not in the form of the teachers intentions.

### **Learning Experiences**

Learning Experiences results from the active participation of students in the stimulus situation which the teacher provides in the classroom. It is the interaction of the learner and the situation provided by the teacher. It should be purposeful, continuous, interactive based on facts, concepts, principles, generalization for making learning experience more functional and effective in teaching learning process.

### **Evaluation**

The teachers can adopt internal and external methods of evaluation to assess whether their transaction is proper according to the pedagogy of teaching in science classrooms. So the objectives, learning experience and evaluation are the three interrelated and interdependent aspects in the teaching learning process.

## **MODEL LESSON PLAN – PHYSICAL SCIENCE**

**Name of the School** :  
**Student Teacher Name** :  
**Standard** : IX  
**Guide Teacher Name** :  
**Unit** : Measurement of Length  
**Date** :  
**Topic** : Measurements and measuring instruments  
**Duration** : 45 minutes

### **INSTRUCTIONAL OBJECTIVES : THE STUDENT**

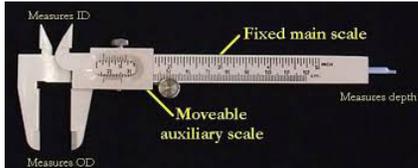
1. Defines the fundamental quantities and S.I. units.
2. Describes about meter scale.
3. Gives explanation of vernier caliper.
4. Draws a diagram of a vernier caliper.
5. Find out the Least Count of a vernier caliper.
6. Calculates accurately the length of an object for the given values.
7. Finds out error of a vernier caliper.

### **INSTRUCTIONAL RESOURCES REQUIRED**

1. Vernier calipers.
2. Charts containing of the diagram of a vernier caliper and the diagram of the types of zero error.

### **PREVIOUS KNOWLEDGE OF LEARNERS**

1. Identify and name of the objects shown to you.  
Meter Scale and Measuring tape
2. What is the use of meter scale?  
To measure the length

Content	Specification of behavioural outcomes	Learning Experiences	Evaluation
Fundamental quantities and SI units.	Defines  Writes	The teacher defines some fundamental quantities and SI units.  Students write SI units and fundamental quantities in their notebook.	Define S.I units.
Uses of meter scale.	Describes  Measures	The teacher describes about the uses of meter scale.  Students measure the length of a cloth by using meter scale.	Describe the uses of meter scale
Vernier caliper	Draws	The teacher draws a diagram of vernier caliper.   Students draw a diagram of vernier caliper in their notebook.	Draw a diagram of a vernier caliper
Parts of a vernier caliper. M-main scale, V-vernier scale, P-ratchet.	Explains  Discuss	The teacher explains about the parts of a vernier caliper.  Students discuss among themselves about the parts of the vernier caliper.	Explain the parts of a vernier caliper
Least Count = 1 M.S.D- 1V.S.D. = 1mm-0.9mm = 0.1mm = 0.01cm	Explains  Calculates	The teacher explains the least count of a vernier caliper by giving an example.  Students calculate the least count in their notebook.	Define Least count.
Function of a vernier caliper	Demonstrates	The teacher demonstrates the experiment to find out the length of a cylinder by using vernier caliper.  Students observe the experiment and they do it themselves.	Give the formula used for calculating the length of an object
Zero error and its two types.	Explains  Measures	The teacher explains about zero error and its two types i.e, positive error and negative error.  By using vernier caliper, the students measure zero error, positive error and negative error	Define Zero error

		for a cylinder.	
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### **FOLLOW UP ACTIVITIES**

1. Draw a diagram of vernier caliper.
2. Find out diameter of a cylinder by using vernier caliper.

**Signature of the Guide**

**Signature of the Student Teacher**

### **TYPES OF TEST ITEMS**

Every teacher wants to find out the progress made by his pupil in the subject he teaches. Achievement in a subject at a particular stage has to be assessed in terms of his mastery in the curricular provisions anticipated for that stage as well as the realization of the objectives expected. A test designed to assess the achievement in any subject with regard to a set of predetermined objectives is called achievement test.

### **ESSAY TEST**

The Essay test refers to any written test that requires an examinee to write a sentence, a paragraph or longer passages and that demands a subjective judgment about its quality and completeness when it is scored. The essay should have a structure which has three main parts: an introduction, a main body and a conclusion

After they have read an essay item, students should have a clear idea of how they should tailor their responses. Below are specific guidelines that can help to improve existing essay questions and create new ones.

- Clearly define the intended learning outcome to be assessed by the item:
- Avoid using essay questions for intended learning outcomes that are better assessed with other kinds of assessment:

- Clearly define and situate the task within a problem situation:
- Present a reasonable task to students:
- The task can be written as a statement or question:
- Specify the relative point value and the approximate time limit in clear directions:
- State the criteria for grading:
- Use several relatively short essay questions rather than one long one:
- Avoid the use of optional questions:
- Improve the essay question through preview and review:

**Advantages:**

1. Assess higher-order or critical thinking skills.
2. Evaluate student thinking and reasoning.
3. Provide authentic experience
4. Minimum chances of copying/cheating.
5. Economic
  - i. The traditional form of examination is less expensive in terms of time, money, manpower and material.

**Limitations:**

1. Assess a limited sample of the range of content
2. Are difficult and time consuming to grade.
3. Lack of content validity
4. Provide practice in poor or unpolished writing.

**SHORT-ANSWER QUESTION**

Short-answer questions are “constructed-responses”, or open ended questions that require students to create an answer. Short-answer items require responses of one word to a few sentences. Short-answer items are an effective measure of a student’s ability to accurately recall specific target information. Short-answer items require students to either complete a statement or answer a direct question using a single word or brief phrase.

**OBJECTIVE TYPE QUESTION**

Objective tests are usually those which come with a defined set of answers. There is a question and there is a defined answer to the question.

Recall Type: The pupil must answer the correct response from his past experience.

Recognition Type: The pupil indicates the truth or falsity of statements given, selects the correct responses from the several possibilities listed, pairs related ideas arranged irregularly in two parallel columns.

Recall and recognition type includes.

1. Multiple choice questions
2. True or false question
3. Matching question

### **MATCHING QUESTION**

Matching questions involve paired lists that require students to correctly identify, or “matching,” the relationship between the items.

Construction:

- Matching test items, along with true –false and multiple choice, are selection items. They are specialized for use when measuring the student’s ability to identify the relationships between a set of similar items. Each of which has two components, such as words and their definitions, symbols and their meanings, dates and events people and their accomplishments, etc.
- Responses should be listed in logical order if there is one. If there is no apparent order, the responses should be listed alphabetically.
- Another way to decrease the possibility of guessing is to allow responses to be used more than once. Directions to the students should be very clear about the use of responses.
- A difficulty sometimes arises in finding sufficient material.

#### **Advantages:**

Matching items can assess a large amount of information in a confined space on the exam page, relative to multiple-choice questions; if developed carefully, the probability of guessing is low. To increase that probability further, avoid equal-sized lists by including a few “distracter” items in the second column.

#### **Disadvantage:**

Matching assess recognition rather than recall of information.

### **TRUE– FALSE QUESTION**

True- false questions are those in which a statement is presented and the students indicate in some manner whether the statement is true or false.

True- false - Offering a series of statements each of which is to be judged as true or false; “a true- false test”

Developing true- false questions:

A good use of True- false questions is for the student to demonstrate understanding or simple logic. These questions can be used effectively in stating cause and effect relationships

Guidelines for writing true- false items:

Statements should be relatively short and simple

- True statements should be about the same length as false statements. (There is a tendency to add details in true details in true statements to make more precise).
- The answers should not be obvious to students who don't know the material
- Sweeping broad general statements or absolutes (all, always, never, none, only), tend to be false, since the student need think of only a single incident in which it is untrue to mark it false.
- Students who make as always have above average IQ scores.
- A similar situation occurs with the use of "can" in a True- false statement. If the student knows of a single case in which something could be done, it would be true.
- Ambiguous or vague statements and terms, such as "large", "long time", "regularly", "some", and "usually" are best avoided in the interest of clarity. Some terms have more than one meaning and may be interpreted differently by individuals.

## **MULTIPLE CHOICE QUESTIONS**

Introduction:

Multiple-choice exams are commonly used to assess student learning. Although E.L.THORNDIKE developed an early multiple choice test, Frederick J. Kelly was the first to use such items as part of large scale assessment, multiple choice testing is particularly popular in the United States.

Definition:

Multiple Choices is a form of assessment in which respondents are asked to select the best possible answer out of the choices from a list.

Parts of multiple choice questions:

- A STEM - the text of the question or incomplete statement.
- OPTIONS – the choices provide after the stem
- KEY – the correct answer in the list of options
- DISTRATERS – the incorrect answers in the list of options

## PLANNING:

The primary objective in planning a test is to outline the actual course content that the test will cover. A convenient way of accomplishing this is taken 10 minutes following each class to list on an index card the important concepts covered in class and in assigned reading for that day.

In developing good multiple-choice items, three tasks need to be considered: writing stems, writing options, and ongoing item development.

## COMPLETE THE STATEMENT

In this type of question, you are given an incomplete statement. You must select the choice that will make the complete statement.

Example: 1. one byte equals \_\_\_\_\_ number of bits.

- a.6                      b.8                      c.16                      d.32

## WHICH OF THE FOLLOWING

You will probably notice that multiple choice questions use word order that is different from what you are used to see in ordinary things you read, like newspapers or books. One of the reasons for the unusual word order of multiple choice questions is that many contain the phrase “which of the following”.

Example:

1. Which of the following computer can compute device that works on continuous range of values?  
a. Digital computer   b. Hybrid computer   c. Analog computer   d. Super computer

## USE OF “NOT”, EXCEPT AND “LEAST” (negative choices)

Use of “not”, “except”, and “least” often make comprehension of test question more difficult. This type of question is used for situations, in which there are several good solutions or ways to approach something, but there is also a clearly wrong way to do it. You are being asked to select ‘not’ the choice that does or fit. You must be very careful with this question type, because it is easy to forget that you are selecting a negative.

Procedural rules

- Use either the best answer or the correct answer format.
  - Best answer format refers to a list of option that can all correct in the sense that each has an advantage, but one of them is the best.
  - Correct answer format refers to one and only one right answer.
- Format the items vertically, not horizontally (ie, list the choice vertically)
- Allow time for editing and other type of item revisions.
- Use good grammar, punctuation and spelling consistently

- Minimize the time required to read each item.
- Avoid strike items.
- Use active voice.
- The ideal question will be answered by 60-65% of the tested population.
- Have your questions peer-reviewed.
- Avoid giving unintended clues such as making the correct answer longer in length than distracters.

Guidelines for writing stem:

- 1: Present a single, definite statement to be completed or answered by one of the several given choices.
- 2: Minimize use of negatives and highlight negatives when they are used.
- 3: Ensure that there is consistency between the stem of the question and all of the response option.
- 4: Ensure that test questions are grammatically consistent between the question stem and response options.
- 5: Avoid using ALWAYS and NEVER in the stem as test wise students likely to rule such universal statement out of consideration.

Writing Response:

- 7: Guidelines for avoiding unintended clues to the correct answer sometimes it is possible to correctly guess the answer to a test question even when you don't know the answer. This happens when the question contains unintended clues to the correct answer. Review the following example to see if you can guess the correct answer. Identify the unintended clue, and apply the guideline that will help you avoid this type of unintended clue when you write test question.

Writing Distractor:

- 8: Ensure that all test question response options are similar in length and complexity.
- 9: Avoid double negatives.
- 10: Avoid repetition of words or phrases in the response option by rewording the stem of the question.
- 11: If possible avoid the choices 'All of the above' and 'None of the above' if you do include them make sure that they appear as correct answer some of the time.

12: Use only plausible and attractive alternative as distracters.

13: Alternatives should not overlap.

## **CONSTRUCTING TEST ITEMS FOR FORMATIVE EVALUATION IN CLASS**

Every trainee must have to evaluate their students, subject knowledge what they taught at the time of training period. This has to be done by applying different kinds of tests. Among the various type of tests, achievement test is more relevant for evaluating student's performances. For considering this view, this section, has been brought out giving a brief account about the planning and construction of achievement test.

Achievement tests serve variety of purposes such as

- Judging the pupils mastery of certain essential skills and knowledge
- Measuring growth over time.
- Ranking pupils in items of their achievements of particular instructional objectives.
- Diagnosing pupil difficulties.
- Evaluating the teacher's instructional method.
- Ascertaining the effectiveness of the curriculum and
- Motivating students.

The achievement test has to make an effective instrument of evaluation. It has to be structured and designed according to a systematic pattern in advance by lay down the following dimensions

- **Weightage to objectives:**

Here, the relative importance of each objective is to be considered. The main task here the Weight age to be given to the different objectives in the unit plan. This weightage should be decided by a committee of experts, including the classroom teacher: but, for an achievement test, the teacher can decide this type of question.

- **Weightage to sub units(content):**

Here, the Weight age is to be divided for the different areas of the content which may include a unit. (There are different methods of weight to sub-units)

- Weightage to each sub-unit according to the number of page allotted to it in text book.

- Weightage to each sub-unit according to the number of periods devoted to it.
  - Weightage to each sub-unit according to the number of specifications that can be achieved through it.
  - Weightage to each sub-unit according to the opinion of the committee of experts in the subject.
- Weightage of different forms of question (item format):

For testing different abilities and sub-units, different forms of questions may be suitably used, instead of using the traditional form, the essay type question. In teaching various learning outcomes, the essay type, the short-answer type and objective type question may be judiciously used.
  - Weightage to difficulty level:

Generally, in a class there are three categories of pupils above average and below average. Accordingly, the test should not be too difficult or too easy. A test should provide a suitable opportunity to the bright, the mediocre and the weak students in the class. Hence, all the test items in a test should not be very difficult or very easy. The teacher is expected to classify test items into three levels-difficult, average and easy. This is quite enough for the achievement test.
- **Scheme of options**

Scheme of option means the option or choices given to the students to select certain questions. There may be external option as well as internal options. External option means the choice is given to the students for selecting a given number of questions only from among the total number of questions provided. For example the students are asked to attend any eight questions out of the given ten. But in case of internal options the choice is given within a question for example write an essay on one of the following.

**CHEMISTRY (Theory) - 2009-2010**

Class XII - Code: 083

**TIME: 3Hrs**

**MM: 70**

Weightage of marks over different dimensions of the question paper shall be as follows:

**1. Weightage to Curricular Objectives**

No.	Objectives	Marks	%
1.	Knowledge	4	16
2	Understanding	6	24
3	Application	8	32
4	Skill	7	28
	Total	25	100

**2. Weightage to different topics/content units**

S.No	Topic	Marks
1.	Environmental Chemistry.	12
2.	Atomic Structure	12
3.	Chemical Bonding	14
4.	Chemical Kinetics – I	06
5.	Basic Concepts of Organic	08
6.	Hydrocarbons	08
7.	Organic Halogen Compounds.	10
	Total	70

**3. Difficulty level of questions**

S.No	Estimated difficulty level	Percentage of marks
1.	Easy	15%

2.	Average	70%
3.	Difficult	15%

**4. Weightage to different forms of questions**

S.No	Forms of Questions	Marks for each question	No. of question	Total marks
1.	Objective	01	09	09
2.	Very short Answer	02	13	26
3.	Short answer	03	05	15
4.	Essay	04	05	20
		<b>Total</b>	32	70

**D. Scheme of Options**

There will be no overall choice. All questions are compulsory.

**Questions for Discussion and Reflection**

1. Explain the steps in lesson plan with illustration
2. Discuss about Taxonomy of Educational Objectives
3. Write a short note on Essay question, Objective question and Short answer question

## **UNIT– III: PRACTICING THE TEACHING SKILLS IN PHYSICAL SCIENCE**

### **Objectives:**

After the completion of the unit, the learners will be able to:

1. To obtain knowledge on the meaning of teaching.
2. To understand the teaching skills.
3. To analyse the major steps in teaching a mini-lesson.
4. To explore, observe and feedback on integration of teaching steps in mini-teaching

### **Introduction**

An educational institution performs a significant function of providing learning experiences to lead their students from the darkness of ignorance to the light of knowledge. The key personnel in the institutions who play an important role to bring about this transformation are teachers. As stated by NCTE (1998) in *Quality Concerns in Secondary Teacher Education*, –The teacher is the most important element in any educational program. It is the teacher who is mainly responsible for implementation of the educational process at any stage. This shows that it is imperative to invest in the preparation of teachers, so that the future of a nation is secure. The importance of competent teachers to the nation’s school system can in no way be overemphasized.

### **MEANING OF TEACHING**

In the complex act of teaching, one complex organism (teacher) directs towards more complex organism (students) in the complex situation (classroom) to cause one of the most important activity called “teaching” .Ban(1961) has exactly remarked that “teaching means many different things, that the teaching act varies from person to person and from situation to situation”.

Gage tentatively defines , “ teaching” as an act of interpersonal influence aimed at changing the ways in which other persons can or will behave (Mitra, 1972). According to Ryans(1965) “ the behavior or activities of persons as they go about doing whatever is required of teachers, particularly those activities which are concerned with the guidance or direction of the learning of others. According to Skinner(1968) “teaching is the arrangement of contingencies of reinforcement under which students learn. They learn without teaching in their natural environments, but teachers arrange special contingencies which expedite learning, hastening the appearance of behavior which would otherwise be acquired slowly or making scene of the appearance of behavior which might otherwise never occur. From these definitions it can be concluded that teaching is an activity like a. imparting knowledge or skill, b. it is a social act of influence, and c. it is doing anything and everything that may lead to learning.

## **SKILL OF INTRODUCTION**

The main purpose of the introducing skills is to establish cognitive report between students and teacher to obtain immediate involvement in the lesson.

A specific techniques of introducing a lesson is the use of analogies that have characteristics similar to the concept , principle or central theme of the lesson.

While beginning the lesson the preservice teacher should

Gain student attention Build motivation Explain why the lesson is important. Introduction of the lesson is usually short. Some simple techniques of introducing a lesson are

- Telling a story connected with the lesson.
- Referring to something related to the experience of students in their area of activity interest or knowledge.
- Linking the present lesson to the previous lesson or to future learning.

## **SKILL OF EXPLAINING:**

A teacher organizes a number of learning experiences in the classroom towards this end. He uses a number of interrelated statements related to the concepts, facts etc. in order to develop understanding among the pupils. The set of interrelated statements that the teacher makes is known as explanation. Therefore explanation is the use of interrelated facts, concepts with a view to develop understanding among the pupils towards the content under study. For example how ice is manufactured? The answer gives different steps and their mutual relationship in the explanation. While giving explanation to pupils, the explainer should keep in mind the age level, their previous knowledge, experiences, their family background, geographical situations etc. These factors significantly influence effectiveness of explanation.

Explanation is defined as an activity to bring about an understanding in some one about a concept, principles or phenomenon. While giving explanation, causes for the phenomenon, reasons behind the action and various logical steps involved in arriving at inferences are given. A good explanation is one which is understood by the pupils. Therefore a teacher must try to explain the concepts, thoughts, ideas etc in such a way that is understandable by the pupils for whom it is concerned .

## **SKILL OF QUESTIONING**

The teacher initiates his lesson by putting relevant questions in the class. He then manages to get correct response from the students. Questioning can achieve its purposes if they are of high quality. Quality, rather than quantity of questions make the teaching effective. A question which can stimulate the student for relevant thinking is a good question. Formulation of good questions is a difficult task which can be mastered through conscious and repeated efforts. Skill of questioning

refers to the formulation of relevant, precise and concise, clear, specific and grammatically correct questions.

When a question is put in the classroom, there are a number of possible pupil response situation such as no response, wrong response, partially correct response, incomplete response or correct response. The skill of questioning is going deep into pupil responses through step by step questioning with a view to eliciting the criterion response.

### **SKILL OF VARYING THE STIMULUS**

Learning in the classroom depends, to a large extent, on the attention of the pupils on the learning task. It is, therefore, essential for the teacher to secure and sustain pupil attention for making his teaching effective. Continued use of the same stimulus or activity for longer period induces inattention. The inattention is caused in two ways. Firstly, continued focus of the pupils on the same stimulus for a long time restricts his postural mobility. As a result, they feel fatigued. Secondly, the continued use of the same stimulus for longer duration introduces the element of monotony; which brings in dullness. The problem of inattention is further aggravated because of the short span of pupil attention. Their attention tends to shift from one stimulus to another frequently.

One of the significant ways to secure and sustain pupil attention is to introduce the element of variation in teaching. The variation can be introduced in several ways depending upon the teaching activity. For example, there can be variation of teacher's position in the classroom while he is teaching. Variation in voice represents another dimension. Use of media provides yet another area of variation. There can also be variation in the classroom interaction pattern. Appropriate variations in these dimensions can help a teacher to secure and sustain pupil attention. The set of teacher behaviours that tend to secure and sustain pupils' attention in teaching learning situation in the classroom constitutes the skill of stimulus variation.

### **NON VERBAL CUES**

Good communication is the foundation of successful relationships, both personal and professional. But we communicate with much more than words. Most of the messages we send other people are nonverbal. Nonverbal communication includes our facial expressions, gestures, eye contact, posture, and tone of voice. The ability to understand and use nonverbal communication, or body language, is a powerful tool that can help you connect with others, express what you really mean, navigate challenging situations, and build better relationships.

Nonverbal communication, or body language, is a vital form of communication—a natural, unconscious language that broadcasts our true feelings and intentions in any given moment, and clues us in to the feelings and intentions of those around us.

#### **Nonverbal communication cues can play five roles:**

- Repetition: they can repeat the message the person is making verbally
- Contradiction: they can contradict a message the individual is trying to convey

- Substitution: they can substitute for a verbal message. For example, a person's eyes can often convey a far more vivid message than words and often do
- Complementing: they may add to or complement a verbal message. A boss who pats a person on the back in addition to giving praise can increase the impact of the message
- Accenting: they may accent or underline a verbal message. Pounding the table, for example, can underline a message.

### **Types of nonverbal communication and body language:**

There are many different types of nonverbal communication. Together, the following nonverbal signals and cues communicate your interest and investment in others.

**Facial expressions:** The human face is extremely expressive, able to express countless emotions without saying a word. And unlike some forms of nonverbal communication, facial expressions are universal. The facial expressions for happiness, sadness, anger, surprise, fear, and disgust are the same across cultures.

**Body movements and posture:** Consider how your perceptions of people are affected by the way they sit, walk, stand up, or hold their head. The way you move and carry yourself communicates a wealth of information to the world. This type of nonverbal communication includes your posture, bearing, stance, and subtle movements.

**Gestures:** Gestures are woven into the fabric of our daily lives. We wave, point, beckon, and use our hands when we're arguing or speaking animatedly—expressing ourselves with gestures often without thinking. However, the meaning of gestures can be very different across cultures and regions, so it's important to be careful to avoid misinterpretation.

**Eye contact:** Since the visual sense is dominant for most people, eye contact is an especially important type of nonverbal communication. The way you look at someone can communicate many things, including interest, affection, hostility, or attraction. Eye contact is also important in maintaining the flow of conversation and for gauging the other person's response.

**Touch:** We communicate a great deal through touch. Think about the messages given by the following: a firm handshake, a timid tap on the shoulder, a warm bear hug, a reassuring pat on the back, a patronizing pat on the head, or a controlling grip on your arm.

**Space:** Have you ever felt uncomfortable during a conversation because the other person was standing too close and invading your space? We all have a need for physical space, although that need differs depending on the culture, the situation, and the closeness of the relationship. You can

use physical space to communicate many different nonverbal messages, including signals of intimacy, aggression, dominance, or affection.

**Voice:** It's not just what you say; it's *how* you say it. When we speak, other people "read" our voices in addition to listening to our words. Things they pay attention to include your timing and pace, how loud you speak, your tone and inflection, and sound that convey understanding, such as "ahh" and "uh-huh." Think about how tone of voice, for example, can indicate sarcasm, anger, affection, or confidence.

Reinforcement is a term taken from the psychology of learning. The term implies the use of the technique for influencing behavior of individuals in the desired direction. The concept of reinforcement is based on the hedonistic principle which envisages that an individual tends to repeat the pleasant experiences and avoid the unpleasant ones. Reinforcement, therefore, constitutes one of the essential conditions of learning.

### **SKILL OF REINFORCEMENT**

While teaching, a teacher encounters a variety of pupil behaviors. Obviously, he would like the pupil's desirable behaviors and criterion responses to be retained and undesirable behaviors to be eliminated. For reinforcing pupils' desirable behaviors and criterion responses, he uses positive verbal and non-verbal reinforces.

These reinforces not only strengthen the pupils' desirable behaviors, but also develop confidence in them. Besides, they enhance their positive self-concept. Absence of a positive, reinforce for pupils' desirable behaviors may erode their confidence and lead to poor self image. Positive reinforcement encourages pupils to participate actively in classroom transactions. It stimulates them to achieve more, thereby, creating a sense of achievement. Skillful management of reinforces help a teacher to promote pupils' learning. The skill of reinforcement refers to the effective use of reinforces. It can, therefore, be defined as "the effective use of reinforces to modify pupils' behavior in the desired direction.

### **SKILL OF CLOSURE**

This skill is useful for a teacher to close his teaching properly. The teacher is to summarize all the teaching during the period and provide opportunities for the students to correlate the learnt matter with the past and future knowledge. This is to be done by statements or by asking questions.

### **SKILL OF FLUENCY IN COMMUNICATION:**

Verbal communication is another important element for teaching. An excellent beginning for effective verbal communication is the ability of the student to be a good listener. **Active listening** is a technique that helps the student be more effective in the communication process (Reynolds, 2008). The teacher begins by being open and approachable and listens carefully to what the student is saying and doing.

- Effective verbal communication is a skill that a person uses throughout her life, and the development of it begins in early childhood. This is the ideal time for parents to begin modelling and actively teaching verbal communication skills. Good verbal communication should go both ways and allow people to speak as well as listen. When children reach school age, they will begin learning more from their teachers and peers, but good verbal communication begins in the home.

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wealth of information to the world. This type of nonverbal communication includes your posture, bearing, stance, and subtle movements.

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## **UNDERSTAND MAJOR STEPS IN TEACHING MINI-LESSON**

Teaching is a planned and structured interactive process that –case student learning teaching is usually done in sequence

Teaching a Mini –lesson consist of a specific steps they are.

**Motivation:**

Motivation is a warm-up activity to get student activity engaged in a new lesson. To get the student really involved in the new lesson, the pre-service teacher should use all the techniques of introducing a lesson.

**Presentation:**

Presentation refers to delivery of the content in the class in an organized way. The presentation should have a beginning, middle, and end. A pre-service teacher should focus on three areas.

- i) Verbal and nonverbal communication
- ii) Effective use of Blackboard and visual aids
- iii) Meaningful organization of content.

**Interaction:**

Interaction refers to the communication between the teacher and student during the delivery of the lesson in the class.

Integration helps the pre-service teacher to reduce their talking time and enable the student to increase their talking time.

Pre-service teachers should encourage pair and group interaction in the class. A pre-service teacher can present the content of the lesson in three ways.

- i) Teacher – whole group interaction
- ii) Teacher – Student interaction
- iii) Student- Student interaction

It has been found that peer interaction about the content of the lesson is a powerful way to reinforce what the student has learned.

**Reflection:**

Reflection refers to involving or encouraging students to think about their thinking. In other words, the teacher asks students to reflect on their learning. During reflection, the students ask themselves what they have learned from doing this activity.

The pre-service teacher can guide the peer (student) to reflect about his learning in three ways.

- i) **Discussion:** The teacher can ask students to discuss their learning experience or classmates can discuss their learning experience among themselves in the class.
- ii) **Interview :** the teacher can interview a student or students can interview classmates about their learning
- iii) **Questioning :** the teacher can ask a student can question classmates about their insight, understanding, and application of their learning.

### **Summing up:**

Summing up refers to ending a lesson with a summary. The pre service teacher can use all the teaching techniques related to ending a lesson during their practice teaching in front of peers.

### **What is mini- teaching**

Mini-teaching is an actual classroom teaching. Mini teaching is much smaller than usual teaching.

The curriculum framework. Two-year B.Ed programmed of NCTE(2014) consists that “teaching should not be practiced through the reductionist approach of micro teaching of isolated skills and simulated lesson. The practice of lesson plans must be meaningful and holistic event and not an isolated and disintegrated one.

There is a difference between micro teaching and mini teaching. Micro teaching breaks teaching into a set of discrete and isolated skills. Whereas mini teaching emphasizes the mastery and integration of teaching skills in a short lesson in a smaller class than the usual one.

In mini teaching a student practices a mini lesson teach to a minimum at co peers for 15-20 minutes. Mini teaching can be practiced with real students. If students available from model schools attached to the college of education.

A student-teacher must practice at least 5 mini lessons with peers or with real students before he/she goes to actual teaching in schools. Mini lesson practice must take place only in the college of education.

**Steps in Mini Teaching:**

The preservice teacher:

1. Chooses a mini- lesson (a short lesson)for 15-20 minutes.
2. Identifies a few appropriate teaching skills required for teaching mini lesson .
3. Teaching a mini-lesson with gradual integration of the teaching skills identified.
4. As soon as a pre service teacher finishes teaching his mini lesson, The peers and the teacher-educator provide a feedback to the pre service teacher his teaching.
5. Then the next pre service teacher in the peer group takes up his mini lesson and practice teaching.(Note: There is no reteach session in mini-teaching just like in micro teaching.

**MINI LESSON**

Name :  
Subject : Physics Date :  
Topic : Laws of Motion Time : 15-20 mts  
Focus : To understand the Newton’s third law of motion and its applications

**1.Objectives**

- i)states the third law of motion
- ii) give the examples of the third law of motion
- iii) application of the third law of motion in day-to-day life

**2. Materials**

Chart, Toy gun, Bow and Arrow

**3. Content outline or lesson description**

Newton’s third law of motion and its application

**4. Teaching skills**

Introducing, Explaining, Varying the stimulus and Closure.

## **5. Instructional procedures and activities**

### **I) Introductory activities (Motivation)**

Teacher : Do you travel in a bus?

Student : yes sir.

Teacher : Do you travel in a car?

Student: Yes sir. We travel in a car.

Teacher: Very Good. What happens if a bus driver applies sudden break?

Student: We move upwards.

Teacher: Exactly, Very good.

Student: Somebody fall down.

Teacher: yes. It is because of Newton's third law of motion.

### **II) Development activities( Presentation, Interaction and Reflection)**

Teacher : “ For every action there is an equal and opposite reaction”. This is Newton's third law of motion. Do you understand?

Student: yes sir

Teacher: I will give an example. What happens when a gun is fired?

Student: The bullet will come out.

Teacher: Very Good. What is the principle behind it?

Student: Third law of motion.

Teacher: Yes. How is it function?

Student: Please explain it sir.

Teacher: O.K. I will explain. When a gun is fired, it exerts a forward force on the bullet.

The bullet exerts an equal and opposite force on the gun. So the gun is fired. This is because of Newton's third law of motion. What is the action takes place in firing a gun?

Student: Pulling the trigger sir.

Teacher: Very Good. What is the reaction?

Student: Pushing out the bullet is equal and opposite reaction.

Teacher: Very Good.

**III) Concluding activities ( Summing up/ Closure)**

Newton’s third law is applicable in every activities of our life. For example a fish moves through water by using its fins to push back water and the water pushes the fish forward with a force i.e. equal to the backward force.

**VI Evaluation and assessment**

Distribute a copy of both assessment format (skill and steps) to the pre-service teacher (peer) for evaluation and assessment.

Distribute a copy of both assessment format (skill and steps) to the preservice teacher (peer) for evaluation and assessment.

**Observation and Feedback on the practice of Integration of teaching skills**

The complex teaching act can be split into component skills, each simple, well defined and limited. These skills can be identified, practiced, evaluated, controlled and acquired through training.

The teaching skills developed through training are to be observed by the peers/ teacher educators. Immediate feedback may be given to the student-teachers individually using the feedback forms.

Distribute a copy of both Assessment formats (skills & steps) to the pre-service teachers (peers)

**Observation and Feedback on Integration of teaching skills in Mini-Teaching**

INTEGRATING SKILLS IN MINI TEACHING (Assessment by Peers/Teacher Educators)				
Teaching skills	AVERAGE (SCORE 1)	GOOD (SCORE 2)	VERY GOOD (SCORE 3)	TOTAL
Introducing				
Explaining				
Questioning				
Varying the stimulus				
Non verbal cues				
Reinforcement				
Closure				
Fluency in Communication				

Range of scores: 8-24

**OVERALL ASSESSMENT OF TEACHING STEPS**

AVERAGE \_\_\_\_ GOOD \_\_\_\_ VERY GOOD \_\_\_\_

**Interpretation of scores**

Average : 8

Good : 9-16

Very Good :17-24

**Observation and Feedback on Integration of teaching steps in Mini-Teaching**

INTEGRATING THE STEPS IN MINI TEACHING (Assessment by Peers/Teacher Education)				
TEACHING STEPS	AVERAGE (SCORE 1)	GOOD (SCORE 2)	VERY GOOD (SCORE 3)	TOTAL
Motivation				
Presentation				
Interaction				
Reflection				
Summing Up				

Range of scores:5-15

**OVERALL ASSESSMENT OF TEACHING STEPS**

AVERAGE \_\_\_\_ GOOD \_\_\_\_ VERY GOOD \_\_\_\_

Interpretation of scores

Average : 5

Good : 6-10

Very Good :11-15

**Conclusion**

Today as never before, meeting our society’s challenges demands educational excellence. Reinvigorating the economy, achieving energy independence with alternative technologies and green jobs, and strengthening our health care system require a skilled populace that is ready for the critical challenges we face. There is widespread consensus, however, that our education systems are failing to adequately prepare all students with the essential 21st century knowledge and skills necessary to succeed in life, career and citizenship.

**Questions for Discussion and Reflection**

1. Briefly explain the major steps in teaching a mini lesson.

2. Write a mini-lesson with multiple teaching skill for class IX std science.
3. Explain the mini lesson format.
4. Critically analyse the skill of varying the stimulus.
5. Explain the skill of explaining with its skill components.

## **UNIT-IV: Methods of Teaching Physical Science**

### **Objectives:**

After the completion of the unit, the learners will be able to:

1. Know the meaning of Lecture and Demonstration method.
2. Explain about Individual activities.
3. Understand the concept of small group learning.
4. Discuss about the recent trends of teaching Physical Science.

### **Introduction**

A teaching method comprises the principles and methods used for instruction to be implemented by teachers to achieve the desired learning or memorization by students. These strategies are determined partly on subject matter to be taught and partly by the nature of the learner. For a particular teaching method to be appropriate and efficient it has to be in relation with the characteristic of the learner and the type of learning it is supposed to bring about. The approaches for teaching can be broadly classified into teacher centered and student centered. In Teacher-Centered Approach to Learning, Teachers are the main authority figure. Students are viewed as “empty vessels” whose primary role is to passively receive information (via lectures and direct instruction) with an end goal of testing and assessment. It is the primary role of teachers to pass knowledge and information onto their students. Teaching and assessment are viewed as two separate entities. Student learning is measured through objectively scored tests and assessments. In Student-Centered Approach to Learning, while teachers are an authority figure, teachers and students play an equally active role in the learning process. The teacher’s primary role is to coach and facilitate student learning and overall comprehension of material. Student learning is measured through both formal and informal forms of assessment, including group projects, student portfolios, and class participation. Teaching and assessments are connected; student learning is continuously measured during teacher instruction. Commonly used teaching methods may include class participation, demonstration, recitation, memorization, or combinations of these.

‘Science is not only knowledge about universe; it is also a way of obtaining knowledge.’ Each teacher may find ways in which he could get the best results. Etymologically method is derived from Greek word ‘Methodos’ which means pursuit of knowledge. Method refers to the way of delivering

knowledge and transmitting scientific skills by a teacher to his pupils. Methods of teaching science can be classified into two types

- i. Teacher-centered
- ii. Pupil Centered

## **TEACHER CENTERED METHODS**

The teacher-centered method is mainly expository in type in which the focus is on telling, memorization and recalling information. The students are passive recipients of knowledge. The teaching environment is very much formalized and the teacher occupies a central position in the classroom.

### **LECTURE METHOD**

The lecture is one of the most basic pedagogic tool which is generally followed in schools and colleges, here the teacher talks and the pupil listens. Despite the fact that this method does not cater for realizing the aims of teaching science and is not in accordance with the principles of teaching, it is the most dominating method today and is liked by majority of teachers. The lecture is an exposition of knowledge, facts, principles or other information which a teacher wishes to present to her students. In short a lecture means one person addressing many students.

#### **Phases of a Lecture**

There are three phases of a lecture. They are preparatory phase, development phase and consolidation phase

##### **I. Preparatory Phase (Warm up Phase)**

In this phase students are to be prepared to receive the contents of a lecture. Variety of formal and informal techniques can be used to prepare the students or to arouse their level of motivation or curiosity. In the classrooms normally teacher relates the contents of the lecture to the previous knowledge of the students.

## **II. Development Phase**

This is the most important phase of the lecture. The entire body of the lecture is delivered in this phase only. Some activities of this phase are using analogies, giving suitable examples, proper illustration, comparison and differentiation, use of proper aids and in recent time's proper use of audio visual technology in classrooms.

## **III. Consolidation Phase**

This is the end part of the lecture. Here the lectures pin point the important aspects of the lecture once again by summarizing. Now proper reviewing can be done to check the level of understanding by asking questions. Provide assignments, feedback and can relate the topic to the future learning content.

### **Skills associated with good lecture**

1. Use of body language
2. Use of communication boosters
3. Varying the stimulus
4. Voice modulation
5. Use of proper language

### **Area of application of Lecture method**

- To introduce new and difficult topic
- To revise the topics already covered
- To give some background of a certain topic
- To present the life histories of great scientist and their struggles and achievement in life
- To explain about certain n procedures
- To impart factual knowledge
- To explain too deep theoretical factors

## **DEMONSTRATION METHOD**

In demonstration method the teacher really teaches the content through proper demonstration of what all things which are important. The teacher performs experiments and goes on asking pupil to observe certain things. The students are compelled to observe and note the important things as

they have to infer some theoretical factors from their recorded observations. Question answer sessions will be the highlighted part of this program. Students are actively involved in the classroom discussions and this develops powers of observation, reasoning and drawing inferences. The method is based on the fact that, things which are seen are believable and is true and this method follows the maxim of teaching from concrete to abstract.

### **Criteria for Good Demonstration**

- Demonstration should be planned and rehearsed well in advance
- The aim and purpose of demonstration must be clear to the teacher
- The demonstration should be arranged in such a way as everything is clearly visible to all
- Throughout the demonstration active participation from all parts should be there
- Pupil should be made familiar with each and every items used in demonstration. Apparatus should be arranged in a sequence on the table. It is better to keep apparatus to be used on the left hand side and used on the right hand side
- Demonstration should be simple and speedy
- Difficult points in the demonstration should be explained before hand
- Teacher should impress upon the students to write what they observe

### **Merits**

- It is economical
- As the teacher alone performs the experiment
- Saves time, when number of experiments are performed in short time
- The method is psychological because the students are shown concrete facts verified practically

### **Demerits**

- There is no scope of learning by doing or develop practical skills as teacher alone performs the experiment
- The method does not show the difference between bright and dull
- No scientific skills are inculcated and possess lack of training in scientific method
- No scope of improving practical skills as teacher alone performs the experiment

## **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. They share insights, argue with one another, and perhaps even challenge students to decide which approach is better. Teams can be single-discipline, interdisciplinary, or school-within-a-school teams that meet with a common set of students over an extended period of time. New teachers may be paired with veteran teachers. Innovations are encouraged, and modifications in class size, location, and time are permitted.

The team-teaching approach allows for more interaction between teachers and students. Faculty evaluates students on their achievement of the learning goals; students evaluate faculty members on their teaching proficiency. Emphasis is on student and faculty growth, balancing initiative and shared responsibility, specialization and broadening horizons, the clear and interesting presentation of content and student development, democratic participation and common expectations, and cognitive, affective, and behavioral outcomes. This combination of analysis, synthesis, critical thinking, and practical applications can be done on all levels of education, from kindergarten through graduate school.

Working as a team, teachers model respect for differences, interdependence, and conflict-resolution skills. Team members together set the course goals and content, select common materials such as texts and films, and develop tests and final examinations for all students. They set the sequence of topics and supplemental materials. They also give their own interpretations of the materials and use their own teaching styles. The greater the agreement on common objectives and interests, the more likely that teaching will be interdependent and coordinated.

Teaching periods can be scheduled side by side or consecutively. For example, teachers of two similar classes may team up during the same or adjacent periods so that each teacher may focus on that phase of the course that he or she can best handle. Students can sometimes meet all together, sometimes in small groups supervised by individual teachers or teaching assistants, or they can work singly or together on projects in the library, laboratory, or fieldwork. Teachers can be at different sites, linked by video-conferencing, satellites, or the Internet.

Breaking out of the taken-for-granted single-subject, single-course, single-teacher pattern encourages other innovations and experiments. For example, students can be split along or across lines of sex, age, culture, or other interests, recombined to stimulate reflection. Remedial programs and honors sections provide other attractive opportunities to make available appropriate and effective curricula for students with special needs or interests. They can address different study skills and learning techniques. Team teaching can also offset the danger of imposing ideas, values, and mindsets on minorities or less powerful ethnic groups. Teachers of different backgrounds can culturally enrich one another and students.

### **Advantages**

Students do not all learn at the same rate. Periods of equal length are not appropriate for all learning situations. Educators are no longer dealing primarily with top-down transmission of the tried and true by the mature and experienced teacher to the young, immature, and inexperienced pupil in the single-subject classroom. Schools are moving toward the inclusion of another whole dimension of learning: the lateral transmission to every sentient member of society of what has just been discovered, invented, created, manufactured, or marketed. For this, team members with different areas of expertise are invaluable.

Of course, team teaching is not the only answer to all problems plaguing teachers, students, and administrators. It requires planning, skilled management, willingness to risk change and even failure, humility, open-mindedness, imagination, and creativity. But the results are worth it.

Teamwork improves the quality of teaching as various experts approach the same topic from different angles: theory and practice, past and present, different genders or ethnic backgrounds. Teacher strengths are combined and weaknesses are remedied. Poor teachers can be observed,

critiqued, and improved by the other team members in a non-threatening, supportive context. The evaluation done by a team of teachers will be more insightful and balanced than the introspection and self-evaluation of an individual teacher.

Working in teams spreads responsibility, encourages creativity, deepens friendships, and builds community among teachers. Teachers complement one another. They share insights, propose new approaches, and challenge assumptions. They learn new perspectives and insights, techniques and values from watching one another. Students enter into conversations between them as they debate, disagree with premises or conclusions, raise new questions, and point out consequences. Contrasting viewpoints encourage more active class participation and independent thinking from students, especially if there is team balance for gender, race, culture, and age. Team teaching is particularly effective with older and underprepared students when it moves beyond communicating facts to tap into their life experience.

The team cuts teaching burdens and boosts morale. The presence of another teacher reduces student-teacher personality problems. In an emergency one team member can attend to the problem while the class goes on. Sharing in decision-making bolsters self-confidence. As teachers see the quality of teaching and learning improve, their self-esteem and happiness grow. This aids in recruiting and keeping faculty.

### **Disadvantages**

Team teaching makes more demands on time and energy. Members must arrange mutually agreeable times for planning and evaluation. Discussions can be draining and group decisions take longer. Rethinking the courses to accommodate the team-teaching method is often inconvenient.

Opposition may also come from students, parents, and administrators who may resist change of any sort. Some students flourish in a highly structured environment that favors repetition. Some are confused by conflicting opinions. Too much variety may hinder habit formation.

Salaries may have to reflect the additional responsibilities undertaken by team members. Team leaders may need some form of bonus. Such costs could be met by enlarging some class sizes. Nonprofessional staff members could take over some responsibilities.

## **LEARNER CENTRED METHODS**

Learner-centered methods are those methods where the focus of attraction is learners than teachers. It is through the involvement of learners the method develops. The recent psychological approaches in the classrooms give more importance to learner centered methods than teacher centered methods.

## **LABORATORY METHOD**

The method provides opportunities for each student to conduct experiments at his own in science laboratories. Every student is provided with a laboratory manual containing the instructions and teacher merely guides and supervises. The laboratory becomes a place where the teacher and the taught solve their problems together.

The teacher divides the experiment in two groups. One set of experiment which needs to be carried out with delicate and costly apparatus are performed by him and other set are conducted by the students in the laboratory. Some of the important aspects considered in the laboratory method are

1. Preparation for laboratory work
2. Supervision
3. Division of experiments among pupils
4. Recording of experiments

## **PROJECT METHOD**

Project method owes its origin to the pragmatic school of philosophy. It was propounded by W. H. Kilpatrick and was perfected by J. A. Stevenson. The method consists of building a comprehensive unit around an activity which may be carried out in the school or outside. The essence of this method is to carry out a useful task in a group in which all the students work co-operatively. Learning by doing and learning by living are the two basic principles involved and children learn through association, co-operation and activity.

### **Principles of the Project Method**

1. The principle of freedom.
2. The principle of reality.
3. The principle of activity.
4. The principle of experience.
5. The principle of utility.
6. The principle of interest.
7. The principle of sociability

### **Major steps of the Project Method**

1. Providing a situation
2. Choosing and purposing
3. Planning
4. Carrying out the project (executing)
5. Evaluating
6. Recording

### **Merits**

1. The method is in accordance with psychological laws of learning
  - a) Law of readiness - pupil are ready to learn creating interest, purpose and life like situation.
  - b) Law of exercise - by practice we learn things, self-activity on the part of students create experience in later life.
  - c) Law of effect - child should be satisfied and feel happy in what he is learning.

2. It promotes co-operation and group interaction.
3. It gives training in a democratic way of learning and living.
4. There is no place for rote memorization.
5. Provides dignity of labour and develop respect and taste for all types of work.
6. Develops initiativeness and self activity.
7. Makes learning natural, spontaneous and interesting.
8. Provide opportunities to participate actively and meaningfully in a purposive venture.

### **Demerits**

1. Project absorbs large amount of time and can be used a part of science work only.
2. Many aspect of curriculum will not yield to project work.
3. Larger projects in the hands of an inexperienced and unskillful teacher lead to boredom.
4. Text book written on this lines are not available.
5. The method is highly expensive aspupil has to purchase lot of item, travel and do outdoor work.
6. Mastery over the content is not achieved.
7. Teaching is not organized, regularized or systematic.

### **PEER TUTORING/TEACHING BY STUDENTS**

Peer tutoring is a flexible, peer-mediated strategy that involves students serving as academic tutors and tutees. Typically, a higher performing student is paired with a lower performing student to review critical academic or behavioral concepts."Peer tutoring is the system of instruction in which learners help each other and learn by teaching. Tutoring schemes have been used in a variety of context, with students teaching students, students teaching school pupils, non-professional adults teaching adults and children, and pupils teaching pupils."

There are many benefits for both the peer tutor and tutee in this relationship, one aspect of this is that the tutor can establish a rapport with the tutee in a way that a teacher cannot. A peer tutor may have taken the same class recently, or have taken similar classes.Because the peer tutor is seen

by the tutee as being more at their own level, advice given by the tutor may be accepted more readily than advice from a teacher. Another key reason for this is that a peer tutor does not give any grade on the paper, whereas a teacher serving in a tutor role may still be perceived as someone who grades papers.

Peer tutors can be trained through on-the-job training, as well as through formal [workshops](#). New tutors can be paired with more experienced tutors for their first few tutorials, and after the tutors are satisfied that the new tutors can operate alone they can give one-on-one tutoring. A key aspect of tutor training is the reflection on tutorials with other tutors. This reflection looks at what could have gone better as well as the tutor's progress in giving tutorials. In higher education tutorial settings, the benefits of peer tutoring programs also extend to class tutors. Using grounded theory techniques, it was found that the following five themes underlie their experiences: role exploration, sharing responsibility, regulation of the peer tutored groups, harnessing the peer tutors' role, and community.

## **Purpose**

There are several reasons to become active in peer tutoring - reasons for both the tutor and the student. Here are a few of the most helpful aspects peer tutoring can offer:

- Peer tutoring allows both the tutor and the student to better understand information. As the tutor and student work through assignments and practice the concepts, both individuals gain a broader and deeper understanding of the material.
- The tutor learns not only how to ask useful questions, but also develops social listening skills that are a sought-after ability in the professional world.

## **Goals and Objectives**

The main goal of this tutorial is to introduce learners to essential peer tutoring techniques. Upon completion of this tutorial, you will be able to:

- Identify good environments for holding peer tutoring sessions.
- Identify elements necessary to build a good rapport with a student.
- Identify important elements of the role of a tutor.

- Demonstrate understanding of basic listening skills a tutor should use in any peer tutoring situation.
- Demonstrate understanding of basic questioning skills a tutor should use in any peer tutoring situation.
- Demonstrate understanding of basic feedback techniques a tutor should use in any peer tutoring situation.

### **INDIVIDUAL ACTIVITIES**

If the student can pursue the activities individually at class room or home then it is called individual activities. This individual activity creates interest of the students. This activity is also useful to understand the particular concept easily.

For example, why is CO<sub>2</sub> increasing in the atmosphere? Who is doing it? Many people think that CO<sub>2</sub> is “pollution,” so that clean burning should be a way to eliminate greenhouse gas emissions. In this demonstration, we review basic chemistry (see illustration) to realize that producing CO<sub>2</sub> is an inevitable product of burning any fossil fuel.

### **Materials**

- At least three large-size plastic foam balls colored white, representing oxygen
- At least one medium-size plastic foam ball colored red, representing carbon
- At least four small-size plastic foam balls colored blue, representing hydrogen
- Pipe cleaners
- Safety scissors

### **Procedure**

1. Prepare plastic foam balls of various sizes and colors (see above). Use safety scissors to cut several pipe cleaners into 1 inch lengths.

Discuss: *What is in a hydrocarbon?* A hydrocarbon is made up of hydrogen and carbon. For example, one carbon molecule attached to four hydrogen molecules is methane, the simplest of the hydrocarbons.

2. Make a model of a hydrocarbon molecule by linking the appropriate hydrogen and carbon balls with short pieces of pipe cleaner.

Discuss: *How do we get energy from hydrocarbon?* A hydrocarbon produces energy when it burns, which means adding oxygen to the fuel in the presence of threshold heat.

3. Use pipe cleaners to add oxygen balls, and pull hydrogen balls off the methane. (You can say “pop” or “bang” as you do so, to symbolize the release of energy.) Add two hydrogen balls to each oxygen ball, and add two oxygen balls to each carbon ball to complete modeling these chemical reactions.

Discuss: *What are the products of the combustion of fossil fuel?* Consider that CO<sub>2</sub> is carbon dioxide and H<sub>2</sub>O is water. Gently toss the model molecules in the air to emphasize what happens to them under “business as usual.”

Discuss: *What do we usually see coming out of the tailpipes of cars or from smokestacks on a cool morning?* This white “smoke” is water vapor condensing. People often are surprised that combustion releases water. We cannot see the CO<sub>2</sub>, but there is at least half as much CO<sub>2</sub> produced as water from most kinds of combustion.

## **EXPERIENTIAL METHOD**

Experiential learning is a method of educating through first-hand experience. Skills, knowledge, and experience are acquired outside of the traditional academic classroom setting, and may include internships, studies abroad, field trips, field research, and service-learning projects. Experiential of learning through experience, and is more specifically defined as "learning through reflection on doing". Hands-on learning is a form of experiential learning but does not necessarily involve students reflecting on their product. Experiential learning is distinct from rote or didactic learning, in which the learner plays a comparatively passive role. It is related to but not synonymous with other forms of active learning such as action learning, adventure learning, free choice learning, cooperative learning, and service-learning.

Experiential learning is often used synonymously with the term learning is the process

"experiential education", but while experiential education is a broader philosophy of education, experiential learning considers the individual learning process. As such, compared to experiential education, experiential learning is concerned with more concrete issues related to the learner and the learning context. Experiential learning has significant teaching advantages. Peter Senge, author of *The Fifth Discipline* (1990), states that teaching is of utmost importance to motivate people. Learning only has good effects when learners have the desire to absorb the knowledge. Therefore, experiential learning requires the showing of directions for learners.

## **TEACHER GUIDED LEARNING**

Guided Learning is a way of interacting with others that is based on individual and group reflection, self-direction, and the fundamental belief that good leadership requires the ability to first be a good community participant. With the inquiry method of instruction, students arrive at an understanding of concepts by themselves and the responsibility for learning rests with them. This method encourages students to build research skills that can be used throughout their educational experiences. Inquiry Based Learning is one approach to help student understand course foundations through a discovery process that supports continuous learning. It also provides a path to a deeper understanding of key concepts and their application. The sites below will help you with ideas to implement inquiry-guided learning in your classes.

### **Objective of Guided Learning Approach**

The guided self-learning approach is set out to help staff from different organizations to better support the delivery of sustainable water supply, sanitation and landscape services. It aims at building on and expanding their capacity in a very practical way of learning in teams in their place of work.

### **Methodology**

The Guided Learning Approach has several impacts on capacity building due to its practical methodological approach:

- Local staffs have a more interactive role in the local community, because the aim is to help them become more systematic with assessments and action plans;
- Doing this training at a community level, an immediate rate of return of the assessments and action plans can be obtained, because one can communicate with the community and ask what can be done without having to wait for government actions;
- Many Water and Sanitation, and Landscape activities can be organized and actively done directly with the community, which creates effective development.

Through Guided Learning Approach training, communities will be capable to carry out many activities and directly solve problems without external support in terms of finance and materials. For example, a community can improve the drainage of a water point – any community can do that, or better cleaning of school latrines for which external support is not required. Communities mainly need to understand the means to and opportunity of solving problems. From this perspective, Guided Learning Approach helps a community to find external support, but most importantly it also encourages local action.

### **PROBLEM SOLVING METHOD**

The method is defined as a planned attack upon a difficulty for the purpose of finding a solution. It is also defined as the process of raising a problem in the minds of the pupils in such a way as to stimulate purposeful reflective thinking for arriving at a rational solution. In this method the person uses his ability to analyze a problem which confronts him in order to arrive at a solution.

#### **Steps in problem solving method**

1. Sensing the problem
2. Interpreting, defining and delimiting the problem
3. Collecting relevant data
4. Organizing and evaluating the data
5. Formulating tentative solution
6. Drawing conclusion and making generalization
7. Application of generalization to new situation

## **SMALL GROUP/ WHOLE CLASS INTERACTIVE LEARNING**

Small group teaching has become more popular as a means of encouraging student learning. While beneficial the tutor needs a different set of skills for those used in lecturing, and more pertinently, small group work is an often luxury many lecturers cannot afford. A further consideration with small group teaching is the subjective perspective of what constitutes a small group. A lecturer used to taking 400 in a lecture would define 50 as a small group, while a lecturer used to a group of 50 would define 5-10 as a small group. In a discussion, where participation is assessed some students may not speak up in a group that begins to be get bigger than 10 participants and in addition tutors would find it hard to assess participation by individual students in groups with numbers greater than this.

Regardless of the group size the learning environment should provide an opportunity for students to obtain a deeper understanding of the material. Biggs (1989) notes that in order to gain a deeper learning the following four components are important:

**Motivational Context:** Intrinsic motivation, student need to see both learning goals and learning process as relevant to them, to feel some ownership of content and subject.

**Learner Activity:** Students need to be active not passive' deep learning is associated with doing rather than passively receiving.

**Interaction with Others:** Discussion with peers requires students to explain their thinking, this, in turn, improve their thinking.

**Well Structured Knowledge Base:** The starting point for new learning should be existing knowledge and experience. Learning programmes should have clearly displayed structure and should relate to the knowledge and not presented in isolation.

## **STUDENT SEMINAR**

A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It has the function of bringing together small groups for recurring meetings, focusing each time on some particular subject, in which everyone present is requested to actively participate. This is often accomplished through an ongoing Socratic dialogue with a seminar leader or instructor, or through a more formal presentation of research. It is essentially a place where assigned readings are discussed, questions can be raised and debates can

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be conducted. Student seminars are the open presentations done by the students before their peers and teachers. The word seminar is derived from the Latin word 'seminarium', meaning "seed plot".

### **Guidelines for seminar preparation**

#### **Choose a good topic**

Choose a topic which will sustain your interest and will allow you to exhibit enthusiasm during your presentation.

#### **Keep your audience in mind**

The primary objective in giving a talk should be to communicate an interesting idea to students who attend the seminar.

#### **Tell a story/anecdote**

Begin with solid motivation for your problem and plenty of illuminating examples.

#### **Keep timing in mind**

Choose a topic that you can motivate and explicate comfortably in this window of time.

### **GROUP DISCUSSION**

#### **Managing Group Learning in Classroom**

Classroom management is the most vital skill that the teacher should demonstrate. The factors of classroom management depend on the teacher's knowledge of structuring his presentation, knowledge about the psychology of the learner, rapport between the students, rule making capacity etc. The efficiency for managing the group learning techniques depends on teacher's efficiency in handling human resources. The teacher should not be a dictator for the execution of the task but he should be dictator of ideas. He should plan the activities in such a way that effective utilization and involvement pupil participation should be maintained. To be an effective classroom manager teacher must learn to exercise, the least amount of power necessary to accomplish the desired result.

### **Tips for Managing group learning**

Teachers can use some techniques for producing better efficiency in group learning techniques

1. Change group composition frequently so that students of different backgrounds, academic achievement levels, and social skills learn to work together. This capacity is build to familiarity, insights, and trust.
2. Organize the work so that each team member contributes to the achievement of the team goals.
3. Use teacher observations, tests, checklists, and individual assignments to measure each student's achievement.
4. Promote group responsibility by holding groups accountable for completing specific tasks or project steps during work sessions.
5. Teach, model, and assess the social skills you expect teams to demonstrate: Listening, taking turns, encouraging, and supporting each other, staying on task, cleaning up the work area, etc.
6. Pick the right sized task. It must be challenging enough to keep students interested, but easy enough for students to achieve success (with effort) in the time allotted.
7. Include a very specific assignment or menu of options for teams to work on. "Every meeting results in a product" - a list to create, a diagram to draw, an outline to display, a form to fill out.
8. Anticipate that not every group will finish at the same time. Have a classroom poster or handout with a list of "what to do if you finish early" items on it.
9. Teach teams how to assess how well they work together. Encourage "team reflection" as part of every activity.

### **Small Group discussions**

Active learning can be implemented by organizing the class into small groups of students who can work together, foster their own learning strategy and create an atmosphere in which information sharing can takes place. Instructional techniques involving group controlled learning experiences provide room for the learners self development and active participation in the teaching learning process. A

discussion is a teaching technique that involves exchange of ideas with active learning and participation by all concerned. Discussion is an active process of teacher-pupil involvement in the classroom environment. This allows a student present its own perspective about something freely. Four basic concepts are to be considered for initiating small group discussions are

**Process** - the interactions that takes place within the group

**Roles** - each group members' specific responsibilities within the group

**Leadership** - the capacity to guide and direct others in a group setting

**Cohesion**- group members support for one another

### **Different Types of Small Group Discussions**

- Brain Storming
- Tutorials
- Buzz session
- Task- directed discussion
- Role playing
- Simulation
- Inquiry centered discussion

### **MIXED ABILITY GROUPING**

“Mixed ability grouping, refers to grouping together students of different abilities. Usually this kind of grouping occurs when the group consists of students with different ages with one or two years span. The term “mixed aged grouping” or “heterogeneous grouping”. But there is distinction between mixed age groupings and mixed ability grouping, the second one is done only based on the ability, since the basic criterion for grouping is ability and not necessarily age. In mixed ability groups there are some students that are more mature and experienced than other ones and thus they have more advanced ability to acquire knowledge. The main aim of setting up mixed ability groups is not to produce homogeneity of ability in a group as this is the case in ability grouping, but to increase interaction across students with different abilities. In other words the purpose of mixed ability grouping is for children to benefit by their intellectual and social interaction with other students of their group that have different social behavior and ability to learn. The former reveals the

main difference of mixed ability grouping with ability grouping. While grouping children with same ability the goal is to achieve homogeneity of the group and homogenize instruction for students of the group on basis different of grades or ages but based on ability. Age may not be an exclusive criterion for indicating different levels of ability of children but it is the first factor that you take into account when you set up mixed ability groups. Putting together students with one or two grades difference you can make a mixed ability group. It is believed that this interaction and cooperation of children with different intellectual level and social behavior, experience and skills can have worth mentioning educational benefits. Research is much more favorable for mixed ability grouping than ability grouping and stress on certain important skills that acquired or improved in mixed ability groups.

Mixed ability grouping is believed to be a valuable tool for the multi grade teacher. It can provide solutions for the multi grade teacher and safeguard good levels of quality in multi grade education. Moreover if the techniques like “peer - tutoring” or the “activity centers approach” along with utilization of ICT in multi grade classrooms are combined together with grouping techniques the results can be even more remarkable.

## **RECENT TRENDS**

### **CONSTRUCTIVIST LEARNING**

Constructivism is a learning theory that has its foundation in philosophy and anthropology as well as psychology. The constructivist approach to education attempts to shift education from a teacher-dominated focus to a student-centered one. The role of the teacher focuses on assisting students in developing new insights. Students are taught to assimilate experience, knowledge and insights with what they already know and from this they need to construct new meanings. Constructivist learning is based on students’ active participation in problem solving and critical thinking regarding a learning activity which they find relevant and engaging. They are “constructing” their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new situations and integrating the new knowledge gained with pre-existing intellectual constructs.

In the constructivist theory the emphasis is placed on the learner or the student rather than the teacher of the instructor. It is the learner who interacts with objects and events and thereby gains an understanding of the features held by such objects or events. The learner constructs her own

conceptualizations and solutions to problems. Learner autonomy and initiative is accepted and encouraged. Exploring or experiencing the physical surroundings, experiential education is a key method of constructivism. To the constructivists, the act of teaching is the process of helping learners create knowledge. In constructivist thinking learning is also affected by the context, beliefs and attitude of the learner.

There are many different schools of thought within this theory, all of which fall within the same basic assumption about learning. The main two are: Cognitive constructivism and Social constructivism.

### **Cognitive constructivism**

Cognitive constructivism is generally attributed to Jean Piaget, who articulated mechanisms by which knowledge is internalized by learners. The process of accumulating the knowledge are through accommodation and assimilation, individuals construct new knowledge from their experiences. When individuals assimilate, they incorporate the new experience into an already existing framework without changing that framework. This may occur when individuals' experiences are aligned with their internal representations of the world, but may also occur as a failure to change a faulty understanding. In contrast, when individual's experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to the theory, accommodation is the process of reframing one's mental representation of the external world to fit new experiences. Accommodation can be understood as the mechanism by which failure leads to learning: when we act on the expectation that the world operates in one way and it violates our expectations, we often fail, but by accommodating this new experience and reframing our model of the way the world works, we learn from the experience of failure, or other's failure.

It is important to note that constructivism is not a particular pedagogy. In fact, constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or following the instructions for building a model airplane. In both cases, the theory of constructivism suggests that learners construct knowledge out

of their experiences. However, constructivism is often associated with pedagogic approaches that promote active learning, or learning by doing. Today constructivist teaching is based on recent research about the human brain.

### **Social constructivism**

Social constructivism maintains that human development is socially situated and knowledge is constructed through interaction with others. It is a sociological theory of knowledge that applies the general philosophical constructivism into the social. Assumptions of Social constructivism is based on specific assumptions about reality, knowledge and learning. To understand and apply models of instruction that are rooted in the perspectives of social constructivists, it is important to know the premises that underlie them. The most important assumptions of the theory of social constructivism is

- (a) The assumption that human beings rationalize their experience by creating a model of the social world and the way that it functions.
- (b) The belief in language as the most essential system through which humans construct reality.

Cognitive growth occurs first on a social level, and then it can occur within the individual. To make sense of others and construct knowledge on such a social level allow learners to relate themselves to circumstances. It also states that the roots of individual 's knowledge are found in their interactions with their surroundings and other people before their knowledge is internalized. Culture and context in understanding what occurs in society and knowledge construction based on this understanding are emphasized in social constructivism.

**Reality:** Social constructivists believe that reality is constructed through human activity. Members of a society together invent the properties of the world. For the social constructivist, reality cannot be discovered: it does not exist prior to its social invention. **Knowledge:** To social constructivists, knowledge is also a human product, and is socially and culturally constructed. Individuals create meaning through their interactions with each other and with the environment they live in.

**Learning:** Social constructivists view learning as a social process. It does not take place only within an individual, nor is it a passive development of behaviors that are shaped by external forces.

Meaningful learning occurs when individuals are engaged in social activities.

### **PROBLEM BASED LEARNING (PBL)**

Problem-based learning (PBL) is a student-centered pedagogy in which students learn about a subject through the experience of solving an open-ended problem. Students learn both thinking strategies and domain knowledge. Problem-based learning (PBL) is an approach that challenges students to learn through engagement in a real problem. It is a format that simultaneously develops both problem solving strategies and disciplinary knowledge bases and skills by placing students in the active role of problem-solvers confronted with an ill-structured situation that simulates the kind of problems they are likely to face as future managers in complex organizations. Problem-based learning makes a fundamental shift from a focus on teaching to a focus on learning. The process is aimed at using the power of authentic problem solving to engage students and enhance their learning and motivation.

Problem-based learning begins with the introduction of an ill-structured problem on which all learning is centered. Most of the learning occurs in small groups rather than in lectures. Teacher's role is more like that of a facilitator and coach of student learning, acting at times as a resource person, rather than as knowledge-holder and disseminator. Similarly, your role, as a student, is more active, as you are engaged as a problem-solver, decision-maker, and meaning-maker, rather than being merely a passive listener and note-taker.

### **Characteristics of Problem-Based Learning (PBL)**

Problem-Based Learning (PBL) is a pedagogical approach and curriculum design methodology often used in higher education and K-12 settings

The following are some of the defining characteristics of PBL:

- Learning is driven by challenging, open-ended problems with no one “right” answer
- Problems/cases are context specific
- Students work as self-directed, active investigators and problem-solvers in small collaborative groups (typically of about five students)
- A key problem is identified and a solution is agreed upon and implemented

- Teachers adopt the role as facilitators of learning, guiding the learning process and promoting an environment of inquiry

Rather than having a teacher provide facts and then testing student's ability to recall these facts via memorization, PBL attempts to get students to apply knowledge to new situations. Students are faced with contextualized, ill-structured problems and are asked to investigate and discover meaningful solutions. Proponents of PBL believe that, as a strategy, it:

- develops critical thinking and creative skills
- improves problem-solving skills
- increases motivation
- helps students learn to transfer knowledge to new situations

### **BRAIN BASED LEARNING (BBL)**

Brain-based learning refers to teaching methods, lesson designs, and school programs that are based on the latest scientific research about how the brain learns, including such factors as cognitive development—how students learn differently as they age, grow, and mature socially, emotionally, and cognitively. It is totally based on the structure and function of the brain. As long as the brain is not prohibited from fulfilling its normal processes, learning will occur. Brain-based learning is motivated by the general belief that learning can be accelerated and improved if educators base how and what they teach on the science of learning, rather than on past educational practices, established conventions, or assumptions about the learning process. For example, it was commonly believed that intelligence is a fixed characteristic that remains largely unchanged throughout a persons' life. However, recent discoveries in cognitive science have revealed that the human brain physically changes when it learns, and that after practicing certain skills it becomes increasingly easier to continue learning and improving those skills.

### **Impacts of Brain Based Learning in Science Education**

All curricular innovations that use research findings from cognitive science can better be utilized in science education than any other.

**Curriculum:** Teachers must design learning around student interests and make learning contextual.

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**Instruction:** Educators let students learn in teams and use peripheral learning. Teachers structure learning around real problems, encouraging students to also learn in settings outside the classroom and the school building.

**Assessment:** Since all students are learning, their assessment should allow them to understand their own learning styles and preferences. This way, students monitor and enhance their own learning process.

## **COLLABORATIVE LEARNING**

Effective communication and Collaboration are essential for becoming a successful learner. It is primarily through dialogue and examining different perspectives that students become knowledgeable, strategic and self determined and empathetic. Moreover, involving students in real world tasks and linking new information to prior knowledge requires effective communication and collaboration among teachers, students and others. Indeed it is through dialogue and interaction that curriculum objectives come alive. Collaborative learning affords students enormous advantages which is not available in traditional instruction.

“Collaborative learning” is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Collaborative learning activities vary widely, but most center on students’ exploration or application of the course material, not simply the teachers presentation or explication of it.

Collaborative learning represents a significant shift away from the typical teacher centered or lecture-centered milieu in college classrooms. In collaborative classrooms, the lecturing/ listening/note-taking process may not disappear entirely, but it lives alongside other processes that are based in students’ discussion and active work with the course material. Teachers who use collaborative learning approaches tend to think of themselves less as expert transmitters of knowledge to students, and more as expert designers of intellectual experiences for students-as coaches or mid-wives of a more emergent learning process.

Collaborative learning puts students together to work in heterogeneous groups. All perspectives of all learners are utilized for enriching learning; all are seen as equal contributors, collaborating to

achieve a mutual goal. Collaborative consultation encourages shared responsibility in planning and decision making. The focus on the collective knowledge and thinking of the group changes the roles of students and teachers and the way they interact in the classroom.

### **Essential features of Collaborative Learning**

1. A group learning task is designed based on shared learning goals and outcomes
2. Students work in teams to master academic materials
3. Reward systems are group oriented than individual oriented
4. Co-operative behaviour involves trust building activities, joint planning and understanding of team support.
5. Students involvement in learning activities are more
6. Encourages students to acquire an active voice in shaping their ideas

### **Advantages of Collaborative Learning**

1. Promotes social and intellectual involvement
2. Cultivation of teamwork, community building, and leadership skills
3. Enhanced student satisfaction and promoting positive attitudes
4. Open expression of ideas in groups
5. Patience in hearing others
6. Team building
7. Shared responsibility

### **FLIPPED LEARNING**

Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.

The flipped classroom is a pedagogical model in which the typical lecture and homework

elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while in-class time is devoted to exercises, projects, or discussions. The flipped classroom describes a reversal of traditional teaching where students gain first exposure to new material outside of class, usually via reading or lecture videos, and then class time is used to do the harder work of assimilating that knowledge through strategies such as problem solving

## **Four Pillars in Flipped Learning**

### **1. Flexible Environment**

Flipped Learning allows for a variety of learning modes; educators often physically rearrange their learning spaces to accommodate a lesson or unit, to support either group work or independent study. They create flexible spaces in which students choose when and where they learn. Furthermore, educators who flip their classes are flexible in their expectations of student timelines for learning and in their assessments of student learning.

### **2. Learning Culture**

In the traditional teacher-centered model, the teacher is the primary source of information. By contrast, the Flipped Learning model deliberately shifts instruction to a learner-centered approach, where in-class time is dedicated to exploring topics in greater depth and creating rich learning opportunities. As a result, students are actively involved in knowledge construction as they participate in and evaluate their learning in a manner that is personally meaningful.

### **3. Intentional Content**

Flipped Learning Educators continually think about how they can use the Flipped Learning model to help students develop conceptual understanding, as well as procedural fluency. They determine what they need to teach and what materials students should explore on their own. Educators use Intentional Content to maximize classroom time in order to adopt methods of student-centered, active learning strategies, depending on grade level and subject matter.

### **4. Professional Educator**

The role of a Professional Educator is even more important, and often more demanding, in a Flipped Classroom than in a traditional one. During class time, they continually observe their students, providing them with feedback relevant in the moment, and assessing their work. Professional Educators are reflective in their practice, connect with each other to improve their instruction, accept constructive criticism, and tolerate controlled chaos in their classrooms. While Professional Educators take on less visibly prominent roles in a flipped classroom, they remain the essential ingredient that enables Flipped Learning to occur.

## **BLENDED LEARNING**

Blended learning is a planned combination of online learning and face-to-face instruction using variety of learning resources. It is a flexible learning strategy that integrates innovative and technological advances of online learning with interaction and participation of traditional face-to-face classroom learning. Blended learning as a way of meeting the challenges of tailoring learning and development to the needs of individuals by integrating the innovative and technological advances offered in the best of traditional learning.

Blended learning strategies vary according to the discipline, the year level, student characteristics and learning outcomes, and have a student-centered approach to the learning design. Blended learning can promote learner s access and flexibility, increase the level of active learning, and achieve better student experiences and outcomes. For teachers, blended learning can improve teaching and class management practices. A blend might include:

- Face-to-face and online learning activities and formats
- Traditional classes with different modalities, such as regular, weekend, evening, part time, semester
- Use of technology interfaces like social media, wikis and various web sources
- Group work, Simulation, debate, Online Assignments, Practicals etc.
- Both usual classroom human factors and digital learning resources of the web
- Psychological concerns are addressed in the face to face interaction and technological

concerns are addressed in the online learning

So incorporating all these aspects in the learning environment, “Blended learning should be viewed as a pedagogical approach that combines the effectiveness and socialization opportunities of the classroom with the technologically enhanced active learning possibilities of the online environment, rather than a ratio of delivery modalities. In other words, blended learning should be approached not merely as a temporal construct, but rather as a fundamental redesign of the instructional model with the following characteristics:

- A shift from lecture- to student-centered instruction in which students become active and interactive learners (this shift should apply to the entire course, including face-to-face contact sessions)
- Increases in interaction between student-instructor, student-student, student-content, and student-outside resources
- Integrated formative and summative assessment mechanisms for students and instructor.

### **Components of Blended Learning**

There are five components of blended learning. They are:

1. Live events
2. Self-paced learning
3. Collaboration
4. Assessment
5. Performance support

#### **1. Live events**

Synchronous, teacher initiated learning environment in which all learners participate at die same time. Teacher may use lecture, demonstration, discussion or computer-based instruction to all the students in live. For many learners, nothing can replace the ability to tap the expertise of a live teacher. It can be in real classroom or can be in virtual learning environment.

#### **2. Self-paced learning**

**Learning experiences that the learner completes individually at his own pace and on his time such as recorded live events,** Internet-based or CD-ROM-based: it implies on demand learning at a pace is managed or controlled by the learner.

### **3.Collaboration**

It implies a more dynamic communication and interaction among many learners that brings about knowledge sharing. Collaborative learning has more advantages which are not available from traditional instruction because a group can accomplish meaningful learning and solve problems better than any individual. It can be extended from discussion in the live classroom to synchronous communications in chat room or in open discussion forums and asynchronous communication by e-mail and threaded discussion.

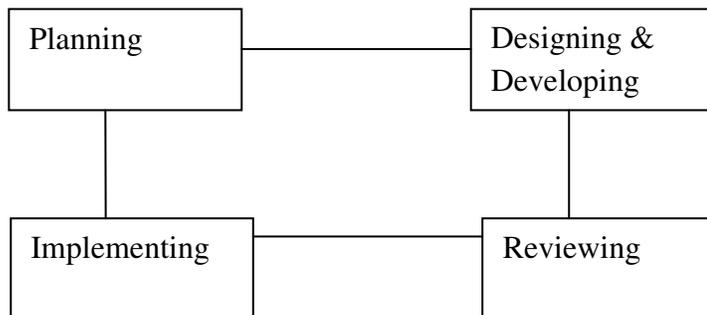
### **4.Assessment**

It is both live and online measure of learners knowledge to determine prior knowledge as well as to measure learning transfer.

### **5. Performance support**

These are the reference materials that enhance learning, retention and transfer. It may be printable references, downloaded multimedia learning objects, documentation etc.

## **BLENDED LEARNING DESIGN**



### **Planning**

Planning is an important process in the Blended learning design. In this step all the stages and design of Blended learning is planned for a course. The person or the group entrusted for this should be aware about the course objectives, course content and mode of delivery of the material, how the assessments can be made and what should be the expected outcome.

### **Designing & Developing**

Designing is an important and largest step which will trace out the path followed in the procedure of this course. This gives a proper array of elements included in this course and how these elements are arranged in different modalities to reach the expected goal. Developing is a process by which each and every element is structured to give a small reasonable result. Developing also gives how the content is developed into a blended learning unit. Proper synchronization of the digital and face to face interaction contributes to the quality of the developed material. The phase designing and developing are treated together without separating one from the other. Some of the sequence involved in designing and developing are

- Formulating Course learning, teaching and learning activities, and assessment tasks need to correspond with each other. That means (1) course resources and learning and teaching activities need to directly support students achievement of the stated learning objectives, and (2) assessment tasks need to be congruent with the activities and the objectives, and they need to allow students to demonstrate those learning objectives. This is called “constructive alignment” .
- Authentic assessment tasks as much as possible relevant, real-world activities so that students can demonstrate their competency in a more ‘true-to-life’ setting.
- Teaching and learning activities need to be clearly linked in time and content
- Establish a clear sequence for engagement in content, activities and assessment tasks

The workload for a blended learning course should not exceed that of a course in Traditional mode

### **Implementing**

Implementing is the direct application of the developed material in the blended learning environment according to the design already formulated. It is the actual step we face difficulties and setbacks. The

quality of the course content, the proper digital media empowered and the knowledge in handling technological devices can have direct impact in this step.

### **Reviewing**

Reviewing is the final step in the Blended learning design. Here the entire course is evaluated based on student's feedbacks and teacher appraisal. The review helps in reorganizing the course, overcoming the limitations in the previous trial.

Blended learning is a learning strategy which works only with the proper support from web technologies so constant review to encourage this mechanism will support this process or increase the accessibility of the masses towards this endeavour.

### **E-learning**

E-learning (or e Learning) is the use of electronic media and information and communication technologies (ICT) in education. E-learning is broadly inclusive of all forms of educational technology in learning and teaching. E-learning is inclusive of, and is broadly synonymous with multimedia learning, technology-enhanced learning (TEL), computer-based instruction (CBI), computer-based training (CBT), computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), web-based training (WBT), online education, virtual education, virtual learning environments (VLE) (which are also called learning platforms), m-learning, and digital educational collaboration. These alternative names emphasize a particular aspect, component or delivery method.

E-learning can occur in or out of the classroom. It can be self-paced, asynchronous learning or may be instructor-led, synchronous learning. E-learning is suited to distance learning and flexible learning, but it can also be used in conjunction with face-to-face teaching, in which case the term blended learning is commonly used.

### **Synchronous and asynchronous**

E-learning may either be synchronous or asynchronous. Synchronous learning occurs in real-time, with all participants interacting at the same time, while asynchronous learning is self-paced and allows participants to engage in the exchange of ideas or information without the dependency of other participants involvement at the same time.

Bernard Luskin, a pioneer of e-learning, advocates that the "e" should be interpreted to mean "exciting, energetic, enthusiastic, emotional, extended, excellent, and educational" in addition to "electronic." This broad interpretation focuses on new applications and developments, and also brings learning and media psychology into consideration.

Synchronous learning involves the exchange of ideas and information with one or more participants during the same period of time. A face-to-face discussion is an example of synchronous communications. In e-learning environments, examples of synchronous communications include online real-time live teacher instruction and feedback, Skype conversations, or chat rooms or virtual classrooms where everyone is online and working collaboratively at the same time.

Asynchronous learning may use technologies such as email, blogs, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents, audio video courses, and social networking. At the professional educational level, training may include virtual operating rooms. Asynchronous learning is particularly beneficial for students who have health problems or have child care responsibilities and regularly leaving the home to attend lectures is difficult. They have the opportunity to complete their work in a low stress environment and within a more flexible timeframe. In asynchronous online courses, students proceed at their own pace. Both the asynchronous and synchronous methods rely heavily on self-motivation, self-discipline, and the ability to communicate in writing effectively.

There are three methods of e-learning process like live broadcasting, Video on Demand (VOD) and interactive communications.

## **E-LEARNING TRENDS**

### **1. Automation**

Education experts predict that automation will finally become a crucial aspect of both content creation and processing. It's most likely that content providers will use an increasing number of automated solutions to create new courses and learning materials, saving the time and money involved in conventional processes. Coursework elements, such as tests, quizzes and exercises will all be generated by tools able to efficiently scan the course content and recognize its most important aspects that should be tested. Courses will undergo the process of optimization to match the

preferences and requirements of every single user. Their skills and knowledge level will be assessed by automated tools that will in turn offer algorithmic solutions used in creating course content.

## **2. Augmented Learning**

**This is another area under intense development. Augmented reality devices ranging from Apple Watch to Google Glass will become a common element of our everyday realities. When it comes to learning, augmented learning offers a great value in adapting environments to the learner. This is a solution for which the market is predicted to grow very fast, reaching a smashing number of 200 million users in just 3 years! 2015 will definitely pave the way to an increased use of augmented reality in eLearning, culminating in its widespread use in future.** In eLearning, learners will be able to access augmented environments by means of QR codes or mobile technologies like Apple Watch or Google Glass. This kind of learning will primarily engage learners with action-based functionalities in real life conducted by means of GPS tracking, as well as with courses developed by Oculus Rift.

## **3. Big Data**

Big data is big everywhere - including eLearning. It's clear that every year we'll have more and more data to process, and learning centers will use tools made especially for big data analytics to make sense of the user-generated information. Only those tools will be able to analyze a heap of data produced during one semester and deliver meaningful and valuable conclusions about user performance or course content optimization. Big data analytics will help learning providers to better understand the learning process itself - by tracking learner and group patterns and performing a thorough feedback analysis, they'll be able to offer full course personalization and compile a comprehensive report for learning.

## **4. Going For Cloud Computing**

The use of cloud is on the rise - in every sector, including eLearning. Enterprises are willing to embrace the functionality, comfort and security of the cloud - even though many people still think that it's not a good idea to keep data on public servers, those attitudes are slowly weaning. E-Learning users will benefit from established cloud technologies assisting their learning process in many different ways.

## **5. Gamification**

Gamification is today a major trend that most of us are still waiting to explode - especially on the e-learning scene. Experts agree that applying game dynamics onto non-gaming contexts brings really great results - most importantly, in motivating people to achieve their goals. This feature can be easily applied to learning and eLearning environments. Gamification offers a potential strategy for improving user engagement with learning materials - some experts claim that the technique can boost learner's motivation to a smashing 90% recall rate. It's quite simple. Once learners assume an active role in knowledge reception, they will automatically improve their chances at remembering it.

## **6. M-Learning**

The general rise of mobile technologies all over the world provided a trend towards M-learning environment. Together with the increased use of mobile devices will emerge an interest in m-Learning. Some industry experts expect mobile learning to dominate the e-learning market someday, even if this prediction sounds a little extreme, you should consider the fact that mobile is actually expected to dominate many other areas too.

## **7. Personalization**

All those trends point to this key insight - the growth of personalization on all levels of eLearning. Once we'll be able to analyze big chunks of data, we'll see e-learning becoming more personalized than ever and addressing the needs, preferences and requirements of individuals rather than groups. All aspects of learning ranging from pedagogy and learning environments to learning tools and course curricula will be tailored to motivate, engage and inspire learners to achieve better results in a shorter time frame. In future the technologies will be concentrating more about developing a personalized approach to learning by adjusting the pace of instruction, leveraging student interests, letting learners to choose their own leaning path and adjusting content presentation by choosing text, images or videos, instructors will be able to deliver their coursework in more efficient ways.

## **VIDEO CONFERENCING**

Video conferencing is two-way interactive communication delivered using telephone or Internet technologies that allows people at different location to come together for a meeting. The video

conference can be as simple as a conversation between two people in private offices (point-to-point) or involve several sites (multi-point) with more than one person in large rooms at different sites. A basic video conference setup has a camera and a microphone. Video from the camera and audio from the microphone is converted into a digital format and transmitted to a receiving location using a coding and decoding device, often referred to as a "codec". At that receiving location is another codec device that decodes the receiving digital stream into a form that can be seen and heard on monitors or televisions. At the same time, video and audio from cameras and microphones at the received location is sent back to the original location.

### **Benefits of Video Conferencing**

Video conferencing saves travel time and money. Participants can see and hear all other participants and communicate both verbally and visually, creating a face-to-face experience. PowerPoint and other on screen graphic, as well as other cameras are also available presentation options. People downtime is reduced and productivity gains are achieved by removing the logistics of flight preparations, airport delays, hotel stays, and all the other inconveniences of business travel. In distance education, video conferencing provides quality access to students who could not travel to or could afford to relocate to a traditional campus. Video conferences can also be recorded and made available in a variety of ways, e.g., DVDs, streaming video. Besides distance education, other applications include meetings, dissertation and thesis defenses, tele-medical procedures, and online conferences.

### **Some Terms in Video Conferencing**

#### **1. Video Conferencing Bridge**

A video conferencing bridge (also called a Multipoint Control Unit or MCU) is a hardware system that is able to connect multiple videoconferencing systems together into a single conference. A video conferencing bridge receives digital video and audio signals from codecs in a designated conference, processes and resends digital video and audio signals back to all the codecs. Multiple conferences involving many locations can be conducted simultaneously. Many bridges can provide advanced features such as continuous presence, people plus content or dual streams, transcoding, and translating.

#### **2. Continuous Presence**

Continuous Presence is a feature available during video conferences that allows all participants

to be visible on the screen at the same time. For instance, if there are 12 participants in the video conference, the screen everyone sees will have 12 windows (which can be of various client defined sizes) with each participant in their own window.

### **3. People Plus Content**

**"People plus content" is a standard that allows a video conferencing system to process high resolution VGA graphics along with the standard video signal. This means video conferencing system in the conference sends and receives two video streams - video and VGA graphics. Example: In a classroom equipped with two monitors, the students could see both the instructor and the presentation on the two different displays.**

### **4. Transrating & Transcoding**

Transrating is a function available on the video conferencing bridge that allows conferences among site and locations with different bandwidths. For instance, transrating allows virtual classrooms with Internet 2 connections participating at 2 Mbps while other locations with limited bandwidth can participate at a lower 384 Kbps rate.

Transcoding is an option available on video conferencing bridges that allows conferences to be established with participants using different video conferencing formats. For example, systems and locations using ISDN can seamlessly communicate with other locations using IP or Internet connections.

### **5. Firewall**

A firewall protects your network from unwanted Internet traffic. A firewall can be an appliance installed on the network or software running on your computer. When installed, a firewall exists between your computer(s) and the Internet,

ie., a virtual wall. The firewall lets you request web pages, download files, chat, etc. while making sure other people on the Internet cannot access services on your computer like file or print sharing.

If a videoconferencing system (any type) is behind a firewall, it cannot receive communications from gatekeeper, so it cannot complete a registration or use gatekeeper services. (The gatekeeper is

not a means of bypassing the restrictions of a firewall.) A videoconferencing system behind a firewall must initiate a videoconference using the IP address of the remote video conferencing system since it cannot make use of the gatekeeper's services. Firewalls make it difficult to use Videoconferencing Bridge for multipoint videoconferencing.

There are four components in Latest Video Conferencing Technology

1. Terminal/Endpoint/Conferencing System/Codec: A basic video conference system has a camera and a microphone. Video from the camera and audio from the microphone is converted into a digital format and transmitted to a receiving location using a coding and decoding device, often referred to as a "codec".
2. Multipoint Control Unit (MCUs): Supports conferences between three or more endpoints
3. Gateway: An optional element, gateways provide translation functions between conferencing codecs and other conferencing terminals.
4. Gatekeeper: Performs two call control functions - address translation from aliases to IP addresses and bandwidth management. The collection of all terminals, gateways, and MCUs are managed by a single gatekeeper is called an H.323 Zone.

**Questions for Discussion and Reflection:**

1. Describe Lecture Method.
2. Explain the Problem solving Method of teaching physical science.
3. Examine the Problem based learning.
4. Discuss about Flipped learning.

**UNIT V: RESOURCES FOR TEACHING PHYSICAL SCIENCE**

**Objectives:**

After the completion of the unit, the learners will be able to:

1. Understand about print resources
2. Explain about the uses of radio talk.
3. Identify the usage of interactive whiteboard.
4. Discuss about the qualities of science book.
5. Use community resources in teaching Physical Science.

## **INTRODUCTION**

There are various forms of print, audio, visual, ICT and community resources that we can use in the science classrooms. Some of them are newspapers, science journals, magazines and science encyclopedias. In the present technological age, the full potential of resource materials needs to be explored by the teachers and learners of science. Printed materials are essential part of science curricula play a vital role in teaching and learning, at the same time over –dependence upon the text book for instance, limits the advantages of other materials in teaching and learning.

Nowadays there is wide variety of learning materials in science and these include the traditional text books, work books, supplementary readers etc. and the highly sophisticated online learning materials, digital libraries and other software solutions in science learning. It is of utmost importance for a teacher to communicate effectively with her students. ICT has entered into schools and has started influencing teacher-learner interaction. The teacher of twenty-first century must be proficient enough in using ICT for his/her teaching-learning in the classroom.

## **NEWSPAPERS**

Newspapers are the cheapest medium of furnishing information to the general public. It can also furnish health messages in local languages which can reach to the public easily. The information will be available in low cost, easy to read and understand and simple language. The people may learn to read and interpret the contents along with pictures to enhance easy grasping.

## **ADVANTAGES**

- Best method to reach a large group
- Pictures will help in easy understanding
- Attractive and easy to understand
- Lot of information can be obtained in various fields

## **DISADVANTAGES**

- Useful for literates only
- Detailed information cannot be given

## JOURNALS AND MAGAZINES

A "journal" is a scholarly periodical aimed at specialists and researchers. Articles are generally written by experts in the subject, using more technical language. They contain original research, conclusions based on data, footnotes or endnotes, and often an abstract or bibliography.

A "magazine" is a periodical with a popular focus, i.e. aimed at the general public, and containing news, personal narratives, and opinion. Articles are often written by professional writers with or without expertise in the subject; they contain "secondary" discussion of events, usually with little documentation (e.g. footnotes). Magazines use vocabulary understandable to most people, and often have lots of eye-catching illustrations. Time, Newsweek, U.S. News & World Report, and Psychology Today are magazines

Science organisations and science associations usually bring out journals in science. These journals publish research-based, experience-based and popular science articles. A number of magazines also publish articles on scientific issues. These materials can be helpful for the enrichment of teaching-learning of science. Some of the science journals are international journal of science education, Education in science, journal of chemical education, Physics education, Science and culture, science education etc.

## ENCYCLOPEDIAS

An **encyclopedia** or **encyclopaedia** is a type of reference work or compendium holding a comprehensive summary of information from either all branches of knowledge or a particular branch of knowledge. Encyclopedias are divided into articles or entries, which are usually accessed alphabetically by article name. Encyclopedia entries are longer and more detailed than those in most dictionaries. Generally speaking, unlike dictionary entries, which focus on linguistic information about words, encyclopedia articles focus on factual information concerning the subject for which the article is named.

Four major elements define an encyclopedia: its subject matter, its scope, its method of organization, and its method of production:

- Encyclopedias can be general, containing articles on topics in every field (the English-language *Encyclopædia Britannica* and German *Brockhaus* are well-known examples). General encyclopedias often contain guides on how to do a variety of things, as well as embedded dictionaries and gazetteers. There are also encyclopedias that cover a wide variety of topics but from a particular cultural, ethnic, or national perspective, such as the *Great Soviet Encyclopedia* or *Encyclopaedia Judaica*.
  - Works of encyclopedic scope aim to convey the important accumulated knowledge for their subject domain, such as an encyclopedia of medicine, philosophy, or law. Works vary in the breadth of material and the depth of discussion, depending on the target audience.
  - Some systematic method of organization is essential to making an encyclopedia usable as a work of reference. There have historically been two main methods of organizing printed encyclopedias: the alphabetical method (consisting of a number of separate articles, organized in alphabetical order), or organization by hierarchical categories. The former method is today the most

common by far, especially for general works. The fluidity of electronic media, however, allows new possibilities for multiple methods of organization of the same content. Further, electronic media offer previously unimaginable capabilities for search, indexing and cross reference.

- As modern multimedia and the information age have evolved, they have had an ever-increasing effect on the collection, verification, summation, and presentation of information of all kinds. Projects such as Everything2, Encarta, h2g2, and Wikipedia are examples of new forms of the encyclopedia as information retrieval becomes simpler.

## **AUDIO RESOURCES**

### **RADIO TALK**

Radio broadcast and audio recordings are the sources of audio learning experiences for the children. In order to provide learning experience beyond the school syllabus and to relate it to the real life outside the classroom, school broadcast programmes could be one of the best medium. It may not always be possible for a science teacher to invite eminent persons of science for the lecture or talk. In such cases the lectures or speeches can be pre-recorded and can be played in the classrooms. There are various types of programmes, such as discussion forums, question- answers, debates, quizzes, speeches, dramas, which can be either play edliveor can be pre-recorded, to be used in teaching- learning of science.

The All India Radio has regular programmes for school children. Programmes generally include talks on educational, scientific, current topics, etc. The topic, date and time of broadcast of such talks are given in advance. The school can take advantage of such talks. Sometimes, it is also possible to synchronise the broadcast on a topic with the actual teaching-learning time of that topic in the class. To get the maximum benefit from such talks, the following points should be kept in mind: To keep students' interest alive, they are facilitated to get familiar with the back ground of the talk before hand. A discussion could be arranged after the talk. Preferably short duration talks are arranged. The student having hearing problem sarelated near the source.

### **AUDIO TAPES**

The major advantage of a magnetic audio tape over a disc is that one can record programmes easily and economically. When the material becomes outdated, or is no longer useful, it could be erased and the tape can be reused. Tapes are not as easily damaged as discs, and they can be easily stored. Records of talks on interesting science topics by eminent scholars can be easily reproduced in the classroom. These talks provide an inspiration to the students. Such a recording could be used to introduce a topic or to develop it. These devices are seldom used these days.

### **COMPACT DISC (CD)**

The disc recording has a number of attributes that makes it an attractive medium of teaching-learning. It can reproduce the audio spectrum even beyond the limits of human hearing. A major advantage of audio CDs (and other optical discs) is that the user can quickly access any part of the disc. Data from the disc can be retrieved in any desired sequence.

Standard CDs have a diameter of 120 millimetres (4.7 in) and can hold up to about 80 minutes of uncompressed audio or about 700 MB of data. The Mini CD has various diameters ranging from 60 to 80 millimetres (2.4 to 3.1 in); they are sometimes used for CD singles, storing up to 24 minutes of audio, or delivering device drivers.

At the time of the technology's introduction in 1982, a CD could store much more data than a computer hard, which would typically hold 10 MB. By 2010, hard drives commonly offered as much storage space as a thousand CDs, while their prices had plummeted to commodity level.

### **DVD/CD**

DVD ("digital versatile disc" or "digital video disc") is a digital optical storage format and the medium can store any kind of digital data and is widely used for software and other computer files as well as video programs watched using DVD players. DVDs offer higher storage capacity than compact discs while having the same dimensions.

DVDs are used in DVD-Video consumer digital video format and in DVD-Audio consumer digital audio format as well as for authoring DVD discs written in a special AVCHD format to hold high definition material (often in conjunction with AVCHD format camcorders). DVDs containing other types of information may be referred to as DVD data discs.

### **VISUAL RESOURCES**

Visuals are used very often as iconic representations of objects. Railway stations, roads, bus terminals and airports cater to people of all strata, from totally illiterate to highly , and people of all nationalities. Universal icons representing various objects have been developed, so that no language is necessary to explain them. Similarly in science, we use various symbols of different electric and electronic devices and symbols for various elements in chemistry.

### **PICTURES**

Pictures are used for the expression of idea. They are more attractive and are easily understandable. Pictures should be considered as short & language of the idea presented picture are only 2-d but should be carefully planned.

This can be prepared by any teacher using simple material. They convey the expected message by combination of visual aids by suitable information effectively.

### **FLASH CARDS**

Flash cards are a set of pictured paper cards of varying sizes that are arranged one by one in a logical sequence. Flash cards can be self-made or commercially prepared and are made up of chart or drawing paper, plain paper using colors or ink on them for drawings.

### **Purposes**

To teach the students about new words, properties etc.

Useful for small group

Used in group discussion

### **CHARTS**

Charts of different types can be prepared by the learners with a little help from teacher depending on the teaching- learning objectives to be achieved and the need of the subject matter. Charts help in effective representation of the subject matter which is in the form of data, diagram, etc. Those charts which cannot be prepared locally may be procured from various educational centres.

Charts depicting pictures of great scientists, instruments, equipment used in industry, industrial processes, etc. could be used as teaching aids. But the pictures used should be of reasonable size, so that it is visible to the whole class. They should not be overloaded with information to avoid distraction of the learners to unnecessary parts.

Pictures or portraits of great scientists displayed in science laboratories not only give proper scientific atmosphere to laboratory, but also inspire learners.

### **POSTERS**

Posters are the graphic aids with short quick and typical messages with attention capturing paintings.

### **Purposes**

To provide general motivation

To create an esthetic or atmospheric effect

To communicate a more general idea

To thrust the message for leading to action

Printed posters on various science concepts and life history of scientists are available from science publishers. These can be used as source in teaching scientific concepts covered in the school

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syllabus. If a desired poster is not available, teacher should endeavour to make one for herwith the help of students. For example, a good large-size poster of Periodic Table and Electromagnetic Spectrum will be of good help in teaching-learning of physical science.

## **PHOTOGRAPHS**

This is one of the most common types of visual aids. The photo helps the extended work to get across an idea and pass on to the audience. It is visual which has to catch the attention of the audience and pass on to them a simple message at a glance.

The audience should become aware of the event, practice or idea you want to communicate.

## **MODELS**

A model is a recognizable representation of a real thing three dimensionally, that is height, width and depth is felt as reality.

### **Types of models**

1. **Solid models:** It is the replica of an original thing made with suitable material like clay, plaster of Paris, wood, iron etc. to show internal parts of the things. Ex: globe, clay model of human and animal.
2. **Cutaway and X-ray models:** These are the replicas of the original things to show internal parts of a thing. Cross sectional models are difficult to make in the classroom or institutions as they require expertise to construct them. Ex. Cross sectional model of human body.
3. **Working models:** These models are either actual working things or their miniature replicas. For illustrating an operation. Ex: a motor, a generator.
4. **Sand models:** It is made by using sand, clay, saw dust, ex: a tribal village, a forest area.

## **ICT RESOURCES**

### **RADIO**

Radio broadcast are of two types. General broadcast and Educational broadcast

#### **General Broadcast**

It provides general information about the facts, events and happenings, assimilating knowledge about the world, culture and life. It always gives information about what is happening all over the world. General broadcasts are routine type process, done by radio stations throughout the day.

#### **Educational Broadcast**

Educational broadcasts are typically designed for educational purposes, familiarizing the instructional process by substituting the classroom instruction, specifying the evaluation methods, creating awareness about the educational opportunities in and around the country etc.

## **TELEVISION**

Television experience, which is a combination of sound and picture received instantaneously on the TV screen, it comes closer than any other contrived experience to that of real it.

(2) Television makes it possible for the talents of the best teachers to be put at the disposal of all schools.

(3) Television can employ all other audio and visual aids and combine their effectiveness in the air medium. Pictures, charts, films, micro slides, graphs, boards, overhead projector can all be employed in the technique of teaching by TV.

(4) Educational authorities can produce TV lessons made to their own requirements for specific local needs.

(5) The TV teacher is more real because of his frequent visual appearance in the classroom.

### **In the classroom TV can be advantageously used to:**

(1) Broaden and enrich the classroom learning experiences of the students.

(2) Create genuine interest in the topic or the subject that is being taught.

(3) Evaluate the quality of classroom teaching process.

(4) To provide a wide variety of experiences, those are quite different from the routine classroom-instruction.

(5) Stimulate less passive slow learners by developing a more critical approach in them.

(6) Provides opportunity to learn, to create productions that can improve students ability to communicate.

### **Television programmes may be made on:**

(1) Teaching demonstrations

(2) Recordings of student's performance

(3) Recordings of teacher's performance

(4) Micro teaching in teacher's performance

(5) Image magnification for demonstrations

- (6) Records of field trips
- (7) Career counselling programmes
- (8) Critical community problems
- (9) Technical training taps
- (10) Guest speakers files

## **INTERNET**

It is a major tool for gathering, accessing, analysing, sharing and disseminating information. With the help of networking your computer is connected with remote computers for accessing the information. This web of computers has certain specific locations called websites which store information on specified subjects. This information can be accessed by any internet user through the website address. Alternately, one can also upload one's information on the web to make it available to any user. The user depending on her/his requirement then navigates through the web to access desired information.

The fast and relatively low-cost access is one of the major benefits of internet. People and students all over the world are getting an internet connection very easily. Communication and information are the two basic uses of the Internet. Information available on websites can be updated or modified at any time and for any number of times, which helps in learning and better understanding.

### **Online learning**

Another positive effect of Internet in education is the onset of distance education or online education (internet-based training (IBT) or web-based training (WBT)). With this facility, you can take up short-term courses with the course material available online, attend virtual classes, learn, and appear for exams. One of the benefits of online learning is that people from any part of the world can gain knowledge on different subjects, complete courses, etc.

### **School/ College Products**

Internet can be very useful for completing projects in schools and colleges. As the Internet is an ocean of information, covering nearly all subjects known to man, one can find information, research work, etc., required for one's projects. Going through the information on the internet is definitely faster than reading an entire book on the subject. Completing homework is also easier with the help of the Internet.

### **Affordable Knowledge**

Investing in research material may be tedious and unaffordable for some. But, now, thanks to the Internet, we have content websites, web encyclopedias, and dictionaries whenever we want them. Today, able as well as less-able students can benefit from the sea of knowledge on the Internet. University courses and learning is now easy for people belonging to all strata of the society with the help of online courses.

### **Easy Education System**

Not only gaining knowledge, but, every part of the education system is simplified because of the internet. You can now view your prospective educational institute, look up courses, enroll for online courses, take classes, research, see your results, and even look for job prospects on the Internet. Therefore, the scope of internet in education is very wide and equal to all.

### **MULTIMEDIA**

Arguably, it is believed that visual data has a greater impact on learning and memorizing than plain text. Therefore, images, graphics, animation, pictures, slides, documentaries, etc., have a greater appeal than a plain textbook. Using multimedia and Internet provides an opportunity for children to gain knowledge about a particular subject in depth. Students can now see actual photographs of rare bird species, or see animated graphics of a volcanic eruption to understand the concept in detail.

### **INTERACTIVE WHITE BOARD**

An interactive whiteboard (IWB) is a large interactive display that connects to a computer. The board is typically mounted to a wall or floor stand. They are used in a variety of settings, including classrooms at all levels of education, in training rooms for professional sports coaching, in broadcasting studios and others.

An interactive white board is an instructional tool that allows computer images to be displayed onto a board using a digital projector. The instructor can then manipulate the elements on the board by using his finger as a mouse, directly on the screen. They are a powerful tool in the classroom adding interactivity and collaboration, allowing the integration of media content into the

lecture and supporting collaborative learning. An interactive whiteboard can be a cost saver as this technology demonstrates how one computer can provide learning stimuli for a whole classroom.

## **COMMUNITY RESOURCES**

### **SCIENCE CENTRES**

Science centres are science museums that emphasize a hands-on approach, featuring interactive exhibits that encourage visitors to experiment and explore. The first science centre was Urania founded in Berlin in 1888. The Academy of Science of Saint Louis (founded in 1856) created the Saint Louis Museum of Science and Natural History in 1959 (Saint Louis Science Centre), but generally science centres are a product of the 1960s and later.

In India, the National Council of Science Museums runs science centres at several places including Delhi, Bhopal, Nagpur and Ranchi. There are few private Science Centres as well, noted among them are Birla Science Museum and The Science Garage in Hyderabad

### **SCIENCE EXHIBITION/ FAIR**

Science fair experiment is generally a competition where contestants present their science project, results in the form of a report, display board, and/or models that they have created. Science fairs allow students in elementary, middle and high schools to compete in science and/or technology activities. The main motive of a science fair is for students to answer a question or task, not from a textbook but found out themselves by conducting a range of experiments and ongoing research in the short amount of time allocated to them. In order that the questions or tasks spark a true interest in the student they should be able to have an interesting, eye catching project. Science fairs also provide a mechanism for students with intense interest in the sciences to be paired with mentors from nearby colleges and universities, so that they can access to instruction and equipment that the local schools cannot provide.

#### **Advantages of science fair**

The advantages of a science fair are

To develop scientific attitude and critical thinking among the students

To develop the spirit of cooperativeness

To develop the real application of scientific knowledge in a newer situation

To develop the power of reasoning

To improve creativity among students

To facilitate the students to update their knowledge in science

### **FIELD TRIP**

Teacher must explore opportunities for active engagement of the parent and the community in the teaching- learning process of physical science. Different members of the community also hold a large variety of valuable knowledge. Many of these members may be willing to share their knowledge and experience with the students. These members can be invited to school and learners can interact with them. Teacher should remain aware of the range of community, individuals and organisations that can be accessed to provide significant learning experiences to learners. Learners can visit their places of work also. The expertise of members varies from community to community.

In many cases learners can be taken to the community resources of learning. When organised from the point of view of enrichment of teaching-learning experiences, it is a field visit. This makes learning realistic, concrete and interesting. Learners get opportunity to discover the concept and their connection with their environment. They can use this opportunity to learn various skills in interacting with the physical world, materials, technology and other people. It helps students to create knowledge by figuring out the components of objects, events, people, and concept. Let us now see the various advantages of field visits in teaching-learning of science.

#### **Advantages of the field visits**

The field visit:

1. helps in providing first-hand experience to the students which is not possible within the four walls of the classroom;
2. enriches general knowledge of students. It supplements the classroom learning;
3. helps in broadening the outlook, deepens insight and widens vision of students;
4. gives new ideas and vision for taking up projects;

5. helps to deep enunderstanding of the concept sand brings clarity in the subject. It also
6. helps in concretizing the abstract ideas;
7. helps the students develop an inquiry attitude towards the environment;
8. develops skills in science processes likeo bservation, collection, classification and analysis of data;
9. Drings the awareness that science is all-around us and not just in books;
10. Relates the community to the learners, teachers and school and encourages sharing of responsibility of child's learning with the community;
11. Acknowledges the authenticity of community knowledge, etc.

### **QUALITIES OF A GOOD SCIENCE TEXTBOOK**

Text books are the most widely used of all instructional materials. Now a day's text book has become a course of study, a set of unit plans and a learning guide as well. A text book should really design for the pupils rather than the teacher. Text book should stimulate reflective thinking and cultivate in students the scientific attitude.

In the teaching-learning process, the text-book occupies an important place. There is a saying "As is the text-book, so is the teaching and learning". A good text-book can even replace class-room teaching. The science text-book should aim at aiding the pupils in the development of their personalities, in developing open mindedness, developing appreciation and understanding of nature and not merely stuffing their minds with facts.

Thurber and Collette suggested six criteria for choosing a good textbook. They are

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

7. Authorship

**I Content**

The content of text books for any one subject matter field is remarkable uniform about 85 percent of the content being common to all of them.

1. The content should be appropriate for the age level and experience backgrounds of the pupils
2. The concept should not be too complex for the maturity of the pupils
3. The content should be consistent with the pupil's needs and interests
4. The statements must be accurate

**II Organization**

1. The subject matter should cover the whole syllabus
2. Subject matter should be developed in psychological sequence
3. The text book has to be organized into units which are based on student interests and probability of use
4. Inductive approach is to be used whenever possible in introducing new topic
5. At the end of each units there should be assignments informing to the following
6. Application to life situations
7. Self- assessment test
8. Suggestions for further reading
9. Numerical questions if necessary
10. Assessment for practicing skills
11. The text book should be written in simple unambiguous scientific language. Prefer simple and compound sentence to complex sentences
12. It should contain a glossary of technical terms used in the books
13. It should suggest some good methods of learning's
14. Historical development of science should be attempted
15. Adequate provision should be made to correlate science with other subject and crafts.
16. It is better if the text book contains examples from the local environment

17. There should be a detailed table of contents and index text books
18. Controversial topics should be treated impartially
19. The social significance of science should be stressed
20. Headings and sub- headings should be in bold type
21. Important principles should be set in italics
22. Each text books should be accompanied by a laboratory manual and pupil's work book
23. It must be supplemented by a teacher's hand book

### **III. Literary style and Vocabulary of text book**

Literary style has much to do with the readability of the book. Although style is difficult to judge

1. Length of sentences
2. Directness of sentences
3. Number of ideas per seconds
4. Use of lead sentence or paragraphs
5. Presence or absence of irrelevant thoughts\continuity of thought

While evaluating a text book the teacher must decide whether or not the vocabulary is excessive or in appropriate text book should be easy to read

### **IV Illustrations**

1. The quality and the quantity of the illustrations should be considered.
2. Photographs should be clearly reproduced
3. Diagrams should be carefully made attractive
4. Colour in the illustrations add to eye appeal and when properly used has considerable teaching value
5. The recently introduced transparencies made on plastic sheets are excellent teaching aids but because of cost it can only be used in small quantities in any one book
6. Photograph should have relation with content in the text
7. Teaching aids
8. The table of content and index should be comprehensive

9. Glossary should be included
10. Activities should be given the end of a chapter
11. Activities should be closely related to content

### **Mechanical make- up and appearance**

1. Artistic cover
2. Durability for binding
3. Size of the book
4. Good quality of paper
5. Length of line and size- legible
6. Attractive over all experience
7. Cover design and colour should be appealing
8. Ample space to be left between lines to provide for ease in reading

## **VII. Authorship**

Only such persons who have experience of teaching the subject should be allowed to become authors of school science text books. Such authors can understand the actual learning's situations. Certain qualifications may also be prescribed for the authors. It will be better if some training is given to them

Text books are important tool in the hand of a teacher. It helps student to how and what they learn to achieve some definite goals. When we make a text we should give importance to its content organization literary style, vocabulary, mechanical makeup and authorship

## **QUALITIES OF A GOOD SCIENCE TEACHER**

Besides possessing the personal qualities, every science teacher should fulfil the following broad requirements.

1. Practical knowledge of child psychology and of the learning process.
2. Trained in the modern methods and techniques.
3. Basic academic requirements.

1. A science teacher must have practical knowledge of child psychology and of the process of learning. The science teacher should be able to cater to individual differences in the class. Knowledge of child psychology helps a teacher to guide the students according to their interests, capabilities and help in educational, vocational and personal problems. Besides these, a science teacher should be of a scientific temper, rational in approach to problems, free of bias and superstitions, innovative, inquisitive about the world around him. A Science teacher should regularly evaluate his teaching so that he can keep improving and also help him identify his weakness.

2. A science teacher must be trained in modern methods and techniques of science. New methods and techniques are being employed in the teaching of science. Science Clubs, improvisation of apparatus, programmed instruction, teaching machines and many other new concepts are coming in. It is, therefore, desirable that a science teacher is trained and well versed in:

(i) Development of aquaria, vivaria, terraria.

(ii) Knowledge of preserving specimens of plants and animals.

(iii) Techniques of evaluation.

(iv) Maintenance and use of science libraries.

(v) Lesson and unit planning.

(vi) The various teaching methods in use today.

3. The basic academic qualifications are laid down by the education department or the employer. In all the cases, the science teachers in high schools are at least B.Sc. and higher secondary schools M.Sc.

### **Advantages of Textbooks**

Text books are economical and relatively inexpensive.

They help individualized instruction.

They help to organize and provide unity for class instruction

They help students learn how to study, to read better, to weigh evidence and to solve problems

**Questions for Discussion and Reflection:**

1. Describe the Newspapers.
2. Explain Interactive Whiteboard.
3. Examine the Science centres.
4. Discuss about qualities of a Science Teacher.

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