



PEDAGOGY OF

PHYSICAL SCIENCE



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UNIT - 1

INTRODUCTION TO SCIENCE AND PHYSICAL SCIENCES

1. What is the meaning of science ? Explain Nature and scope of science ?

Ans : Meaning of Science : The English word Science is derived from a Latin verb 'Scire' Which means to "know" and Latin Noun "Scientia" which Means knowledge.

Meaning of Science is based on German word Wissenschaft which means systematic organized knowledge. Thus, science is a systematized body of knowledge.

"Science as "an accumulated and systematised Learning in general us age restricted to Natural Phenomena"

- **Columbia Encyclopedia**

"Science as an accumulated and system, sed learning in general us age restricted to Natural Phenomena".

- **Johnwood burn E.O. obourn.**

Nature of Science : Nature of Science can be briefly described as below.

+ Science is based on observations. + Science develops scientific attitude. + Science is a product + Scientific facts are tentative + Science is a process

Scope of Science : The scope of a science is the range of disciplines. Scientific or social, which it includes.

Science has brought about a change in such important aspects such as health, communication. Transportations etc. Actually the modern world is created by science and maintained by science.

Importance of Science : + Science also deals with human problems, environmental problems and health hazards which are solved by scientists efforts. + The important aspect of science is new creation, discoveries and technologies. + Science have become the back bone of todays development in all the fields.

It helps us to understand the Nature and Life around us and lead a comfortable life and pleasant life.

2. - What is the meaning of Physical Science ? Explain Nature and Scope of Physical Science.

Ans : Meaning of Physical Science : Physical Science branch of Natural science that studies Non-Living systems, in contrast of life science. It is turn has many branches each referred to as a physical science together called the "Physical Sciences" However the term physical creates an unintended.

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

Nature of Physical Science : Physical Science is an encompassing term for the branches of Natural Science, and science, that study Non-Living systems, in contrast to the biological sciences. The term physical creates an involuntary, some what arbitrary distinction since many branches of physical science also study biological phenomena.

Scope of Physical Science : Physical science is the study of matter and energy. It includes chemistry and physics.

Importance of physical science : Science with physics as its base, can solve many of the crises facing the world such as global warming. Waning energy, over population, Natural disasters and the slow poisoning of our planet.

3. Explain the structure of science ?

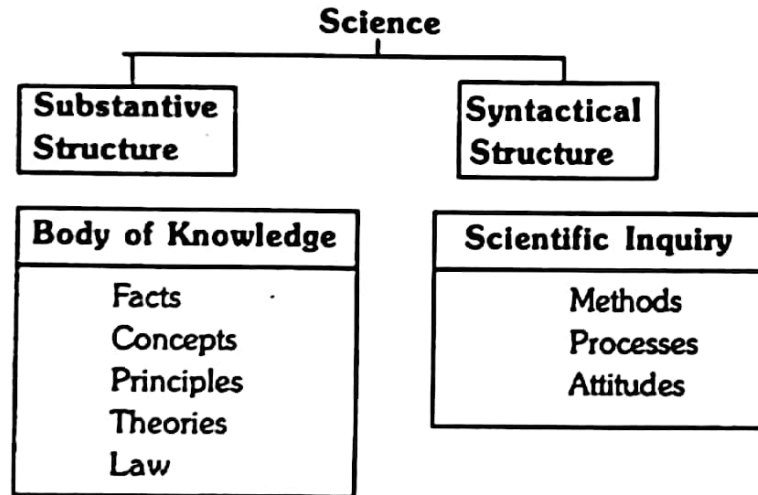
Ans : If we analyse the definition of science, we find two statements describing science a) science involves methods of inquiry or processes of science b) This inquiry results in a body of systematized knowledge or content or concepts.

i.e. Science = Conceptual Scheme + Process of Scientific Inquiry

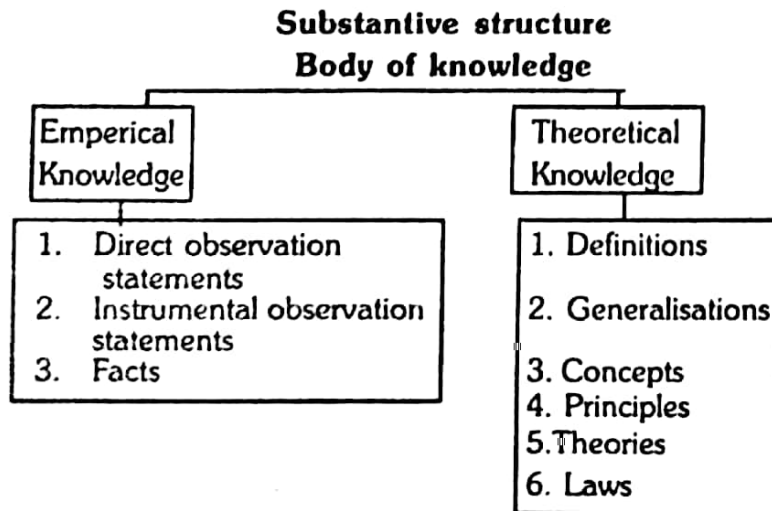
The Nature of Physical Science includes not only concepts but also the methodologies which are used to find out these concepts. Joseph J. Schwab (1964) and Bruner (1962) have contributed to this field. It can be divided into two parts.

a) Substantive structure of science (b) syntactical structure of science.

The substantive structure of science represents the major conceptual schemes which constitute the basic knowledge used in science. The substantive structure of science contains different classes of statement. Definitions, theory statement etc.



Substantive structure : The substantive structure consists of the interrelated collections of powerful ideas. This systematic body of knowledge can be divided into two broad categories as empirical knowledge and theoretical knowledge.



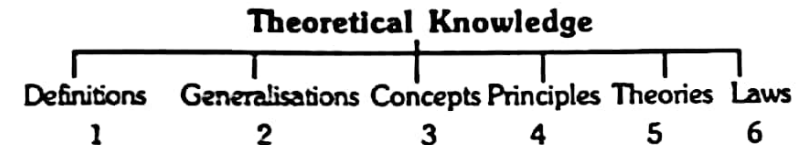
Empirical Knowledge : Empirical knowledge contains direct observational statements, instrumental observation statements and facts.

a. **Direct observation statements** : These statements are made by our unaided senses Example : ICE is cold

b. **Instrumental observation statement** : These are made with the aid of instruments. Example : The sun has black spots.

c. **Facts** : A statement is truth, unchanging and indisputable and it is the product of a single observation. Example : Water boils at 212°F.

d. **Theoretical Knowledge** : This knowledge is based up on probability and is not necessarily verifiable.



1. **Definitions** : Definitions explain terms.

2. **Generalisation** : As facts accumulate, they may show patterns of relationships. A statement of one of these patterns is called generalization or a concept.

3. **Concepts** : When a series of facts seem to fit together, scientists call this a concept. Example : Molecule

4. **Principle** : When generalizations are based on many direct observations and repeatable demonstrations, they become principles. Example : The like poles of Mas nets will repel each other.

5. **Theories** : Theories explain scientific finding in an efficient way.

6 **Scientific Laws** : Scientific laws are derived from and explained by theories.

Example : Boyle's law is derived from and explained by the kinetic molecular theory.

4. What are the values of teaching physical science.

Ans : The term valve is derived from Latin Word 'Valerie' which means to be strong and vigorous.

Definitions : Valve is that which satisfies human desire - Urban

Some of the values of Teaching physical Sciences are : Herein, a great experimenter was referring to the faculty of theoretical reasoning.

Vocational value : A student of science has a wide range of career options ranging from engineering, technology, Medicine to pure science like physics, Chemistry and Applied science like Biophysics Biochemistry etc.

Intellectual value : Physical Science provide opportunities to the student to develop all his intellectual abilities like meaningful observation. Purposeful thinking, critical reasoning and synthesis.

Disciplinary value : Science inculcates a spirit of enquiry, seriousness, open - mindedness and unbiased decision making

Utilitarian value : Physical science have wide ranging application. In the field of industry, transport and communications, agriculture and medicine.

Moral value : Science in its pursuit not only includes traits of morality like honesty of purpose, punctuality, self control, tolerance but also instils them in a student of science.

5. How do you correlate physical science with other subjects ?

Ans : Physical science has correlation with other subjects. Some of the significant roles played by science in our daily life are

Physical science with Mathematics : Physical Science is probably incomplete with out mathematics. It is mathematics thus has given a sound footing to the scientific laws. For the real understanding of science the knowledge of Mathematics is important.

Physical Science with Biology : The correlation

between physics and biology is so large that at present we came across such subject as Bio Physics.

Physical Science and Social Studies : Physical Science and Social studies are related to each other to a great extent. History and its study pave the way for the present generation to learn from the past experiences.

Physical Science and Language : Science students should be able to express their thought in clear, concise, concise correct and attractive language.

Physical Science and Fine arts : Physical Science and fine arts can commonly deal with colours and colour mixing. The knowledge of different notes, typical vibrations system in strings and air columns, musical scales etc.

Physical Science with Environment : Environmental Science is an interdisciplinary academic field that integrates physical sciences (Including Physics, Chemistry) to the study of the environment, and the solution of environmental problems.

6. Write about analysis of selected concepts of physics and chemistry.

Ans : Analysis of selected concepts of Physics and Chemistry of classes 8-10

| S.No. | Plotting | 8th Class | 9th Class | 10th Class |
|-------|----------------------|--|--|---|
| 1. | Materials | Synthetic Fibres - Plastics -Metals -Non metals | matter around us -Is matter pure - Atoms -Molecules -What is Inside the atom | Chemical reactions - Equations - Acids - Basis -Atomic structure - Periodic Table |
| 2. | Natural Resources | -Coal - Petroleum - Fuels | | - Metallurgy - Carbon and its compounds |

UNIT - 2

DEVELOPMENT OF SCIENCE- PHYSICAL SCIENCES

1. Discuss the Milestones in the development of science?

Ans. Milestones in the Development of Physics:

Physics is the science of matter and its behaviour and motion. The first written work of physics with that title was Aristotle's physics.

✦ In 1687 Isaac Newton published *principia mathematica*, a summary of his contributions to physics. Newton created Mechanical Engineering, Bridges, tunnels, ships, planes - all are designed on Newton's principles.

✦ In 19th century a comparable revolution led by Michael Faraday and James Clerk Maxwell. The nature and behaviour of things electrical currents and charges, Magnetism and the electrical nature of light - were unified into one comprehensive theory.

✦ In 20th century x-rays were discovered (Röntgen), radioactivity was discovered by Becquerel, the electron was discovered by J.J. Thomson and in 1890 Max Planck made the first attack on the mysteries of atomic structure by proposing the existence of quanta.

✦ The conquest of the atom led by Ernest Rutherford, Niels Bohr and others between 1910 and 1930 gave rise to quantum mechanics which revolutionized physics, most of chemistry and an important part of biology.

✦ In 1944 Erwin Schrödinger wrote a book entitled *What is life?*

✦ Einstein gave us a new view of the cosmos and a new and unobvious view of the nature of space and time.

Milestones in the History of Chemistry: The history of chemistry begins with the discovery of fire, then Metallurgy which allowed purification of metals and the making of alloys, as well as the exploitation of many minerals and natural substances.

✦ Atomism can be traced back to ancient Greece and ancient India. Greek atomism dates back to 440 BC, as what might be indicated by the book *De Rerum Natura* (The Nature of Things) written by the Roman Lucretius in 50 B.C.

✦ Aristotle opposed the existence of atoms in 330 BC.

✦ Robert Boyle (1627 - 1691) is considered to have refined the modern scientific method for alchemy and to have separated chemistry further from alchemy.

✦ Boyle was credited with the discovery of Boyle's law.

✦ Antoine Lavoisier who developed his law of conservation of mass in 1789 also called Lavoisier's law.

✦ Mendeleev made his prediction in 1870.

✦ In 1912 Ernest Rutherford and Niels Bohr discovered atomic structure.

✦ In 1951 a milestone article in quantum chemistry is the seminal paper of Clemens J. Roothaan on Roothaan equations.

✦ In 1983 Kary Mullis devised a method for the in vitro amplification of DNA known as the polymerase chain reaction (PCR).

2. Discuss the contribution of ancient Indian and Western scientists for the development of science?

Contributions of Indian Scientists.

Contributions of Aryabhatta (476-499)

Ans: The first Indian built satellite launched by a Soviet rocket in 1975 was in honour of Aryabhatta. This eminent Indian astronomical scientist and mathematician lived during 476-551 A.D.

Aryabhatta's greatest work is *ARYABHATTEYAM* which was written at his age of 23 (499 AD). *Aryabhateeyam* is a literal work containing 4 quadruplets of 121 hymns. His major contribution to the field of astronomy and Mathematics was the most accurate value of "pi" as 3.1416 because "pi" is the sign of the value of radius and perimeter of circle. In Geometry the use of "pi" is very common.

Aryabhatta around the 6th century developed astronomical science into a regular science on a regular and systematic pattern. Only Aryabhatta brought algebra to light.

To conclude, Aryabhatta continues to be a polestar for many more New Investigations in astronomy, he was an authority on astronomy and his formulae in solving many astronomical problems are very simple and are accepted and adopted even to day.

2. Contributions of C.V. Raman (1888-1970)

Chandrasekhara Venkata Raman was born at Tiruchirapalli, Tamilnadu in 1888. It is almost a household name in India reverberating "Raman Effect".

Raman opined that Roentgen's epoch making discovery of x-Rays marked the beginning of new physics.

Raman's Contributions:

✦ On cosmic radiation the purpose of science is to obtain deeper understanding of the powers of nature ✦ Studies in acoustics: ✦ Studies on vibration - percussion instruments mridangam

(b) studies on whispering gallery in St. Pauls Cathedral London

Study in optics: The wave like nature of light is subject to reflection refraction, diffraction oblique diffraction has also been described.

Raman Effect:

(i) Mono chromatic light from a mercury arc was passed through transparent materials, and was made to fall on a spectrograph to record its spectrum. He observed some new lines in the spectrum called "Raman Lines".

(ii) Suppose a beam of light is Incident on a liquid the incident light will either be absorbed by the molecules in the system or it will be scattered called Raman scattering. He did work on scattering of light in crystals.

His ambition, Instead was to serve science.

3. Contributions of Subrahmanyan Chandra sekhar: Subrahmanyan Chandra Sekhar was born on

19-10-1910 in Lahore, British India. He is well known as Chandra Sekhar limit.

According to him, the important contribution to science as follows.

✦ Stellar structure, Including theory of witedwarfs (1929-39) ✦ Stellar dynamics, Including the theory of Brownian motions (1939- 43) ✦ Hydro dynamic and hydro magnetic theory (1950-61) ✦ The equilibrium and stability of ellipsoidal figures of equilibrium (1960) ✦ The mathematical theory of black holes (1971 - 83). ✦ Theory of colliding gravitational waves.

II. WESTERN SCIENTISTS

1. ARISTOTEL The Greek period has produced great thinkers whose contributions are responsible for changing the entire course of world civilisation of later times. One the geniuses among a galaxy of contributors for scientific thought especially in mathematics and astronomy are Aristotle. He is considered as the father of Biology. He is born in the year 384 BC at 'Stagera', He is student of Plato. His wife is the sister of Herminius. Alexander is the pet student of him. Aristotelian philosophy spread to the universities Western Europe and special emphasis was laid on the study of logic and mathematics. Aristotle's physics emphasised the values of experimental studies in science over scholastics studies. Based on the resources available at that time and his logical reasoning Aristotle suggested so many theories.

Awards : father of Modern Science and Father of Terminology.

Books : 1. De Anema 2. Argonan 3. Parvathuralia 4. Eudemous 5. Ethics 6. Protestican 7. Politics 8. History of Astrology.

Discoveries : Phisiology, Characteristics of Blood, Sensory knowledge, origin of earth, change of dialectic in to teaching technique. He is the founder of ancient school.

Some errors in his discoveries: 1. Geo centric method 2. Moon is also a star 3. Energy doesn't necessary for object motion. 4. Heavy bodies are falling on the earth fastly than thinner bodies.

He is dead in 322 Bc at Yabbou Iceland. Some of the ideas suggested by Aristotle were later found false by experiments conducted by Nicolas Copernicus, Galileo Galilee and Isaac Newton.

2. NICOLAS COPERNICUS

Copernicus, as he is popularly known as was a polish astronomer was postulated in 1507 that the sun and not the earth was a centre of the universe, With the earth and other planets revolving around the sun and the stars in the vast and limitless havne surroundings then all. He said that the earth revolves. On its own axis to cause days and nights and this accounted for the old belief that the earth was at the centre of the universe. This theory is known as the Copernicus world system which is found in his famous book, entitled on the revolution of planets, which was published on the day of his death, which occurred during 1543. The finding of Copernicus was often a long period of constant and careful study. Though Copernicus was not the first man state this truth. People did not accept it. He could not therefore publish what he found and this fact on the planetary system was made known the world only by Galileo.

Copernicus was born on 19th February 1473 in Totun, Poland of wealthy merchant who was also a magistrate and civic leader. Copernicus was very intelligent and after the premature demise of his father, with the guidance and benevolence of his uncle, he began to study at Cracow at the age of 17. There he studied mainly philosophy, astronomy, geometry and geography, during the time of Copernicus, astronomy was of greater importance for a general study and there was a great need for setting up an accurate calendar for proper celebrations of the church holidays, Copernicus also studied medicine for the useful service in the church where his uncle was a bishop. At the age of 39, his uncle died and Copernicus had to work as a canon of the cathedral in the church at Franeesbug.

Copernicus became famous for his mathematical and philosophical formulations of the theory of the universe. Also being at the service of the people in the church Copernicus published a book on his findings and observations entitled 'Revolutions'.

Copernicus De revolution bus orbium coelestium, published a few days after his death, gave new currency to the ancient Pythagorean hypothesis that the Sun was at the centre of the

universe and that the planets (including the Earth) revolved around the Sun.

3. ISAAC NEWTON:

Sir Isaac Newton is born in a small village in England on 25th December 1642. His father was dead before his birth. He brought up under the love and affectionate of mother and Grandmother. His relatives were gave a big hand to his studies. He did his graduation in Trinity College of Cambridge University. At the age of 27 he become as a professor of Mathematics in Cambridge University.

Some of the article prepare by Newton.

1. Wind Mill
2. Water clock
3. Shadow clock on the rock

Once he sat under an Apple tree and found that the apple fallen on the earth. With that observation he did many research works and he proposed the Gravitation Law. First Newton proposed three laws of motion.

1. Newton's First Law of motion
2. Newton's Second law of motion
3. Newton's Third law of motion

His works:

1. Principia Mathematica
2. Anmotion
3. New theory about Light and Colour Universal Arthimetic
4. Write about land marks status an development Indian science and Technology.

Science and Technology have always been an integral part of Indian culture. The department of science and technology plays a pivotal role in promotion of science and technologies in the country.

Vikram Sara Bhai - A physicist considered to be the father of India's space program was instrumental in the creation of both the Indian space research organisation and physical research laboratory.

✦ Jawaharlal Nehru Initiated reforms to promote higher education science and technology in India. ✦ The Indian Institutes of Technology conceived by a 22 member committee of scholars and enfrapreners in order to promote technical education was Inaugurated on 18-08-1951 at Kharagpur by the minister of education maulana Abdul Kalam Azad. ✦ More IITS were opened in Bombay Delhi, Madras, Kanpur as well in 1950-60. Beginning in the 1960s, close this with the soviet Union enabled the Indian space research organization to rapidly develop the Indian space

program and advance. + Nuclear power in India even after the first nuclear test explosion by India on 18-05-1974 at Pokhran + India Invested US 3.7 billion in science and technology in 2002 - 2003.

Impact of science and Technologies on society.

Sociological factors effects on Society: Society has under gone rapid and radical changes due to advances in science & Technology in recent years.

ENVIRONMENT: The effects of technology on the environment are both obvious and subtle.

Economic & Technological Development: Technology is an inseparable part of human society especially in its economic aspects funding sources for New technological endeavours is essential

3. Write about landmarks, status and development Indian Science and Technology.

Ans : Science and Technology have always been an integral part of Indian culture. The Department of Science and Technology plays a pivotal role in promotion of science and technology in the country.

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4. Explain the role of physical science Inhuman life?

Ans : Physics the study of matter, energy and their interactions is an international enterprise, which plays a key role in the future progress of human kind physics is the most basic of the physical sciences.

Physics has the capability of playing a major role in finding solutions to many of the problems facing the human race. Physics can play an important role in developing strategies to combat climate change, In the development of cleaner energies and in the development of technological advancements.

Physics is important to Man's life because it is used in
+ cooking food + cleaning clothes + watching T.V + heating your house + playing sports + every thing else in your life

Physics plays an important role in health + Economic development + Education + Energy and + The environment

Inspiring students to study physical science:

- + To encourage students to make the habit of reading
- + To provide opportunity for social training
- + To help the teachers for developing their Up to date knowledge

5. Write about Rationale in inspiring students to study physical science.

Ans. Physical science helps students to develop the skills, knowledge and competencies to live healthy and physically active lives at school and for the rest of their life.

- + To help the students to use their spare time in a right manner. To acquire knowledge of good teaching methods of physical science at National level + The teacher should participate in work shops meetings etc. + To provide opportunity for social training + To listen to and watch various programmes based on physics and chemistry on the T.V. and radio + To arrange science exhibitions and science fairs.

UNIT - 3
AIMS, OBJECTIVES AND
COMPETENCIES OF TEACHING
PHYSICAL SCIENCES

1. Briefly discuss the aims of teaching physical science? Explain the objectives of teaching physical science?

Ans. An Aim is a declaration of intent which gives direction to a teaching programme aims in physical science teaching according to Thurber and Cullite (1964) are

1. Towards understanding the nature of science 2. Meeting the Goals of general education 3. Help young people fit themselves in to their society 4. Maintaining physical health the well being 5. Helping pupils with personal adjustment 6. Provide training for development of attitudes and values 7. Giving pupils exploratory experiences 8. Provide opportunities to develop vocational and a vocational interests

Aims of teaching science as suggested by various committees and commissions in India.

The Kothari Commission: The Indian Education Commission (1964-66) has suggested the aims and objectives of teaching science at various levels

Lower Primary stages:

+ In classes 1 and 2, the emphasis should be on clean lines and formation of healthy habits

+ In classes 3 and 4 the study should also include personal hygiene and sanitation

Secondary Stage:

+ At the lower secondary level physics, chemistry, biology, earth sciences should be taught as compulsory subjects

+ At the higher secondary stage there should be diversification of courses and provision of specialisation.

National Council for Educational Research and Training (NCERT - 2001)

Primary Stage:

- + Able to appreciate the need to live in harmony with Nature
- + Physically socially and mentally healthy

Secondary Stage

- + Understands the Nature of science and technology
 - + Understands the basic concepts and law of science
- objective of teaching physical science

Objective of Teaching Physical Science: Objective as an end towards which a school sponsored activity is directed

- Carter V. Good

Characteristics of objectives: + Objectives are very specific + Objectives are outcome - base + Objectives are measurable + Objectives describe student behaviours

Importance of objectives + + Guide students learning + Help in modifying the goals + Indicate the way to follow + Provide direction to class room teachers

Functions of objective + Gives meaning to content + Makes learning functional + Grades learning experiences + Helps in evolving proper learning situation

Criteria of good objectives of physical science

- + They should be feasible + They should be useful to the student + They should be based on psychological principles + They should be able to bring about desired changes

Thurber and Cullite have suggested the following criteria for selecting objectives as

1. Usefulness: The desired learning should have value in the lives of the students.

2. Fitness: The learning should fit into a sequence to words broader objectives

3. Probability: Experience needed for the development of the learning should be possible.

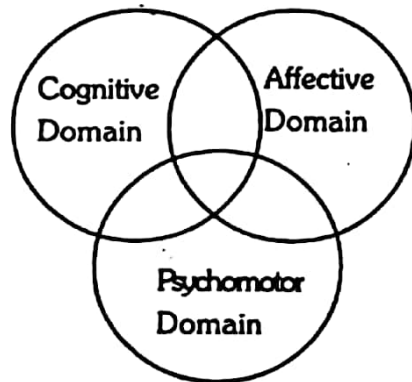
2. Describe the blooms taxonomy of educational objectives ?

Ans: The word Taxonomy is derived from the Greek word "Taxa" meaning arrangement. In the field of education Prof. B.S Blooms have attempted to classify the educational objectives into an hierarchy. He is considered as a pioneer in this field and was the editor of the first volume of "Taxonomy of educational objectives "(1956) produced by an American committee of college and university examiners. He has classified the Taxonomy in to 3 domains as follows.

The classification of Blooms Taxonomy

| COGNITIVE DOMAIN | AFFECTIVE DOMAIN | PSYCHOMOTOR DOMAIN |
|------------------|---------------------|--------------------|
| 1. Knowledge | 1. Receiving | 1. Perception |
| 2. Comprehension | 2. Responding | 2. Limitation |
| 3. Application | 3. Valuing | 3. Manipulation |
| 4. Analysis | 4. Organisation | 4. Precision |
| 5. Synthesis | 5. Characterization | 5. Articulation |
| 6. Evaluation | | 6. Naturalization |

All these three domains are interrelated as shown in figure below



1. COGNITIVE DOMAIN: This domain containing six major classes or categories as proposed by Bloom.

1. Knowledge: It involves the recall of specific and universals, methods and processes, or of a pattern, structure of setting

- Knowledge of terminology and facts
- Knowledge of conventions, trends and sequences classification and categories criteria, methodology
- Knowledge of principles and generalizations of theories and structure.

2. Comprehension: It represents the lowest level of understanding and includes translation, interpretation and extrapolation.

i) Translation: Translation means that an individual can put a communication into other languages, into other terms, or into another form of communication i.e.,

a) Translation form one level of abstraction to another: It means the ability to translate a problem given in abstract terms into concrete or less abstract.

Ex: State the problem in your own words

The ability to translate a lengthy part of a communication into briefer or more abstract terms.

Ex. To explain the whole experiment in two or three sentences.

The ability to translate an abstraction, such as some general principle, by giving an illustration or samples.

Ex. Give example for Newton's third law of motion i.e., for every action there is equal and opposite reaction

To answer the questions given above the students writes the problem in simple language in order to make it concrete.

b) Translation from symbolic form the another form, or vice-versa.

It means the ability to translate relationships expressed in symbolic form, including illustrations, maps, tables, diagrams,

graphs, mathematical and other formulas, to verbal form and vice versa

Ex. 1 Ability to translate geometrical concepts into verbal terms and into visual terms

2. The pupil translates a given problem into an equation.

c) Translation from one verbal form to another: It means the ability to translate non literal statements (Metaphor, symbolism, irony, Exaggeration) to ordinary language.

Ex. 1 The building is touching the sky

2. The student re-states it as "The building is very high".

It is also the ability to translate from (with or without a dictionary) one language into another language.

ii) Interpretation: In order to interpret a communication, one must be able to translate each of the major parts of it. It includes competence in recognizing the essentials and differentiating them from the less essentials or from the relatively irrelevant aspects of the communication. It requires the ability in abstracting generalization from a set of particulars.

The essential behaviour in interpretation is that when given a communication the student can identify and comprehend the major ideas which are included in it as well as understand their inter-relationships.

iii) Extrapolation: To extrapolate one must be able to translate as well as interpret and in addition one must be able to extend the trends or tendencies beyond the given data and findings in order to determine implication, consequences, corollaries, effects, etc. Extrapolation can only be an inference which has some degree of probability. Extrapolation includes.

- a) Drawing conclusions and
- b) Making predictions.

Ex: † Strike a matchstick against the rough surface, what happens? (The Pupil Predicts)

† The pupil concludes that all living beings require, oxygen to live

3. Application: Application occupies the third position in the hierarchy of the objective under cognitive domain. It requires something more than knowledge and comprehension. It implies the ability to apply an abstraction, method, theory, principle, formula etc. to an unfamiliar or novel situation.

The effectiveness of the teaching program lies in how far students are able to carry over the effects of their learning into situations that they may face in future.

Under the objective application we try to inculcate the following abilities among the students.

- i) Searching familiar element in an unfamiliar situation.
- ii) Using familiar elements to re-structure problem in familiar context.
- iii) Classifying the problem as familiar in type.
- iv) Selecting abstractions (theory, principles, idea, method) suitable to problem type.
- v) Use of abstraction to solve problem
- vi) Finding solution to a problem

4. Analysis: The breakdown of a communication into its constituent elements or parts so that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit.

Analysis refers to the ability to breakdown material into component parts so that its organizational structure may be understood. Learning outcomes here represent a higher intellectual ability than comprehension and application because they require an understanding of both the content and the structural form of the material.

Analysis is attempted at three levels.

- a) Analysis of Elements
- b) Analysis of Relationship
- c) Analysis of Organizational Principals.

5. Synthesis: The putting together of elements and parts so as to form a whole. This includes the production of unique

communication, of a plan or proposed set of operations and derivation of a set of abstract relations.

6. Evaluation: Judgments about the value of material and methods for given purposes. This includes judgments in terms of internal evidence or external evidence.

i) Internal Evidence: Judgments in terms of internal evidence is qualitative in nature such as logical accuracy, consistency and other internal criteria.

In internal evidence judgments is made on the basis of a) Accuracy b) consistencies c) reliability d) precision e) exactness

ii) External Evidence: In external evidence the judgments are made on the basics of a) results b) Efficiency, c) Economy d) Utility e) Standard, F) Generalization.

Evaluation thus represents use of a standard of appraisal in a complex process which involve some combinations of all other behaviours of knowledge, comprehension, application, analysis and synthesis.

II. AFFECTIVE DOMAIN: This domain is concerned with feelings and includes attitudes, interests, values and appreciation. These characteristics are hard to define and evaluate.

The different categories of the affective domain are described as follows:

1. Receiving : Receiving means to orient the learner to learn which is the first step. "Sensitivity to the existence of certain phenomena and stimuli, that is, the willingness to receive or attend to them. "Receiving consists of three sub-categories that represent a continuum.

It includes:

a) Awareness: Awareness is almost a cognitive behavior without specific discrimination or recognition of the objective characteristics of the objects.

b) Willingness to receive: Willingness to receive is to tolerate a given stimulus not a avoid it. It involves a neutrality or suspended - judgment toward the stimulus.

c) Controlled or selected attention: At a somewhat higher level we are concerned with a new phenomenon, the different ialities of a given stimulus into figure and ground at a conscious level.

2. Responding: This class comes after the learner has given his attention. "Behaviour which goes beyond merely attending to the phenomena, it implies active attending doing something with or about the phenomena, and not merely perceiving them" sub categories of responding are .

a) Acquiescence In responding : It is the first level of active responding after the learner has given his attention (we might use the word compliance to describe the behaviour)

b) Willingness to Respond: It is voluntarily response to outside prompting, the response get social approval.

c) Satisfaction in response on subjects: In addition to the willingness to respond, the consent, the assent responding the behaviours is accomplished by a feeling of satisfaction an emotional response generally of pleasure or zeal.

d) Appreciation on subjects and teachers

3. Valuing: It includes acceptance of a value, preference for a value and commitment to or a conviction with regard to a certain point of view.

It includes:

i) Acceptance of a value: At this level we are concerned with the describing of worth to a phenomenon, behavior objects etc. At this level, there is more of a readiness to re-evaluate one's position then at the higher levels.

ii) Preference for a value: Behaviour at this level implies not just the acceptance of a value to the point of willing to be identified with it, but the individual is to be sufficiently committed to the value, to pursue it, to seek it out, to want it.

iii) Commitment: Belief it this level involves a high degree of certainty, The ideas of conviction, certainty beyond a Shadow of doubt "help to convey further the level of behaviour intended.

4. Organization : When the learner develops certain

values, he encounters situations for which more than one value is relevant. In such a case values are organized into systems.

It includes :

i) **Conceptualization of a value :** After developing values the quality of abstraction or conceptualization is added. This permits the individual to see how the value relates to those that he already holds or to new ones that is coming to hold. The process of abstraction involves analysis & differentiation.

ii) **Organization of value system:** Objectives properly classified here are those which require the learner to bring together a complex of value, possibly disparate values and to bring these into an ordered relationships with one another.

5. Characterizing: The individual starts acting constantly in accordance with the values he has developed.

It includes:

i) **Generalized Set:** The generalized set is that which gives an internal consistency to the system of attitudes and values at any particular moment.

ii) **Characterization:** Objectives, categorized here are more than generalized sets in the sense that they involve a greater inclusiveness and within the group of attitudes, behavior, beliefs or ideas, an emphasis on internal consistency.

III. PSYCHOMOTOR DOMAIN:

This domain includes those objectives which deal with all motor skills and their perfection through practice.

1. Perception : This includes sensory stimulations such as auditory, visual, tactile, taste, smell and kinesthetic (Muscular movement) and also we selection (i.e., directing ways, means etc).

2. Imitation: Observing others work and repeating the same. (Imitating the teacher's good demonstration, drawing, handling of apparatus etc.).

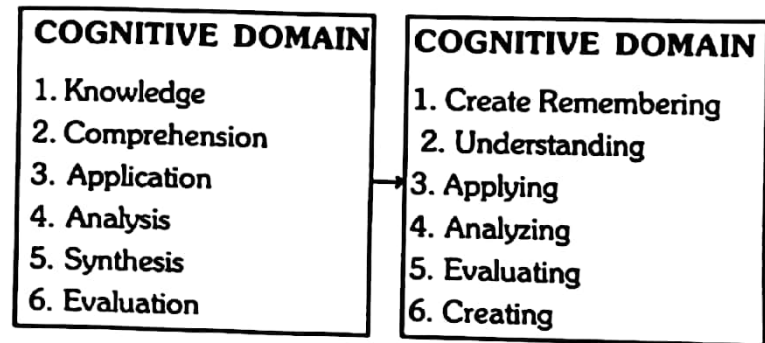
3. Manipulation: Acquires skill and confidence by doing things correctly. Learns the mechanism by handling any appliances and involving physically.

4. Precision : Performance should be carried out with precision without any confusion. Because one has acquired correct skill and ability he makes resolution of uncertainty, one is capable of automatic performance having in mind the task sequence without any hesitation.

5. Articulation: In this stage there should be establishment of relationship in learning by combining and organizing.

6. Naturalization: All activities or learning should become natural and habit.

Revised Bloom's Taxonomy:



◆ Bloom's taxonomy is a convenient way to describe the degree to which we want our students to understand and use concepts, to demonstrate particular skills and to have their values, attitudes and interests affected.

◆ Bloom's taxonomy can be used in a repeated fashion to first state and then refine course goals.

◆ It can be used to identify which classroom assessment techniques are most appropriate for measuring these goals.

1. Bloom's classification is not applicable to all areas of the curriculum. 2. This classification lays emphasis more on measurable behaviour and does not give importance to immeasurable work of the pupils. 3. Bloom's educational objectives are not that much helpful to socialize the child. 4. Evaluating the Affective Domain objectives is very difficult.

Lewtom (1973) and Kelly (1977) have criticized this method of classifying educational objectives as:

1. The three fold classification is somewhat artificial as in practice all three are closely interrelated

2. There is not always agreement on the appropriate classification for certain behaviours.

3. What do you mean by Instructional objectives?

Ans : INSTRUCTIONAL OBJECTIVES AND SPECIFICATIONS OF TEACHING PHYSICAL SCIENCES:

The Taxonomies of objective helps us to state instructional objectives of various school subjects. These instructional objective can be stated at two levels.

1. General Level (Non- behavioural objective or Simply objectives)

2. Specific Level (Behavioural Objectives or Specific objectives)

1. **General Objectives:** The objectives that are state at very general level are known as general objectives. These objective do not contain a behavioural verb (action verb).

2. **Specific Objectives :** Objectives that are stated at specific level are known as specific objective or simply specifications. As they are specific, they are not only clear but also meaningful to the classroom teacher.

4. **Write the instructional objectives physical science and specifications of teaching.**

Ans : OBJECTIVES AND SPECIFICATIONS COGNITIVE DOMAIN:

I. COGNITIVE DOMAIN:

1. **Knowledge:** People acquire the knowledge of facts, Terms, Concepts and Principles in the field of Physical Science.

Specifications:

1) **Recall:** People recall facts, concepts and principles

2) **Recognize:** People recognize different scientific instruments. Devices etc.

II. AFFECTIVE DOMAIN:

1. **Interest:** Student get interest on the topic related to planets and satellites.

2. **Participation:** Student participates the discussions on topic of satellites, and planets.

3. **Appreciation :** Students Appreciate discoveries, Innovations and Scientists Contribution towards science, new Technology.

4. **Valuing:** Students shows respect on scientists & Science Teachers.

3. **Scientific Attitude:** Students will develop scientific attitude, towards science concepts.

a. **Positive Attitude:** Students gets positive attitude on the lesson of Universes.

b. **Determination:** Students shows determination doing science Experiments.

PSYCHOMOTOR DOMAIN:

i) **Experimental Skills:** Pupil develops experimental skills.

Specifications:

a. **Judges:** Pupil Judges parts of apparatus materials etc.

b. **Observations:** Pupil shows a keen sense of observation.

c. **Handle:** Pupil handles the instrument apparatus and materials.

d. **Arranges:** Pupil learn to arranges the different apparatus.

ii) **Drawing skills:** Pupil draws graph, charts and prepares tables etc.

Specifications:

a. **Draws:** Pupil draws diagram with reasonable accuracy and speed.

b. **Construct:** Pupil construct tables and charts

c. **Select:** Pupil select suitable scales and ranges to draw graphs.

iii) **Observation Skills:** Pupil observe the various expand charts and model shown

Specifications:

a. **Observes:** Pupil observes to experiment.

b. **Imagine:** Pupil draws clear diagrams after their imagination.

INSTRUCTIONAL OBJECTIVES FOR TEACHING PHYSICAL SCIENCES (IN DETAIL)**1. COGNITIVE DOMAIN:**

1. **Knowledge:** The pupil acquires knowledge of physical terms, facts, concepts, principles, formulae etc.

Specifications:

The pupil

1. Recalls physical science terms, facts, concepts principles and process, and

2. Recognizes physical science terms, facts, concepts, specimens, principles, generalizations and apparatus.

3. **Understanding:** The pupil understands physical science terms, facts, concepts principles processes etc.

Specifications:

The pupil

1. Translates physical science terms, formulae, formulae, diagrams etc. 2. Illustrates a given Physical science phenomenon 3. Detects errors in faulty statements, concepts, processes etc 4. Identifies relationship between various facts, concepts, process etc, and 5. Interprets charts, graphs, data etc., 6. compares physical science facts, concepts, processes etc., 7. selects relevant terms, facts, data etc. 8. Discriminates between closely related concepts, principles, processes etc., and 9. Explain physical science concepts, principles process etc

3. **Application:** The pupils apply knowledge of Physical Science in new situation.

Specifications:

The pupil

1. Analyses the problem 2. Makes Hypothesis. 3. Suggests appropriate methods and material for a given purpose

4. Establishes cause - and - effect relationship 5. Gives reasons for a physical science phenomenon. 6. Draws inference and conclusions from the observed facts and 7. Predicts Physical science phenomenon from the given data

II. AFFECTIVE DOMAIN:

1. **Interest:** The pupil develops interest on experiments and science events

Specifications:

The pupil

1. Actively participates in the activities of science clubs 2. Contributes science material for school and other magazines 3. Read extra books and journals on science and scientists 4. Visits botanical gardens, Zoos, museums, and forests for getting additional information. 5. Improvises science apparatus and models on his own

2. **Scientific Attitudes:** The pupil develops scientific attitudes towards science phenomena

Specifications:

The pupil

1. Are Curious to know various science phenomena 2. Shows willingness to consider new interpretation of science data, 3. Develops intellectual honesty in expressing and recording science data 4. Believes in cause - and - effect relationship in science data 5. does not accept or reject views and conclusions without valid reasons, 6. Suspends judgments in the absence of proper evidence, and 7. Shows perseverance in accomplishing various science tasks

3. **Appreciation:** The pupil appreciates the science phenomena in nature and the role of science in human welfare.

Specifications : The pupil assimilates the knowledge of science, derives pleasure in the pursuit of its study and realises the real significance of the

1. role of science and their importance in daily life, 2. role of science in developing aesthetic sense 3. struggle for existence in life 4. contribution of scientists in human welfare. 5. Balance of life in nature 6. Unity underlying diversity exhibited by plants and animals, and

7. Complementarity of structure and function.

III. PSYCHOMOTOR DOMAIN

1. Skills: The pupil develops skill in

- A. Drawing Diagrams
- B. Manipulating apparatus and instruments,
- C. Observing Physical science specimens parts, structures etc.,
- D. Scientific Expression

A) Drawing Skills :

Specifications:

The pupil

1. Draws accurate sketches and diagrams neatly
2. Makes diagrams with sense of proportion
3. Labels diagrams neatly, methodically and correctly, and
4. Draws sketches and diagrams at a reasonable speed.

B) Manipulative Skills:

The pupil

6. Arrange the apparatus systematically
7. Handles the apparatus and instruments properly.
8. Reads the instrument with precision
9. Maintains the apparatus and instruments in order, and
10. improvises apparatus and models.

C) Observing Physical science specimens parts, structures etc.,.

The pupil

21. Notices the relevant details in the specimen carefully
22. Reads the instruments correctly
23. Discriminates between closely related structures, parts and specimens accurately
24. Locates the desired parts exactly and
25. Detects error in experimental set up and procedures

D) Skills in Scientific Expression

The pupil

31. Makes use of correct biological terminology in describing a biological phenomenon.
32. Uses the appropriate terms at the proper place
33. Puts the ideas in clear, precise and unambiguous terms, and

34. Organizes his thought's systematically

CRITERIA FOR THE SELECTION OF OBJECTIVES:

In selection the objective Thurber and Collette have suggested the following criteria

1. **Usefulness:** The derised learning should have some value in the lives of the pupils concerned
2. **Practicability:** Experiences needed for the development of the learning should be possible
3. **Fitness:** The learning should fit into a sequence leading towards broad objectives.
4. **Timeliness:** Learning should be concerned with material familiar at the present time, not with absolute devices and ideas.
5. **Appropriateness:** The learning should be appropriate for the maturity and back ground of the pupils.

Besides this there are some other criteria like :

1. **Specificity:** A good objective should be specific
2. **Unambiguous :** A good objective should not be ambiguous it should be clear in specifying the desired learning outcome.

3. **Feasibility:** The objectives should be easy to achieve in the classroom

5. COMPETENCIES FOR TEACHING OF PHYSICAL SCIENCES - EXPLAIN

No system of education can rise higher than its teachers.
"The way to child centered education can only be through teacher centered school".

Indian Education Commission rightly said that of all the different factors which influence the quality of Education and its contribution to national development the quality, competence and character of teachers are undoubtedly the most significant.

CHARACTERISTICS OF AN IDEAL SCIENCE TEACHER

The specific and ideal characteristics of an ideal science teacher can be categorized into 3 categories.

1. Personal philosophy of science
2. personal life and teaching style and
3. personal knowledge of learners and learning

1. Personal Philosophy of science: This is the most important characteristic of science teacher because the personal philosophy of science acknowledges the unity of science. A teacher should know that all the specialized sciences are sub division of the larger science.

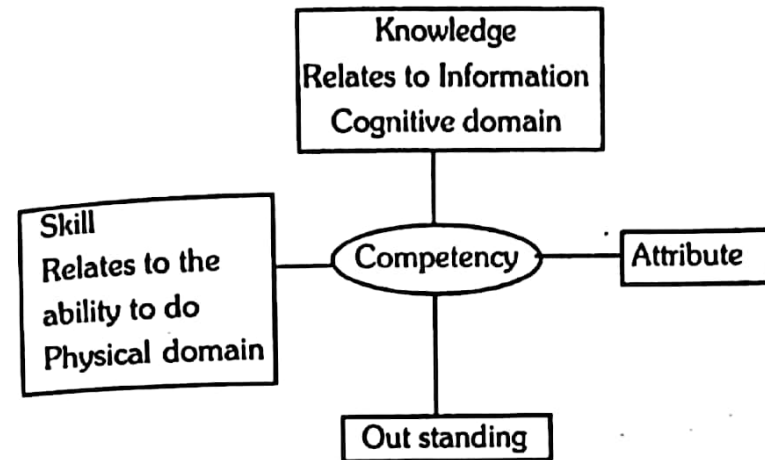
2. Personal life and teaching style: Another desirable characteristic of a science teacher is related to personal life and teaching style. Science as inquiry is one of the major themes of science education.

3. Personal Knowledge of the learners and learning: The third characteristic required of a science teacher is an awareness of the nature of learners and the learning process. A teacher should believe that

1. School and curriculum are to help student.
2. Individuals learn at different rates
3. Individuals learn in different style

Competenary includes the following elements

Competencies of a Science Teacher : The term comeptence first appeared in an article authored by R.W. White in 1959. Competenary includes the following elements.



Competencies can also be categorized into the following categories.

1. Core values : a) Integrity b) Respect for diversity c) Professionalism

2) Core competencies : a) Commuicative b) Team work c) Creativity

Managerial competencies : + Leadership + Vision + Building Trust

According to Socrates programme European Commission - The competency of Science Teaching are

Competency 1 : Understanding Nature and context of Science.

Competency 2 : Inquiry

Competency 3 : General Skills of Teaching

Competency 4 : Curriculum

Competency 5 : Assessment

Competency 6 : Professional practice

UNIT - 4

APPROACHES, METHODS AND TECHNIQUES OF TEACHING PHYSICAL SCIENCES

1. **Concept of teaching with special reference to physical science - Approaches and methods - student part co pattern in learning - Discuss.**

Ans : Meaning of methods and Approach.

The word "Method" in latin means "Mode" or "ways".

An approach is a way of treating or dealing with some thing. Approaches to science education means the ways in which we are going to treat science in the class room and impart instruction.

Need and significance of the approaches:

✦ To create interest, attitudes and mathematical spirit
 ✦ Proceeds from concrete to abstract ✦ To attain the desired objectives at various stages of education.

Characteristics of good teaching method:

1. Suitable to the level of students
2. related to life
3. motivation to students
4. Opportunities to participate

Types of approaches: Different educational philosophies have led to different approaches to science teaching

1. Conceptual approach: A concept is defined as a unique quality common to a number of objects, processes, phenomenon or event which are grouped according to this unique quality.

2. The process Approach: In this approach instead of teacher feeling and explaining the concepts, the student is encouraged to construct knowledge on his own by using one or more process skills.

3. The authoritarian approach: In this approach the

teacher presents a body of organized information for students to assimilate.

4. The discovery approach: This approach confronts pupils with problems to be solved through references to primary sources such as experiments and field observations.

5. Inductive approach: This method is known as formula construction method. In this inductive approach the concept / generalization is derived after electing a number of examples from pupils. It is reasoning from "Particular to general".

The steps of this approach are given below.

1. Observations
2. comparison
3. formulating tentative hypothesis
4. verification
5. generalization

Principles of inductive approach:

1. Examples to generalization
2. Known to unknown
3. Concrete things to abstract things

Examples:

1. On heating copper expands
2. on heating aluminium expands
3. to find out action of acids on blue litmus paper

Merits of the Inductive approach:

✦ It helps understanding ✦ It develops the habit of intelligent hard work ✦ It develops self confidence

Limitations:

✦ It is a time consuming and laborious method ✦ It is limited scope and cannot be used for all topics in science

6. Deductive approach : The most widely used approach in science teaching is the deductive approach. This method also called as a method of verification of formula. In this approach the students are given the rule first and then shown the examples. In this method the learner, proceeds from a general rule to a particular instance or shown an abstract concept to concrete examples.

Steps in deductive approach to problem solving:

1. Understanding the problem
2. collecting information

3. Reviewing the relevant principles / rules etc 4. Drawing inference 5. verification.

Principles:

1. Generalization / principles to examples 2. unknown to known 3. general to particular 4. abstract things to known things

Examples of using deductive approach: Verify the

formula for finding the focal length of a lens $F = \frac{1}{4} \left(d - \frac{x^2}{d} \right)$

Advantages : + it is adequate and advantageous method for the revising of a topic + it enhances speed and efficiency in solving numerical problems

Limitations:

+ in this method students are not completely active it does not develop thinking, reasoning or discovery.

Classification of teaching methods: Generally the methods of teaching physical science can be classified into two categories.

They are

1. **Teacher centered methods:** In this three kinds of methods are included. They are a. lecture method b. Historical method 3. lecture cum demonstration

2. **Pupil centered methods:** In this following kinds of methods are included they are

a. Heuristic method b. Project method c. Problem solving method.

2. **Explain the lecture method**

Ans : Lecture method The lecture is one of the oldest and basic methods of teaching. This method has been used in education from ancient days. It is also called telling method. At present also this method has occupied on important place in Indian schools.

Definitions: Carter good defined lecture as "an instruction procedure by which the lecturer seeks to create interest to influence, stimulate or mould opinion to promote activity, to impart information, or to develop critical thinking, largely by the use of

the verbal message, with a minimum of class participation, illustrations, maps charts or other visual aids may be employed to supplement the oral technique."

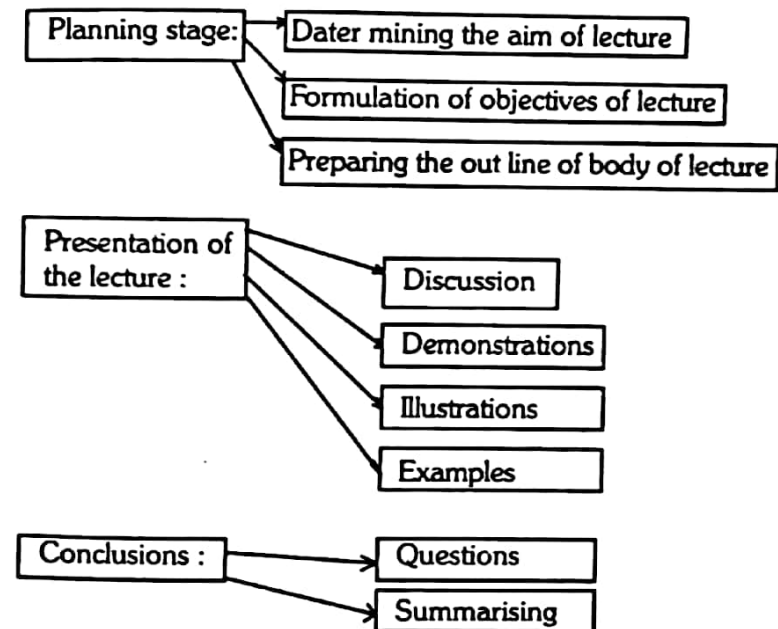
Characteristics of a good lecture:

+ Use of verbal clues and visual aids enhance the lecture
+ The presentation includes an overview logical organization and closure,

+ The audience is challenged to become intellectually involved with the topic being presented.

Steps: Three main steps

1. Planning stage 2. presentation of lecture 3. Conclusions



Advantages: + The lecture helps to channelise the thinking of students in a given direction + This method also psychological in nature + In this method pupils and teacher remain active

Limitations : + Limited time + It is one sided + Lack of deep study

3. Explain the lecture cum - demonstration method

Ans : Lecture - cum - demonstration method: In this method the faults of the lecture method are removed and combined with the merits of demonstration method making the method impressive economical and useful. This method works on the principle "concrete - Abstract" lecture cum demonstration methods helps us to minimize the limitations in lecture method.

Characteristics of good demonstration;

1. **Apparatus :** The apparatus should be big enough.

2. **Arrangement of the apparatus:** The apparatus for demonstration should be arranged in order.

3. **Simple and speedy:** Demonstration should be simple and speedy

Steps in lecture - cum- demonstration

1. **Planning and preparation :** A great care has to be taken by the teacher while planning and preparing his demonstration lesson

2. **Introduction of the lesson:** The lesson should be started by motivating the students.

3. **Presentation of the subject matter:** It should be presented in an interesting way .

4. **Performance of experiment :** Some of the important points to be kept in mind while demonstrating an experiment are

+ Involve the students while performing the experiments

+ Experiments should be simple and speedy

+ Arrange the apparatus in an order in which the experiments are to be shown.

5. **Chalk board work:** It is an important aid in a demonstration lesson writing on the black board should be neat, clean and legible. The diagrams should be labelled properly.

Common errors in a lecture - cum- demonstration lesson

+ The apparatus may not be ready for use

+ Teacher has not given proper attention to supervision

+ Teacher may some times fail to ask right type of questions

Merits:

+ It can be used successfully for all types of students

+ It is an economical method as compared to purely student centered approaches + Activity method

Limitations:

+ Students are not active participants in the process

+ It is not suitable to give training in scientific method.

4. Explain the Historical method.

Ans : Historical method: In Historical method the topic is developed from its very beginning and carried through various stages of evolution This method is particularly suited for teaching to primary classes where the students are much interested in listening to the stories

Approaches:

1. **The anecdotal approach:** As teachers we construct the lesson with an interesting incident or anecdotes from the lives of scientists leading to a particular scientific discovery such as Archimedes and eureka or Newton and the Ripeapple falling down

2. **The evolutionary approach:** According to this approach different theories arranged in a chronological order may be presented as they developed.

3. **The Bio graphical approach:** The complete study of the life history and work contributed by scientists.

4. **The social approach:** Scientists have often engaged themselves in taking the problems of Immediate importance and interest to the society.

Application : Principle of Archimedes "To arose interest in students to wards a relatively difficult concept we can narrate the story of Archimedes and eureka.

Advantages : Science is a humanstic endeavour and students understand humanness of science the relation between science and society can be made explicit using this method.

Limitations :

✦ It is not suitable for a vast number of topics ✦ It is very difficult to find relevant case histories for different age groups.

5. Explain the Heuristic method

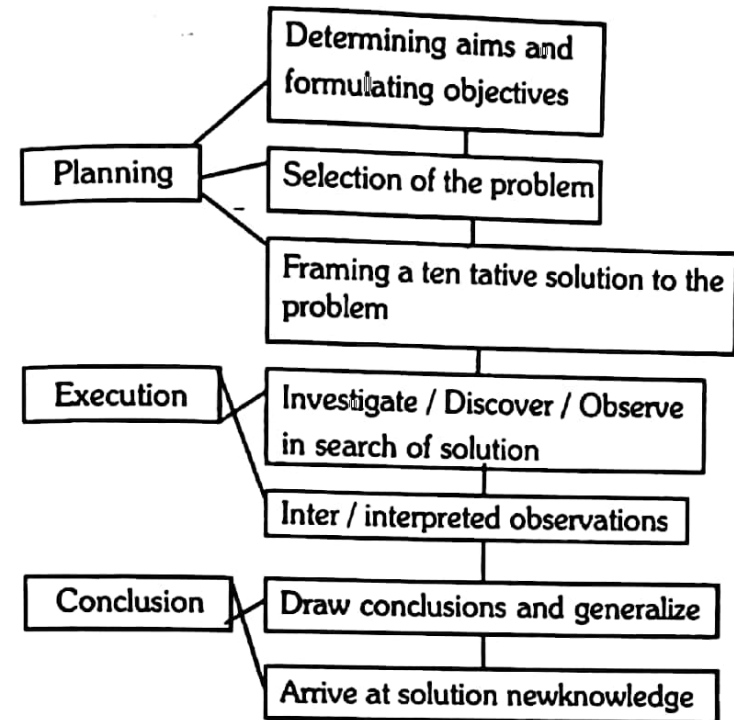
Ans : Heuristic method: Heuristic mean discovery in Greek. It is derived from the Greek work "Heuriskin" prof. H.E. Armstrong advocated this method. In this method the students learn by exploring the teachers role is that of the path setter who rectifies the faults at the proper time.

Definitions: "Heuristic method is a method of teaching which involves our placing the students as far as possible in the attitude of a discoverer. **-Prof H.E. Arm strong**

Children should be told as little as possible and induced to discovered as much as possible **- Herbert spencer**

Procedure to be adopted in using Heuriotic Method:

A problem is assigned to the class and each child is made to feel responsible for finding out solutions by ones own self. Each child tries to acauire information about the problem form different sources. The child is free to move about and discuss the problem with the close matter. Each student is given a sheet of instructions regarding the problem in hand. The student can get guidance from the teacher. The teacher should try to induce answer from students by raising as many questions as possible. In this way they inferpret their observations and finally draw relevant conclusions.



Examples : Find the atomic structure role of the teacher of crystals

✦ The teacher should be well prepared ✦ The teacher should act as guide and a friend ✦ The teacher should encourage students ✦ The teacher should help to develop values ✦ The teacher should keep psychological principles in mind

Advantages:

✦ It develops in students self confidence
 ✦ The havristic method is based on the important psychological principle of learning by doing

Limitations:

✦ This method cannot be used in primary classes
 ✦ Text books written on this method are not available

6. Explain the project method

Ans :Project method John Dewey an American Philosopher gave this method. Project means some thing that has been planned or a plan of a scheme or an undertaking project method was developed by Kilpatrick and it was perfected by Stevenson.

Definitions:

" A project is a problematic act carried to its completion in its natural setting" - **Stevenson**

"A project is a bit of real life that has been Incorporated in to the school" - **Ballard**

Qualities of a good project

The essential qualities of a good project are

✦ The project should be timely ✦ The project should be fevibile ✦ The project should be challenging

Principles of Project Method: Project method is based on the following principles

1. Principle of Activities learning by doing 2. Principle of experience 3. Principle of active participation 4. Principle of utility 5. Principle of freedom 6. Principle of correlation 7. Principle of economics

Steps involved in the project method.

Teacher may create some suitable problems for them in which they are interested

Role doing a situation:

Choosing and proposing: The students should be allowed to choose a project

Planning of the project: The students are encouraged by the teacher to plan out the details of the project

Executing the project: The students collect information and perform a variety of activities

Judging the project: The project is reviewed by the students and teacher from time to time to achieve the objectives of the project

Recording the project: A complete record of the project has to be kept by the students.

Example : Plane mirror reflection experiment, magnifying power and focal length of lens

Role of a teacher ✦ The teacher is a Friend guide and a working partner ✦ The teacher may converse with the class on different topics of interest to them ✦ The teachers is top all resources to provide worth while situations

Kinds of projects: According to W.H. Kilpatrick projects are of four types

1. Producer types 2. consumer types 3. problems types 4. drill types

Merits

✦ It helps all round development of the students
✦ It upholds the dignity of labour

Limitations :

✦ The whole syllabus cannot be covered by this method
✦ This method is time consuming

7. What do you mean by scientific problem solving method?

Ans : Scientific method or problem solving method: It is a method for discovery learning basically it is a problem solving method or it is a method of solving a problem scientifically.

Definitions: Problem solving in all of its elements is closely associated with a group of attitudes or mind sets which are important as out comes of instruction in science

- **Hlless obourn and Ho FFman**

Problem solving may be defined as planned attack up on a difficulty or perplexity for the purpose of finding a satisfactory solution

- **T.M. Risk**

Essential features of a problem:

✦ Correlation with life ✦ Clearly defined ✦ Education value
✦ Solutions to be found out by the students

Steps in problem solving:

John dewes has out lined this method in the following series of steps

1. Identifying the defining problem
2. formulating the hypothesis
3. testing hypothesis by collecting and evaluating data
4. Inter preting results
5. drawing conclusions

Principles of problems solving:

✦ The pupils must feel the problem as their own ✦ The problems must be started definitely ✦ The means of solving the problem must be vague to the pupils ✦ Solution must be definite and clear

Merits: ✦ Is based on the principle of learning by doing ✦ Helps in creating new ideas ✦ Helps in paying individual attention

Demerits: ✦ It is time consuming ✦ It is not suitable for all students ✦ It is an expensive method

8. Explain the laboratory method

Ans : Laboratory method : It is an Important method of teaching science. Laboratory method is pupil centered method. It is based on the principles of " Learning by doing".

Organisation of laboratory work; Laboratory work organized in the following way.

1. Even front system: In this system all the students are asked to do the same experiment at a time individually

2. Group system: in this systems one group of students will be doing the same experiment.

3. Rotation system: In this system the above two systems are combined

Procedure to be adopted to use laboratory method

1. Planning a) Identify need for experiment b) Plan the experiment c) Aims and objective are formulated d) Introduces experiment e) Provides instructional card and explains

2. Execution : a. students perform experiments b. records observation in observation sheet c. Tabulates observation d. Calculates inters and interprets.

3. Conclusion. a. Prepares a laboratory b. Group discussions

conclusion

Advantages:

✦ It develops the spirit of discovery ✦ It gives training in problem solving ✦ It is a learner centred approach

Limitations:

✦ It is time consuming ✦ It is an expensive method

9. How would you use brain storming technique in your class.

Brain storming : Brain storming method was first popularized in the late 1930s by Alex Faickness osborn an advertising executive in a book called applied imagination. Brain storming is a group creativity technique which was designed to generate a large number of ideas for solving a problem OS born proposed that groups could double their creative out put by using the method of brain storming

Brain storming is a democratic system. The teacher writes pupils vleivs on black board

Steps in brain storming method

1. Raise and define the Problem 2. create a back ground memo 3. select participants 4. create a list of lead questions 5. session conduct

There are four basic rules in brain storming. These are intended to reduce to social in hibition that occur in groups and there fore stimulate the generation of new ideas.

1. Focus an quantity 2. No criticism 3. unusual ideas are welcome 4. combine and improve ideas

10. Describe team teaching

Ans : Team teaching: Team teaching is one of the important instructional strategies for the improvement of instructional program. Team teaching is a method which involves team work between two or more teachers who together, make presentations to a group of students,. Team teaching is based on

the assumption that no single teacher possesses expertise to do full justice to the entire course

Types of team teaching.

✦ The first type of team teaching is traditional team teaching in which both teaching actively share the instruction of content and skills to all students

✦ The second type of team teaching referred to as complimentary or supportive instruction, occurs when the teacher assumes the responsibility for teaching the content to the students while the other teacher provides follow up instructional activities on related topics or study skills

✦ Parallel instruction is a third type of team teaching

Prerequisites to successful team teaching: Successful team teachers are

✦ Positive thinkers ✦ Honest ✦ Flexible ✦ Resourceful

The Instructional advantages of team teaching:

✦ Team teaching provides opportunities for interaction with the audience ✦ Teaching staff acts as a role models for discussion and disagreement ✦ Team teaching makes effective use of existing human resources.

11. Explain the models of teaching

Ans : Models of teaching: Teaching model is a tentative theory of teaching. Silverman differentiates between some of the functions of theories and models

Meaning and definition of teaching model Model of teaching is a plan or pattern that can be used to shape curriculum, to design instructional materials and to guide instruction in the class room or other settings.

Assumpting of teaching model ✦ Teaching environment has various components that are interdependent ✦ Teaching is a means for generating an environment of learning.

Characteristics:

1. **Specialization of operations:** All models of teaching

specify the mechanism that provides for the reaction of students and interaction with the environment.

2. **Scientific producer:** A model of teaching is based on a systematic procedure to modify the behaviour of the learner.

Sources of models of teaching: Four important sources from which all the models of teaching have been derived are given below.

(a) Behaviour modification as a source (b) The personal sources (c) The social interaction sources (d) The information processing sources

Important of teaching models:

✦ The new models of teaching may be invented to use the psychological forces in teaching ✦ Teaching can be made more effective and purposive ✦ Teaching and learning relationship may be established empirically by the use of these needs.

Categories of teaching models: On the basis of the specific educational goals and means into the following four families

a. Information processing models b. Personal development models c. Social interaction models d. Behavior modification models

12. Explain the Bruner concept attainment model

Ans : Concept attainment model (JEROME BRUNER) Concept attainment: It is based on the work of Jerome Bruner concept attainment is an Indirect instructional strategy that uses a structured inquiry process. In concept attainment students figure out the attributes of a group that has already been formed by the teacher.

Purposes: ✦ it engage students into formulating a concept through the use of examples ✦ it is possible to use concept attainment to teach almost any concept in all subject

Steps of concept attainment:

✦ Select and define a concept ✦ Select the attributes

✦ Develop positive and negative examples

† Introduce the process to the students † Present the examples and list the attributes † Develop a concept definition † Give a additional examples † Discuss the process with the class † Evaluate

Example: 6 + 6, 13-1, 12×1 , 5+5 +2 14-2, 15-3, 11+1

13. Explain the such man inquiry model

Ans : Inquiry raining model (such man inquiry model) The inquiry model, developed by Richard suchman, is based on the premise that the infellectual strategies used by scientites to solve problems and inquire into the unknown can be taught to students using the Natinal curiosity of students the model was developed from analyzing the methods used in creative research personnel.

General goals of inquiry training: † acquire and processtate logically † develop infellectual strategies that they can use the find out why things are as they are

The inquiry process with help students:

† To begin to consider success and failure as information rather than reward or punishment † Approach future problems with confidence in their abilities to seek out the solution

Phases of inquiry training: Inquiry training has five phases

1. Students canfrontation with the puzzling situation
2. 2,3 data gathering operations of verification and experiment action
3. the students organize the information obtained during the data gathering phases and try to explain the discrepency
4. students analyze the problems solving strategies they during the inquiry.

14. Describe the concept and meaning of micro teaching? What do you mean by skills of micro teaching?

Ans : Micro teaching concept and meaning: Micro teaching was designed by Dwight w. Allen of stan ford University in 1960. It was experimentally used in teacher training programmes in 1960-67. Micro teaching is a procedure in which a student teacher practices teaching with a reduced number of

pupils in a reduced period of them with emphasis on a Narrow and specific teaching skills

Definitions: "Teaching strategy with reduced class strength pupils and time is called micro teaching - Dwight W. Allen

Micro teaching as a system of controlled practice that makes it possible to concentrate on specific teaching skills and to practice teaching under controlled conditions - Allen and Ryan

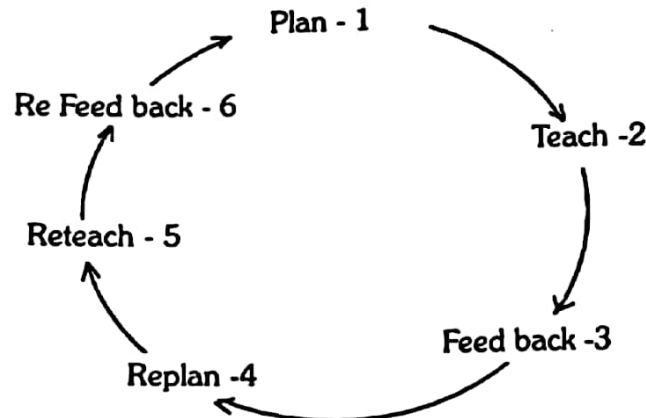
Objectives of micro teaching:

† To develop useful teacher education programmes † To identify new teaching skills and encourage research † To bring out behavioural change in teacher † To improve the efficiency of teaching through supervision

Nature and Characteristics: † Micro teaching is a new experiment infield of teacher education † It gives opportunity to get the needed feed back of their performance from the teacher after exhibiting their skill.

Method of micro teaching: In a micro teaching procedure the student teacher is involved in a scaled down teaching situation - in terms of class size, class time and teaching skills. The tasks may include practising and mastering of a specific teaching skill such as explaining, questioning, introducing, mastering of specific teaching strategies, flexibility use of instructional materials and class room management.

The short lesson given to peer group students is recorded at least on an audio cassette or a video tape if available and the student teacher gets to hear or see for him self/her self in the lesson immediately. T he people who attend the lesson are asked to fill in rating questionaries and evaluate specific aspects of the lesson. The supervisor also records and suggests remedial measures. If asked to re teach, the student teacher replaying his lesson and immediately re teaches the lesson to another group of peer students which is observed, recorded and feed back is provided this cycle continues until he masters the specific skill. The micro teaching cycle is represented below. Micro teaching cycle



Micro teaching steps

- + skills of presentation + skill demonstration + preparation of microlesson plan + creating micro teaching environment
- + learning the teaching skill + giving feed back + replan
- + repeating the micro teaching cycle + integrating the skills

Merits: + Micro teaching helps in reducing time and energy as there is no room for trial and error + Micro teaching helps in easing the complexities of normal class room teaching + The quality in traditional teaching increases

Limitations:

- + It is artificial to teach using only one skill
- + It is a time consuming and costly affair and requires costly media technology

Micro lesson plan format

| | |
|-----------------------------|----------|
| Name of the student teacher | Subject |
| Topic | Date |
| Skill | Class |
| Session | Duration |
| Supervisor | |

| S.No. | teacher activity | Pupil activity | Component Behaviour |
|-------|------------------|----------------|---------------------|
| | | | |

Various skills of micro teaching

1. Skill of introducing the lesson : Meaning of the skill: The attention of the students towards learning the matter starts with the introduction of the lesson in this the new knowledge may be properly linked with the existing knowledge of pupils.

Components of the skills: a. Utilization of previous experiences b. Use of appropriate devices c. Maintenance of continuity d. Relevancy of verbal or non verbal behaviour.

Micro teaching lesson plan - 1

Micro lesson - skills of introduction (Example)

Name of the student teacher : _____ Class: _____
 Class number: _____ Date: _____
 Topic : _____ Time duration _____

| Content analysis | Teachers activity | Pupil activity | Behavioural components |
|------------------|-------------------|----------------|------------------------|
| Introducing | | | |
| Topic | | | |

Observation schedule CMR rating scale

Skill introducing the lesson

| Components | Ratings | Remarks |
|---|-----------|---------|
| 1. Utilisation of previous experience of the pupils | 1 2 3 4 5 | |
| 2. Use of elevices | 1 2 3 4 5 | |
| 3. Maintenance of continuity | 1 2 3 4 5 | |

2. Skill of explaining: Explaining can be defined as the use of interrelated statements about a concept, produce and reason with a view to providing its understanding to some one else

Components: + Cognitive link + Uses of illustrating
+ Compare and contrast + Meaning full repetition

Micro teaching Lesson plan - 2

Micro lesson : Skill of explanation

| Content analysis | Teachers Activity | Pupil activity | Black Boardwork | Behavioural Components |
|---------------------------------|-------------------|----------------|-----------------|------------------------|
| Explaining the concept of topic | | | | |

Observation schedule can rating scale

Skill : explaining a lesson

| S.No. | Components behaviour | Rating | Remarks |
|-------|-----------------------|-----------|---------|
| 1 | Appropriate beginning | 1 2 3 4 5 | |
| 2 | Continuity | 1 2 3 4 5 | |
| 3. | Interesting | 1 2 3 4 5 | |

3. Skills of probing questions : The skill of probing questions involves going deep into student response through step by step questioning with a view of eliciting the required response.

Components: + Seeking further information + Refocusing
+ Redirecting + Developing critical awareness (DCA)

Micro teaching lesson plan - III

Micro lesson : skill of probing questions

| Content Analysis | Teachers activity | Pupil Activity | Behavioral components |
|------------------|-------------------|----------------|-----------------------|
| | | | |

Observations schedule cum rating scale

| Components | ratings | Remarks |
|--------------------------------|-----------|---------|
| C desirable behaviour | | |
| 1. Seeking further information | 1 2 3 4 5 | |
| 2. Refocusing | 1 2 3 4 5 | |
| 3. Redirecting | 1 2 3 4 5 | |

5. Skill of re infrocement: The skill of reinforcement is used to avoid the unpleasant expresses and replace with the pleasant experience.

Components: + Positive verbal reinforcements + Positive nonverbal reinforcements + Negative non verbal reinforcements

Micro Teaching Lesson Plan - IV

Micro lesson : Skill of reinforcement

| Content Analysis | Teachers Activity | Pupils Activity | Behavioural Components |
|-----------------------|-------------------|-----------------|------------------------|
| Transmission of Topic | | | |

Observation schedule for the skill of revinforcement

| S.No. | Components behaviour | Rating | Remarks |
|-------|---------------------------|-----------|---------|
| 1 | Use of praise words | 1 2 3 4 5 | |
| 2. | Use of discouraging words | 1 2 3 4 5 | |

5. Skill of closure: In closure the teacher can consolidate the main points by putting a few questions based on the topic tough.

Components: + Consolidation of major points + Home work or assignment + Providing opportunity to apply new knowledge to a new situation or different situation

Micro teaching lesson plan - V
Micro lesson : Skill of closure (Example)

| Content Analysis | Teachers activity | Pupil Activity | Behavioural Components |
|------------------|-------------------|----------------|------------------------|
| | | | |

Observation schedule for the skill of closure

| S. No. | Components | Ratings | Remarks |
|--------|-------------------------------|-----------|---------|
| | C desirable behaviour | | |
| 1 | Consolidated the major points | 1 2 3 4 5 | |
| 2. | Applied new knowledge to new | 1 2 3 4 5 | |

UNIT - 5
PLANNING FOR TEACHING
PHYSICAL SCIENCES

1. **Explain the importance of Planning for Teaching**
Planning is very essential in the field of education.

Ans : Good teaching requires adequate and extensive planning. The teacher has to plan above the following factors in education.

✦ The objectives to be achieved by teaching a particular Method. ✦ The methods to be used for teaching ✦ The teaching activities to be provided ✦ The tools to be employed for testing How best to use the evaluation results

The teacher has to plan at three levels

Level 1 : Plan for the whole year - Year plan

Level 2 : Plan for the units - Unit plan

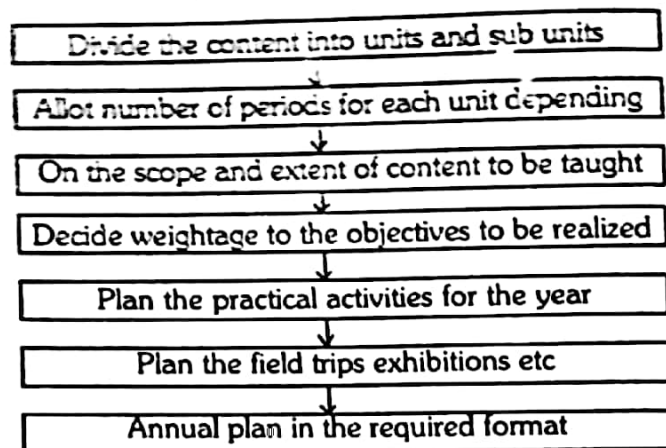
Level 3 : Plan for each lesson - Lesson plan

2. **Explain how you will prepare a year plan for your teaching process with suitable example ? Mention the uses of year plan ?**

Ans : Year plan is a long range plan in which one plans the layout of one's instruction for the year. A year plan should act as a guide for the teacher to organise her day-to-day class work keeping in mind the long term goals. The annual plan should be flexible and allow the teacher to make necessary changes as and when required.

Essential factors influencing the Year Plan : ✦ The number of units to be taught in the subject ✦ Objectives to be realized through the various units ✦ The arrangement of Topics ✦ Methodology to be adopted ✦ Resources available ✦ Time available

Steps in the year Plan :



Importance of year Plan : + Methodological year planning leads to effective teaching + The year plan helps the teacher in smooth conduct of the teaching activity + It helps in deciding allotment of periods required for teaching different units.

Model format of a Year plan

Class Subject Academic year

Total Number of periods Name of the teacher

| Name of the Month | Name of the unit | Number of periods | Resources | Activities to be organized (According to CCE) |
|-------------------|------------------|-------------------|-----------|---|
| | | | | |

Year Plan (C.C.E. Model Annual Plan - VI Class)

| Month | Name of the Chapter | No. of Period | Activities to be organized (C.C.E.) |
|--------------|--------------------------|---------------|-------------------------------------|
| 1 | 2 | 3 | 4 |
| June July | Our Food Playing with | 10 | |

| | | | |
|-----------|--------------------------|----|--|
| | Magnets | 12 | |
| July | Rain | 10 | |
| August | What do Animals Eat | 12 | |
| August | Materials and Things | 12 | |
| September | Habitat | 12 | |
| September | Separation of substanges | 12 | |
| October | Fibere to Fabric | 11 | |
| November | Plants | 10 | |
| November | Changes arounds | 11 | |
| December | Water in or Life | 11 | |
| December | Simple Electric Circuits | 12 | |
| January | Learning how to measure | 11 | |
| February | Movements in animals | 12 | |
| February | Light shadows and images | 12 | |
| March | Living and Non living | 10 | |

3. Describe the steps involved in Unit Planning

Ans : Unit Plan : The second level of planning involves unit planning. The planning for a unit is known as unit plan. A unit plan is developed by the teacher and serves as a long range plan.

In unit planning the whole syllabus is divided into small workable sections or sub units, teaching units and leads to the development of skills and insight.

Definitions : "A unit is large a block of related subject matter as can be over viewed by the learner - **Preston**

"The unit is an organized body of information and experience odesigned to effect significant out comes for the learner.
- **Wisley**

Characteristics of a good unit : + It should be complete in itself + It should have similar type of content + It should have ample scope for evaluation + It should eater to individual differences.

Steps involved in unit planning :

1. **Preparation :** This is to motivate children for learning.
2. **Previous knowledge tested :** The back ground knowledge of the students is to be tested.
3. **Presentation :** The subject matter is presented with teaching aids, extra activities and exercises
4. **Summarization :** The whole unit is summarized under systematized subheading.
5. **Drill or recapitulation :** The whole unit is revised by putting small questions.
6. **Evaluation :** The fulfillments of objectives are tested and remedial plan can be planned after evaluating it.

Kinds of Units : All units can be classified into 3 basic kinds 1) Resource Units 2) Teaching Units 3) Text Book units

Importance of Unit Plan : + It saves time + It develops interest of the students towards learning + It helps to develop certain type of skills among the students + It clears the general aims as well as specific aims of teaching.

C.C.E. Model Unit Plan

Class : Subject No.of Periods

Lesson :

| Period | Teaching Points | Teaching strategies | TLM | CCE Evaluation |
|--------|-----------------|---------------------|-----|----------------|
| | | | | |

4. Write about lesson plan

Ans : Lesson Plan : A lesson plan in the words of B.Standa is actually a plan of action. It is a class room guide for the teacher as a visualisation of the class room experiences he desires to occur and is a guide to effective teaching.

Definitions : A teaching out line of the important points of a lesson arranged in orde~~r~~ in which they are to be presented

- **Carter V. Good**

Criteria of a Good Lesson Plan : The components of a lesson plan are

Title of the Lesson : What is the title of the Lesson ? One should write a descriptive title of the lesson that should indicate the content to be taught.

Subject area : The class and subject should be specified.

Unit Name : The name of the unit has to be written.

Instructional objectives : They are the learning out comes for the lesson.

Description of Lesson : The description of the lesson is given

Time allotted for Lesson : This is the number of class meetings that the lesson is expected to take.

Materials, Tools and Resources : These are the teaching aids, Materials, library resources etc.

Teacher preparation : The content to be taught has to be written in numbered bulleted format in a sequential order.

Pre-requisite technology skills : These are the skills that students must be well verged with before receiving the present content.

Class Layout and grouping of students : Where will the learning take place ? How is the room to be organised ?

Procedures : There is a set, definite procedure to be followed for each lesson.

Advantages of planning a lesson : + Lesson planning helps in linking the past lesson with the present + It enhances the

self confidence and self reliance of the teacher + Lesson planning helps in choosing appropriate learning procedures.

5. Explain the Herbartian steps in Lesson Planning.

Ans : 1. Herbartian Approach : John Fredrik Herbart a great educationist divided teaching units into six steps. His approach is based on a perceptive - Mass theory of learning and classical Human organization theory. The proposition of this theory is that the learner is like a clean slate and all the knowledge is given from outside.

The six formal steps for the development of a lesson plan are

1) Introduction / Motivation : It pertains to preparing and motivating the child to the content of the lesson by linking it to the previous knowledge of the study by arousing their curiosity and appealing to their senses.

2) Presentation : This step is also known as development. The teacher should bear in mind the following principles while presenting the Lesson.

1. Principle of selection and division 2. Principle of successive sequence 3. Principle of absorption and integration

3) Comparison or Association : The task of this step is to strengthen the acquisition of New knowledge.

4) Generalisation : In this step the aim of the lesson is achieved.

5) Application : In this stage, the students will make use of knowledge gained in familiar and unfamiliar situations.

6) Recapitulation : This is the last step in which the teacher summarizes the complete lesson.

Advantages of Herbartian Lesson Planning: It is an easy and simple approach. It ensures that the lesson has been prepared well. It helps in achieving cognitive objectives of teaching.

Demerits : It confines teaching only to memory level. It emphasizes mainly on the content aspects.

It is highly dominated by the teacher.

6. Describe the constructivist approach lesson plan in Physical Science Teaching :

Ans : Constructivist Approach : Constructivist learning is based on students active participation where they are constructing their own knowledge by testing ideas and approaches based on their prior knowledge and experience, applying these to new situation and integrating the new knowledge gained with pre existing intellectual constructs.

Characteristics constructivist Learning and Teaching : Embed of learning in social experience Encourage self awareness in the knowledge construction process Embed learning in realistic and relevant contents Provide experience with the knowledge construction process.

Lesson planning in constructivist's Approach : The following steps were considered for planning the lesson.

Step 1 : Planning for engage Step 2 : Planning of student exploration step 3 : Planning for explain step 4 : Planning for elaborate Step 5 : Planning for Evaluation.

Give E's of constructivism : The five E's are as follows

1. Engage 2. Explore 3. Explain 4. Elaborate 5. Evaluate

Benefits : + Constructivist learning is transferable. In constructivist class rooms, students create organizing principles that they can take with them to other learning settings.

+ Children learn more and enjoy learning more when they are actively involved, rather than passive listeners.

Limitations : + A student will never achieve solid learning. + Syllabus cannot be finished in time

7. Write about academic standards and Teaching strategies, CCE Model period plan for class room teaching.

Ans : Academic Standards

| S.No | Academic Standard | Explanation |
|------|--|---|
| 1. | Conceptual understanding | Children are able to explain, cite examples, give reasons, explain the process of given concepts in the text book |
| 2. | Asking questions and making hypothesis | Children are able to ask questions to understand, to |

| | |
|---|--|
| | clarify the concepts and to participate in discussions. |
| 3. Experimentation and Field investigation | They are able to participate in field investigation and making reports on them |
| 4. Information skills and projects | They are able to conduct their own project works |
| 5. Communication through drawing and model making | Children are able explain their conceptual understanding by drawing figures and making models. |
| 6. Appreciation and aesthetic sense and values | They are also able to follow constitutional values |
| 7. Application to daily life and concern to bio diversity | They are able to show concern towards biodiversity |

Teaching strategies and Academic standards

| S.No. | Academic Standard | Teaching Strategies /Methods |
|-------|--|---------------------------------|
| 1. | Conceptual understanding | Lecture, Explanation |
| 2. | Asking questions and making hypothesis | Question - answer, role play |
| 3. | Experimentation and field investigation | Experimentation, Field trips |
| 4. | Information skills and projects | Interview, Internet |
| 5. | Communication through drawing and model making | Assignment, Group work |
| 6. | Appreciation and aesthetic sense and values | Group discussion, Demonstration |
| 7. | Application to daily life and concern to bio diversity | Role play, Field trips |