Experimental Edition, for Limited Circulation only

CURRICULAR MATERIAL
FOR
DIPLOMA IN ELEMENTARY EDUCATION (D.El.Ed) COURSE
IN DIETs OF
ARUNACHAL PRADESH

Course Code: 18

PEDAGOGY OF SCIENCE AT UPPER PRIMARY LEVEL

STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
GOVT. OF ARUNACHAL PRADESH
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The curricular material has been developed keeping in view the learning needs of the D.El.Ed Course trainees as per the current PSTE curriculum. While developing the material authentic textual/reference materials from various sources have been referred. As far as possible the content of the materials have been presented in an objective manner. The ideas and opinions as presented in the content of the materials are entirely of the developer of the material.

FOREWORD

The Diploma in Elementary Education (D.El.Ed.) curriculum for 2 year PSTE course of the DIETs in Arunachal Pradesh was revised and updated as an exercise deemed necessary in the context of National Curriculum framework-2005 and enforcement of Right to Education (RTE) Act-2009. The curriculum was revised on the basis of recommendations of the National Council for Teacher Education, National Curriculum Framework for Teacher Education (NCFTE) and the guidelines of Bordia Committee Report entitled "Implementation of RTE, Act and Resultant Revamp of SSA" (2010). Since 2013-14 the revised D.El.Ed Curriculum is being implemented in all the eleven DIETs of the state. However, in view of change in the structure and content of the revised curriculum, there has arisen a pressing need for content specific and contextualized curricular materials which could be handy for both teacher educators and student teachers of the DIETs in the state. Further Justice Verma Commission Report on Teacher Education-2012, constituted by the Hon'ble Supreme Court of India observed," our prospective teachers are educated through substandard readymade materials available in the form of 'guides' which are conceptually confusing and regressive in perspectives". Hence, the commission strongly recommended for development of learner friendly curricular materials for different types of teacher education courses.

The D.El.Ed curricular material has been developed in workshop situation with participation of Resource Persons from Department of Education, Rajiv Gandhi University, Itanagar and faculty members of SCERT and DIETs of the state.

I am immensely grateful to the Joint Director, SCERT, Mr. Gania Leij for his guidance, Professor Jaydev Sahu, Dept. Of Education, Rajiv Gandhi University, Itanagar for his academic support, members of SCERT Academic Team, Assistant Directors, Shri G.C.Baral, Sri S.Pradhan and Sri V.R.Sharma for supervision and finalisation of curricular materials. I am specifically thankful to the author on **Pedagogy of Science at Upper Primary Level course code-18, Sri V.R.Sharma, Assistant Director SCERT, Itanagar** for his efforts in writing the texts of the course materials as per the need of the syllabus.

Lastly, it is hoped that the curricular materials will be highly useful as reference materials for the teacher educators and student teachers of the DIETs of the Arunachal Pradesh.

Moto Nyori,
Joint Director SCERT, Itanagar

ACKNOWLEDGEMENT

I am extremely glad to express my gratitude to Shri Gania Leij, Jt. Director, SCERT, Itanagar, for giving me the opportunity and moral support to develop this Curricular Material of the D.El.Ed Course.

I take this opportunity to express my gratitude to the Secretary (Education), the Directors of Elementary and Secondary Education, Govt. of Arunachal Pradesh for their kind guidance and resource support from time to time.

I am also thankful to Shri G.C.Baral, Asstt. Director (Academic), SCERT and Sri R.K.Sah, Sr. Lecturer DIET Naharlagun for his commendable effort, guidance and all necessary support in this endeavour.

I also take this opportunity to express my gratitude to all the learned faculty of SCERT for their suggestions and moral support in the completion of this work.

I shall be failing in my duty if I do not convey my indebtedness to all the fellow participants of the workshop and the members of the review team for their valued suggestions for bringing the material to its present shape.

V.R.Sharma

INTRODUCTION

Teaching of Science is an integral part of elementary school curriculum. The Science perspectives and knowledge are indispensable to building the knowledge base for a just and peaceful society. It is of crucial importance because it helps the learners to grow into well-informed and responsible citizens with necessary attributes and skills for being able to participate and contribute effectively in the process of development and nation building.

It is necessary to promote creativity, aesthetic values and understanding among students on various social issues, and develop critical perspectives in them to draw relationships between past and present, understand changes taking place in the society, and actively engage in various social activities. Both NCF 2005 and NCFTE 2009 recommend that children's life in school must be linked to their life outside the school. To make it operational and child friendly, social science teaching needs to be revitalised for helping the learners to acquire knowledge and skills in an interactive environment.

Keeping the above aspects in view, the course "Pedagogy of Science" is divided into seven units.

Unit – 1 deals with the "**Understanding Science and Children's idea in Science**" by discussing nature, scope, objectives, scientific attitude, competencies to be developed and Children's idea in Science.

Unit – 2 "**Revisiting School Science Concepts (in brief)**" focuses on the world of Living, Diversity, Cell, Life Processes, Heredity & Evolution, Matter- Nature, Basic units of Matter and their structure, Natural phenomena- Force and Motion, Gravitation Magnetism and Electricity,Natural Resources- air, water, soil and their conservation and sources of energy.

Unit – 3**: "Class room Transaction**" basically discusses the Lecture cum demonstration Method, Scientific method, Activity method, Problem solving method and Process approach

Unit – 4, "**Assessment**" deals with the various Assessment-Formative Assessment, Summative Assessment, Continuous and Comprehensive Evaluation and Constructing /setting of questions and question paper, objective wise and question type wise. It discusses how a teacher should plan assessment and why it is necessary to construct a question paper.

Unit – 5, "**Use of Teaching – Learning Resources**"- It deals with various types of resources a teacher use as-Integrated Science Kit, Audio-Visual aids, Secondary sources of Information and useful local resources, Multimedia Package and Community/Environmental Resources for effective teaching and learning.

Unit-6, "**Innovative Experiences"-** It discusses Science Museum, Science Exhibition, Field Trips, Namdapha Tiger Project and D. Ering Wild Life Sanctuary for practices as innovative experiences.

Unit-7, "**Science for All"-** It deals with Issue of Gender, Language, Culture and Equity in science class, Introduction to science and society interface

It is hoped that student-teachers of DIETs would find the material useful in construction of knowledge and understanding of the contents.

This curricular material is exclusively for the use of only student-teachers of DIETs of Arunachal Pradesh. It is not for sale and marketing.

Any comment and suggestions is most welcome for further improvement

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UNIT -1
Understanding Science and Children's idea in Science

1: Understanding Science and Children's idea in Science

1.6 Nature of Science – Definition, Need and Scope.
1.7 Objectives of teaching Science at Upper Primary Level.
1.8 Scientific Attitude.
1.9 Competencies to be developed through teaching of science.
1.10 Children's idea in Science – Probing, Documenting and analyzing in relation to science concept.

Introduction

Science has played a tremendous role in our lives and changes our entire existence in respect of health, communication, transportation and power. To visualize what science has done for man, it is simply necessary to sit in a modern room and look around. There you will find nothing, which the hand of science has leftuntouched. Modern world has been created by science and is being maintained by science.Science Education programmes will be designed to discover the relationship of Science with health, agriculture, industry and other aspects of daily life. (NPE- 1986)

1.1 Nature of Science

Science is universal and so can be it benefits. Its material benefits are immense and far-reaching industrialization of agriculture and release of nuclear energy, to mention two examples but even more profound is to contribution to culture. (Kothari commission)

Science is a dynamic, expanding body of knowledge, which covers all new domains of experience. Children learn through observation, looking for regularities and pattern, making their own logical or illogical hypothesis, verification or rejection of ideas through observation and experiments, thus arriving at conclusions after going through the process of similar to the process of science. It is multi-dimension. It is application oriented. It is also based on sound theoretical, philosophical and sociological foundations.

(i) Science as a body of knowledge

Generally, we take science as a body of knowledge, which includes facts, definitions, concepts, principles, theories, laws etc. This is one aspect of the nature of science. Science can be characterized as a body of knowledge as scientific knowledge. Is it high time that teachers should come up with the strategy to provide students with real experience of science? Teachers should provide them with an opportunity to feel, experience, explore and analyse. They will themselves generalize and develop their own body of knowledge.

(ii) Science as a process of Enquiry:

Science is considered as a process of enquiry. There are six science process skills that are required for scientific explanation. These skills are: Observation, Inferences, Classification, Measurement and Prediction. The process skills are important for scientific investigation and in everyday life. In a science classroom the teacher expected to provide opportunities to the children to participate in some investigative activities, which will help them to understand the nature of scientific inquiry. Such practices will encourage the children to think about the relationship between facts, options, processes and incidents.

(iii) Science as a way of thinking

Famous Scientist Carl Sagon says that "Science is more than a body of knowledge. It is a way of thinking". The success of a science teacher will depend upon the degree of scientific thinking and scientific attitude developed among the children. Scientific way of thinking can be promoted by making our children able to explore, analyse, evaluate and work in a scientific manner. Scientific way of thinking will make our children to collect evidence that can be physically observed and measured. Scientific way of thinking also allows starting questioning why and how things are as they are. Science as a way of thinking involves scientific temper, scientific enquiry and a sense of humanity.

What is Science?

Science has been derived from Latin word "scientia", which means knowledge. In the literal sense, science means the persuit of knowledge, but it has wider connotation for our purpose, and can be said to mean knowledge of nature in the widest possible form. This includes nature study, physics, astronomy, meteorology and much more.

Definition

Science has been defined in different fashions by different persons.

"Science is a systematized body of knowledge".

"Science is a heap of Truth"

According to B.F Skinner:

Science is first of all a set of attitudes. It is disposition to deal with facts rather than with what someone has said about them.

According to Albert Einstein:

Science Searches for relations which are thought to exist independently of searching individual.

According to John Woodburn & E.O. Osborn;

Science is that human endeavour seeks to describe with ever-increasing accuracy, the events and circumstances that occur or exits within our natural environment.

The report on policies for science Education revels:

Science is a cumulative and endless series of empirical observations, which result in the formation of concepts and theories with both concepts and theories being subject to modification in the light of further empirical observation. Science is both a body of knowledge and the process of acquiring and refining knowledge.

Need and Scope of Science

One of the important aims of science education is to help students to become responsible democratic citizens of the country. Science enhances the quality of our life and it is visible in all work of life. Since science has been developed by people who are part of a group, it is expected that their social, psychological, political, economic perceptions could change the course of development of science.

Science education need or aims to make students develop scientific attitude, so that in later life they can help the society make rational choices when confronted with various possibilities and challenges. Science is knowledge and knowledge is power. With power comes wisdom and liberation. Science, tempered with wisdom, wisdom is the surest and the only way to human welfare.

Science and Health

Science has proved to be a saviour of mankind. Science has served human kind to a great extent for making its member healthy and free from diseases. Science has also generated preventive measures so that the people do not fall prey to disease like malaria, tuberculosis, leprosy; radiotherapy has proved to be a potential therapy for removing tumor.

Science and Agriculture

The impact of science through agriculture is vivid and clears to everyone, since the Green Revolution brought about the mechanization of agriculture is before our eyes. The use of chemical, manures, seeds and machines is great born of science. Science has revolutionized agriculture.

Science and Industry

The discoveries of science have brought about drastic changes in the ways and process of industry. In industrialized advance country men and women merely work on machines and in turn, the machine do all the work for them. The textile, printing, manufacture of electrical appliances, radio, television, drugs, agricultural implements, ornaments industry have all been revolutionized by the magic wind of science.

Science for Peace

Science has brought about an overall betterment of life of human kinds. The scientific knowledge is universal and it has no boundaries. If peace does not prevail in the society, there must be other which has to be controlled. One of the indicators of peace is absence of violence. Feeling of peace has to be brought about at all levels i.e. individual, society and state.

Science and Democracy

Many qualities of a good citizen for democracy have been taught to us by science. The capacity for clear thinking and receptivity to new ideas, intellectual integrity, and

Service to humankind respect for others point of view, are the lessons of science. Diversity should be valued in school and each individual should be respected. Researchers have shown that the boys and girls perform equally well in science learning. Therefore, no gender bias should be practiced in the classroom. All attempts should be made to motivate the parents to encourage their children to opt for science. Science teacher should develop in all students including those with special educational needs the ability to analyse the options available, and to facilitate the possibility of making informed decisions.

1.2 Objectives of Teaching Science at Upper Primary Stage

National Policy on Education (1986) and objective of science teaching at upper primary stage

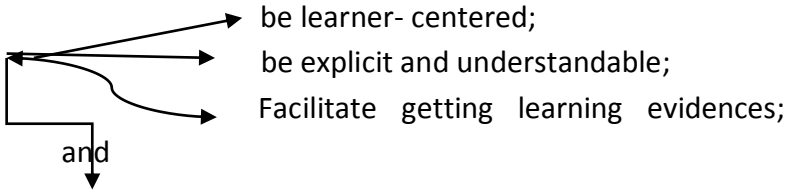
National Policy on Education (1986) has laid great stress on the development of scientific temper among the students of all the classes. Specifically, it is stated that science education will be strengthened to develop in the children the following:

1. Spirit of Inquiry
2. Creativity
3. Objectivity
4. The courage to question
5. Aesthetic Sensibility
6. Problems solving and decision making skills
7. Relationship of science with health, agriculture, industry and other aspects of daily life

Meaning of Learning Objectives

Education is a process of bringing about changes in an individual in a desired direction. It is a process of helping a child to develop his potentialities to the maximum and to bring out the best from within the child. Identifying certain perceptible changes in terms of remembering, understanding, applying and analyzing etc. that needs to be brought out in the learner before transecting a particular topic/unit in the class helps a teacher to discharge this responsibility. These desirable strands of remembering, understanding, applying and analyzing for a particular topic/unit in terms of perceived learning are broadly known as teaching- learning objective. Learning objectives are the statements in specific and observable term that tells what the learner is expected to achieve as a result of engaging in teaching-learning process. Learning objectives should be aligned with three major components of teaching-learning process: the objectives, teaching –learning activities and assessment. Whether the objectives are realized or not is known by assessment of learners. Accordingly, teaching- learning activities are modified to realise the objectives. Thus, three components are consistent with each other. If three components are congruent, teaching – learning is meaningful.

Learning objectives should reflect what the learners will do rather than what the teachers will do:



Objectives of Teaching Science at Upper Primary Level (NCF-2005)

i) At the Upper Primary stage, the child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and modules.

ii) Students should continue to learn more about the environment and health, including reproductive and sexual health trough activities and surveys

iii) Scientific concepts are to be arrived at mainly from activities and experiments. Science concepts at this stage are not to be regarded as diluted versions of secondary school science.

iv) Group activities, discussions with peers and teachers, surveys, organisation of data and their display through exhibitions etc in schools and neighborhood should be important components of pedagogy.

1.3 Scientific Attitude

Scientific attitude is a composite of a number of mental processes or tendencies to react consistently in certain ways to a novel or problematic situation. These include accuracy. Intellectual honesty, open mindedness, respect for evidences, suspended judgment, critical thinking, perseverance and looking at true cause and effect relationship.

Scientific attitude can be defined as open-mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge and expectations that the situation of the problem will come through the use of verified knowledge.

On acquiring scientific attitude, pupils will show the following behaviours.

- They will respect the teacher
- They will have a keen desire to know how and why of any event or phenomenon
- They will record, report and interpret their observation honestly.
- They will not accept or reject anything without valid reasons.
- They are unbiased in their approach to problems.
- They are willing to consider new ideas and discoveries.
- They will admit their mistakes unhesitatingly

- They will show a spirit of team work

Scientific attitude are certain mindset in a particular direction. So by adopting verified techniques, such mindset may be created. Scientific attitude can be developed and nurtured during the teaching learning process among students by inculcating the following:

- **Respect for evidence:**
  For developing skills of collecting evidences for verifying and testing ideas, the learners must be trained to confront ideas with evidences. If ideas conflict with evidences, student should be encouraged to check again and collect more evidences for reading a conclusion. They should be flexible and willing to change their ideas where there is convincing evidence to the country.

- **Open- mindedness**:
  For true leadership in science it is important not to have a set mind with preconceived notions. An open minded person evaluated all reasonable inferences, remains open to alternative interpretations, accepts new priorities in response to a re-evaluation of the evidence or reassessment of existing ideas and does not reject unpopular views outrightly. He structures and restructures his ideas as he progress in leadership.
- **Truthfulness in reporting observations:**
  It is important to report the authentic observations in the experiments to arrive at the conclusions. In scientific procedure observations in an experiment are repeated and verified before arriving at conclusion. Teachers should encourage honestly in reporting the result of the experiments among students.
- **Critical thinking**:
  Critical thinking increases science learning potentials. It requires deliberate review of the way in which activities are carried out, the ideas immerges and the way there can be improved. It is the ability to analyse information and experiences in an objective manner.
- **Logical thinking:**
  The process of linkage of the past experience in terms of cause and effect relationship on the basis of set rules i.e. thinking with reasoning is known logical thinking. The refinement in logical thinking can be brought in, by taking observations, quantifying the observations to increase the resolution of our observations and organising the information gathered from observations.
- **Scepticism:**
  It is questioning the accepted beliefs, ideas or facts in the society on the basis of scientific investigation. For instance, superstitions among the people follow due to fear and mythical explanations of such events. Science teaching- learning can help the students in questioning such beliefs, myths and superstitions should be discarded by making and evaluating judgment on the basis of evidences.

- **Objectivity:**

  Objectivity is looking at the things without any pre-conceived notions, bias, prejudices or discrimination. It can be developed by understanding the importance and use of evidence. Learners should be open to others ideas and should respect others point of view, but they should accept the ideas only after testing and verification or with sufficient evidences.

- **Perseverance:**

  It is expected that the students are given opportunities to work repeatedly to arrive at conclusion which is scientific valid. The continual steady effort made to fulfil some aim is called perseverance. The teacher educators may elaborate on this aspect through narration of the efforts of the scientists such as Marie Curie, Thomas Alva Edison etc. Edison tried thousands of materials for the filament before he hit upon the right one that made the bulb long lasting and practical.

1.4 Competencies to be developed through teaching Science

At Upper Primary Level (VI-VIII) certain competencies are to be developed in children when teaching science. National Policy on Education-1986 (POA)-92 has two recommendations on science education:

1. Science education will be strengthened so as to develop in child well defined abilities and values such as the spirit of inquiry, objectivity ,the courage to questions and on aesthetic sensibility
2. Science education programmes will be designed to enable the teacher to acquire problem solving and decision –making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. Every effort will be made to extend science education to the vast members who have remained the pale of formal education.

   The development of competencies pointed out here given below depends on how science teachers teach science to the children

- Ability to apply the knowledge of science in everyday life.
- Ability to investigate new knowledge in the field of science
- Ability to reduce all sorts of prejudices based on sex, caste, religion, language or region
- Ability to use and maintain science equipments
- Ability to build proper base for professional and higher science courses.

1.5 Children's Idea in Science -Probing, Documenting and Analysing in relation to Science concept.

Science is nothing but all that happens around us. Aristotle said, "All men by nature desire to know". Children learn more due to their natural curiosity. Children came across many questions out of curiosity. Curiosity leads to inculcation of learning to learn aspect of education. Curiosity can be generated in the learners by exposing them to science centres, science projects, scientific literature, to participate in science Quiz, Exhibition and Science activities. In children curiosity gets aroused as a result of doubt, perplexity, contradiction,

cognitive conflict, ambiguity, lack of clarity etc. When children ask questions to a teacher, she should not give him/her direct answer but should not try to reply her/his answer about their question. Teacher should give some hints or some situations which is similar to that particular question.

Science is actually an integral part of our daily life. Children see many things in their surroundings and ask different types of questions. These questions and inquiry approach help them to learn. Their inquiring and imaginative minds are always working and they react in many different ways to natural phenomenon. As a teacher educators or teachers, just try to correlate the dynamism of children's ideas with the nature of science.

Encourage learners to share their experiences to clear their doubts and share their existing ideas with the class. There is a lot of science in their experience. Those experiences and ideas can be used as a stepping stone to learning scientific concepts. When learners are encouraged to share and seek out knowledge from sources other than the text books, in their own experiences, in the experiences of their press, homes and surroundings, outside the school, in the laboratory and library, they realizes that knowledge can be sought out, authenticated and constructed. Knowledge is always constructed. We need to view the learners as constructing knowledge all the time. When learners undergo an experience, they try to make its connection with the existing ideas. If idea matches to their previous knowledge than they get it deeply embedded.

Children keep on trying to make sense of their surroundings all the time when they do so using their thinking and reasoning, it is not natural that they scientific view of that they end up forming same ideas that do not match with the scientific view of things. Many of the conceptions which children develop about natural phenomenon desire from their sensory experiences. These ideas may make sense of the children themselves. We call these as "Misconceptions", "Alternative conceptions", "Intuitive ideas", "children's science" etc. it is important that the teacher takes these ideas seriously. Therefore, in helping develop scientific concepts, it is important to start from children's ideas and help them, through scientific absent observations, reasoning and testing, to change them or replace them with ideas which fit the evidence better than their own reasoning .It is not easy task as is demonstrated by classroom researches throughout the world.

Science teacher must be aware about the certain characteristics of children's idea to facilitate them, the concept development among children these are;

Children's ideas are personal: Children construct their own meanings and these ideas may be shared children individual ideas may seen incoherent at times, te same child may have different conceptions of a particular type of phenomenon sometimes using different arrangements leading to opposite predictions.

Children's idea are stable and often resist change: it is found very often that even after being taught, children do not modify their existing ideas in spite of attempts were made by their teachers to challenge them by offering counter evidences.

Teaching and learning based on concern for constructing ideas requires that children not

only ‘do’ practical work, but also think about how their investigations relate to the ideas, they are developing. It is important for children to know how scientific ideas are developed and evaluated, so that they can—

- appreciate the significance of sharing and revising the personal ideas.
- appreciate the ‘provisional ‘ nature of science ideas, and
- gain confidence in trying and testing ideas

  The strategies, which can be helpful in promoting conceptual leadership in science classes, consider children already possessing a prior knowledge about the science concepts. These are

  (i) Providing opportunities for pupils to make their own ideas explicit.

  (ii) Introduce discrepant events, sometimes observing on unexpected event also stimulate children to think about the situation this may even lead them to have dissatisfaction with their prior knowledge and create a conceptual conflicts thus creating a need for change in conceptual understanding.

  (iii) Questioning **:** it can help pupils to appreciate the possible lack of consistency in their own thinking and to reconstruct their ideas in more coherent ways

  (iv) Encourage the generations of a range of conceptual schemes: this can be done through the use of small group discussions brain storming in class as a whole.

  (v) Practice in using ideas in range of situations: provide them with an opportunity to check out the range and limits of applicability of their ideas learnt in a given situation.

UNIT – 2

REVISITING SCHOOL SCIENCE CONCEPTS (in brief)

Course Outline

2.5 The world of Living, Diversity, Cell, Life Processes, Heredity & Evolution.

2.6 Matter- Nature, Basic units of Matter and their structure.

2.7 Natural phenomena- Force and Motion, Gravitation Magnetism and Electricity.

2.8 Natural Resources- air, water, soil and their conservation and sources of energy.

Introduction

We see a variety of living organisms in our surrounding some of them are Plants – herbs, shrubs and trees. Some of them are animals as goat, pig, sparrow, honeybee, butterfly, yak, mosquitoes' fish etc. Each organism is different from all others to a lesser or greater extent. Some are microscopic bacteria of a few micro-meters in size. While other are blue whale and real wood tree of California of approximate size of 30 meters and 100 meters respectively. Some pine trees live for thousands of years, while insects like mosquitoes die within a few days. Life also ranges from colourless or even transparent worms to brightly coloured birds and flowers. This wildering variety of life around us has evolved on the earth over millions of years.

2.1 Diversity in Living Organism

Diversity is "a single statistics in which the number of species and evenness are compounded". At its simplest level, diversity can be defined as the number of species found in community, a measure known as species richness. Attempts at classifying living things into groups have been made since time immemorial. Greek thinker Aristotle classified animals according to whether they lived on land, in water or in the air. Now-a-days we look at many inter- related characteristics starting from the nature to cell in order to classify all living organisms.

Biologists such as Ernst Haeckel (1894), Robert Whittaker (1959) and Carl Woese (1977) have tried to classify all living organisms into broad categories, called kingdoms. The classification Whittaker proposed has five kingdoms: Monera, Protista, Fungi, Plantae and Animalia and is widely used. These groups are formed on the basis of their cell structure, mode and source of nutrition and body organization.

Five kingdoms of Whittaker are as follows:-

1. **Monera:-**Bateria, blue green algae or cynobacteria and mycoplasma.
2. **Protista** :- Unicellular eukaryotic organisms, autotrophic and heterotrophic nutrition. Unicellular algae, diatoms and protozoa- amoeba, paramecium and euglena.

3. **Fungi**:- Heterotrophic eukaryotic organisms.
   - Use decaying organic material as food and called Saprophytes.
   - Aspergillus, Penicellium, agricus etc.
4. **Plantae**:- Mullticellular, Eukaryotes with cell wall and autotrophs. All plants are included in this group. Plants further classified into various subgroups.
   a) Thallophyta: - Alagae, predominatly aquatic Spirogyra, Ulothrix, Cladophora, Chara etc.
   b) Brayophyta:- Amphibians plants, No specialized tissue to conduct water and other substances fromone part to other. Riccia, Marchantia and Moss (Funaria).
   c) Pteridophyta: - Body Differentiated root, stem and leaves and specialised tissues for conducting water and other substances. Marsilea and fern.
   d) Gymnosperms: - Naked Seed, Perennial, evergreen and woody.Pines and Deodar.
   e) Angiosperms:- Covered Seeds (Fruits),Cotyledons (Predesigned plants in seed)
      - Monocotyledones or monocot- Wheat, Paphiopedilum.
      - Dicotyledones or Dicot- Ipomia, Gram Bean etc.
5. **Anemalia:-**Eukaryotic, multicellular and heterotrophic lack of cell wall. Animals are further classified into subgroups.
   (i) **Porifera –** Pores (holes) bearing animals, non motile(sessile), body is covered with a hard outside layer called Skelton. Sponges- Euplectela. Spongilla Sycon.
   (ii) **Coelenterate** (Cnidarians) – Aquatic, body made up of two layers- Hydra, obelia, Jellyfish and Sea anemone.
   (iii) **Platyhelminthes:-** Bilateral symmetrical, three layered body wall (Triploblastic),no true coelom, they are called flat worms. They are free living or parasitic. Planaria, Liver Flukes.
   (iv) **Nematoda:-**Bileterlty symmetrical, triploblastic, Pseudo- coelomate, Example – Filarialworm (Elephantiasis), roundworm,Ascaris etc.
   (v) **Annelida:-**They are bilaterally symmetrical and triploblastic body is metamerically segmented. They are bisexual or hermaphrodite. Example – Earth worm and Leech.
   (vi) **Arthropoda:-** This is probably the largest group of Animals. They have open circulatory system. They have joint legs. Example- Prawn, butterflies, houseflies, scorpions and crabs etc.
   (vii) **Mollusca:-** Animals are bilaterally symmetrical. They have foot which is used for moving around. Example Snails, Unio, Octopus etc.
   (viii) **Echinodermata:-** They are spiny skinned animals. They are allmarine. They have peculiar water driven tube system that they use for moving arounf. Example Starfish and Sea Urchins.
   (ix) **Protochordata:-** They have notochord at least at same stages during their lives. They are marine. Example Belanoglossus, Herdmania and Amphioxus.
   (x) **Vertebrata:-** These Animals have a true vertical column and internal skelton. They are bilaterally symmetrical, triploblastic coelomic and segmented, with

complex differentiation of body tissues and organs. They are grouped into five classes.

a) **Pisces:-** These are fish. They are aquatic, skin covered with scales. They use gills for extract oxygen from water. They are cold blooded and heart is two chambered. They lay eggs Example:-Scoliodon, Labeo (Rohu), Tuna, Torpedo etc.
b) **Amphibia:-**They live on land and water both. They have three chambered heart, Respiration through gills or lungs. They lay eggs. Example- Frog, Toad and Salamanders.
c) **Reptilia:-** These animals are terrestrial or arborial, cold blooded and breathe through lungs. Most of them have three chambered heart but crocodile has four chambered heart. They are eggs laying animals. They lay their eggs on land. Example:- Snakes- Turtles, Lizard and Crocodiles.
d) **Aves:-** Aves are warm blooded animals and have a four chambered heart. They lay eggs. There are two forelimbs which are mollified for flight. They breathe by lungs. All birds are the example of Aves i.e. Sparrow, Pigeon, Peacock, Emu, Crow etc.
e) **Mammalia**- These are warm 'blooded animals with four chambered hearts. They have mammary glands for the production of milk to nourish their young ones. Their skin has hairs as well as sweat and oil glands. A few mammals like platypus and Echidna lay eggs. Example- Rat, Cat, Human, Bat, Whale, Kangaroos etc.

Cell

Cells were first discovered by Robert Hooke in 1665. He observed the cells in a cork slice with the help of a primitive microscope. Cell is the structural and functional unit of life. A single cell may constitute a whole organism as in Amoeba, Chlamydomanas, Paramecium and bacteria. These organisms are called Unicellular. Some organisms whose body consists of many cells are called Multicellular. These are all 'plants and animals which we see in our surrounding.

Each living cell has the capacity to perform certain basic functions that are characteristic of all living forms. Infect, each cell has got certain specific components within it known as cell organelles. Each kind of cell organelle performs a special function, such as making new material in the cell, clearing up the waste material in the cell and so on. These organelles together constitute the basic unit called the Cell.

1. **Plasma Membrane or Cell Membrane:-** This is the outer most covering of the cell that separates the contents of the cell from its external environment. The plasma membrane allows the entry and exists of same materials in and out of the cell. The cell membrane therefore, is called a selectively permeable in membrane.
2. **Cell Wall: -**Plant cells; in addition to the plasma membrane have another rigid outer covering called the cell well. The cell wall lies outer side of the plasma membrane. The plants cell wall is mainly composed of cellulose. It is a semi rigid, external and non- living covering of the cell.

3. **Nucleus:-** The nucleus is a centrally located and spherical cellular component which controls all the vital activities of the cytoplasm and carries the hereditary material the DNA in it. The nucleus consists of three structures (i) Nuclear membranes (ii) Nucleoplasma (iii) Chromosomes (iv) Nucleolus.

   The nucleus plays a central role in cellular reproduction, the process by which a single cell divided and forms two new cells. The organisms, whose cells lack a nuclear membrane are called Prokaryotes (Pro= Primitive, Karyote or Karyon= nucleus. Organisms with cells having a nuclear membrane are called eukaryotes. Prokaryotes also lack most of the other cytoplasmic organelles present in eukaryotic cells.
4. **Cytoplasm:-** The cytoplasm is the fluid content inside the plasma membrane. It also contains many specialized Cell organelles.
5. **Endoplasmic Reticulum:-** The Cytoplasmic matrix is transferred by a vast reticulum or network of inter connecting tubules and vesicles which is known as endoplasmic reticulum. The membranes of endoplasmic reticulum may be either smooth when they donot have attached ribosome or rough when they have attached ribosome with them. The ER forms the ultra- structural skeletal frame work of the cytoplasmic matrix and it provides mechanical support to it. It also acts as an intercellular circulatory system and it circulates various substances into and out of the cells by the membrane flow mechanism. ER also acts as a storage and synthetic organ.
6. **Golgi complex:-** In cytoplasmic matrix, a stack of flattened, membrane bounded, parallel arranged organelles occur in the association of ER and Known as Golgi complex. Each Golgi complex is composed of many lamellae, tubules, vesicles and vacuoles. The function of the Golgi complex is storage of proteins and enzymes which are secreted by ribosome's and transported by Endoplasmic Reticulum to them.
7. **Mitochondria:-** In the cytoplasm of most cell occur many large sized, rounded or rod like structures known as mitochondria. It is double membrane body. The functions of mitochondria are respiration, oxidation of food and metabolism. It is called power house of cell.
8. **Ribosomes:-** Many minute, spherical structure known as ribosomes. They are remain attached with the membrane of endoplasmic reticulum and forms granular or rough type of ER. It consists of mainly the Ribonucleic Acid (RNA) and proteins. Each ribosome is composed of two units. Ribosomes also occur freely in the cytoplasm. They are the sites of protein synthesis.
9. **Lysosomes:-**The cytoplasm of animal cells contains many tiny, spheroid or irregular shaped, membrane bounded vesicles known as lysosomes. They contain many digestive enzymes. They are called suicidal bag of cells.
10. **Plastids:-** Plastids are present only in plant cells. There are two types of Plastids- Chromoplast (coloured Plastids) and Leucoplasts (White or colour less plastids) Plastids containing the pigment chlorophyll are known as Chloroplasts. It is important for Photosynthesis in Plant. Leucoplasts are primarily organelles in which materials such as starch, oils, proteins granules are stored.

11. **Vacuoles:-** Vacuoles are storage sacs for solid or liquids . Vacuoles are small sized in animal cells while plant cells have very large vacuoles. The central vacuole of same plants cell may occupy 50-90%; of the cell volume. Many substances of importance in the life of the plant cell are stored vacuoles. These include amino-acid and some proteins. In single celled organism like amoeba, the food, vacuole contains the food items that the amoeba has consumed.

Each cell thus acquires its structure and ability to function because of the organization of its membrane and organelles in specific ways. The cell thus has a basic structural organization. This helps the cells to perform functions like respiration, nutrition and forming proteins. Thus, the cell is the fundamental structural unit of living organisms. It is also the basic functional unit of life.

Life Processes

Various functions carried out by living beings which are necessary to maintain and continue life are called life processes. There, are several things all living beings to do and an organism is only alive if it does all life processes. Major of these are movement, respiration, sensitivity, growth, reproduction, excretion and nutrition and transportation.

Movement is a very common life processes. Animal move from one place to another to find shelter, to escape from predators and other dangers, and find food and mating. Plants still or move to face the sun.

Nutrition:- All organism take food in order to get energy to perform various activities/ tasks and body growth. Green plants prepare their food with the help of CO_2, water and sunlight. The process of making food by plants is called **Photosynthesis.** Green plants are called autographs. Green plants are also called producers because they produce food. Animals take their food from green plants and animals. They are called heterotrophs. The process of taking and consumption food is called nutrition, animals take food inside mouth. There are five processes of taking and consumption food in animals (human) these are:-

(i) Ingestion (ii) Digestion (iii) Absorption (iv) Assimilation and (v) Egestion

We take food to provide energy for daily body activities. We chew food with teeth and then it goes to food pipe than it goes to stomach and intestine and finally undigested food egested out of the body through anus. Alimentary canal begins at mouth and end at anus. Large food particle as bread, rice are made of carbohydrates, the pulses, egg and meat or fish contain proteins and ghee or oil are fat. As such these cannot be absorbed and used in the body, only small molecules such as water, minerals and vitamins can be absorbed in intestine. The large food molecules must therefore be broken down into smaller ones before they can be absorbed into blood.

The process of breaking large food molecules to smaller ones is called digestion. It is done in mouth, stomach and intestine. The digested food is absorbed in intestine. Proteins

are digested in stomach and intestine. Carbohydrates are digested in mouth and stomach. The glucose, amino-acids and fatty acids finally absorbed into blood in intestine. The blood carries these digested molecules to cells and they are assimilated to provide energy and build the body. Undigested food is egested outside the body through anus. Some parasites do not have organs for digestion as they use digested food from the host body.

Respiration:- Respiration happens in all living beings. Respiration is the process of release of energy from glucose and other organic chemicals in cells. The food taken into the body is burnt in cells using oxygen and release energy and produces CO2. In the cell, by using oxygen the food (glucose) is broken down into carbon dioxide and water. In most of the living beings, break down of glucose occurs with the use of oxygen and this is called aerobic respiration. The process of respiration takes place in cells hence it is called cellular respiration. The respiration takes place in absence of oxygen is called anaerobic respiration. In human body the main respiration organs are- nostrils, wind pipe (trachea), lungs. When we breathe, the air (oxygen) rushes from nostrils to trachea and then two bronchi to alveoli in lungs. Alveoli are covered with blood capillaries. Oxygen diffuses into blood while carbon dioxide diffuses out from the blood in alveoli. Surface area of all the alveoli in both lungs is about 70m2 (almost equal to the area of tennis court) this enormous Surface area helps in diffusion between air and blood in lungs.

When we run vary fast, our muscles use lot of energy and need more oxygen. Due to lack of oxygen supply under such a situation, anaerobic respiration occurs in skeletal muscles which produce lactic acid instead of carbon dioxide. When lactic acid accumulates, fatigue sets in and we have to stop running. We get rid of lactic acid by rapid breathed after we stop running. Now, with extra oxygen breathed in, lactic acid breaks down to, give carbon dioxide and water.

The air around us is not always clean as we would like it to be. Air is polluted due to automobile exhausts and smoke of factories. Breathing can be dangerous in area with air pollution. Pollution of air leads to bronchitis (inflammation of bronchi) and emphysema (Mucus accumulation in air passages) which causes people suffer from respiratory diseases.

Transportation

Transportation of food, water and oxygen is an essential process in all living organisms. In every animals and plants food, water and oxygen is transported to the cell for release of energy and body building. Processes of transportation are different in animals and plants. In human circulatory system consists of blood vessels, capillaries and heart.

Blood is fluid tissue in human body. It has four important components. They are- plasma, red blood corpuscles (cells) (RBCs) white blood corpuscles (WBCs) and platelets.

Plasmas is non-living part of blood, it carries the glucose, salt, vitamins etc. the Red Blood cells contain hemoglobin and transports oxygen from lungs to cells and carbon

dioxide from cells to lungs. The white blood cells help in killing the foreign germs which enter our body. It protects our body from diseases. The platelets help in clotting of blood during injury.

There are two types of blood vessels in our circulatory system. Arteries are the blood vessels which transport blood from heart to different parts of the body. Arteries carry oxygenated body. Veins are blood vessels which carries blood different body parts to heart. They carry de-oxygenated blood. Capillaries are the fine one cell thick pipes where exchanges of materials take place. They deliver oxygen, food and other substances to body tissue and collect carbon dioxide and other waste materials from them. Heart is a pumping organ. Human heart is four chambered left side of the heart pumps blood to all body parts. This is pure blood. The right side of heart receives blood from different parts of body. This is deoxygenated blood. The right side of heart pumps the blood to lungs for oxygen uptake. Heart pumps the blood received from lungs to left atrium then left ventricle to dorsal aorta to different parts of blood. So the left side of body pumps oxygenated blood. The right atrium receives deoxygenated blood from different body parts than blood pushed into right ventricle. From there blood pushes to both lungs for oxygen uptake. In this way heart pumps the blood to the body. Teacher can explain basic structure and functioning of heart with the help of model and animation video.

Excretory System

The process of removal of waste materials which are formed by metabolic activities is called excretion and the system through which it is done known as the excretory system. All the day along, our body produces waste substances such carbon dioxide and urea. Lungs remove carbon dioxide while kidney removes urea. A pair of kidneys is present towards the back of our body just above the waist. Urea is a waste produced by liver. Kidneys remove urea and other waste from the blood and excrete it in liquid called urine. Urine is an excretory product of the body which contains many toxic substances like uric acid, urea and yellow pigments generated in liver after the decomposition of RBCs. If kidneys stop functioning, urine formation stops and patients have to go for dialysis.

Reproduction

Reproduction is the process of production of new offspring from the parents. Every living organism undergoes a kind of reproduction. There are two type of reproduction:-

Asexual reproduction:- The reproduction in which only one parent produces new individual is called Asexual reproduction. Plants and microorganism produce new individuals by asexual reproduction. In plants, the major forms of asexual reproduction are vegetative propagation, budding, fragmentation and spore formation.

Vegetative propagation is a type of asexual reproduction in which new plants are

produced from the roots stems, leaves, and buds, example rose, potato, ginger, bryophyllum.

Budding- In same micro- organism like yeast, hydra a small bulb like projection comes out from body side and grows and de-attaches from the body to form a new individual. This is called budding.

Fragmentation- Some algae like spirogyra breaks into new fragments. Every new fragment develops into a new strand.

Spore formation- In some fungi, spores are formed and spread to grow as a new individual in favourable condition, e.g. Rhizopus

Some plants reproduce sexually. Flower is the important part of plants which helps in sexual reproduction and seed formation. Flower contains sepals, Petals, Stamens and Pistil. Stamen is male part while pistil is female part of a flower. Pollen grains from the anther of stamen fall to stigma of pistil and fertilization takes place in ovary. After fertilization the zygote develops into an embryo. Ovary after ripening leads to the formation of fruit and seeds.

In most of animals, the major mode of reproduction is sexual. Males and females have different reproduction organs. In males, major reproduction organs are testes, vas deferens and penis. The male gamete i.e., sperm are produced in the testes carried away through vas deferens to the penis. In females, major organs are the ovary, oviduct, the uterus and the vagina. The female gamete is known as the ovum and is generated in ovary. The ovaries generate one egg every month by rotation.

Fertilization is internal and it takes place in oviduct. The formation of zygote is considered as the beginning of a new individual. The zygote undergoes repeated divisions and forms an embryo. The embryo grows into a baby inside the mother's body. When the baby is fully formed, it is born from the mother body.

Heredity and Evolution

In organisms or in human feature like height, complexion, shape of hair, colour of eyes and shape of nose and chin are same either on mother or father. These features are called character of trails. Mother and father as parents are involved in sexual reproduction. So mother and father contribute equally amount of genetic material to the child. This means that each trait can be in flounced by both parental and maternal DNA. So the children have either mother's or father's trait in them.

The transmission of characters or traits from the parents to their offspring is called heredity. Heredity means continuity of feature from one generation to next. The hereditary information is present in the sex cells (gametes) of the parents. The gametes of mother (ovum) and father (Sperm) carry traits and fuses together to form zygote and later grow into

embryo. Offspring inherit the characters (traits) of the parents and resemble them very closely.

The offspring are never a true copy of the parents. In fact, no two individual are exactly alike and the members of any one species differ from one another in same characters or traits or the other. These differences are known as variations. These variations are the occurrence of differences among the individuals of a species. The variation is necessary for organic evolution.

The variations produced in organisms during successive generations get accumulated in the organisms. The significance of a variation shows up only if it continues to be inherited by the offspring for several generations. The great advantage of variation to a species is that it increases the chances of its survival in a changing environment.

Evolution is the sequence of gradual changes which takes place in the primitive organism over millions of year in which new species are produced.

The process by which new species develop from the existing species is known as **speciation**. The formation of new species is called speciation.

Some important sources which provide evidences for evolution are:-

(i) Homologous organs
(ii) Analogous organs
(iii) Fossils
(iv) Embryological evidences

Charles Robert Darwin gave the theory of evolution in his famous book 'The **Origin of Species'**. The theory of evolution proposed by Darwin is known as '**The Theory of Natural Selection'**.

Natural selection is the process of evolution of a species whereby characteristics which help individual organisms to survive and reproduce are passed on to their offspring, and those characteristics which do not help are not passed on. Genetic variation is the raw material of evolution. These days, the most accepted theory of evolution is the synthetic theory of evolution. It states that origin of species is based on the interaction of 'genetic variation' and 'natural selection'.

Birds evolved feathers as a means of providing insulation of their bodies in cold weather but later on these feathers became more useful for the purpose of flying.

2.2 Matter

We use a large variety of things for our survival. The air we breathe, the food we eat, the clothes we wear, stone, plants, animals, clouds, sand, everything is matter. Everything in this universe is made up of materials, which scientists have named "Matter". Every Indian

Philosophers classified matter in the form of five basic elements- " The PanchTatva"- air, earth, fire, sky, and water. According to them everything living or non- living was made up of these five basic elements.

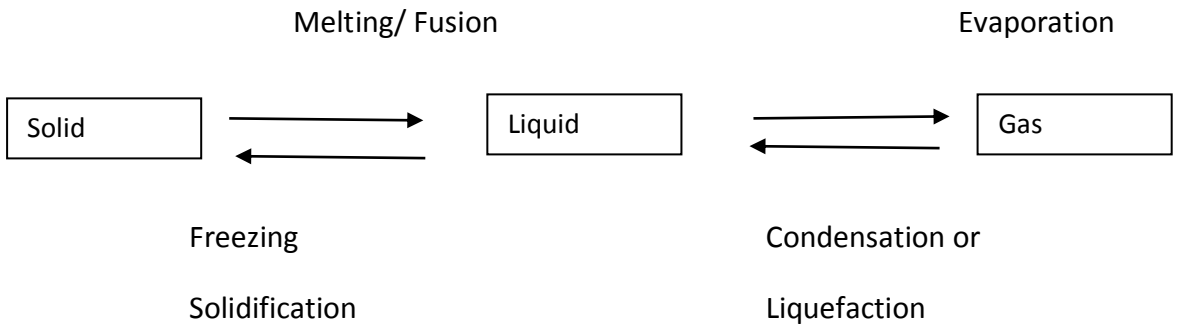
Modern day scientists have evolved two types of classification of matter based on their physical and in constant motion. These particles of matter are very small. They are small beyond our imagination.

Particles of matter have space between them; on the basis of space between them. They are classified as solid, liquid and gaseous state. Matter exists in three states as solid, liquid and gas. Particles is solid are closely packed together. They are held together by strong forces. So they cannot leave their position. They can make tiny too and for vibrations. Particles have a very little space in between them which is called intermolecular space. In solid, strong force called intermolecular force hold the particles together in a three dimensional structure. Solid have fixed shape and volume.

In liquid space between particles is larger than solid. In a liquid the particles can move about and slide past each other. They are quite close to each other but are not arranged in a regular pattern. They are held together by weaker forces as compared to solid. Liquids have no fixed shape but have fixed volume.

In gas the particles are very far from each other. In air, spaces between particles are very large. They move about very quickly colliding with each other and bounce off in all possible directions. The forces holding the particles are almost neglible. So the gases have neither fixed shaped nor volume. Gases are highly compressible as compared to solids and liquids. The Liquefied Petroleum Gas (LPG) that we get in our home for cooking or oxygen supplied to hospitals in Cylinders Compressed Gas. Compressed Natural Gas (CNG) is used as fuel in vehicles.

Three states of matter are interchangeable. The effect of heat on the three states of matter is an important idea. When heat is given, solids change to liquids and then gases. When heat is removed these changes occur in the reverse order. When a solid is heated, its particles get more energy and vibrate more. Due to this the solid expands. At the melting point the particles vibrates so much that they break away from their position and a solid becomes a liquid. When a liquid is heated its particles get new energy and move faster. This makes the liquid expand. At the boiling point the particles get sufficient energy to overcome the forces holding them together and form a gas. When gas is cooled the particles lose energy. They move slowly and slowly and when they do not have enough energy to bounce away, they come together and form a liquid. When a liquid is cooled the movement of particles even slows down further. By changing the condition of temperature and pressure, the three states of matter can be inter-converted, that is, the three stage of matter are inter-convertible.



Basic units of matter

Matter can also be classified as pure substances elements and compounds and mixtures. Elements are made up of only one kind of atoms. Compounds are formed by the chemical combination of the atoms two or more elements. Mixtures are formed by mixing two or more substances in any ratio. Each elements can be represented by a symbol where as compound can be represented by a formula.

Element

Everything which we see in our environment is made up of simple substances called elements. An element is defined as the simplest form of a substance that cannot be broken up into anything simples by ordinary chemical reactions. Carbon, oxygen, nitrogen, copper etc are the elements; they cannot be further broken down into simpler substance.

There are 115 elements known at present. The fist element i.e, Phosphorus was discovered in 1669. An element is made up of same kind of atoms.

John Dalton, a British chemist provided the basic theory about the nature of matte. He took the idea of divisibility of matter, which was till then just a philosophy. He took the name 'atoms' as given by the Greeks and said that the smallest particle of matte are atoms. His theory was based on the laws of chemical combination. Dalton's atomic theory provided an explanation for the law of conservation of mass and the law of definite proportion.

Atom

Atom is the smallest unit of matter which participates in a chemical reaction. There are some elements whose atoms can exist in isolation and have independent existence. For example:- Helium, Argon, Neon etc. For example Hydrogen is always present as two atoms of H, represented as H_2 molecule and oxygen is present as O_2 molecule. The word molecule is used in chemistry as an aggregate of atoms. Each element is known by a symbol of one or two letters.

According to Dalton's atomic theory, all matter, whether an element, a compound or a mixture is composed of small particles called atoms. The postulates of this theory as follows:

(i) All matter is made of very tiny particle called atoms.

(ii) Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.
(iii) Atoms of a given elements are identical in mass and chemical properties.
(iv) Atoms of different elements have different masses and chemical properties.
(v) Atoms combine in the ratio of small whole numbers to form compounds.
(vi) The relative number and kind of atoms are constant in a given compound.

Atoms are building blocks of all matter. Atoms are very small. Dalton was the first scientist to use the symbols for elements in a very specific sense. Broadly, elements based on common properties can be simply classified into metals and non metals. One important way of classification of all elements is the Periodic Table. Elements can combine to form new substances that we encounter in daily life.

Molecule

A molecule is a group of two or more atoms that are chemically bounded together that is, tightly held together by attractive force. A molecule can be defined as the smallest particle of an element or a compound that is capable of an independent existence and show all the properties of that substance. Atoms of same element or of different elements can join together to form molecules.

(i) Molecules of elements:- the molecules of an element are constituted by the same ,type of atoms, for example O_2, O_3 etc.
(ii) Molecules of compounds:- Atoms of different elements join together in definite proportion to form molecules of compounds. Water, (Hydrogen and oxygen), carbon dioxide (carbon and oxygen) .

Compounds

Compound can be defined as the substance formed by the chemical combination of two or more elements. A compound is formed by chemical combination of two or more elements in a fixed ratio by number of atoms of each element or by mass. In a compound, the constituents lose their individual properties and they cannot be separated by physical means.

The chemical formula of a compound is a symbolic representation of its composition. The chemical formulas of different compounds can be written easily, carbon dioxide (CO_2), Ammonium chloride(NaCl), calcium carbonate($CaCO_3$) etc.

Mixture

A mixture is formed by mixing two or more substances in any ratio. The constituents of a mixture do not combine chemically and they retain their individual properties, Milk, Soil, Soft drink etc are mixture. The mixture contains more than one substance.

Depending upon the nature of the components that forms a mixture, there are different types of mixture.

(i) Alloys Homogeneous solution
(ii) Suspension and Non- Homogeneous solution.
(iii) Colloidal solution.

2.3 Natural Phenomenon – Force and Motion, Gravitation, Magnetism and Electricity

In everyday life we use energy with different types of objects. Some of which are movable and some are stationary or at rest. There are evidences of children's ability to measure objects. They also want to know the causes of motion. Why does the speed of an object change with time? We always observe that on object dropped from a height falls towards the earth. We know that all planets go around the sun. Since measurement of object, distance, force, gravitation, magnetism and electricity, is so much a part of our lives, acquainting children with these concepts is essential. In this unit or present topics we will discuss all in brief.

Force

In our everyday life we observe that some efforts are required to put a stationary object into motion or to stop a moving object. We ordinary experience this is a muscular effort and say that we must push or hit or pull on an object to change its state of motion. The concept of force is based on this push, hit or pull. Pushing, hitting and pulling of object are all wages of bringing object in motion or rest. The object moves because we make a force act on them.

Any push, pull or lift that causes a change in motion, position or the shape of an object is known as force. In daily life, children apply force to do different tasks as opening and shutting the door, writing, kicking the ball, lifting school bag etc.

Force can be used to change the magnitude of velocity of an object. Force can be used to make an object move faster when applied force in greater extent or move slower, when force is applied lesser extent. During balling a cricket ball, a bowler applied more force to throw it faster.

Force can also be used to change the direction of moving body. During football game a player change the direction of a ball towards the opponent goal by applying force.

Force can also change the shape and size of the object. Making flour (dough) balls or chapatti.

There are different types of forces.

- Muscular force- The force exerted by muscle to do different activity is called Muscular Force. Throwing ball, lifting water etc.

- Magnetic force- The force exerted by magnet is called magnetic force.
- Electrostatic force- The force exerted by a charged body on another charge or uncharged body is known as electrostatic force.
- Gravitational force:- Earth pull everything towards it. This force is called the force of gravity or gravitational force. In fact, every object in the universe, whether small or large, exerts a force on every other object. This force is known as gravitational force.
- Friction force:- Any object, moving over the surface of another object slows down and finally stops. Moving ball on the ground stops after soma time. The force which opposes the motion of moving body is called force of friction. If an object started moving, it would never stop if there were no friction.

Motion

We often perceive an object to be in motion when its position changes with time. The phenomenon of sun rise, sun set and changing of seasons are due to motion of the earth. Most motions are complex. Some objects may move in straight line, or in circular path. Some rotates and some vibrates. The simplest type of motion is the motion along a straight line.

When an object covers equal distances in equal intervals of time, it is said to be in uniform motion. In our day to day life, we come to across motion where objects cover an equal distance in equal internal of time is called non uniform motion. When a car is moving on a crowded street or a person jogging in a park is the example of non-uniform motion.

When an object moves in a circular path with uniform speed, its motion is called uniform circular motion. The motion of moon and earth, a satellite in a circular orbit around the earth are some examples of uniform circular motion.

There are three laws of motion which are also known as Newton's Law of motion. The first law of motion as stated as:-

An object remains in a state of rest or of uniform motion in a straight line unless compelled to change that state by an applied force. All objects resist a change in their state of motion. The first law of motion is also known as the law of Inertia.

The second law of motion states that the rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of force.

The third law of motion states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction.

Gravitation

We always observe that an object dropped from a height falls toward the earth, Moon goes

around the earth. There must be some force which acting on object. Isaac Newton could grasp that the some force responsible for all these. This force is called the gravitational force.

Every object in the universe attracts every other object with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them. The force is along the line joining the centers of two objects.

It is seen that a falling apple is attracted towards the earth. Does the apple attract the earth? According to the third law of motion, the apple does attract the earth. But according to the second law of motion, for a given force, acceleration is inversely proportional to the mass of an object. The mass of an apple is negligible small compared to that of the earth. So we do not see the earth moving towards the apple.

Newton concluded that not only does the earth attract an apple and the moon, but all objects in the universe attract each other. This force of attraction between object id called the gravitational force.

Electricity

Electricity is a basic necessity of our everyday life as it is being used for many purposes like lighting our home using TV, refrigerators and computers etc. in many devices like wall clocks, radio, torch we use electric cells. An electric cell has two terminals i.e, (+) Positive and (-) Negative terminal. The metal cap is positive terminal and metal disc is the negative terminal of an electric cell. The main body of the cell has chemicals stored in it which produces electricity or electric current. When two or more electric cells are connected to each other in a series, it is called an electric battery.

Electric current is produced only when two terminals are externally connected with each other through a wire and the circuit is complete. Flow of charge is called electric current.

The objects through which charge (electrons) can flow or electric current pass are called conductors as aluminum, copper, or any metal wire. The objects through which current cannot pass are called insulators as plastic, rubber and glass.

There are three effects of electric current.

(i) Heating effect: when electric current is passed through a wire,it gets heated up. This is called heating effect of current. This characteristic of current is used to produce heat through heater example electric press, water heater etc.

(ii) Chemical effect:-The passage of an electric current through a conducting solution causes chemical reactions. As a result, bubbles of a gas may be formed on the electrodes. Deposits of metal may be seen on electrodes. Changes of colour of solutions may occur. The reaction would depend on what solutions and

(iii) electrodes are used. These are some of the chemical effects of the electric current.

Electroplating: The process of depositing a layer of any desired metal on another metal by means of electricity is called electroplating. It is widely used for chromium plating on many parts of car, bicycle handle etc.

(iv) Magnetic effect: When electric current is passed through wire, the wire acts as a magnet. This is called magnetic effect electro- magnet is used to separate iron materials from garbage or industrial garbage.

2.4 Natural Resources

Nature influences us in many ways. Human beings since the early times have been curious to understand the natural world around them. The curiosity of human to understand nature has resulted in the development and use of resources for their welfare. We use or consume many materials as food, clothes, furniture, fuels, vehicles, water etc which are obtained from the resources on this earth. Anything in the environment which can be used is called a natural resource. Some of our important natural resources are: Forest and Wild life, air, water, soil coal and petroleum. We should use the natural resources judiciously. The natural resources are tools for development for human beings. The protection of the environment from harm or destruction is called conservation of environment. Conservation of environment and natural resources are must for future generation. The conservation of natural resources is also necessary to check global warming and sustainable development. Natural resources on which the entire life on planet depends are air, water and soil. Unfortunately these resources are fast getting polluted making it necessary for us to recognize their importance and take necessary action for preservation and cleanliness.

Air

Earth is covered by a thin layer of gases called the atmosphere. Air contains 21% Oxygen,78% Nitrogen and .033% CO_2 and others. Oxygen is used by all life forms during respiration and CO_2 is expelled out. Plants supply us oxygen and consume CO_2 by the process of photosynthesis. This helps in maintaining the balance of various gases in the atmosphere. But certain activities of human beings like deforestation, smoke released by industries and vehicles tend to disturb this balance. The contamination of air by the release of harmful gases is called air pollution.

- Burning of fuels like coal, petroleum and wood release harmful gases like CO_2, and carbon monoxide in air. These gases are responsible for increasing respiratory problems like asthma, cough and wheezing.
- Burning of fuel in automobile refineries release oxides of carbon, nitrogen and sulphur and unburnt particles which causes complete lung damage. Irritation of eyes and skin, corrosion of marble and monument. By causing acid rain they

- damage building and monuments and also make soil more acidic.
- Chlorofluorocarbons used in ACs and refrigerators and aerosols sprays damage the ozone layer.

Effects of Air Pollution.

(i) Global warming
(ii) Acid rain
(iii) Depletion of ozone layer
(iv) Health hazards

Reducing Air Pollution

- Use clean fuels such as CNG, LPG etc.
- Use public Transport, use clean source of energy as solar, wind and water.
- Plant more and more trees.

Water

Water is the most precious thing for survival of life. Water covers almost 75% of the earth surface. Water is present in rivers, lakes, oceans, glaciers and in the ground of the earth. The regions having good availability of water are flourishing because they have good crops. The regions having shortage of water are poor due to poor crop growth. Scarcity of drinking water and water pollution has become a burning issue.

Causes of water pollution

- Industrial waste- The untreated wastes from industries and domestic sewage is discharge into the water bodies making them unfit for use and causing harm to the aquatic life.
- Human activities- bathing, washing clothes also make water polluted.
- Pesticides and fertilizers- farmers used fertilizers and pesticides which mix in water bodies through rain water.
- Nuclear waste- When radioactive wastes dumped in water bodie couses water pollution.

Effects of water pollution

- Industrial wastes discharged in water make water unfit for drinking and polluted for aquatic life.
- Sewage discharged in water causes many water borne diseases.
- Eutrophication – Excessive growth of hydrophytes or algae in water bodies due to nutrient rich water in water bodies from agriculture field. These algae and weeds robe oxygen and causes of deadening aquatic life.
- Oil spills- A thin layer of oil is formed on the surface of water that block light. This is a serious threat to aquatic life.

Prevention of water pollution

- Avoid throwing garbage in water bodies.
- Avoid discharging sewage in water bodies.
- Fertilizers and pesticides should be used judiciously.
- Religious activities that pollute water should be restricted.
- Creating awareness among people to stop water pollution.

Conservation of water is must. Rain water harvesting should be used to recharge water underground. Plantation of trees also helps to check soil erosion and helps water percolation.

Soil

Soil is important medium which helps in growth of plants by providing support and essential nutrients. Soil also helps in the percolation and retention of underground water which is used for drinking and other purposes. Soil helps in decay of waste products and pollution. Soil helps in maintaining environmental balance as it supports, the growth of plants that are a major factor in influencing water cycle on earth. Soil should be conserved.

Certain natural processes and human activities are responsible for carrying way soil from one place to another. This is called soil erosion. The top layer of the soil is rich in nutrients and its loss adversely affects the growth of plants.

Causes of Soil Erosion

Soil erosion is caused by-

- High speed of wind and water
- Over garaging
- Deforestation
- Natural calamities like drought and floods
- Tillage or ploughing.

Reducing soil erosion

- Mannuring the Soil- Maximum group cover of vegetation can be achieved by Mannuring the soil to produce bumper crops. Soil permeability can be increased by adding organic matter.
- Contour Bunding- Bunds are made at intervals to check the speed of water overflow.
- Dam construction
- Plantation.

Planting more trees, contour farming, avoid excessive tilling, covering the soil with leguminous crops between two crops are some of the ways of preventing soil erosion.

Sources of Energy

We all use up energy all the day right from the time we get up and until we go to bed or even while we are asleep. We need energy to run industries vehicles and many other gadgets for our survival. For every walk of life we need energy. We need more and more energy for society and growing population. Source of energy can be classified as primary and secondary Renewable and Non- Renewable.

- Sources, which are used to give energy directly such as wood coal etc., are called primary sources of energy.
- Sources, which are produced by conversion from a primary energy source as electricity etc, are called secondary sources of energy.
- **Renewable resources** are resources that are replenished by the environment over relatively short periods of time. This type of resource is much more desirable to use because often a resource renews so fast that it will have regenerated by the time you've used it up as wind, Thermal energy, water and Bio-fuels.
- **Non-renewable resources** are those natural resources that are available in limited quantity. These resources cannot be renewed or replenished in short duration. Therefore they are also known as *exhaustible resources*. Examples- coal, natural gas, petroleum etc.

UNIT – 3
CLASS ROOM TRANSACTION

Course Outline

3.6 Lecture cum demonstration Method
3.7 Scientific method
3.8 Activity method
3.9 Problem solving method
3.10 Process approach

Introduction

Learning science is related to the aims of teaching- learning of science, students and teacher's conceptions of science, content, nature of science conception and nature of learning process. We live in a scientific and technological age and no citizen can survive in a developed society without scientific literacy and certain elementary skills. Science cannot be used in society unless some human resource is trained in its use. Some teachers, from the very start, may have a flair for teaching. They possess the wonderful ability to awaken interest and arrest the attention of the students. The process of transferring and interpretation of science contents to the child's mind is called method of teaching. It is just way of teaching. Teaching a particular content and process has to be compatible with the nature of science and objectives as well as with the cognitive level of children and existing classroom conditions. There are different methods and approaches to teach science content. An approach may be explained as a comprehensive way of dealing with a particular problem. It is a general plan, on the basis of which, various methods are evolved. A method is an orderly and logical arrangement of ideas based on a particular approach. There is no best approach or strategy of teaching learning that is applicable to all situations.

3.1 Lectures cum Demonstration Method

In Lecture method one teacher talking too much about a topic and the students /learner listen passively. This talk is augmented by the use of demonstration. It is called a lecture cum demonstration. The main purposes of lecture cum demonstrations are:

(i) To convey information
(ii) To generate understanding
(iii) To stimulate interest

In this method teacher and taught (children) are taking part in educative process. The teacher performs experiments before the class and meanwhile goes on asking relevant questions from the class the students are compelled to observe carefully because they have to describe each and every step of the experiment accurately and draw inferences. The students are questioned and cross questioned concerning the problem in hand and their inferences discussed in the class. While using this method teacher educator /facilitator, he should use appropriate stimulus variation techniques (voice tone, questioning, facial

expressions etc.) and motivation techniques. Too many ideas or demonstration should not be taken up in one go. A 35 minutes lecture can be intercepted with about 2 demonstrations taking up about 15 minutes.

Advantages

(i) A lot of knowledge can be imparted consuming less time.

(ii) Theory and practical aspects can be taken up side by side.

(iii) Examples can be illustrated verbally as well as in front of the eyes of students.

(iv) In groups, this method can be used for developing problem solving skill and scientific attitude.

Disadvantages

(i) Student involvement is quite less.

(ii) It is not always possible to hold student attention while using this method.

(iii) The teacher cannot receive immediate feedback as to the effectiveness of the lesson.

(iv) The desirable laboratory skills are not developed among the students.

Lecture cum demonstration method is one important method for teaching science at elementary stage at the time of demonstration teacher may take the help or evolve the students to perform experiment /activity to clear the concept. Students will learn through learning by doing.

3.2 Scientific Method

The development of scientific attitude and scientific training are two cardinal aims for the teaching of science. It has been observed that scientific attitude and scientific method cannot be taught or imparted directly in some formal way. These can be imbibed through the atmosphere of the class and personal behaviour of science teacher.

Scientific method is a method for solving a problem scientifically. It is a method or procedure applied by the scientist in the persuit of science but there cannot any commonly agreed definition of scientific method because the scientists use many methods for attacking their problems, scientists have certain common characteristics wood burn and obourn put forth the following list of such traits.

(i) Scientist has an insatiable curiosity, inquisitiveness and spirit of adventure and a desire to investigate things that capture his curiosity.

(ii) The scientist is independent in thoughts seek to improve status quo, and is ready to abandon the disproved.

(iii) He has a fertile inventiveness, a strong imagination and creativity.

(iv) The scientist is knowledgeable enlightened and informed and possess sound judgments and prudent for sight.

(v) The scientist has high mental energy and is capable of extreme degree of perseverance.

Steps in Scientific Method

Many people feel that scientific method is nothing but scientific thinking and the common features or steps in such thinking are as follows:

1. **Statements of the Problem:-**The problem should be stated in clear, exact, simple and unambiguous words. It should be well defined and must exhibit the scope and limitations of the problem.
   What does a child want to know/learn? (ii) Does air has weight?
2. **Formulation of Hypothesis:-**A hypothesis is the tentative solution to the problem in hand. There can be a number of predictive or tentative solutions for a problem. Therefore, a student of science should design his hypothesis quite objectively on the basis of facts or information he has gathered in the name of data.
   What does a child think answer would be?
3. **Experiment: -**If experiments show that the hypothesis formulated is not correct, a new hypothesis is formulated and subjected to experimental verification. A hypothesis is accepted only when it has been confirmed by experimentation the experiments will show the occurrence and non-occurrence of the predicted phenomenon.
4. **Drawing Conclusions:-**The last step is to accept, reject or modify the given hypothesis and draw conclusions out of that. If the experiments and observations made in the light of set predictions, prove a particular hypothesis. It is rejected, if any hypothesis is neither proved nor disapproved rather some exceptional results are observed, then it is modified in the light of that observation.

   Scientific method will benefit immensely, if we imbibe the spirit of scientific method in our personal life. Scientific method tells us to be honest in reporting our observation or experiments results, keep an open mind and be ready to accept other points of view if our own view is proved wrong. These values from what called the scientific temper or scientific attitude or rational thinking.

3.3 Activity Method

Activity based teaching has been accepted as a paradigm for science education and is reflected in some measures in the textbooks developed at the national and state level. But it has hardly been translated to class room practice. Activity is regarded as a way to verify the ideas/principles given in textbooks.

Lev Vygotsky (1863-1934) believed that “Children undergo quite profound changes in their understanding by engaging in joint activities and conversation with others students/ peoples. Learning is a complex process. Learners learn a lot when they interact with their environment peers, materials, teachers, parents etc.

Most of the topics, children can only understand by doing activities. Activity should be done by using easily available materials. Science teachers may use science kit for performing an activity. While performing an activity teachers should engage students, so that they can clarify concepts properly. Thus, activity method helps the teacher and students evaluation also. Students are involved in doing some activities, the role of the teacher to facilities them to perform the activities by using different types of materials.

During the activity performing, the children interact with books, materials teachers, peers which help them to perform the activity properly. The activity method helps the students and teachers;

- Utilizing arranging co- curricular activities;
- Proper classroom for the environment;
- Inspiring for the study of scientific literature;
- Involving children in investigating science projects;
- Using scientific method in decision making;
- Self example of the teacher;

Merits and Demerits

Activity based teaching is expensive, need more time. It does not prepare the child for examination and competitive examination.

Research findings have shown that activity method help the learners to understand the concept better. Learning science is doing science and there is no other way to learn the science.

3.4 Problem Solving Method

Learning experiences that allow independent thinking and multiple ways of approaching the problem encourage independence and creativity in learners. Problem solving method is based on the idea of involvement of students in real life problem. It gives students opportunity to actively construct their learning by thinking, questioning, visualizing the situation, searching for solution, doing activities and experiments and arriving at conclusion on their own.

Students realise that problem exist. They conceive the situation as problem provide rational of the problem. Students attempt to solve the problem. They make observation and collect data to explore the solution. In this process, they apply their understanding to construct their knowledge. Students draw conclusions. Students present the record and generalize the conclusion.

Different problems may require different sequence as steps. Studies show that it same problem is presented to different groups of students in classes; they tackle the problem in different ways connecting their prior understanding. Teacher should encourage students to plan their method of problem solving. Students learn by thinking themselves while working on problem and struggling to find the solution.

Steps in Problem Solving Method

1. Selecting and stating the specific problem or question
2. Collecting, organising, comparing and judging significant information in the lights of defined problem.
3. Expressing the problem and framing some possible solutions.
4. Drawing preliminary conclusion for further exploration and study.
5. Evaluating findings and establishing a conclusion.
6. Considering the summarization with the possibility of further study.

Advantages

Experiences undertake to solve problems and answer questions result in a sequence of learning. Problem solving method points out a logical of thinking to the pupils. She /he understand the necessity and sequence of following each step properly. The problem can be adjusted to groups and individuals.

Limitations

- It is monotonous if used too frequently
- It is not suitable of employing in social pertinence.

3.5 Process Approach

Science is a process of inquiry. An approach is used in the broader sense. It means a way of thinking and working in a set direction so as to accomplish certain goals. A teacher can use process approach in teaching learning science. This implies that whatever strategies a teacher plans to apply will be guided by the process approach. Teacher may adopt any of those innovative teaching learning strategies and techniques that are guided by process approach.

Strategy is a proper and systematic plan, which aims to achieve the objective. Strategy means selection of suitable pedagogical process by means of using appropriate techniques, such that all of these lie in the realm of the approach, the teacher chooses to follow. Strategies can be changed or modified depending upon teaching –learning situation. There is no best approach or strategy of teaching –learning that is applicable to all situations. When a teacher starts teaching of science, he has to go through various processes there are thirteen process of science- observing, defining operationally, classifying, using numbers, measuring, using space-time relationship, communicating, Predicting, inferring, formulating of hypothesis, Interpreting data controlling variable and experimenting.

The process skills are important for scientific investigations and in everyday life. In science class room, the teacher expected to provide opportunities to the children to participate in same investigations activities which will help them to understand the nature of scientific inquiry.

The main process involved in learning sciences are:-

Observing and Defining Operationally.

The Pupil:

- Recognizes the properties of objects and phenomenon using the sense of sight, sound, taste, smell and touch.
- Recalls the properties of objects from previous experiences.
- Identifies objects, events, and changes occurring in the environment.
- Distinguishes objects on the basis of their properties and develop a habit of noting minute differences in the characteristics of objects and Phenomena.
- Develops curiosity to see new objects of environment.
- Define on the basis of observations, in his own words

Classifying

The Pupil:

- Describes difference between objects and Phenomenon on the basis of given or chosen criteria.
- Distinguishes between objects and Phenomenon on the basis of similarity and differences
- Identifies and names, properties which could serve as the basis for possible classifications.
- Appreciates that there are several different ways of grouping objects and events.

Using Numbers and Measuring

The Pupil:

- Identifies sets and their numbers.
- Compare areas and masses of different shapes and sizes.
- Demonstrates measurement of length , area, volume, time temperature and weight using relevant instruments.
- Determines number relationship.
- Distinguishes differences between estimation and measurement of objects and Phenomenon.
- Design tables for reading.
- Prefers to be accurate in measurement.
- Appreciates the need to measure for interpreting relationship between phenomenon.

Using Space- Time Relationship

The Pupil:

- Recognizes specified objects in relation to other objects.
- Identifies directions and movement of objects in space.
- Interprets trends and changes in environmental phenomenon.
- Compares changes in the spatial position and relationship between physical and social Phenomenon over time.
- Appreciates the dynamic nature of natural and social system and develops awareness of the diversity and constant change of social and physical processes.

Communicating

Communicating skills is a valuable skills with the help of which pupils communicate observations. It is essential to keep accurate records, which can be checked when needed complete experimental reports are essential to scientific communication.

The Pupil:

- Use relevant new words, sounds, actions, tools and instruments correctly.
- Translates observations, conclusion into suitable means of expressions.

- Precisely describes objects, phenomena, trends, experiments, producers through words, drawings, writing and demonstrations.
- Willingly shares ideas and accepts arguments and ideas of others.

Predicting Inferring and Formulation Hypothesis

Prediction and inferences are formed on the basis of observations to evaluate on event. The formulations of hypothesis depend directly upon questions. The process consists of devising a statement, which can be tested by experiment.

The Pupils:

- Deduces relationship between variables.
- Verifies conclusions with further evidences
- Extrapolates trends, implications, assumptions based on obtained data and previous knowledge.
- Devices principles on the basis of relationship between variables.
- Supports ideas and arguments with sound and logical arguments.

Interpreting Data

Interpreting data requires the applications of other basis process skills in particular ,the processes of inferring ,predicting ,classifying and communicating it is through this complex process that the usefulness of data is determined in answering the question being investigated. Interpretations are always subject to revision in the lights of new or more refined data

The Pupil:

-organizes data efficentify.

- recognizes trends and patterns of observed phenomenon.

-establishes relationship between variables.

-forms a habit of systematic enquiry.

Experimenting

Experimenting is a process of gathering data for the purposes testing a hypothesis. Experiments are conducted to make observation in an experiment variable may be identified and controlled as much as possible.

The Pupil:

-poses questions and identifies problem which are likely to be answered by investigations and experimentation

- identifies variable

-Controls variables

- establishes possible relationship between variables

-construct and assembles relevant apparatus for experimentation

-prepares appropriate tools for investigation.

-practices honesty in repeating results.

Integration of science process skill to use an approach relies on the student's capabilities to think at a higher level and to consider more than one thought at a time. Thus, one integrated skill includes many basis skills and processes. These processes are defining operationally, forming hypothesis, experimenting, controlling variable, interpreting data etc.

UNIT-4:

ASSESSMENT

Course Outline

4.5 Formative Assessment

4.6 Summative Assessment

4.7 Continuous and Comprehensive Evaluation

4.8 Constructing /setting of questions and question paper, objective wise and question type wise.

Introduction

Assessment is usually considered important for teachers and students both. Teaching and assessment are interdependent and a science teacher should take these aspects together to make teaching-learning process effective. Teaching learning comprises objectives, curriculum and evaluation, these components have a two- way relationship among them, i.e. each affects the others and in turn is affected by them.

According to the Indian Education Commission- Evaluation is a continuous process, forms an integral part of the total system of education, and is intimately related to educational objectives. It exercise a great influence on the pupils study habits and the teachers method of instruction and thus helps not only to measure educational achievement but also to improve it. There are, however, several important aspects of student's growth that cannot be measured by written examination but other methods such as observation, oral test and practical examinations have to be used or devised for collecting evidences for the purpose. These methods need to be improved and made reliable instrument for assessing the student's performance and educational development.

Assessment is an attempt to measure not the pupil as a whole, nor his 'worth' but some particular ability, knowledge or skill (or perhaps an attitude or other quality) which he may or may not possess. Since education is concerned with the total (all-round) development of the child and schools support and encourage this, all aspects need to be assessed. The assessment process needs to be a way of providing information and feedback on the context to which the school and teachers have been successful in imparting quality education to every child.

The belief that assessment lead to finding learning difficulties and then those difficulties can be remediated, is often very impractical and not founded on a sound pedagogic practice. Problems regarding conceptual development cannot and do not wait for formal tests in order to be detected. A teacher can in the course of teaching-learning itself come to know of such problems by asking questions that make children think or by giving them small assignments. She can then attend to them in the process of teaching learning by ensuring that her planning is flexible and responsive to the teachers and their learning –NCF-2005.

4.1 Formative Assessment

Formative Assessment is a tool used by a teacher to continuously monitor student's progress in non-threatening and supportive environment. When the teacher starts any lesson, she needs to known the existing ideas other of the students. She gets the learners involved in dialogue, conversation and inquiry. It helps to known about their prior knowledge various learning opportunities are provided to known about their capabilities, interest and needs.

During teaching learning process the teacher is interested in knowing, what are the existing ideas of the students? What are their misconceptions and concepts? What modifications are required to improve the performance of the teacher? How is the class progressing? How effective has been her approaches and strategies teaching? In order to do so she again has to make a kind of evaluation. Purpose of such evaluation is to find if there is any learning gap between student's concept and scientific explanations of the concept. She monitors process of their learning and concept development, provides continuous feedback and encourages them to reflect on their learning. She facilitates them to construct and reconstruct of the new knowledge. Formative Assessment provides chance for the student to reflect on the performance, take advice and improve upon it. It also involves student's being essential parts of assessment from designing criteria to assessing staff or pears.

Formative Assessment is diagnostic and remedial. It gives the provision for effective feedback and provides the platform for the active involvement of students. Further, it recognizes the need for students to be able to assess themselves and understand how to evaluate and improve what is taught to him/ her. It also corporate varied learning styles into deciding how and what to teach again. It encourages the learner to understand the criteria which will be used to judge their work. It offers an opportunity to students to improve their work after feedback. It helps the students to support their pears, and expect to be supported by them.

Formative assessment is thus carried out during a course of instruction for providing continuous feed back to the teachers and learners for taping decisions regarding appropriate modifications in the transactional procedures and learning activities.

4.2 Summative Assessment

Summative assessment is carried out at the end of a course of learning / term. It is usually a graded test i.e. it is marked according to a scale or set of grades. It will not by itself be able to yield a valid measure of the growth and development of the students. It, at least certifies the level of achievement only at a given point of time. Summative assessment is the most traditional way of evaluating students work.

At the end of term/unit/session a teacher has to make judgment of learning of the students and document their learning evidences. The teacher comes to know the extent of success of her teaching learning process. When the learner is promoted to next class, a grade is allotted to her. Thus, she has to make a final assessment of the learners, for which teacher again has to take recourse to same kind of evaluation.

Thus, we see that assessment and evaluation are ongoing process. These are seamlessly integrated with teaching-learning process. Teacher has to make her aware of the learners, learning process and their performance both and evaluate the students holistically.

4.3 Continuous and Comprehensive Evaluation (CCE)

Continuous and Comprehensive Evaluation (CCE) is a development process of assessment which emphasis on two folds objectives. These objectives are continuity in evaluation on the one hand and assessment of broad range of instrumental outcome on the other.

Continuous and comprehensive evaluation refers to a particular process of evaluation which is school based and aims at all round development of the students. This process includes continuity of testing with reasonable internals and covering different aspects of curricular and co-curricular areas so as to help the students.

Continuous refers to continuity and regularity of assessment during the whole session. The frequency of class tests, unit test and terminal tests can make the evaluation regular. The test in science may be followed by the diagnosis of the hard spots of learners and remedial interventions to correct them. The evaluation should be the integral part of teaching-learning process.

Comprehensive refers to the areas of assessment, which includes both scholastic and co scholastic aspects of pupils growth helping the all round development of the child. In scholastic aspect, cognitive growths in subject specific area-science and in co-scholastic aspect the growth in affective and psychomotor area are covered. A variety of tools and techniques such as question paper, observation etc to be used for the assessment of science.

Evaluation is the process that deals with the collection of evidences regarding the changes, which occur in the pupils' behaviour during the instruction; evaluation involves four main sub process are;

- Gathering information.
- Interpretation of information.
- Making judgments
- Taking decisions.

Any technique of evaluation depends on good and sound tools. A number of tools are being used for evaluation in science. These are;

Tests: unit tests, diagnostic test and term test, assignment / project work.

However, school and teacher have the freedom to adopt / select more evaluation tools which should be more systematic and technically sound. In written examination, science question paper or test paper is an effective tool for evaluating science achievement for development of a good question paper the following steps are suggested. Selection of curricular area or contents: The contents of science to be decided in which the performance of students is to be tested. Competencies in science may be identified which may be broken into learning abilities in knowledge, understanding or comprehension, application and skills as per the students level with respect to their classes.

4.4 Construction/Setting of Question Paper- Question Type Wise and Objective Wise

Formulation of instructional objectives: instructional objectives are to be written for evaluation of students performances in a comprehensive manner.

Development of the question paper: After identification or writing instructional objectives, the question paper may be developed. A question paper should be based on-

- **Weightage of objectives** means the selection of objectives desired to be tested and allotment of marks to each objective according to its relative importance. This help to reduce emphasis on memory alone and ensure testing of higher abilities.
- **weightage to different areas of content**s- it entails the analysis of syllabus and the delimitation of the scope of each topic therein and, in the light of that, allotment of marks to each such topic for the purpose of framing questions.
- **Weightage to different forms of questions**: the teacher has to decide the use of different forms of question and their weightage in the question paper.
- **Sections in the question papers**: objective type of questions may necessitate the division of question paper into sections and the allotment of a separate time limit for answering each.

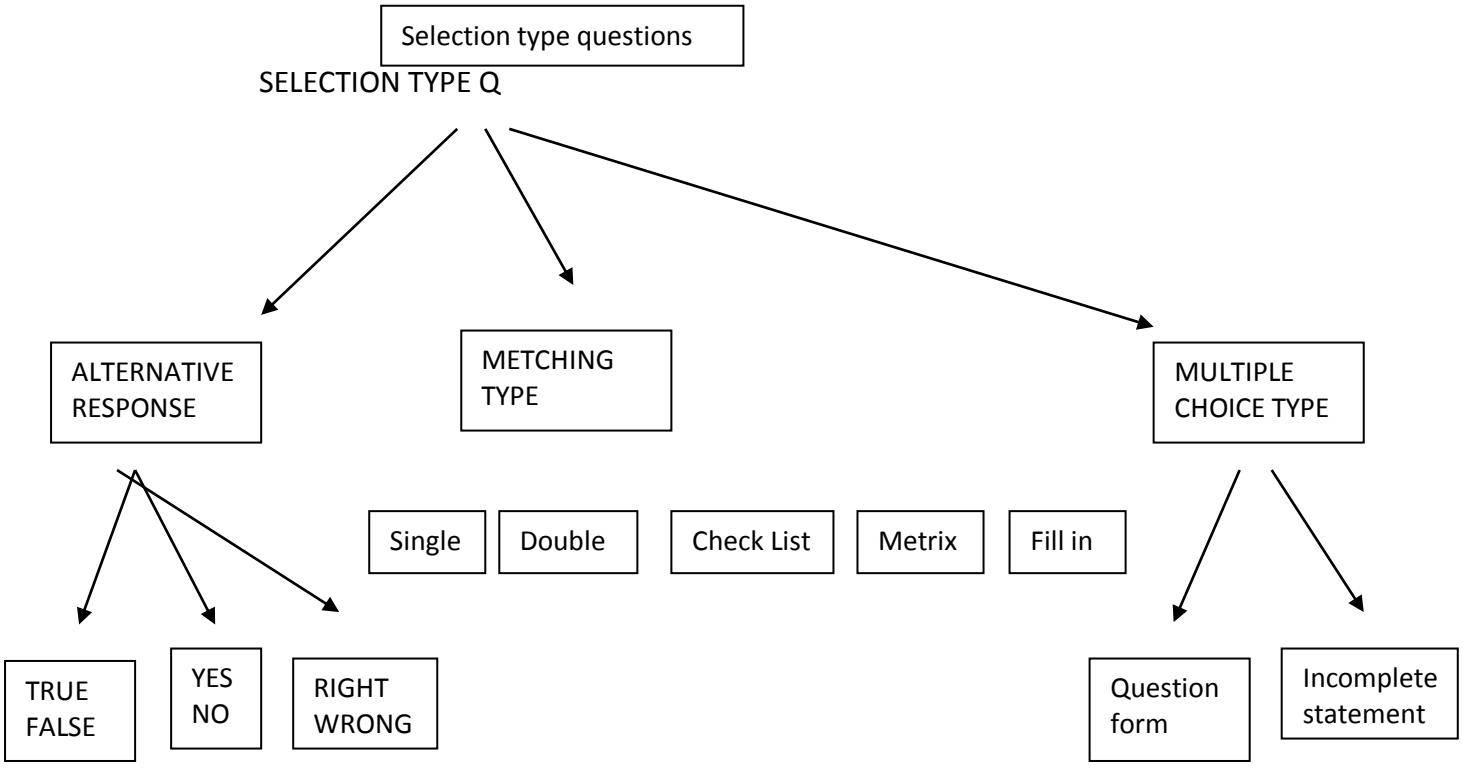
A good question paper should contain different types of questions. There two type of questions; supply type questions and selection type questions.

- **Supply type questions**: In this type of questions student has to supply the answer may vary from one word to several paragraphs. They are also called as free response questions. They may be divided into four categories.

- Essay type questions
- Short answer type questions
- Very short answer type questions
- Fill in the blanks type questions.

- **Selection type questions.**

In this type of questions, students are supposed to answer them by selecting the correct answer among the provided choices. Such questions are also known as objective type questions. These questions may be divided into alternative response type, matching type and multiple choice type questions etc.



Selection type of question is all objective type questions. Objective type questions have only one correct answer which the student has to choose out of the given choices. As these questions can be marked objectively, they are called objective type questions. The following are different forms of objective type questions:

Alternative response type: In These Type of Questions Students have to select one, out of two alternatives as a correct answer.

True –False or Yes –No Type Questions: In this type of question a statement is given and the candidate is asked whether it is true or false (T/F).

Write 'T' if the statement is true and 'F' if the statement is 'False'

1. Both animals and plants are living things-
2. All animals eat small animals.

Right /Wrong Type or Yes/No type;

Put tick (√) mark if statement is right and (X)if wrong.

(i) Liquids do not have a definite shape.

(ii) Ice is lighter than water

Matching type: The words or statements given in column-I are to be matched with the answer given in column-II

Column-I	Column-II
Photosynthesis	Process of reproduction of new individual
Respiration	Process of elimination of Nitrogenous waste from the body
Excretion	Process of release of energy
Reproduction	Process of making food in plants

Check List Items

Students are provided two /three alternatives as The Key List to make decision about a number of statements on the basis of provided key list.

For each of the following matters use letters to indicate whether the nature is solid (S)/ Liquid (L)/Gas (G)

Matter	Sate
1. Water	_____
2. Mercury	_____
3. Vapour	_____
4. Iron	____

Matrix Items: In this type of question, students are asked to check each cell in which the response across the cell, it is true of each of the stimuli along the side. The stimuli are presented vertically (in now) wherein response are presented horizontally (in column)

Put tick mark (√) below the disease against the vitamin name

	DEFICIENCY CAN CAUSE					
Vitamins	Excessive Bleeding (I)	BF (2)	Rickets (3)	Anaemia (4)	Survey (5)	Night Blindness (6)
A						
B_1						
B_{12}						
C						
D						
K						

Fill in the Blanks Type- students are asked fill in the blanks

Fill in the blanks with suitable word.

(i) All living organism respire in order to obtain_____

(ii) The _____ is the Reproduction organs of a plant.

Multiple –Choice: In these questions, there is a stem which poses the problem. The stem may be in question form or in the form of an incomplete statement. Then there are four choices given four answers only one which is correct and rest are distracters.

Which of the following is related to excretion?

1. Neuron
2. Nephron
3. Stamen
4. Stigma

Essay Type Questions: essay type questions usually begin with such term as 'discuss' explain, evaluate, define, comprise, contrast, describe etc. It is quite suitable to test written expression.

- Discuss the reproduction system in plants.
- Explain the transportation system n human being.

Short Answer Type Questions- A short answer question should be a question whose answer may be within 50-60 words or may be two to six- seven lines. it may have 2 to 4 credit points and can be answered in 3 to 5 minutes.

- Why the wall of the ventricle is thicker than atrium?(question form)
- Give four –points to show that plants cell is different from animal cell(statement form)

Objective Wise Questions:

While framing questions based on objectives as described by B.S.Bloom, one should use appropriate action verbs.

1. **Knowledge Type Questions**

   Associated action verbs-define, name, state, recall, recognize, write etc.

a. State Any Four Physical properties of water.
b. Name different type of energy.
c. Define balanced diet.

2. **Understanding Type Questions**.

   Associated action verbs- classify, explain, formulate, identify, illustrate, differentiate etc.

   - Why does fire get extinguished by throwing sand of water on it?
   - Differentiate between photosynthesis and respiration.

3. **Application Type Questions**

   Associated action verbs- demonstrate, establish, find, predict, solve, use etc.

   -what are the uses of oxygen?

   -Why should we get vaccinated against disease?

   - How is energy wasted? Give remedial measures to avoid wastage of energy?

4. **Skill Type Questions**

   Associated action verbs- draw, sketch, comment etc.

   - Draw the diagram of Heart.
   - Construction of a triangle.

Unit-5

Use of Teaching – Learning Resources

Course outline

5.5 Integrated Science Kit

5.6 Audio-Visual aids, Secondary sources of Information and useful local resources.

5.7 Multimedia Package.

5.8 Community/Environmental Resources.

Introduction

Man acquired knowledge in two ways, through direct experiences and by learning from others experiences. The objectives of teaching of Science at upper Primary level are to develop scientific knowledge dealing with environment. The objectives comprise increasing such competencies and skills in the student teacher so that he/she is able to plan suitable activities, organize group activities and select appropriate resources. It is not necessary to purchase equipment to teach all concepts of science. Thus the teacher has to develop skills in improving, handling and demonstrating no & low cost teaching and learning materials such as use of primary science kit and mini tools kit and integrated science kit developed by NCERT, New Delhi. A science teacher collects many materials from surrounding and place them a corner of classroom .This is called science corner .This can be used at the time of teaching.

5.1 **Integrated Science Kit**

Science curriculum programmes at national level started coming after the establishment of National Council of Educational Research and Training (NCERT) on 1st September 1961 with its headquarter at New Delhi. Beside many functions, NCERT develops curriculum, instructional materials, techniques of evaluation, teaching aids, kits and equipment etc. As an aid to adopt this new approach to science teaching at upper primary level, an integrated science kit has been developed by NCERT. It essentially certain items of carrying out all of the experiments indicated in the textbooks. The kit also has a manual, which contains list of items, list of suggested activities, illustrations and brief description of items, so as to enable the user to identity and handle them properly. These items are having low cost and multipurpose. The integrated science kit offers the scope to further explore systematically. Many experiments are suggested in the kit manual. Many can be added to the list. Students can use materials like empty bottles, plastic bags plastic parts, fused bulbs, damaged starters and clothes, metallic containers, disposable syringes, rejected radio puts packing box, steps thermocole packing pieces, plastic rubber pipes, straws, small bamboo pipes, coconut skills etc to made and use to widen the activities. Integrated science kit has the following 127 items.

A- ***Science Equipments***: Meter scale cum level, ICC spoon Beam balance, laboratory

stand, kerosene burner ,tripod stand, wire gauze, sundial, clock pendulum, steel ball, spring balance, action and reaction syringe, trolleys, zoom ruler cum lever, pulley with frame, wedge, Maxwell wheel, weight with hook-50gram each of aluminium, mild steel and lead, calorimeter, aluminium wire, and pointer for expansion of solder, decimeter cube vessel, bimetallic strip ,rods with holder for conduction of heat and operated generator set with panel for connectors, connecting wires with crocodile clips, demonstration ammeter, electric meter ,toy D.C. meter, 1.5 V set of three resistors (5 ohms,10 ohms, 20 ohms), magnetic compass, bar magnet (pair), electric bell, ray streak apparatus, colour disc, electroscope, aluminium wire with insulated (thermaede) sheet, toothed disc, chalk holder, pith/Plastic ball, transparent stiff plastic tube, turning fork, sitar string, shaving blade, aluminium tray cum solar still, dissecting microscopes and glass slides bead microscope, Laboratory thermometer with case mounting needles, insect mounting board, Petridis, garden trowel, graduated syringes with needle, deflagrating spoon with a rubber stopper, pain of tags cork borer, funnel, test tube brush, spatula, test tube holder, pinch cork, plastic tray, dropper, forceps, knifes, scissors, screw drivers, bottle opener with cork screw and screw driver tip, rubber, bottle opener with cork screw and screw driver tip, rubber stopper and screws, wash bottle, copper wire enameled, 24 cms-1 meter, iron nails, rubber bands, filter papers plasticine, wax, paper clips, office pins, rubber balloons cotton threads, candles, kit box with packing materials, padlock with keys and packing materials, poly fab bags, thermocole sheet, paper cutting , polyethene bags, polythene sheet etc.(90 items)

B- Chemicals: Sodium hydroxide ,sodium chloride ,copper sulphate, calcium hydroxide, copper oxide, calcium oxide calcium carbonate , potassium permanganate, washing soda sulphur ,glycerin, alum, sugar, hydrochloric acid, sulphuric acid, nitric acid, zinc pieces, aluminium strips, magnesium ribbon, copper turnings, iron power, naphthalene balls, litmus paper (red& blue), phenolphthalein. (24 items)

C- Glasswires **and Others:** Measuring cylinder -100ml, insect killing bottle, beakers, test tubes, test tube stand, aluminum sheet, round bottom flask, glass bell jar, glass rod with rubber tube at one end, glass tube, plastic /rubber tubing, rubber stoppers, Kipps apparatus (improvised)reaction tube apparatus for exhaled and inhaled air. (13 items)

5.2 Audio- Visual Aids

Teaching aids play very important role in the educational process. In majority of the countries the world chalk and Black Board is the commonest teaching aid and it is widely in use by the teachers today. To make their lessons interesting and more Communicable some dedicated teachers use visual aids like charts, models, pictures and photographs. Audio- visual aids are helping hands for the teacher and learning resources for students. Audio- visual aids helps in making meaningful experiences and it extends learning experiences of the students. When a learner uses his sensory organs in learning, he gets concrete and direct experiences. Such learning is permanent.
A variety of audio- visual aids can be used in science teaching. They can be classified in various ways;

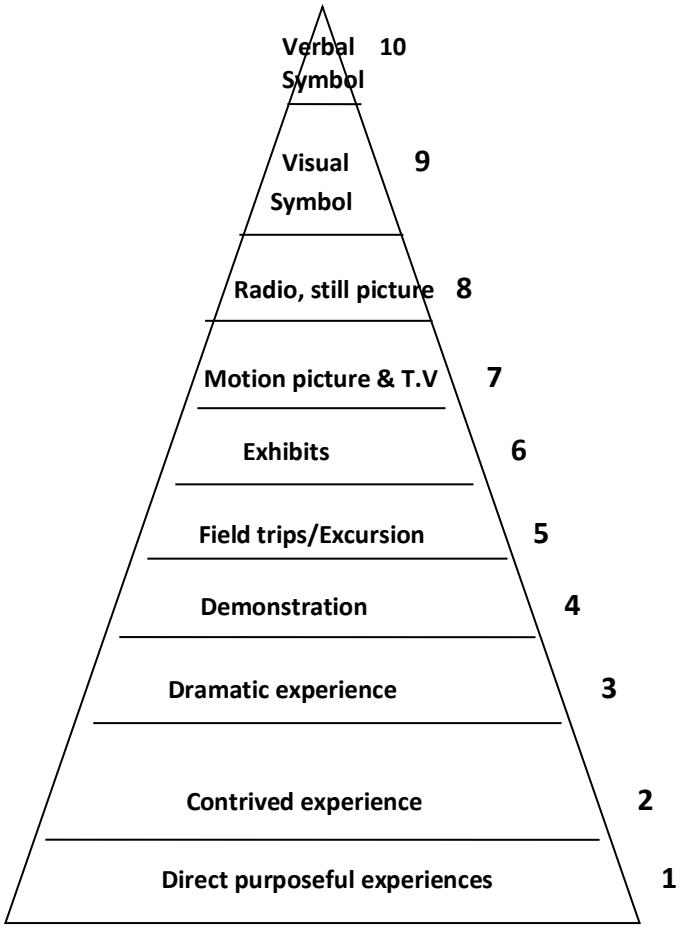
(i) Visual aids –charts, photographs, diagrammatic.
(ii) Audio-aids- radio recordings on discs, tapes and cassette.

(iii) Audio- visual aids –Films, T.V. sets.

Another way of classification, it can be;

i) Graphic aids diagrams photographs, charts, play cards etc.
ii) Three dimensional aids –models, specimens, real objects.
iii) Projected aids-slides, filmstrips, films.
iv) Aids through activity excursions, project setting and maintenance of aquarium, vivarium, and botanical garden.

Some of these aids are more concrete in nature and some of them are comparatively are abstract. Edger dale (1969) has developed a cone of experience for the proper selection of teaching aids in which priority has been given on the use of concrete and direct experience. Some of teaching aids are more concrete in nature and some of them are comparatively more abstract. Edger dale has arranged the various audio- visual aids in pictorial from which he called cone of experiences



Edger dale cone of experience

The cone of experience encourages direct purposeful experiences which make learning meaningful and intensive. Direct experiences provide live and permanent learning.

Teaching Aids, Which are used Regularly

In Indian context, these are some teaching aids which are used by teachers are blackboard, flannel board, models, specimen, overhead projector, computer and television.

Black Board

Black board is an essential teaching aid used in all classrooms to draw, to explain a point or to write or write definition, main points etc. Blackboard should be clean before and after its use, a science teacher should use a coloured calk to explain or to clear a point. Teacher should use the space judiciously while drawing a diagram on the board. Teacher should summarize his lesson in points on the black board.

Flannel Board:

It is also called flannel graph and can be used effectively for teaching science. It serves as a very good medium for displaying prepared cuttings. It is like a board where the picture or figure to be shown one cut in advance, out of any rough paper, preferably from coloured blotting paper, and are stuck to the surface of the board. It is time saving, economical and simple students are also encouraged to have their own cuttings out of news paper and journals on various topics of science. These cuttings can also be shown to whole class through flannel graph.

Charts, Picture and Models

A chart is a flat surface upon which diagrams are drawn with names of the parts or short notes on them. The main purpose of a chart is to make the idea that it represents simple, clear, and easily comprehensible. A chart may be used for initiating a discussion or for reviewing. It can also be used for testing the pupils. It is however not feasible for the teachers to make all charts. Important and essential charts must be procured from scientific or commercial firms. It is advantageous to use charts because they are easy to use.

Pictures of scientific interest and the portraits of great man of science give a right atmosphere to the science room. There use in teaching –learning or demonstration work makes the teaching somewhat real, interesting and effective. Picture should be bold direct and sufficiently large, so that everyone in the class can see clearly. ‘One picture-one idea’ means a successful pictorial illustration.

Models are used a great deal in science teaching models are intended to simplify ,by making it easier to understand the form and function of the object or things about which, it is difficult to gain direct experience. Models are simply replica of a thing or object. Many models can be prepared in the schools and others procured. Enlarged models of the eye, ear, teeth animal/ human’s skeleton, plant and animal cell etc.

Television

A television brings the world into the living room or a classroom. It has served as a powerful means of communication as well as education the world, world over. Instructional television programme has grown much popular and useful. It was found that the TV lessons were more advantageous than classroom teaching in the sense that it is more economic, interesting attractive and can make use of such costly and intricate apparatus and rare materials as well as other audio- visual aids that cannot be availed of by the schools. The follow up activities after a TV lesson inculcate the habit of discussion criticism and classification. A well organised T.V. instructional programme can become the most effective and potent aid to the teaching of science.

Radio Broadcasts

Radio-broadcasts can also be a valuable teaching aid. Popular talks on scientific topics should be broadcast from the radio- station, such talks, in addition to giving scientific information, create interest in the minds of listeners for studying science. Radio talk or broadcast can be a useful agent for disseminating scientific knowledge over an extensive area. The radio instruction programme is prevalent in the developed countries.

In addition to the above audio- visual aids, the school should possess the following visual aids. Some of these may be made by the teacher him- self with the help of the pupils.

Aquarium

An aquarium in the classroom creates an environment for the study of science. An aquarium may represent complete natural environment. The pupils get an opportunity to acquire first hand experience of many interesting events of aquatic animal life. They can observe and study the plant- animal relationship. The pupils can see how the aquatic animals and plants collect their food, how they grow: how they reproduce and how they interact to external stimuli. The aquarium helps pupils acquire the valuable concepts such as water contains dissolved air, many plants and animals live in water, plants and animals are interdependent, fish have special organs for breathing and moving freely in water etc.

Science Museum & Biological Garden

A school should also possess a science museum and a biological garden. The young pupils love collecting things and if the science teacher encourages them, there will be no dearth of science materials for the museum. Making a museum with the help of pupils is an interesting and motivating task and offers a wide range of interests and satisfaction. A proper use of Audio- Visual aids should make the teaching of science more fruitful and effective. It has been found that about eighty-five percent of the knowledge is gained through the sense of sight.

"Things seen are mightier than the things hear and one picture is worth a thousand words." These emphasize the importance of teaching aids in teaching.

Secondary Sources of Information-

At the time of science teaching students use science textbooks together some scientific information teachers give information to their students by some lectures or lecture- demonstration and discussion. In science some times, teacher also refers to some science books, which students take from libraries and read them. These are called primary sources of information.

On the other hand students can also gather a lot of scientific information from TV, radio, newspapers magazines, journals, videos, internet, U- tube, films etc. these are called secondary sources of information. Newspaper, magazines and journals give lot of scientific information to students. Students should be motivated and encouraged to read them at home, in libraries and share information with pears. Student should also be encouraged to write articles on science from newspapers, journals etc and such information if possible display them at the classroom bulletin board. Science teachers also make a habit for such readings and give some references to their students so that they could known, what to read and from where to read. The role of science teacher is to facilitate their students in how to use these resources.

A science teacher should also use local resources to make them familiar of science concepts. He should also have a good rapport with community and invite them for teaching –learning process.

5.3 Multi-Media Package

A variety of media is available to the teacher to enhance teaching and to deepen learning. Media provide rich visual experiences and help in managing education. Apart from the usual classroom aids like black-board, charts, flesh card, abundant use of various other instructional materials are made. They are over head projectors films, films slides ,films strips audio tape materials ,TV /Video tapes, U- tubes ,internets and computer etc. Every teaching aid has its individual's merits and it depends, on the expertise of the teacher to optimize the advantage of the aids with the methodology of his lecture.

A package of learning in which more than one medium is used is called multi- media package. Multi- media package contain textbook or printed materials audio- tapes, video cassettes, radio programme TV programme, computer programme etc. Multi media- is a very effective tool of learning science. Use of computer is a recent and fast method of learning process. The children start learning computer from class III onwards in many schools.

In Arunachal Pradesh under the aegis of SSA many schools are using smart class room facilities for effective learning. Teacher can use every effective material for learning. An ideal teacher can adopt any method and use any aid-visual, audio or audio- visual for he is all in all. The only point he has to keep in mind is that in behaviourial terms the objective

must be achieved by the child. Combination of two or move media as pointed materials. Slides, Audio tapes TV, Radio, Computer etc. are multimedia package. It can be developed and used to make science teaching more interesting.

5.4 Community / Environmental Resources

Teacher with her experience and planning use many learning materials for designing effective learning experiences in transaction of concepts applying various approaches and strategies. Students feel a sense of ownership to their learning when it is related to their own experiences. All the materials required for teaching and learning may not be available in the school. In such a situation the teacher may have to depend or fall back upon resources available in the community. There are a number of community resources that can be used for facilitating the learners in the construction of knowledge of science and to find the relevance and meaningfulness of this knowledge in the context of the world beyond the four walls of the classroom. The community resources can be physical or human.

The community or environmental resources can be utilized in two ways- either community can be brought to the class or class can be taken to the community. In fact, teachers, student's administrators and community can collaboratively work to utilize various community resources. It can be organised field visit or just stepping out of the classroom. Urban schools can have access to science centre, museums, national laboratories etc. whether the school is located in urban or rural area, it can utilize physical surroundings and its immediate environment as learning resources to further students interest in science. Integrating classroom learning with learners own experience outside the classroom contextualize their learning.

Limited resources and geographical condition should not be a barrier to meaningful learning of science. Information and communication technology (ICT) has made it possible for us to contact a person from any corner of the world. The expertise of specialist of various departments can be utilized for the enrichment of teaching –learning experiences. Using community resources is also advantageous for strengthening linkage between the school and community.

The immediate environment of the learner is natural resources. It includes physical, nature and socio- cultural world. Process of constructing knowledge is a continuous one, which goes even outside the school. Teacher of science should appreciate that the environment around the student is full of learning opportunities. They might utilize every conceivable situation for learning process; in school certain things are almost such as soil, plants, trees, insects, birds' sunshine and shadows, bicycle and automobiles. A corner of room may be used to organize learning materials, to keep some appropriate reference and other self-learning materials collected by the students. Teacher can use many materials in school for teaching –learning such as turmeric, pulleys bicycle tyres, electric fan, common salt, etc.

Learners should be encouraged to construct and reconstruct their knowledge from observing classifying, categorizing, questioning, reasoning, arguing and interacting with the natural world and people around them.

Community resources can be used in teaching –learning of science either by brining community to the class or by taking class to the community.

Using community resources

Bringing Community to the Class; Different members of the community have a large variety of valuable knowledge. These members can be invited to school and learners can interact with them. Learners can visit their places of work also. Electrician, carpenter, veterinary doctors, potters and farmers should be invited to school to discuss various topics in schools.

Taking classes to the community and field visit.

Whenever needed, the learner can be taken to the community resources for learning. Learners get opportunity to discover the concept and their connection with their environmental. Students can use this opportunity to learn various skills in interacting with physical world, materials technology and other people.

The resources maintained by the community can provide great learning experiences for students. These resources when tapped properly help us to understand science as an experience.

UNIT- 6

INNOVATIVE EXPERIENCES

Course Outline

6.5 Science Museum
6.6 Science Exhibition
6.7 Field Trips
6.8 Namdapha Tiger Project and D. Ering Wild Life Sanctuary

6.1 Science Museum

It is desirable that every School should have a science Museum. Tha teacher should encourage the students to collect materials of scientific interest and improvise some apparatus. It should be a result of the cooperative and active endeavour of the teacher and the students. Materials from different branches of science should be collected and arranged systematically and labelled. Each exhibit should contain the following information:

(i) The name of article
(ii) The place from where the specimen was collected
(iii) Time or season of collection
(iv) Name of person who gave it
(v) The family to which the specimen belong
(vi) The purpose of the specimen collected with a brief description about it.

Museum plays an important part in the intellectual and cultural life of the individual.

The main objectives in establishing Science Museum are–

(i) To help young science learners in understanding concepts of science
(ii) To provide a glimpse of part as well as an insight into the future;
(iii) To help schools in their class activities by providing them with a number of equipments and specimens which are otherwise difficult for a single school to procure;
(iv) To arrange extension activities such as field trips lectures film shows and exhibitions by Mobil Science Unit.

It should always be borne in mind that the purpose of museum should not merely be as a visual aid in teaching but should appeal to and stimulate.

a) The sense of curiosity in the pupils' in order to widen their experiences.
b) The sense of beauty to see and appreciate the beauty of nature.
c) The spirit of inquiry at the complexity of nature.
d) The skill of man in using nature's resources for his own betterment.

A couple of science Museums have been set up in the country including one at Delhi. It is better to establish a mobile science unit. There are good Science Museum in various parts of the country as in Mumbai, Bangalore and Calcutta. All these science Museums are doing very good job, carrying out various innovative activities, exhibitions in science for the improvement of science education.

Nehru Science Centre

The Nehru Science Centre (NSC) is established in Mumbai by National Council of Science Museums. The most important and attractive part of the Nehru Science Centre is a science park for children. It has exhibits on time motion, energy, power, and work. There are models of railway engines, tramcars, aeroplanes, steam engines, a windmill and a sun dial. There are birds, animals, and fish to acquaint children with nature. The science centre also offers a gallery on light and sight. It presents different principles involved in the process of seeing and vision. Nehru Science Centre also organizes extension activities such as science extension in rural areas, film shows, science seminars for schools, film loan service, radio classes for special sciences film festivals etc.

Some Science Museums have mobile science units, museums on wheel. They are usually sent to the places, where there are no science museums. They are not as big as a science museum. This affects sources of learning science for students at upper primary level.

In Arunachal Pradesh, there is a science park at Indira Gandhi Park, Itanagar. Children can see the different types of exhibits of science as models of different satellites etc. Teachers of different schools of Naharlagun and Itanagar and their adjoining areas can arrange a visit of school children to Science Park at Itanagar.

6.2 Science Exhibition

Learning by doing and learning by living are the two cardinal principles of teaching and same is true in the case of teaching science. The present curriculum does not provide ample opportunities to the student for self expression. Independent research, constructive activities and other prospects has shown there is no time is allotted for such type of work in the time –table. Naturally these arise, the need for such an organisation which can provide an outlet for the pent up emotions of children and channelize their energies towards desired goal. The science exhibition is also a programme which caters the need of inculcation of scientific attitude, a genuine interest in science and scientific activities, supplements the work of classrooms and the laboratory.

Every school should organize science exhibition at least once a year. NCERT, New Delhi has been organising a national science exhibition at national level every year. In Aruanchal Pradesh also a state level, district level science exhibition are organized by Govt. in schools every year. Science exhibition have social, intellectual, psychological and educational values. The students take part in group projects and activities and learn many things which cannot be learnt through classroom teaching. They develop not only intellectually but also socially, psychologically and educationally. The instincts of construction, acquisition, curiosity etc also gets satisfaction. Science exhibition provides an excellent for discovering and encouraging science talent. The students should be encouraged to take part in science exhibition at school, District, state, and national level.

The organisation of science exhibition should be teacher –pupil activity and everything should be thought of, well in advance. Every year NCERT announces a main theme and sub themes for science exhibition.

Every year, NCERT, New Delhi sent the information about the science exhibition to states and union Territories. After receiving this information children starts working on their projects- static or working models or investigatory science projects under the guidance and supervision of their science teachers. Very often in science exhibition some static model and working model or some experiments demonstrated by the students with the help of chart

and graphs. Students should be encouraged and motivated to work on some investigatory science projects. A project which involves investigation, discovery and finding out something which was not known to the student before, is an investigatory project, working on an investigatory science project is the way, a student can learn science by using scientific method which involves the steps –problem hypothesis, experiment and conclusion.
In science exhibition, it is desirable that each exhibit is self explanatory. It should be well labeled, preferably with an explanatory card with title and explanation. The selected students should be made incharge of various experiments and they should be given full explanation of each experiment or exhibit. The exhibition may be inaugurated by some important man of science. Students of all schools and community member may also be invited.

The exhibition should be judged by different judges who are chosen from amongst the individuals in the community having some back ground of science, scientist, college professors and science teachers. The judging criteria should be developed and it should be made available to students. It is better not to allow the public or students to see the exhibition before the judging has been completed. Criteria of judging the exhibit should be on originality, creativeness, technical skills and utility.

Every Year science exhibition are organised where exhibitions and experiments developed by the students are displayed. The NCERT, state institutes of science education and the Jawaharlal Memorial Fund provide financial support to these exhibitions.

6.3 Field Trips

Concerted efforts have been made to device learning strategies and instructional procedures which will improve the effectiveness of teaching. Organising field trips is one such instructional procedure which will improve the effectiveness of science teaching.Organising field trips is one such instructional procedure which provides new learning situation to pupils. A science teacher should arrange such field trips or visit to local centres such as factories, gardens, farms or museum. In every place, the community resources provide immense possibilities for educative experience in science. The scientific facts and principles become more realistic to them and they see the relation between science and society.

A field trip enables the pupils to get clear idea about the lesson or topic that is being taught. It provides an excellent opportunity for correlation field trip means a biological excursion or nature study trip; the term can be applied to any activity outside the classroom in which the pupils participate. **Field trips are a means of acquiring knowledge and understanding through a systematic and direct study of the biological and physical environment**. It is an out of classroom activities where pupils observe, experiment investigate, explore and interpret the natural phenomena.
Field trips may be considered an active, special of laboratory situation where pupils collect, observe manipulate, study, interpret and evaluate the scientific principles. It stimulates learning and encourages interests in activities.

Planning of Field Trips
A science teacher should plan before going on the field trip. He should know the place to be visited and its curricular relevance. How and where these activities will sit into curriculum, is to be determined by the science teacher.

The following points should be consider at the time of planning-
• Selection of place of visit
• Discussion with students about the field trips
•Permission from head of the institution
• Consent of parents
• Finalisation of duration, times of departure, rest transport and required materials.

Conducting the field trip

Conducting field trips successfully demands carefully planning, skillful execution and meticulous follow up and evaluation.

Purpose of the field trips
• Utility of the field trips
• Place to be visited
• Transportation and cost
• Discussion with parents
• Preparation of agenda
• Plan for follow- up and evaluation

Follow- Up of the Field Trips

Teacher should plan follow- up activities in order to make learning experience, a fruitful one after coming back from the field visit students can discuss their observations and experiences, ask questions and share photographs. Teacher needs to encourage students to submit the report and mention explicitly what they learned from the visit. Evaluation of the field visit can be done in the light of the planned objectives

Advantages of Field Trips

Field trip are useful for both the individual work or smell group work where the students learn collection of data, formulate hypothesis, devise models , develop experiments manipulate variables and draw inferences.

The Field trip

• helps in providing firsthand experience to the students which is not possible within the four wells of the classroom
• enriches General knowledge of students. It supplements the classroom learning.
• helps in broadening the outlook, deepens in sight and widens vision of students.
• helps to deepen understanding of the concepts and bring clarity in the subject
• develop an inquiry attitude towards the environment
• develop skills in science processes like observation, collection, classification and analysis of data.
• brings the awareness that science is all around us and not just in books
• relates the community to the learners, teachers and school and encourages sharing of responsibility of child's learning with the community
• Acknowledge the authenticity of community knowledge.
• provides an opportunity to learn about the ecological problems, their importance and relationship with the people.

4.4: Namdapha Tiger Project and Ering Wild Life Sanctuary

Namdapha National Park is the largest protected area in the Eastern Himalaya biodiversity hotspot and is located in Arunachal Pradesh in Northeast India. It is also the third largest national park in India in terms of area. It is located in the Eastern Himalayan sub-region and is recognized as one of the richest areas in biodiversity in India. The park harbours the northernmost lowland evergreen rainforests in the world at 27°N latitude. The area is also known for extensive Dipterocarp forests.

Because of many different vegetation zones, the park is home to a great diversity of mammal species. Four big cat species occurred in the park: snow leopards, clouded leopards, common leopards and tigers. Other large predators are dholes, wolves, and Asiatic black bears. Smaller carnivores include red panda, red fox, yellow-throated marten, Eurasian otter, Oriental small-clawed otter, spotted linsang, binturong, common palm civet, small Indian civet, large Indian civet, masked palm civet, marbled cat, fishing cat, Asiatic golden cat, and two species of mongoose. Large herbivores are represented by elephants wild boar, forest musk deer, Indian muntjac, hog deer, sambar, gaur, common goral, mainland serow, takin and bharal. Seven species of non-human primates including Stump-tailed macaque and Slow Loris, Hoolock Gibbons, Capped Langurs, Assamese Macaques and Rhesus Macaques.

Namdapha was established as a wildlife sanctuary in 1972. It was declared a tiger reserve and national park in 1983. Total area of the park is about 1807.82 Km^2. The park is located in the Changlang district of the state of Arunachal Pradesh.

Namdapha National Park is famous for being the only park in India to have four big cat species, like leopard, tiger, clouded leopard and snow leopard. Around 96 mammal species are found here of which 29 species are listed on Schedule I of the Wildlife (Protection) Act, 1972.

National park is an area which is strictly reserved for the betterment of the wildlife & biodiversity, and where activities like developmental, forestry, poaching, hunting and grazing on cultivation are not permitted. Their boundaries are well marked and circumscribed.

UNIT 7

SCIENCE FOR ALL

Course Outline

7.3 Issue of Gender, Language, Culture, Enquiry in science classes
7.4 Introduction to Science and Society Interface

Introduction

Science is one of those human activities that man has created to gratify certain human needs and desire. The search for truth is the dominant motive in the prosecution of science. Science is valued mostly for its practical advantages. The great value of science is that it has introduced us to new ways of thinking and reasoning

7.1 **Gender and Science Education**

Preparation of the individual for the future is one of the aims of education. Science as a subject is rightly serving this purpose. Studies have shown that girls in the same class get science education different from boys. Science textbooks and science teachers like others are not free from gender bias. Science teacher also gender stereotypes as others. More discerning efforts are needed to remove gender bias from textbooks and classroom practices. Gender sensitization of teacher both at pre- service stage and during in service training programme is critical to promote gender fair in science education. Further measures (including motivating the parents) are needed to encourage more girls to pursue science education and careers in science and technology.

The curriculum should strive to make the contribution of women to the field of science and technology 'visible'. Teachers should be sensitized to promote equitable classroom practices to ensure 'science experiences' of comparable quality to girls. Teachers, teacher educators, textbook writers and educational administrators are to be made sensitive and responsive to gender related issues. Studies should be undertaken to understand how gender bias operates in schools both within and outside the classroom.

Science and Language

Science students are usually weak in their expression so it is very essential that the science students should be able to express their thought in clear, concise, correct and attractive language. Science learner can be provided the opportunity for literary expression by being asked to write the details of their observations, procedures and conclusions of scientific experiments they perform. They should be encouraged to write all observations precisely. For example, on completion of a project, an experiment or a field trip or observation of a scientific demonstration, the students may be asked to write an essay describing all aspects of such an under trip. The students will have to be creative in his writing and will learn the use of right words to describe his experience which is good exercise in composition and translation of thought and feelings in to words.

In the field of literature, there are a number of writings in science study. Similarly the historical events and the biographies of scientists provide an excellent material for reading. The language teacher or science teacher can ask the students to write an essay on some inventions or on the life history of a scientist. The language teacher can occasionally be invited to criticize the expression of science students and give some constructive and valuable suggestions for improving the style of expression.
In Arunachal Pradesh, many students could not perform well in science education due to language (English) problem. Language must be taught properly at primary stage so that student can write and express their views properly.

Culture and Science

Science has made a tremendous impact on the cultural life of the present day society which is a product of science. The thinking feeling and actions of a modern man are practically guided by the effects of science. There is an involvement of science, direct or indirect, in all works as well as leisure of a modern man, our habits and attitudes have also been affected by science. The study of science brings behavioural change in the learner and enriches his character and personality. Science gives opportunity for creative thinking and constructive imagination.
Science is a subject where ideas can be experimented upon and verified. The learners develop the habit of searching for the truth. These qualities affect the patterns of behaviour of the learner.

Culture, in addition to knowledge, includes all activities, thoughts and feelings, attitudes patterns of individuals or social life of man. The study of science gives opportunity for the development of favourable traits of human character which becomes a positive contribution to the cultural life of the society. Science fiction being interesting it adds to the cultural heritage of man. Similarly, the literature on history and development of science is no less interesting. It is the study of the origin and development of civilization itself and has developed into a separate branch of study which contributes to the cultural heritage.

In Aruanchal Pradesh, many things have been changed by the impact of science education, for example-killing or hunting of wild life banned in the society to conserve the environment. People use artificial beak of Hornbills in their capturing festivity.
Science education aims to make students develop scientific attitude, so that in later life may be able to help society make rational choices when confronted with various possibilities and challenges.

“If science is to be pursued with full vigour and zest and is to become a mighty force in the Indian renaissance, it must drive its nourishment from our culture and spiritual heritage and not by pass it. Science must become an integral part of our cultural and spiritual heritage”.

Equity in Science Class

Equity is the fundamental goal of any democratic society such as ours. Yet, so far the system has failed to address the issue of quality science education for all adequately. Many students come out of schools as 'scientific illiterates'. This is basically because many groups of students are placed in a disadvantageous position Vis-à-vis learning of science. The disadvantageous group includes girls, children from rural areas, tribal and other socio-economically under privileged children in rural as well as urban areas, those with learning difficulties and physically challenged children. Learning needs of these disadvantaged groups require greater attention. The system, in general, and the teacher in particular have to be sensitive to the needs of these diverse groups of children.

Given the low levels of literacy and schooling in the country and state, the majority of students are first generation learners. In this context education is often blamed for bringing about an alienation of the child from the family and society. Local situation and technological education too should serve to integrate the child into the society. (NCF-2005)

Science learning should be used as an instrument of social change to reduce the socio-economic divided. Science education ought to empower student to question the social beliefs, nations and practices that perpetuates social inequality.

Equitable educational systems foster the maximum development of individual potential. A commitment to equality ensures that all children have access to quality education. To assure educational excellence for all students, schools must appreciate the diversity that students bring to the environment and organize schools and classrooms in such a way that the overall development of all students is ensured. Equality helps to ensure that all students experience the highest level of academic achievement possible, economic self- sufficiency and social mobility. Diversity should be valued in school and each individual should be respected.

Researchers have shown that the boys and girls perform equally well in science learning. Therefore, no gender bias should be practised in the classroom and in allotting scientific work to the students. Teachers, teacher educators, textbook writers and educational administrators must be made sensitive and responsive to gender related issues.

There are other sections or groups of students whose needs are special. The education system should display conviction and mobilize required resources to put in place support systems that will help these children to overcome their inadequacies in learning science in a meaningful manner. Books written in Braille must be made available to all visually challenged students. Science teacher should develop in all students including those with special educational needs, the ability to analyse the options available, and to facilitate the possibility of making informed decisions.

A science teacher may use the following actions to foster equality among students in teaching of science.

• use science curriculum as an instrument of social change to reduce the socio- economic divided and to help to fight prejudices related to gender cast, religion and region. Teacher should highlight the contribution of scientists belong to various nationalities, caste, races, colours and sex etc. during teaching learning of science.

• emphasize gender sensitization of teachers both at pre- service and during in-service training to promote gender fair science education.
•during practical work, importance should be given to all students irrespective of gender, religion caste etc.
•use (ICT) information and communication technology as a powerful tool for bridging the social divided in education and as an opportunity equalizer.

7.2 Science and Society Interface

Human's inquisitiveness and use fullness of the knowledge of science are the two main factors which have led them to continuously strike to understand the behaviour of nature and use the knowledge of science to make their life more comfortable. Science has influenced and benefited us so immensely that it has become indispensable. At the same time, the society has also helped science to grow.

The present world is a world of science and Technology. Everything or every event happening around us demands some knowledge of simple scientific facts or principles. Without the elementary knowledge and information of science we will be at a loss in the society. Science is how every day, science for everybody, its knowledge must no longer be can fined to the classes but must reach the masses.

The achievements and the benefits of science touch all sectors and all levels of the modern society. The modern man has applied science and technology for the well being of mankind by inventing machines and by harnessing the resources of nature. The recent advancement in the field of science and technology, the wide application of the achievements of science in industry, agriculture, medicine, transport and communication as well as their uses in domestic life. Science enhances the quality of our life and it is visible in all walks of life. The need of the society has always played a very important role in the development of science.