Centre for Distance and Online Education

Punjabi University, Patiala

Class : B.Ed.-I **Semester : 2**

Paper : XI & XII (Teaching of Science)

Medium : English **Unit: 1**

Lesson No.

1.1 : Science Laboratory: Planning, Purchase and maintenance of apparatus, stock and store registers, maintaining records and safety procedures.

1.2 : Co-curricular and non-formal Approaches; Science club, science excursion, science quiz and school gardening

1.3 : Visit to science museums, science fairs, field trips, Science club and seminars

1.4 : Science note books, reference books, science journals and library for Science.

PAPER- XI & XII: PEDAGOGY OF A SCHOOL SUBJECT (PART-II)

(VI) TEACHING OF SCIENCE

M.M. 50
SUBJECT CODE: EDUBED1204T **External: 35**
SUBJECT CODE: EDUBED1205T **Internal: 15**

(A) COURSE OUTCOMES

After completion of the course the student teacher will be able to:

- Understand the need, planning and maintenance of science laboratory.
- Maintain stock and store register with special reference to safety.
- Use various methods with appropriateness of content, level and classroom situations to make pupil's learning meaningful.
- Develop lesson plan and unit plan.
- Understand the qualities and role of a good science teacher.
- Organize Co-curricular activities & practical work in Science.
- Understand the concept, importance and techniques of evaluation in Science.

(B) SYLLABUS

SECTION–A

(i) Science Laboratory: Planning, Purchase and Maintenance of apparatus, Maintenanceof stock and store registers, Maintaining Records and Safety Procedures.

(ii) Co-curricular and non-formal Approaches: field trips, school gardening, biology clubs, visit to science museums, science fairs, excursions, quiz, seminars. Science note books, reference books, science journals and library for Science.

SECTION–B

(iii) Methods of teaching: Lecture method, Lecture-cum-demonstration method, Heuristic method, Problem solving method and Unit Planning. Lesson planning in Science: concept, objectives, importance and steps.

(iv) Evaluation: concept, importance and types, Continuous and comprehensive evaluation (CCE), qualities of a good test, tools of evaluation, various types of questions and construction of an achievement test in Science.

Activities (Any one of the following)

(i) Practicing at least two experiments to be conducted /demonstrated in secondaryclasses.

(ii) Writing two lesson plans.

(iii) Construction of an achievement test.

Head,
Department of Education & C.S.,
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(C) BOOKS RECOMMENDED

1. Cutting, Roger and Kelly, Orla (2014). *Creative Teaching in Primary Science.* Sage.
2. Dunne, Mick (2014). *Primary Science* (2nd ed.). Sage.
3. Their, H.D. (1970). *Teaching Elementary School Science: A Laboratory Approach.* New Delhi: Sterling Publishers.
4. Vaidya, N. (1989).*The Impact Science Teaching.* New Delhi: Oxford andIBH Publishing Company.
5. Mohan, R. (2002). *Innovative Science Teaching.* Delhi: Prentice-Hall.
6. Collete, Alfred T. and Eugene L. Chiappeta (1994), Science Instruction in the Middle& Secondary Schools, Macmillan, New York.
7. Jerry Wellington (1996), Teaching Science in Secondary Classes, Routledge, USA.
8. Kaur, Rakshinder (2007), Teaching of Science, Twenty First Century Publications,Patiala.
9. Kohli, V.K. How to Teach Science, Shri Krishna Publication, Ambla.
10. Mohan, Radha (2004), Innovative Science Teaching for Physical science Teachers,Prentice Hall of India, New Delhi.
11. Siddiqi & Siddiqi (2002) Teaching of Science Today and Tomorrow, Doaba House,New Delhi.
12. Sundarajan, S (1995) Teaching Science in Middle School: A Resource Book. Orient Longman, Hyderabad.
13. Tony Turner & Wendy Dimareo (1998), Learning to Teach Science in SecondarySchool, Routledge Publication, USA.
14. UNESCO (1966) Source Book for Science Teaching; UNESCO: Paris.
15. Vaidya N. (1999) Science Teaching for the 21st Century, Deep and Deep Publishers,New Delhi.
16. Venkataiah S. (2000) Science Education, Anmol Publications Pvt. Ltd., New Delhi.

(D) EVALUATION

External Examination	35 Marks
Internal Assessment	15 Marks
Attendance	3
Written Assignment/Project work/ Response sheets	6
Two Mid-term Examinations/ House Test	6

(E) INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three Sections: A, B, and C. Section A and B will have two questions from the respective sections of the syllabus and will carry 12 marks each. Section C will consist of 5 questions of 2 marks each and one objective type question of one mark which will cover the entire syllabus uniformly.

(F) INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt one question each from the sections A and B and the entire section C.

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B. Ed. PART-I **PAPER XI & XII Option (vi) Part-II**
SEMESTER-II **(TEACHING OF SCIENCE)**

Science Laboratory: Planning, Purchase and maintenance of apparatus, stock and store registers; maintaining records and safety procedures

LESSON NO. 1.1 **AUTHOR : DR. T. R. SHARMA & EDITED BY DR. AMITA**

1.1.1 Objectives: After going through this lesson students will be able to

(i) understand the need of laboratory in a school.

(ii) know the concept of organization of a laboratry.

(iii) understand the process of Selection and purchase of apparatus and chemicals for laboratory

(iv) Arrange, store and maintain laboratory equipment

(v) know Types of Registers and their uses

(vi) Apply Labortory safety measures

1.1.2 Introduction :

There is a difference between teaching of History, Political Science or Philosophy on one hand and teaching of science like Physics, Chemistry or Zoology on the other. Science always has two aspects namely (a) Theory and (b) Practicals and these two parts are so woven into one another that they are not separable. In fact they should not be separated

as our teachers usually do. They supplement each other. It is out of experiments and practices that a theory is born and developed and it is through experiments and practices that theoretical truths are verified and put to use. In teaching of science and also in its learning theoretical work and practical work always go hand in hand, side by side with due importance given to both. Both aspects are equally important. You can't say theory precedes practicals or practicals succeed theory. In our schools unfortunately most teachers distinguish between theory and practicals. They give more importance and more time to theory and very little time is devoted to practicals and they teach theory and practicals independent of each other. When they teach theory they ignore the practicals and when they conduct practicals they ignore theory. This is the basic mistake they do. Again their theory lessons and practical lessons don't have coordination. For example in the theory lesson they teach four parts of a candle flame and in the laboratory, they setup apparatus for 'charging gold-leaf electroscope +ively', in theory they teach preparation of Oxygen Gas and in practicals they do' Electrolysis of Water'. Such a practice kills the spirit of science teaching. In some schools it has been seen that entire theory is completed in the 9th class and practicals are done in the 10th class. This practice is responsible for separate rooms, one for theory and the other for practicals. Unfortunately science is taught through lecture method, even demonstration is not given. They should not be separated in time or place. They should be conducted at the same place and the same time. It is unwise to have separate lecture theatres and separate laboratories. Dr. R. H. Whitehouse, principal. Central Training College, Lahore as back as 1940, had planned a laboratory-cum-class-room for science teaching. His plan was recommended for implementation in Secondary School by the Education Department Punjab, but it could not find its takers in long run. The result is that schools still have separate rooms for teaching theory and for conducting practicals.

But in most advanced countries of the world the modern, laboratories combine theory and practicals and every care is taken that no distinction is made between theory and practice. Getting right type of apparatus and material in adequate quantity is necessary for teaching science in schools. Generally our schools have limited funds, so the science teacher has to be very careful while selecting, purchasing, storing and maintaining the science materials and apparatus. Money has to be used very wisely and usefully. Every rupee must run the maximum distance and nothing should be purchased which would not be used. We will discuss this topic under different headings.

1.1.3 Need of a Laboratory

Laboratory is not just a desirability, but an essential condition of teaching science. Without laboratory work science teaching is lame, perhaps cripped, unproductive and futile. Learning by doing is a cardinal principle of teaching science. Experimentation has put many theories on a sound footing and has also resulted in the rejection of many. Experimentation is responsible in annihilating superstitions and wrong beliefs and dogmas of man. Modern achievements of science are the result of experimentation and constant objective investigation and laboratory is a place where theories are tested and where consequent upon experimental work theories are born. Laboratories, thus is an essential requirement of every school. Other advantages of experimentation done in the laboratory are as follows :

(1) Things learnt through doing, by practically experimenting are more permanently fixed in the pupils' mind.

(2) In the laboratory the students find the truth and significance of matter read in books or in the class-room. Knowledge not experienced through experimentation is artificial, superficial, not long lasting and not born of conviction.

(3) Laboratory provides a place to satisfy the curiosity of children of

knowing and seeing if really happen as they have been given in the books. Practical work is emotionally satisfying.

(4) It is only practical work which produces a scientific temper, a scientific attitude and develops a scientific approach which are two main aims of teaching science, and practical work can only be done in laboratories.

(5) Laboratories make a child an active learner while lectures make only passive listeners. Laboratory produces scientists, inventors, discoverers and innovators.

(6) Laboratories inculcate good habits like keen observation exact measurement, unbiased inference making, co-operation, initiative, resourcefulness, self-dependence and self-reliance. It develops character, morality and love for truth.

(7) Laboratory develops very useful skills of handling apparatus, reagents, taking readings, using scales, scalpels, spatulas, blowpipes, tongs, tweezers, foreceps, scissors, maps, charts, sketch making etc.

Check your progress

1. What is the concept of a modern science laboratory?
2. Bring out the need of laboratory in Teaching of science in Secondary Schools.

1.1.4 Organisation of a Laboratory

Whether it is Physics Laboratory or a Chemistry the basic principles of organisation and planning are the same. Of course additional care has to be taken in the case of Chemistry Laboratory where poisonous gases are produced and acids may cause some accidents. The following points must be kept in mind while organising a laboratory work.

(1) There should be coordination between theoretical work and practical work they should go hand in hand in matter of time and place.

(2) The student' interest and curiosity should be exploited to maximum. Reflective thinking must be encouraged.

(3) Experiments arranged for students should neither be difficult nor too easy, they should have some specific question to answer and the students must know what they are looking for and how.

(4) Students must keep a very faithful and correct record of what they have done and observed in the laboratory. And recording should be done then and there in the laboratory and not near the examinations when science note-books are going to be evaluated.

(5) No student should be allowed to enter the laboratory without his completed science practical note-book.

(6) The teacher should go through the laboratory and observe how students work. He should make sure that all students have the needed equipment and apparatus. Students' problems, if any, must be attended to.

(7) Note-books should be corrected and signed in the laboratory. At that time some questions should be asked to test the student's comprehension.

(8) Students should be properly grouped for joining experimentation and every time new grouping be done.

(9) Proper discipline must be maintained so that accidents are avoided in the laboratory.

(10) Teacher's presence while students are working in the laboratory is essential.

(11) Before an 'experiment starts detailed instructions must be given to the students and ensured that the same are strictly followed. For this purpose the laboratory must have three documents :

(a) Laboratory Manual.
(b) Instruction Card.
(c) Laboratory Instructions.

These booklets must show students have to conduct themselves in the laboratory, what precautions they must follow and what experiments they have to perform all through the session and on which dates.

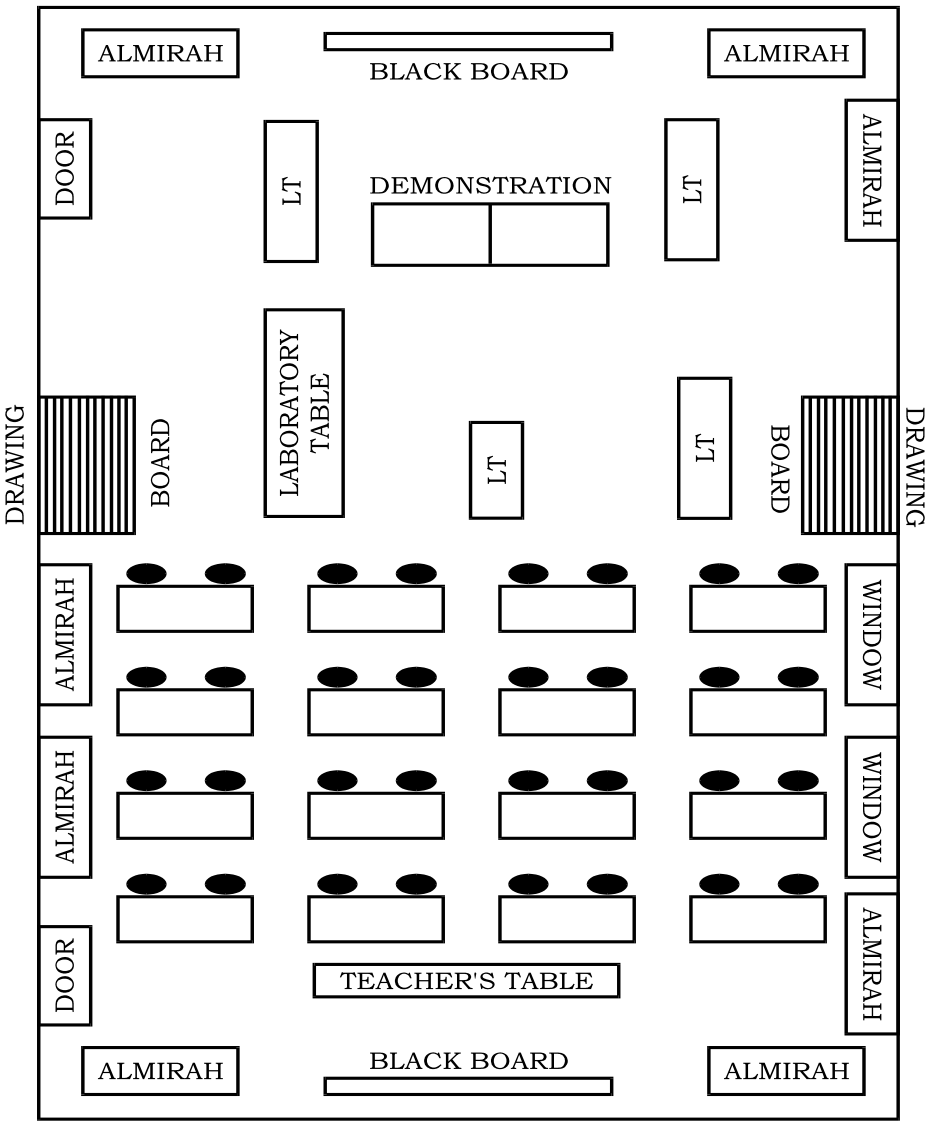
(12) Laboratory assistants and attendants must do the job assigned to them and they should never be allowed to outstep their jurisdiction.

(13) Apparatus and material after use should be cleaned and returned to the places from which it was taken.

1.1.4.1 Planning a Laboratory :

In our schools science Laboratory is planned as suggested by Dr. Whitehouse. The plan is given below :

LECTURE-CUM-LABORATORY



The details are given below :

(a) **Walls and Floor :** Walls should be 18" thick and should be painted or distempered. Floor should be perfectly smooth with cement plaster. Round corners between the wall and floors are recommended.

(b) **Doors and Windows :** Two doors, one near the lecture room and one near the laboratory are provided. Doors should open outward. Three windows each 6' across and 8' high are provided on the side opposite to the door. Two windows are near the seats, one near the practical tables. Windows too open outwards so that inner window could be used as shelves. Windows should have wire-gauze screens.

(c) **Water supply :** Sufficient water must be available in laboratory. A storage tank of not less than 2000 litre capacity must always can be available on the roof of the laboratory if running water supply is not available.

(d) **Furnishing and Fittings**

(i) Lecture Room : It must have a wall black-board 10'x4' at a distance of 3 feet from the teachers' table which is used as demonstration and also as a teacher's writing table.

Seating accommodation is provided on dual tables and chairs. Twenty tables and 40 chairs are needed for this purpose. Table should 3'-5" long 1'-6" wide and 2' high. Tables should be plain and simple in construction. Tops should be flat and not sloping. Sufficient moving space be provided.

(ii) Laboratory : A large Black-board be provided on the Laboratory side also. Six laboratory tables are arranged as shown in the diagram. Tables measure 6'x3'-6". Four students work at each table. Teacher's table is covered with lead. No diameters are provided with the tables. Sinks are provided not on tables but separately. Draining boards are provided with sinks. Beakers, flasks, cylinders etc. are placed diverted on the draining boards for drying and draining off water.

For balance recesses in the wall are preferred to wooden shelves. The recesses are one foot wide at a height of 3'-3" from the ground.

The plan provides 8 almirahs each 7' high and 5' wide having shelving accommodation 1'-6" deep left being resessed in the wall and 6" projecting into the room.

1.1.4.2 Co-operation of Students

(i) For maintenance of Laboratories

Students' cooperation must be enlisted for the maintenance of science laboratories and also for cleaning the apparatus. It has been seen that students take interest in this work as a labour of love and if a proper appeal is made to them they do this work most willingly and happily. It must also be remembered that they are not servants and they should never be treated as such. Another point to be

noted is that the same students should not always be forced to clean the apparatus or arrange the almirahs. The whole class be divided into 3-4 smaller groups and every fortnight or every month one particular group be given the responsibility of the upkeep of the laboratory. Democratic principle should be employed. The following points should be kept in mind.

1. Dirty apparatus must not be returned to the shelf or the almirahs. It should be properly cleaned and dried before it is restored to its original place. This particularly applies to apparatus in chemistry.
2. For cleaning glass articles soap, hot alkaline solution, surf, aciified $K_2Cr_2O_7$ may be used.
3. Iron articles must be given a coating of Japan black or aluminium paint as the case may be. If articles are rusty, rust must be removed before applying the paint.
4. Wooden articles must be polished with spirit and left in the sun for some time.
5. Table tops must be waxed every three months and their legs and sides duly polished.
6. Sinks should be kept clean.
7. Glass stoppers and corks should be attached to the bottles with rubber bands and no bottle should be left uncorked.
8. Apparatus and articles which need repair must be attended to well in time.
9. Articles from almirahs must be taken out once in three months and put back after cleaning the almirahs.
10. All stock be physically verified and broken and missing articles be written off.
11. Students who have been cleaning and maintaining the laboratory must be honoured at the time of School Annual Day Programme.

1.1.5 SELECTION OF APPARATUS AND CHEMICALS :

To teach science to school students, it is necessary to teach them using apparatus and chemicals. While selecting the apparatus, the teacher should keep in mind (i) the type of apparatus required for teaching biology, (ii) the quantity of each item and (iii) the minimum amount of apparatus and material required for efficient teaching at various levels. Besides this the teacher should also keep in mind the following factors:

(i) Finance : The most important factor while selecting the apparatus is to know that the finance at the disposal of the teacher is sufficient or not. Keeping in mind the finance available, the teacher should determine the quantity of the apparatus. He should prefer that apparatus which

indispensable for work. One should have more quantity that apparatus which is most desirable it should also be decided whether the work will be at individual or group level. Keeping the above considerations, teacher should select the material within the budget available to him.

(ii) **Method of Teaching :** The teacher should plan the whole subject matter in to different portions and decide the method of teaching for those portions. Accordingly he should prepare the list of requirement of apparatus and material on priority basis. Apparatus and material can be bought according to the schedule of requirement. Many teaching methods require less number of apparatus and material, thus buying of that material and apparatus can be adjusted accordingly.

(iii) **Level of Students :** The apparatus and material should be selected according to the age of students. More fabricated and complex apparatus for junior classes is not needed. The costly and specialized apparatus should not be given to small children. Individual work may be done by the students in symbol situations and in the higher age group. Thus, the purchase of apparatus should be according to level of students.

(iv) **Size of Class :** While selecting the quantity of apparatus, the size of the class should be kept in mind. Provision should be made for the purchase of some more apparatus than the required number in case of breakable and consumable material.

(v) **Time Schedule :** The time allotted for teaching biology is also a matter of concern while buying the material and apparatus. In case of consumable material, the quantity of material should be much less if less time devoted for practical work in that school. Where more time is spent on experimental work, the quantity of material can be increased.

(vi) **Storage Space :** Before making purchases, the storage space should be kept in mind. In sufficient storage accommodation leads to breakage of apparatus. If the apparatus or material is not properly arranged, it may break or spoil something.

(vii) **Physical Environment :** Before buying apparatus and material, one should keep in mind the availability of sources of supply, facilities for teachers to mend and repair equipment, help available to teacher and whether the school is in rural or urban area.

(viii) **Efficiency of Teachers :** In many schools non-science teachers are teaching science or the knowledge of the science teachers is limited or they do not have interest and ability for teaching science. In the above circumstance it will be of not used buying apparatus and material which are beyond the knowledge of the science teacher.

1.1.5.1 Purchase of Apparatus :

The apparatus and material should be purchased after making a selected

list of it. Quotations should be asked from well established firms and detailed requirement should be given to them. It is advisable to give quantity, size and quality before placing the order for apparatus and material. It should be kept in mind that quality should not suffer at the cost of price. If possible the teacher should go personally to get the things to save time as well as money which is otherwise wasted in postage etc. It is also advisable to get the glass apparatus insured against any damage.

There are different procedures to buy apparatus and material in different states. In some places, there is some central organization and in some places, grants are given to schools to get the equipment out of the approved list of items and firms. In many places sophisticated and costly equipment are purchased centrally and sent to various schools and local purchases are made for low cost material and consumable items.

1.1.5.2 Arrangement of Laboratory Apparatus :

After purchase of apparatus it is necessary to store it in an orderly manner. There should be a definite scheme to arrange the apparatus to avoid any type of breakage. It should be easily available when required.

The apparatus can be arranged subject wise or in a alphabetical order. One should follow one system at one time. The glass apparatus should be kept separately and should be properly spaced so that breaking of glass apparatus is avoidable. The apparatus and material in daily use should be easily approachable. Such apparatus should be stored separately. The apparatus should be so arranged so that it can be prevented from dirt, water and acids.

An attempt can be made to solve the storage problem by providing portable laboratory table or work bench that can be moved from room to room. Any table around school preferably 6'x6' can be mounted on wheels. The lower level of the table can be used for the storage of supplies and equipment. Such tables are extremely useful because they can be moved out the way when space is needed.

Same bench can be made more useful by boxing in the ends and back and adding a shelf of two inside.

Having one of these for each two rooms is extremely useful since they can be moved out of the way when the space is required. The custodian in the school could probably make a portable table within a couple of hours. The cost of converting such a table would be very little since the basic table would be available in the school. Occasionally parents can be asked to help with such projects.

Storage space for a science programme can be improvised by using orange crates or other partitioned wooden boxes. Besides being either free or extremely inexpensive, the crates are easy to use. These boxes can be arranged side by side in a row along the wall in the science area. Casters could be attached to the bottom of the crates so that they could be moved around the room or from room

to room. A piece of plywood attached to the back and extending over the top of the crate can supply display space. The possibilities for a variety of uses for these crates is limited only the ingenuity of the children and teachers.

1.1.5.3 Maintance of Apparatus :

The upkeep or care or maintenance of apparatus is important than even the storing of it. The apparatus requires its cleaning and polishing from time to time. The teacher should clean the apparatus immediately after use. It is better to keep the unclean the apparatus at one place for washing if the teacher feels that it can not be cleaned immediately after demonstration. The cleaned apparatus should be kept at its place.

Special care is needed for brass articles.

Care is also needed for metal and wooden articles in rainy season.

The iron articles require weekly rubbing and oiling to prevent rusting. Such articles should be polished at least once in a year. Rust should be removed before polishing.

Ordinary glass cloth can be used for polishing glassware and can be cleaned with soap or hot alkali solution etc.

The broken articles should be immediately repaired or replaced.

The top of laboratory tables should be coated with molten wax to avoid corrosion.

It is better to use ceramic tiles in the laboratory because they are easy to clean and maintain.

Students should be asked to follow the laboratory instructions strictly.

The apparatus and material should be properly checked after the purchase and entered in the stock register. Such register should be properly maintained the school should have three registers according to the nature of equipment i.e. permanent breakable or consumable.

The **permanent stock register** includes the articles or material made up of metal, wood or iron and is not liable to break or consumed.

The **breakable stock register** includes the articles of glassware which are liable to break.

The **consumable stock register** includes the items which are consumable. Such items should be entered in the register alphabetically.

The register should be properly paged and should have an index so that it may help in finding the material without any loss of time.

There should be space between the entries of the registers so that additions can be made under the same heading without disturbing the whole page. Such registers should be maintained by the teachers.

1.1.5.4 Apparatus needed for teaching science :

The most important apparatus and items required for the teaching of science

are:

(i) refrigerator
(ii) centrifuge
(iii) thermostatically controlled oven
(iv) thermostatically controlled water baths
(v) electric blender
(vi) pressure cooker or autoclave
(vii) deionizer
(viii) standard reagents like acetocarmine, alcohol, agar, barium sulphate, bicarbonate etc.
(ix) working models
(x) incubator
(xi) models
(xii) osmometer
(xiii) photometer
(xiv) aquarium and vivarium
(xv) respirometer
(xvi) test tubes
(xvii) Burners
(xviii) Beakers
(xix) Screwgauge etc.

1.1.6 Selection of Apparatus and Chemicals : While making a list of the requirements, the teacher should take into consideration the following points:

(i) the type of apparatus and chemicals required.
(ii) the quantity of each article.
(iii) the minimum quota of apparatus and materials necessary for efficient teaching at the various levels.

The quantity of the apparatus and chemicals will depend upon the following factors.

(i) finance
(ii) method of teaching
(iii) level of students
(iv) size of class
(v) time schedule
(vi) storage space
(vii) physical environment
(viii) efficiency of teachers

Purchase of Apparatus : When the list of selected apparatus and chemicals has been prepared, quotations from three or four standard firms should be asked and order be placed with the firm which quotes the best quality at cheaper rates.

It should be borne in mind that full details of the articles are given while asking for quotations in order to facilitate the dealers to send the quotations of the articles which are desired.

Arrangement : The apparatus received should be stored in order to avoid any breakage etc. The teacher may arrange the apparatus in an alphabetical order or subject wise is convenient for him. Precaution should be taken that glass articles are not placed side by side with metal ones.

Care and Maintenance : The care and maintenance of apparatus is even more important than the storing of it. The laboratory equipment should be regularly cleaned, washed, polished, repaired and replaced.

The articles should be entered in the stock registers the same day. Three registers may be maintained:

(i) permanent stock register
(ii) breakable stock register
(iii) consumable stock register

Before selecting the material the teacher must decide upon (a) type (b) quantity of each item and (c) use of material required for demonstration and for practical purpose. The following factors must be attended at the time of making selection of material :

(i) Finance i.e. money available with the school.
(ii) The number of students.
(iii) The method of teaching and the plan of work.
(iv) Relative emphasis on (a) individual work (b) group work (c) assignment work (d) heuristic work etc.
(v) The level of students whether they can benefit from abstract thinking or need concrete demonstrations.
(vi) The total number of subjects (sciences) to be taught in the school.
(vii) Time available for teaching science and number of sections engaged in teaching science in particular period.
(viii) The number of laboratories—senior and junior and the capacity of each laboratory.
(ix) The number of specializations of teacher available in the school.
(x) The type and quantity of apparatus which can be borrowed from neighbouring schools or colleges.
(xi) The type and quantity of apparatus which can be improvised.
(xii) The type and quantity of material already available with the school, the items which can be serviceable by repairing on adjustment afresh.

II. Purchase of Apparatus and Chemicals

After deciding what and how much and of what specification and quality is required, four to five lists are prepared and quotations are called from four to five

well established firms, dealers or factories. While sending out the letter it is always necessary to name the article, quality, size and quantity of each article in different columns. An example given below will make the point clear :

Sr. No.	***Name of article***	***Quality***	***Size***	***Quantity***
1.	Flask	Pyrex, round bottom	500 ml.	2 dozen
2.	HCL	Concentrated pure	—	1 gal.
3.	KOH	Pellets	—	1 lb.
4.	Troughs	Pneumatic glass	12" dia	6 only

After the quotations have been received, order should be given to the firm or shop or dealer which supplies better material, soon and at cheaper rates. But no compromise should be made with quality. It is always good if materials are inspected before the firm is allowed to despatch them after good packing. In different states different methods are employed for making purchases. Rate-contract facility, if available, must be used. In some cases the government makes purchases in bulk at a central place and then goods are distributed according to the needs of different institutions. This saves the teacher from botheration of calling quotations etc. Sometimes the government makes purchase committees which are given the authority to see things on the spot and make bulk purchases.

Arranging, Storing and Maintenance of Equipment

After the material has been received and checked as per order, it should be arranged methodologically and systematically either alphabetically or as per subject-wise requirement. The apparatus for daily use should be put on open shelf or on the tables. Reagents must be allotted two open shelves on either side of the laboratory or on small shelves made in the middle of tables. Demonstration apparatus may be arranged subject-wise but stored in almirahs near the demonstration table.

Maintenance means looking after cleanliness and repair of the apparatus. It is necessary that once in three months apparatus in the almirahs be taken out, checked, dusted, cleaned and if needed polished and lubricated. Uncleaned beakers, flasks, jars etc. should not be returned to the shelves or almirahs. After use, the apparatus must be cleaned and dried up. For cleaning glass ware, soap, hot alkali-solution, acidified K_2 Cr_2 O_7 solution may be used. Iron articles must be given coating of Black-J paint or some other black paint. Rust must be removed before giving a paint-coat. Brass articles be given a spirit coating or a varnish coating as the case may be. Table tops in the laboratory must be waxed, Sinks should be always cleaned properly. No tap should be left leaking. Glass stoppers and corks should always be kept attached to the bottles with the thin copper wires of rubber bands. A laboratory must have a small workshop to be used for repairing etc.

Short in Text Questions

1. What points should be kept in mind while organiging a laoratory?

   .....

   .....

2. List the requirements should be considered while selection of apparatus for science laboratory.

   .....

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1.1.7 Registers

It is always important to keep a proper record of apparatus, other materials and the reagents besides the items of furniture. Some important registers are enlisted below.

I. Permanent Stock Register

In this register articles of metal, wood or of permanent nature which are not consumed are entered. Iron stands, troughs, magnets, telescope etc., are examples of permanent stock.

II. Stock Register of Breakable Articles

In this register are recorded glass item such as beakers, test tubes, retorts, gas jar etc.

III. Stock register of Consumable Articles

Chemicals, reagents, salts etc. are entered in this register.

IV. Order Register

Whenever things are ordered for purchase, they are entered in the order register.

V. Requirement Register

In this register the teacher puts on the names of articles which during the course of teaching or conducting practicals he feels, are required to be purchased. This register is consulted at the time of placing the annual purchase order.

VI. Issue Register

Some time some apparatus is issued to teachers or students to be used outside the school or during off hours. Such articles are entered in this register and the name and signature of the teacher/student to whom the articles are issued are written and obtained respectively.

Every register must have its name written on it in bold letters, the pages should be numbered and a certificate is given on the first page with respect to the pages the register contains. Every register has an index showing what material is entered on which page. Whenever an article is added, its specifications, date of purchase, the firm from where purchased and its cost must be entered. Whenever an article is

broken and written off or is consumed in the laboratory, entry to this effect must be made by the science teacher and got countersigned by school head. Entries in register should be physically verified and a certificate to this effect be recorded in the register.

(We give below a specimen page from a Stock Register)

Name of the Article..... Page.....

Year Month and Date	Name of the firm Bill No. and date of purchase	Receipt ------- Qty. Rate Amount	Consumed or Written off ---------- Qty. Amount	Balance -------- Qty. Amount	Initials of teacher	Remarks

1.1.8 Laboratory Safety Measures

Laboratory is a place in a school, where students are to perform experiments with the help of certain electric appliances and chemical reagents. During conduct of experiments some mishappenings may occur either due to negligence or accident. Therefore, some precautions are to be made for prevention of any mishappening and first aid box is to be kept to deal with any accidental situation. Some important safety measures are listed below :

1. Maintenance of Electrical Instruments

The apparatus, operated with electricity, need regular maintenance. The wiring of instruments including switches and plugs are to checked periodically and especially before conduct of an experiment.

2. Accidents and Remedies

There is a possibility of some accidents in laboratory for which remedies are to be made.

i) **Burns** by dry heat due to flame or hot objects should be treated by applying Burnol. In case of blisters caused by burns, apply Burnol and refer the victim to doctor for further medical treatment.

ii) **Acid Burns** are to be washed with water and saturated solution of sodium bicarbonate, followed by application of Burnol or mustard oil.

iii) **Alkali Burns** are to be washed with water and acetic acid. Dry the skin and apply Burnol.

iv) **Cuts** due to mishandling of glassware need to be treated with dettol or methyolated spirit, and providing medical treatment from a doctor.

v) **Acid in eye** is to be washed by sprinkling cold water and washing with sodium carbonate solution.

vi) **Alkali in eye** is to be washed by sprinkling cold water and washing with boric acid solution.

vii) **Foreign particles in eye** are to be removed by washing and sprinkling

water into the eye. Rubbing is to be avoided. Remove the particle softly by means of a clean handkerchief, and again washing freely with water.

viii) **Poisnous inhalation of gases** need to be treated by shifting the victim to an open airy space at once and referring the case to doctor for further treatment.

ix) **Fire burns** are to be extinguished by wrapping the victim with a heavy blanket. Caution is to be taken while helping such a victim that water should not be used as of will cause serious boils. Medical treatment is to be provided at once by taking the victim to a doctor.

x) **Burning due to Reagents** need to be treated carefully and seeking medical treatment to deal with such a victim.

3. **First Aid Box**

First aid box should be kept in science laboratory to provide immediate medical treatment to a student in case of an accident. There should be following materials in first aid box :

i) Bandages (of different sizes), gauze, cotton work and glass dropper.

ii) A pair of scissors, forcepts, safety pins etc.

iii) Vaseline, Boroline, boric acid powder sodium carbonate powder, Burnol and some, other ointments/lotions as per doctors' advice.

iv) Picnic acid solution, tannic acid solution, accetic acid solution, sodium bicarbonate solution (the dilution should be made by seeking doctor's advice).

v) Methylated spirit, rectified spirit, dettol etc.

It is suggested that first aid box should be maintained properly and replacing the materials after expiry date. Needless to mention, first aid box is must for a science teacher to deal effectively with any minor accident in science laboratory.

1.1.9 SUMMARY :

For an effective teaching of science adequate apparatus and chemicals are indispensable. The following procedure should be adopted while purchasing the apparatus and material.

Science has two aspects theory and practicals. These two aspects are inseparable. They are supplementary in nature, interdependent and help each other. Theory is tested for its truth and authenticity in practicals and through investigation and experiments are born out of theory. Science teachers should ensure that theory and practicals go hand in hand and they are not separated in terms of time and space. It is wrong to teach theory now and practicals later on.

Laboratory is not a desirability but a condition essential for teaching science. If purpose of teaching science, namely, scientific attitude and scientific method are to be achieved, we specifically need laboratory work in our schools. Besides, things learnt through doing are permanently fixed up in the mind. In the laboratory the truth of the theoretical knowledge is tested, verified and confirmed by the students

themselves. Laboratory provides a place to satisfy curiosity and emotional satisfaction to students. It provides a scientific temper. It makes a child active and skilful and laboratory inculcates good habits like keen observation, cooperation, initiativeness, resourcefulness etc.

A Laboratory Plan suggested by Dr. Whitehouse is fairly workable and has been recommended by the Education Department, Punjab.

Experimental work should be carefully organised and a record of the practical work should be kept regularly and punctually. Note-books are completed on the day of experiment and not on the day of examination.

There is a possibility of some minor accidents in laboratory and a teacher should remain prepared to deal with such situations. Purchased material should be property stored, stocked, registered and maintained. Cleanlines and repair of the furniture must be ensured. The science teacher msut maintain the necessary stock and store registered and every year at the end of the academic session, stock should be physically verified.

1.1.10 KEY CONCEPTS

1. Laboratory- A room or building that is used for scientific research, testing, experiement etc. or for teaching about science.
2. Apparatus- The things or tools or equipment that are used to carry out an experiement.

1.1.11 SELF CHECK EXERCISE: TRUE/FALSE

1. Laboratory is not an essential condition for teaching science.
2. To aviod accidents in laboratory proper discipline should be maintained.
3. Experiments arranged for students should be difficult.
4. Dirty apparatus should be restured to the shelf or the almirah.
5. The papparatus and material should be seleted according to the age of stduents.

Ans: 1. False 2. True 3. False 4. False 5. True.

1.1.12 SUGGESTED QUESTIONS :

1. Which are factors to be kept in mind while selection of apparatus and material?
2. List the equipment needed for a science laboratory of high class.
3. What are the considerations for purchasing of apparatus?
4. How will you care and maintain the apparatus in your laboratory?
5. Write how a laboratory should be organised and maintained
6. Name the main registers which a sience teacher must maintain for unkeep and maintenance of stock. Discuss the stock register in detail.

1.1.13 SUGGESTED READINGS & BOOKS

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B.ED. PART-I **PAPER-XI & XII (OPT.-VI) Part-II**
Semester-II **(TEACHING OF SCIENCE)**
Co-curricular and non formal approaches, Science Club, Science Excursion, Science Quiz, school gardening

LESSON NO. 1.2 **AUTHOR : DR. PARVINDER KAUR**

1.2.1 Objectives: After going through this lesson students will be able to

1. know the Role of Science Quiz, Science excursion and science club in Study of Science
2. Explain the Importance of sciene club in teaching of science.
3. Analyise the working of science clubs etc.
4. organize sciene excussion.

1.2.2 INTRODUCTION

The goal of education is not to increase the amount of knowledge but to create the possibilities for a child to invent and discover. The teaching-learning process in science teaching, therefore, means creating situations, beyond classroom teaching, where the students get enough of opportunities for their optimal learning. The increased emphasis on scientific method enables a teacher to freely invite students to perform experimentation, collect samples of various plants, animals and non-living materials by visiting nearby surroundings, write short articles, make some observatory notes by reading magazines, newspapers reference books and arrange these collections for their display in science laboratory or library or on the news bulletin board. All such activities need attention of the teacher and school authorities to be conducted in a meticulous way. Some of the activities in the science teaching are briefly discussed.

1.2.3 Co-Curricular and non-formal approaches

Co-Curricular approaches to learning emphasize a holistic view of students learning, making connection an overaching goal: connection to existing

professional practice, or connection to other social groups, or connection to communities outside school.

- Volunteering
- Dance, sports and Athletics Events.
- Organizing cultural events at school or college level.
- Participation in debates, quizzes, Olympiads, seminars etc.
- taking up eletives such as a foreign langange.

Non formal appraches- Non formal learning takes, places outside formal learning environments but within some kind or organizational framwork. It arises from the learner's conscios decision to master a particular activity, skill or area of knowledge and is thus the result of internationa effort. Non-formal appraches includes various strctured learning situatins which do not either have the level of curriclum, syllabus, accreditation and certification associated with 'formal learning', but have more structure than that associated with informal learning, which typically take place naturally and spontaneously as part of other activities.

1.2.4 Science Club

Two principles of teaching, "learning by Doing" and Learning by Living" are also true in the case of teaching Physics and Chemistry. Every individual has his own ideas, interests and hobbies, which he may like to explore on his own. Experience has shown the one of the most effective and exciting ways of trying out science hobbies, exploring ideas and developing creativity through science clubs which offer opportunity to a student to work on his own ideas, projects, experiments, hobbies etc., Or we may say that an organisation which caters for the inculcation of scientific attitude, a genuine interest in science and scientific activities, supplements the work of the class-room and the laboratory and puts the syllabus a practical bias, may be named science club.

The science club offers an opportunity for self-expression and specialization in an informal atmosphere. It provides an outlet to pent up energies of students. In this way students can wider their mental horizon and moreover it provides better means of utilising their leisure time. Science clubs make learning of science a joyful experience.

Aims and Objectives of Science Clubs :

1. To inculcate critical attitude and provide opportunities for training in scientific method.
2. To encourage critical thinking and to develop creative and inventive faculties.
3. To develop interest in scientific hobbies e.g. photography, candle making, chalk making, preparation of soaps, ink etc.
4. To encourage environmental studies.
5. To acquaint the students with recent developments in the field of science.

6. To develop self-confidence among the students.
7. To carry out more complicated experiments not permitted in time-table.
8. To give idea of self-government.
9. To prepare pupils for effective participation in science fairs and exhibitions at different levels.
10. To get the club affiliated to the District and Regional Science Club.

Organising Science Club

Every science club should have its own constitution and every member should abide by it. The head of the institution should be the patron of the club and teacher-in-charge the sponsor. The patron extends all types of administrative facilities and co-operation for the successful execution of the activities of the club. The sponsor is just an advisor and helps in making the club self-conduction. There should be an Executive Body elected from amongst the students consisting of a chairman, a secretary, an assistant secretary a treasurer, librarian, a store-keeper, a publicity officer and class representatives.

The chairman usually presides over all the functions of the club. The secretary keeps an accurate and concise record of members and activities of club. The treasurer keeps all the accounts. The librarian is the in-charge of science club library. The store-keeper maintains the record of the equipment of the club. Publicity Officer is responsible for all sorts of publicity inside and outside school for the activities of clubs. He represents the club at pupil-teacher meetings.

The membership to the science club should not be imposed upon students and should not be restricted to science students only. It should be open to all the students in the school. A normal fee my be charged from each member.

Activities of the club :

1. Organising science fairs, science exhibitions and to conduct more complicated experiments.
2. Holding discussions, declamations, debates, paper reading, quiz contests etc.
3. Arranging excursions and visits to places of scientific interest.
4. Improving and preparing hand-made apparatus.
5. Collections of living and non-living things for science museum.
6. Novelty number such as production of musical selection by blowing upon test tubes.
7. Preparation of soap ink, cream, boot-polish, candle etc.
8. Preparation of charts, pictures and models etc.
9. Arranging extension lectures by eminent scientists.
10. Celebrating science days etc.
11. Rendering possible services to the community.
12. Science quizzes and competitions.

The success of the science club mainly depends upon science teacher who is the back-bone and main force of the club. An enthusiastic teacher can make the whole programmes a success even it he is very burdened and does not have adequate facilities. Proper guidance should be provided by the teacher. He should know the objectives and organisation of the science club.

1.2.5 SCIENCE EXCURSIONS

A teacher will always use the resources of the community for purpose of enrichment, supplementation and correlation of his class work. Community, whether rural or urban offers a large number of opportunities which are of immense value from educational viewpoint. Some of the community resources, appropriate for science teaching are :

(a) Telephone exchanges, Radio Stations and Power Plants
(b) Museums, Zoological parks and Botanical gardens
(c) Chemical and other industrial plants
(d) Air ports and Sea ports
(e) Computer Centres
(f) Weather Bureaus
(g) Farms, Dairies and Woods
(h) Water Works and Sewerage Works
(i) Science Centres
(j) Television Station

Visits to these places are to be organized not for sight seeing but with some specific educational aim. Main educational purposes can be :

(a) For fostering a spirit of scientific enquiry
(b) For a certain 'project'
(c) For supplementing class work
(d) For developing local interest

The place or places to be visited will depend upon the locality and the subject of study at school. Places like radio stations, power plants, museums, telephone exchange etc. are situated in big cities and the schools situated in these cities, near these places can only avail of these. Farms, orchards, modern dairies etc. are situated in rural areas and are within easy reach of rural schools.

A class studying generation and application of electricity will plan visit to generating stations, radio stations, telephone exchanges etc. A class studying "Nature" cannot do without planning field excursions. Some museums are built up from a purely educational view point. A single visit to such a museum is worth many a theoretical lessons.

All these places will render useful scientific information and create interest for further studies. Sometimes very good literature is available with large firms,

industrial concerns and big stores which can be used for illustration purposes in the class.

Planning an Excursion

The entire planning and conduct should be done by the students under the guidance of the teacher. While it should be an enjoyable experience, it should also be a serious undertaking. Each student should feel that he has some responsibility not only for appropriate observation, information or other skills but also for co-operating with the teacher and other members of the trip.

There should be the following three major steps for the proper organization of an excursion :

(a) Preparing the Guide Sheet.
(b) Conducting the Trip.
(c) Follow-up Work.

(a) Preparing the Guide Sheet

A Guide sheet, which is nothing but detailed planning, should contain two major divisions.

(i) Learning activities.
(ii) Physical details.

Items relating to *Learning Activities* should include :

(i) Apparatus and materials to be taken, such as graph papers, rulers, tape, thermometers, lens, tape recorder etc.
(ii) Responsibilities of individuals on various committees for observation, data collection, recording etc.
(iii) Lists of questions, terms, principles and their applications to be studied.
(iv) Particular processes, devices, or departments to be observed. Items relating to *Physical Details* should include :
(i) Routes or itinerary to be followed.
(ii) Time schedule.
(iii) Dress.
(iv) Personal equipment-cameras, binoculars, umbrellas etc.
(v) Provisions for refreshments and meals.
(vi) Transportation arrangements.
(vii) First-aid and emergency provisions.

In order that the trip be well planned, it is usually necessary that one or more members of the class have some first hand contact with first hand information about the place to be visited, its resources and possibilities. Sometimes it is desirable that the teacher has such an over-view, in order that he may guide and direct discussions, planning and preparation.

Certain administrative details should also be carefully pre-planned such as:

1. Approval of school authorities.
2. Arrangements with other teachers (If students are to miss other classes, the cooperation of the teachers concerned should be ensured.)
3. Permission of parents.
4. Transportation (Government or private buses and Railway concession order should be arranged sufficiently before the commencement of the tour).

For any further detail about the place to be visited, nearest tourist office may be consulted.

(b) Conducting the Trip

It is up to the teacher-in-charge to conduct the trip to his best possible way, so that there is no mishap or misconduct and all participants take it as a source of enjoyment and education.

(c) Follow-up Work

The value of trip can be greatly increased by a planned follow-up. A few suggested activities are listed below :

1. General discussion on the trip with students, their questions, reactions and suggestions for similar future trips should be invited.
2. Preparation of models, charts, albums etc.
3. A talk by a qualified person concerning the place visited.
4. Preparation of guide sheets for another group who would take the same trip on some other occasion.
5. Preparation and filling of materials secured during the tour.
6. Written papers, sketches, drawings, paintings, assignments or articles for bulletin-board or school magazine.
7. Preparation of an album of the photographs taken during the tour.
8. Taking objective test relating to the trip.
9. Writing letters to the news papers or authorities concerned on problems brought out by the trip or suggestions for improvement of facilities for tourists.

1.2.6 SCIENCE QUIZ

There are some simple and interesting ways of helping the students to remember important principles and facts. The method is to evolve some common or even non-sensible word or phrases, having a link with the fact to be memorized. By good experience and interest the teacher can create such original 'aids' in the form of quiz. Even students can be encouraged to help themselves in this connection. A few examples are being listed below :

1. In calorimetry, amount of heat gained or lost by a body is calculated by getting the product of mass, specific heat and temperature difference, which can be

easily learnt by the following way;

My	(M for mass)
Science	(S for sp. Heat)
Teacher	(T for temp. difference)

(Remember as MST or My Science Teacher)

2. Similarly, when there is change of state and latent heat involved, the amount of heat given out or absorbed is found out by multiplying mass with latent heat.

My	(M for mass)
Laboratory	(L for latent heat)

(Remember as ML or My laboratory)

3. Seven colours of a spectrum are remembered in this way.

V iolet
I ndigo
B lue
G reen
Y ellow
O range
R ed (Remember as VIBGYOR)

If the colours are taken in reverse order

R ama
O f
Y ale
G ained
B attles
I n
V ain

(Rember as Rama of yale Gained Battles in Vain)

4. Following are the common properties of a gas :

C ombustion (Whether it supports combustion or not)
L itmus (action of litmus)
O dour ('hue' or colour)
U n visible (unseen)
D ensity (compared with air)
S olubility (in water)

(Remember as CLOUDS)

5. Following are the common characteristics of living bodies :

M ovement
E xcretion
R espiration
R eproduction

I rritability

N utrition

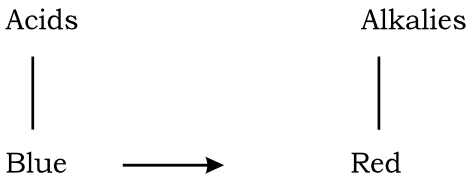
(Remember as MERRING)

6. 'Acids turn blue litmus red' is generally confused with Alkalis turn red litmus blue. It may be remembered in this way :

Acids (AC……) comes before Alkalies (Al…..)

Blue comes before Red

So 'Acids' and 'Blue' have common link



Certain problem solving activities can also form the past of quiz.

1. Effervescence is a qualitative in which acid is used to identify carbonate rock. If a gas is given off when acid is added, the substance tested may be carbonate. Under what conditions and to what extent can calcium carbonate be dissolved in acids ? Do salts containing calcium ions and salts not containing ions influence this solubility? Does a negative ion have any effect ?
2. Why does black board chalk of constant length generally break onto the same number of pieces when it is dropped ? Why does it break in a spiral when twisted ? Why does chalk open squeak when used on a black board ? How does natural chalk compare with manufactured chalk in density, adhesion to slate, fossil content, and porosity ?
3. The Crystals of $CaCO_3$ may occur in the either of two forms, calcite or aragonite. Which is the more soluble ? Does this stability-solubility relationship hold true for other compounds that occur in more than one crystalline form ?
4. The origin of fine-grained non-fossiliferous limestone is difficult to determine in more localities. Are there clues in the composition of the limestone of your area that would indicate how it was formed ?

The questioning in classroom teaching is often memory based dealing with a particular topic, being taught. A list of questions can be prepared in the form of a quiz to be conducted once in a month to correlate the content matter, taught during this period Similarly a teacher can assign students some topics to prepare questions and collate these in the form of a quiz. The quiz activity is useful to enhance student participation and making teaching-learning process a joyful activity.

Short in Text Questions

1. Write about few activities which can be organized during science club.

.....

1.2.7 School Gardening

It is not difficult to make and keep a colourful garden. The important thing is thoroughness, even simple job must be done properly, patiently and at right time. The first thing required by the gardening process is tools. Some of the tools are spade, fork, hoes, rakes, measuring sticks, wheel barrow, moving machine, shares, edging iron, spraying and dusting .equipment, roller, water can, sieves, sundries etc.

All tools and equipments must be stored under cover, preferable in a well- built dry frost proof shed which can also be used for storing fertilizer, bulbs, fruits and vegetables. After use all tools must. be cleaned, dried and wiped. Every tool must be used properly and for its particular purpose.

Soil is generally a complex mixture of inorganic or mineral matter formed by the age old erosion of rocks, and organic matter of vegetable or animal origin loosely called humus. For gardening proper type of soil is to be taken into account before going in for laying out for garden. The different types of soils are sandy, clay, chalk, gravel, loamy etc. Proper drainage system should be planned according to the type of soil you have. All bricks, stones, rubbish should be collected and stacked in a heap, they may be useful later on. Brambles and self-sown thorns should be grubbed up and burnt but no tree or shrub should be removed until the final plan for the garden has been made. Digging is the most important of all the garden work because it has such great effect on soil texture. It must therefore be done properly. The art of planning a garden or remaking of an old one lies in making the best use of a particular site. Gardens should always be designed so that the best parts can be seen from the principal rooms of the house. A sound boundary fence, proof against dogs, cattle etc. are essential. Walks and terraces may be paved with stone or brick or a combination of both and various patterns and designs can be worked out. Beds and Borders should be well planned. Pergolas are prominent and permanent features and must therefore appear to have a purpose in a general design. Before the sowing season begins, all boxes, pots, base and bars and crocks should be washed clean with an ordinary detergent and rinsed in order to destroy the fungi which cause the fatal damping off of seedlings. Annuals offer a wide range of colour and a long period of flowering. Ornamental trees or shrubs can be planted in autumn or spring. Great care is necessary for choosing conifers for an average sized garden. There are several vegetative methods by which many plants can be multiplied like cuttings, layers, runners, root division budding, grafting etc. Gardens can also be equipped with a proper store room and should be kept dry and well ventilated. The last important job for a gardener is to keep the plants healthy and free of diseases. Proper control measures should be used to avoid the spoiling of gardens.

1.2.8 Summary

Co-curricular and non-formal approaches in education, such as school gardening, school clubs, excursins and quizzes, enrich the learning experience beyond traditinal classrooms. School gardening engages students in hands on earning, fostering environment awareness.Science clubs provide a platform for collaborative exploration and experiementation. Science excursions expose students to real world applications, enhancing practical understanding Quizzes stimulate intellectual curiosity and critical thinking. These approaches collectviely contribute to a holistic education, nurturing skills like teamwork, problem solving and creativity. By combining formal and non foral method, educators create dynamic learning envirnments cultivating well rounded individuals prepared for the challenges of the modern world.

1.2.9 Key Concepts

1. Co-Curricular approaches- Activities program and learning experiences that complement, in some way students are learnig in school.

2. Non formal approach- This takes place outside formal learnig environment but within some kind of orgranizational framework.

1.2.10 Self Check Exercise

Fill in the blanks:

1. Sciences club offes an opportunity for ..... informalatmosphere.
2. The guide sheet of excursion has two major division i).....ii).....
3. For..... proper type of sail is to be taken into account.
4. Science club and excursion make .....a experience.

Ans: 1. Self-expression 2. Learnig activities 3. physical datails.
4. Gardening 5. Learning.

1.2.11 Suggested Questions

1. How do science quiz, science excursion and science club help in the study of science.
2. Discuss importance of science club in teaching of science.

1.2.12 Suggested References

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B.Ed. Part-I (Semester-II) **Paper-XI and XII (Opt.VI) Part-II**
Teaching of Science

LESSON NO. 1.3 **Writer : Mrs.Manmeet Oberoi**

1.3.1 Objectives : After going through this lesson students will be able to

1. know the Educational significance of life science museum.
2. understand the Importance of Science museum
3. explain the need and Importance of Field trips and seminars

1.3.2 Introduction :

Today India is striving hard to initiate an industrial take off, but the people of India are not subjectively equipped to undertake such a task. The people of country are still under the influence of the worst forms of dogmas and prejudices, even the people of scientific community are influenced by these.

The dichotomy between the theory and practice is actually the greatest hindrance in making India a modernizing society. If the country is to advance industrially, it is essential to take massive efforts in the field of education.

Science education forms an integral part of our school curriculum up to the secondary level in the process of universalization of science education. The qualitative improvement in science education depends on many vital components.

The teacher is considered to be a very crucial factor in the teaching learning process, developing positive attitudes in learners for better achievement and the formulation and implementation of science education programmes.

1.3.3 Use of Resources to Improve Science Education :

The teachers have to discard their traditional methods and usual practices in relying entirely on text books because the class room is the limited place, bounded narrowly by four walls. It is meant for providing pupils only narrow experiences. Outside the class rooms there are vast resources which a teacher might love to utilize.

These resources can become the supplementary to classroom teaching and such an approach can bring an improvement in our science education at school stage. One of the

innovative experiences in science education at school level is to take a field trip to the local museum which is the great and a wonderful way to demonstrate many concepts to students. It is infact a very effective and interesting source of learning science.

1.3.4 Science Museum :

The term 'Museum' literally means "a spot dedicated to the muses" It was deemed to be a place where a person could attain aloofness above the humdrum affairs of life. An important branch of museums are science museums. Science museums can be literally defined as museums devoted to science; Science museums concentrate mainly on display of things related to geology, paleontology, botany, zoology, industry, and industrial development. However, in recent times, science museums put more stress on showcasing the technological developments made by man. Thus, the purview of the science museums has broadened in recent times.

1.3.4.1 Important Science Museums :

India has a number of museums dedicated to science or industrial development. Some of the important science museums of India are:-

* Birla Industrial and technological museum, Kolkata.
* Goa Science Park, Kapila.
* National Science centre, Delhi,
* Nehru Museum of Science and Technology, Kharagpur.
* Rama Science centre, Nagpur
* Regional Science centre, Lucknow.
* Regional Sceince centre and Planetarium, calicut.
* Science Centre, Dhenkanal
* Science City, Kolkata.
* Visvesvaraya Industrial and Technological Museum, Bangalore
* Shri Krishna Science Centre, Patna.

Let us discuss some science museums a little bit in detail.

1.3.4.1.1 Nehru Science Centre :

The Nehru Science Centre (NSC) is established in Bombay by the National Council of Science Museums. The most important and attractive part of the NSC is a 'Science Park' for children. With green surroundings, the Children's Science Park has exhibited on time, motion, energy, power and work. Also, there are models of railway engines, tram cars, aero planes, steam Lorries, a windmill and a sun dial. There are birds, animals and fish to acquaint children with nature. While children enjoy the Science Park the most. It also helps them to understand 'what' 'why' and 'how' of the queries, questions and problems haunting their minds.

Nehru Science Centre, Bombay is basically multi-disciplinary in character. Collection of antique exhibits of historic value, presentation of the same through permanent and temporary exhibitions on selected themes, extension activities offering multiple avenues of learning, enjoyment and training to the student community as well as the public, taking science to rural areas through mobile science vans, aiming towards interacting mode of presentation of themes are some of the ways in which the NSC operates. The Science Centre also offers a gallery on 'light and sight'. It presents different principles involved in file process of 'seeing and the vision'. A survey is made of vision, its importance, its complexities and varieties. Nehru Science Centre also organizes extension activities such as science extension in rural areas, film video shows, science seminars for schools, films, video cassettes loan service, amateur weather station, amateur radio classes for children, sky observation programmes,

astronomical camps popular science lectures, special science film festivals, aeronautic modeling programmes and training camps for under-privileged children.

1.3.4.1.2 Visvesvaraya Industrial and Technological Museum :

The Visvesvaraya Industrial and Technological Museum is established in Babnalore. It organises various activities and programmes such as motive power gallery (science museum), teacher training, hobby centre, student's science seminars, science quiz, science fair, temporary science exhibitions, science demonstration lectures, mobile science exhibitions, film shows, popular science lectures, etc. The museum has also a regional science centre at Gulbarga.

If you have a science museum at the place where you teach, plan a visit to that museum. If your students go to some places. Where there are science museums, ask them to visit them with their parents or if your arrange a field trip to any place, where there is a science museum, take your students there, and see how much science they learn - the science which is not there even in their science books.

1.3.4.2 Mobile Science Vans :

Some Science museums have mobile science units, museums on wheels. They are usually sent to those places where there are no science museums. These are very effective source of learning science for students at upper primary level.

Natural History museum, New Delhi, National Science Centre, New Delhi, Nehru Science Centre, Bombay have mobile science vans. With the help of such mobile museums, students may visit the science museums even in their schools and can learn a lot of scientific concepts.

1.3.5 Objectives of Science Museums :

Main objectives for the establishment of science museums are:-

1. To help the young learners in understanding the concepts of science.
2. To provide a glimpse of past as well as an insight into the future.
3. To help schools in their class activities by providing them with a number of equipments and specimens which are otherwise difficult for a single school to procure.
4. To arrange extension activities such as field trips, lectures, film shows and exhibitions for the students as well as public.
5. To stimulate the sense of curiosity in the pupils in order to widen their experiences.
6. To inculcate the sense of beauty.
7. To inculcate the spirit of inquiry among students.

1.3.6 Organization of Science Museums in Schools :

The science department of every school can build a science museum. It can create the right atmosphere for learning new things in the school. The location of the museum depends upon the space available in the laboratory or it can be a corner attached to the laboratory.

The life sciences museum contains collected and preserved specimens, models, skeletons and herbaria etc, arranged in ordered and organized manner. The space for the museum should be selected according to the amount of collection. A museum should have proper showcases in which the articles prepared or collected by the students

should be displayed. These should be systematically arranged and should be thoroughly labelled. Worn out and damaged articles should be replaced by new articles.

Models, specimens, materials displayed in dissected form etc. should bear the names of organisms as well as those of different organs. Specimens, models, stuffed animals etc. Should bear their common as well as biological names and if possible their classification according to their class and order should be displayed. A card (about 5"x 4") should be attached to each specimen. Each card should contain following in simple language.

* The name both in scientific and common language.
* The family of the specimen
* When and where found.
* Name of the person who found it.
* Importance of the specimen of the exhibit.

1.3.6.1 Museum Material :

The life sciences museum may be stocked with various plants, animals and models of micro organisms. In plants, the students can preserve specimens of algae, fungi, bryophytes, pteridophytes (Whole or parts), gymnosperms (cones or leaves) and angiosperms (various parts of plants). In animal's different types of specimens of worms, fishes, amphibians (frogs, toads etc.), annelids (earthworms and leaches etc.) reptiles (lizards and snakes), some birds and some lower mammals like squirrels and rabbits etc. can be preserved and kept in the museum.

In addition to the preserved specimens, models of micro-organisms and micro-organisms and animals and plants can be put in the museum.

Some stuffed materials of rabbits, bats and birds can be placed in the museum. Life cycles of some insects, amphibians etc. can be placed in the museum. Herbaria dried stems, roots, leaves; whole plants can find a place in the museum. Charts and models showing various systems (digestive, circulatory, skeletal system etc.), cell structure, tissues, various dissected animals parts etc. can be displayed in the life science museum.

1.3.6.2 Sources of Museum Material :

The above materials for setting up museum can be collected by organizing excursions, field trips etc. or can be purchased from some other agencies like homes, butcher shops and slaughter houses for anatomical material, scientific matter supply houses for models, specimen etc. and public museums for purchasing low cost material.

1.3.7 Educational Values of life Sciences Museum :

A museum not only helps teaching but creates the right atmosphere about the school. It gives the opportunity to the students to observe the objects and phenomenon in their natural setting in the ideal way to gain knowledge. The educational values of life science museum are as follows:

* The students are able to see the actual things or their models and develop the scientific concepts about the size, shape, color and structure etc.
* The Students observe various new things related to their syllabus.
* Students learn from concrete things so learning is from concrete to abstract.

* During the development of the museum, the student work in group so it develops the habbit of working in group and team spirit develops among students and makes them social.
* Students try to observe their surrounding carefully because making collections for museum explores the collection instinct among students.

But is very sad that the extent to which museums should be used as an agency to stimulate learning among students, is not at all that is ought to be.

1.3.8 Seminars:

Seminars is the most common type of group discussion and is meant for the study and analysis of difficult problems over a period of time. The group consists of a chairman, resource person and members ranging from 6 to 25. The effiectiveness of group discussion depends on free exchange of ideas. Seminars is seuted for specific situations. It is often used in isolation. When space and leadership are available it is used in combination with other tools. It is also called 'staff Group', Seminar provides a scope for free frank interchange of views on a particular problem. Large groups may be subdivided into smaller sub-groups and each sub-group may discuss in separate rooms.

Merits of Seminars:

(i) It facilitates high degree of participation.
(ii) It pursues the topic in depth.
(iii) It can work out its own rules and programme.
(iv) It provides wide variety of ideas and experiences.

Demerit of Seminars:

(i) It requires more time personnal space.
(ii) Poor participation
(iii) Success depends on the ability of the group leader.
(iv) It often degenerates into a question and answer session.

1.3.9 Field Trips

(i) It offers first hand experience.
(ii) It enables intionate contact with environment.
(iii) It improves the power of observation and exploration.
(iv) It helps in the correlation of school subjects.
(v) It makes pupils active participants
(vi) It effects a real socilazation of school work.
(vii) It develops problems solving skill
(viii) It faciliates collection of specimen for school musem

Purpose of Field Trips: The specific purposes for which the field trips may be conducted are:

(i) Serving as a preview of a lesson and for gathering instuctional materials.
(ii) For creating teaching situations.
(iii) Serving as a means of arousing specific interest.
(iv) Supplementing class-room instructions and securing definite information for a specific lesson.
(v) Verifying previous information, class discussion and conclusion.

Conditions to be borne in mind in using Field Trip as teaching Aid: In

using field as an aid to teaching sciences following points be borne in mind:

(i) Previewing the place and determining the purpose.
(ii) Making necessary arrangements with school authorities.
(iii) Preparing the students physically and mentally for the trip.
(iv) The teacher should be prepared to act as a guide during the trip.
(v) To evaluate the trip in terms of specific educational games.

1.3.10 Science fairs and exhibitions

Holding of science fairs by individual institutions and also by several institutions in a district jointly have proved quite useful in creating interest in scientific studies and in encouraging the students to make their contributions making full use of their creative and inventive faculties.

A visit to such fairs and exhibitions is also quite rewarding. It helps to wider the knowldege of the progress of sciences in the present age and also inspires the young students to contribute something from their side for the enhancement of this progress.

(i) To give impetus and provide encouragement to students to try out their ideas and to apply their knowledge of science into some creative channel.
(ii) To provide opportunities to students to see for themseleves some achievements of their collagues and in this way stimulate them to plan their projects
(iii) To make science activities more popular amongst the students thereby hoping to improve standards of performance
(iv) To encourage bright and enthusiastic students having speical science talent.
(v) To identify talented students in science and nurture the future scientists.
(vi) To provide an opportunity to the people of area to come in contact with school and to meet the teachers and students.
(vii) To provide a competitive forum to various sciecne clubs in the area

Exhibits. There could be a variety of exhibits in a science fair. For exhibiting in a science fair the science master can select a few interesting experiments, charts, working models of useful appliances specimen collected by students during excursions, application of scientific principles to daily life, scientific toys etc. For sake of convenience exhibits can be classified as under:

(i) Experiments
(ii) Model
(iii) Specimens
(iv) Collections
(v) Improvised apparatus
(vi) Charts and diagrams
(vii) Investigatory projects

Organisation of a science Fair. Whenever a science teacher plan to organise a fair he should inform his students about it well in advance. Then he should start to find

a good and suitable location in the school where such fair can be organised. Having located a suitable place he should start planning or arrangement of exhibits. In this planning he should always keep in mind that time consuming exhbits are spread all over the available space and are not accumulated at one place.

He should then train some selected students to act as student guide. Science teacher should see that these student volunteers can guide the vistors and can explain to them various scientific priniciples involved in any exhibits.

Evaluaton. To encourage the participants some prize in the form of general science books or merit certificates may be insituted and awarded to purils whose exhibits have been adjusted best by a panel of judges. For purpose of award of prize various exhibits at a science fair be classified in various categories and prize be awarded separately for some good entries in each class. While judges an exhibit some criteria on the following lines may be used by the judges. Various aspects he given the following weightage.

1.	Scientific approach	30%
2.	Originality	20%
3	Technical skill	20%
4	Thoroughness	10%
5	Dramatic value	10%
6	Personal Interview	10%

1.3.11 Science Club:

In the present curriculum there are little opportunities for the students, for self-expression, independent research, constructive activities and new projects. So there is a need of an organisation which can **satisfy the instinct and urges of children and channelise their energy properly.** We may call such an organisation as biology club. It means an organisation which helps the learners to know more about plants and animals inculcate scientific attitude, supplements the work of classroom and the laboratory. It can provide better understanding of things and develop the power of thinking and reasoning.

1.3.11.1 Need and Importance of Biological Club:

To meet the challenges of time, there is an urgent need of biological clubs. They provide an opportunity for self-expression, learning by doing and learning by living. Biology club is the right place where individual attention to abilities of every student can be paid. According to Davis, "If the future of India belongs to Youth and since there should be much wide place for science clubs in school curriculum." It means there is crucial need of biology clubs as they provide proper means of utilising the leisure time purposefully. They make learning of biology such an experience which provides full joy. The students can widen their mental horizon by participating in various activities held through these clubs.

Biology Clubs play an important role in developing all round personality of the students as they:

(i) Motivate the students to do something new.
(ii) Provide a idea of self-government.
(iii) Develop interest in various scientific hobbies e.g., seed collection, plant collection, bone collection, colouring the different venation styles of leaves.
(iv) Acquaint the student with up-to-date knowledge of various fields of biology.
(v) To develop creative powers of the students.
(vi) To help the students for different educational competitions in a healthy way.
(vii) Provide practical experience for co-operative living i.e. students learn self-discipline and social discipline.
(viii) Impart vocational information through different activities.
(ix) Reduce the gap between classroom teaching and community.
(x) Develop extra-reading habits among the students according to their own interest and mental abilities.

1.3.11.2 Factors governing the success of a biology club:

The success of a biology club depends upon the following factors:

(i) Science teacher
(ii) Accommodation
(iii) Equipment required
(iv) Guidance to teachers.

1.3.11.3 Organisation

The biology teacher with the help of his students and the blessings of the head of the institution can organise the biology club. While organising a club certain points are essential to be kept in mind. As the success of these clubs depends upon biology teacher who is the back bone of their organisation. A dedicated and enthusiastic teacher can run this club properly. Every club has its own rules and limitations but teacher-in-charge can increase or decrease the functioning units according to the demands of the students. The head of the institution may be the patron of the club as he has to extend the facilities and resources for the successful execution of different activities, organised by the club. The teacher-in-charge should be an advisor, guide and supervisor of the students. He should have an .indirect check or observation on all the activities of the members of the club. Membership of the club should be open to all the students of the biology subject, whereas associate membership may be allowed to limited number of other students interested in scientific activities. For proper functioning, the club may have an elected executive committee. This committee may include Chairman, Vice-Chairman, Secretary, and Treasurer, one or two class representatives from each class, a librarian and a public officer. The President of parent-teacher association should also be included in

the working group of the club to tap local resources. The above said fond of organisation of a club may be different in different schools. The teacher-in-charge can modify the structure of working committee of the Club. Such a club may include the activities as follows.

(i) Arranging excursions to the places having biological importance and upkeep of science museum.

(ii) Arranging fairs and exhibitions of items related to life of plants, animals and our environment.

(iii) Collection of plants, animals, minerals and specimen, preparation of models and charts.

(iv) Quiz Contest, essay competition, debates and declamation can be arranged.

(v) Extension lectures of eminent personalities in the field of biology.

(vi) The club members can increase the awareness of community members about prevention and cure of physical and mental diseases.

(vii) The club members can inculcate healthy habits of drinking, eating and living among community members.

(viii) The members of the club can take up the production of useful things as james, jellies, ink, candles, detergents etc.

(ix) Maintenance and adding to school apparatus and equipment.

(x) Organisation of classes in scientific hobbies.

1.3.12 Summary :

Teaching science is a challenge and teachers have to face the challenge. Our teachers still follow the traditional methods of teaching and our students have to mug up so many things without understanding. This is a painful experience for our children, so it important that outside should be brought into the class room and laboratory through exhibits and other concrete representation of things .So every school should build a science museum in which there should be show cases in which the articles collected or made by students should be preserved and displayed.

Two important things about museum are:-

* Systematic arrangement and
* Labelling of the material.

A life science museum can have various exhibits like plants, animals and micro organisms. Charts, models etc. can also be displayed there.

These museums create right atmosphere in the school and link the education of a child with his immediate environment and encourage the child to create his own knowledge. If children are taught in such a manner, they will learn faster and retain much more .

1.3.13 Glossary :

Dogmas	-	A dogma is a belief which is accepted as true
Hertaria	-	Collection of dried/ preserved plants or parts of plants
Mobile	-	Something that is able to move freely from place to place
Prejudice	-	An unreasonable dislike.

1.3.14 Self Check Exercise :

1. The man objective for the establishment of science museum is to help student in understanding ..... of science.
2 Some science museum have .....science units called museums on wheels.
3 In science museums the students got the opportunity to observe the.....in their natural setting.
4 In museums student learn from concrete things so learning is from..... to.....

Answer Key :

1	Concepts	2	mobile
3	objects	4	Concrete, abstract

1.3.15 Suggested Questions :

1. Discuss the educational significance of life science museum.
2. How will you set up a small museum in you laboratory with the help of your students so that it can be an effective teaching aid ?
3 What is the meaning of museum? Name some important science museums of India. Write the objectives for establishment of science museums?

1.3.16 Suggested Readings :

Chhikrara, M.S. and Sharma, S. (2004) *Teaching of Biology,* Tandon Publication, Ludhiana.

Kohli, V.K. (2004) *How to Teach Science,* Vivek Publishers, Ambala.

Sharma, R.C. (2003) *Modern Science Teaching,* Dhanpat Rai Publishing company (P) Ltd, New Delhi.

Wikipedia : The Free Encyclopedia (2009)

Zaidi, S.M, (2004) *Modern Teaching of Science,* Anmol publication Pvt. Ltd, New Delhi

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B. Ed. PART-I **PAPER XI & XII Option (vi) (Part-II)**
SEMESTER-II **TEACHING OF SCIENCE**

LESSON NO. 1.4 **AUTHOR : DR. MEENAKSHI**

CONVERTED INTO SLM BY: DR. AMITA

SCIENCE TEXT-BOOKS, NOTE-BOOKS, REFERENCE-BOOKS, SCIENCE JOURNALS AND LIBRARY FOR SCIENCE

1.4.1 Objectives: After going through this lesson students will be able to

1) To know about Text Books and their Importance
2) understand the Importance of Science library
3) apply their knowledge to Use reference books and science journals in teaching of science

1.4.2 Introduction:

In the realm of science education, the utilization of essential tools such as science notebook, referece books, science journals, and libraires play a pivotal role in shaping a comphresenive learning experience. Science notebook serve as personal repositories, capturing the essence of experiments and observations. Referece books provide depth and context, enhancing understading. Science journals are gateways to the latest research, fostering intellectual exploration. Meanwhile, libraries stand as bastions of knowledge, offering a diverse array of resurces. Together, these elements form a symbiotic relationship, empowering students and professionals alike to delve into the vast realms of scientific inquiry, discovery and continuous learning.

1.4.3. Need of books and note-books : Teaching and learning apart from thinking, observing, analysing, arriving at conclusions, generalising and applying

knowledge to new situations calls for use of books and note-books and also of work-books. The knowledge gathered by man over centuries of hard work and experimentation lies preserved in books and everyone has free access to this precious gift handed down to us by our fore-fathers. The knowledge is vast, enormous, extending beyond limits and everyday new knowledge is born and more books are added to our libraries. The reader has to wisely select the material which he wants to read and make use of.

But the chunk of knowledge, the part of information which educationists decide to impart to children of different ages and different classes is given the name syllabus. Syllabus is thus a collection of topics in a particular subject which is earmarked for a year or so to be taught to a particular class. To facilitate teaching some experts in the field of science prepare text-books which deal with only the syllabus earmarked for different classes. Text-books, therefore, determine the scope of the study and inform the teachers and students how much to study and to what depth and level of understanding. Text-books are used by teachers, students and also by the examiners. They are like the rungs of ladder and students pass from one to another gradually and continuously reading text books, one after the other and going from one stage of education to the other. Text-books tell only the minimum what is required to every student, they are to be supplemented by reading reference books from the library. In this lesson we will discuss how to select text-books, how to use them and we will also discuss the role of library and work-books in teaching and learning of science.

1.4.4 Science Text-Books : A text-book is a special book prepared by experienced teachers for the use of teachers and students of a particular class in particular subject according to the syllabus prescribed for a particular class and particular subject. It is usually prescribed by the State School, School Board of Education and it determines the scope of the subject, scope of learning and also the scope of examination. If functions as a pivot round which teaching moves and it is a vital tool in the hands of a teacher in teaching science.

1.4.5. Functions of a Text-Book : As is a text-book so is teaching or learning. A text-book should aim at aiding the student in understanding what the teacher is a teaching. It should be self teaching, it should be written in a simple language and it should be profusely illustrated with pictures, charts and diagrams. It should contain homely and day-to-day examples. It should develop open-mindedness, critical attitude and a heuristic approach.

It should be written according to the prescribed syllabus and should fulfil the aims and objectives of teaching science. It should give correct and accurate scientific knowledge. It should develop scientific attitude and also a scientific approach as described in Lesson III.

It should provide situations and examples where a student can apply scientific knowledge in day-to-day living.

It should be so prepared that students are encouraged to take to scientific

activities and experimentations and, thus develop the required skills and also begin to improvise apparatus. A text-book should be able to suggest the names and relevant chapters of books which can be read for more knowledge. Some important functions of text books are enlisted belows :

1. To supplement the class-room teaching.
2. To suggest exercises, practicals and experiments to be done at home.
3. For preparation of assignments and helping in completing the Home-Work.
4. For systematic and speedy revision.
5. For developing scientific attitude.
6. To encourage scientific method approach.
7. To enable the teacher and the student to understand the scope of the syllabus and set limits for examination preparation.
8. To direct the student what to study, how to study and to what depth and level and thus saves the student's time, effort and energy. It shows the path to the student to decide the area of his work and understanding.

1.4.5. Characteristics of good text-book :

1. **The author-his qualification and experience :** A good text-book is a one which has been written by a qualified and experienced author or authors and has been tried for a year before it is allowed to be used in all schools. Recently the NCERT has prepared good science text-books by eminent authors.
2. **Mechanical features of the text-book :** A good text-book must have a good appearance i.e. a good get-up. The quality of paper, printing, diagrams, binding etc. should be appealing.
3. **The subject-matter—Its nature and organisation :** A good text-book must be written according to the prescribed syllabus and the subject matter should have been developed psychologically as well as logically. The treatment to the subject matter should neither be too lengthy that it becomes boring, nor too brief that it cannot be understood. In fact, the style should be self-teaching in which pictures and examples have been widely used. Each chapter should have an interesting introduction and a good motivating summary.

At the end of the chapter many exercises should be given so that students could test their comprehension and can find application of the concepts learned by them. New type of tests recommended by Ministry of Education should be used in the text-books.

As far as possible the text-book should be available in the mother tongue of the learner, English equivalents of technical terms must also be provided.

Suggested readings should be given at the end of each chapter.

All chapters should be inter-connected and treatment to subject matter

should be linked with life.

4. **Cost and Availability :** Text-books should be easily available. In fact, schools should make arrangements so that text-books are provided to the children by the school. Text-book should be handy, in a manageable size and shape and durable, the binding should be firm and the paper should be strong. The Printers and Publishers are none other than the government. So no profits should be made out of the trade of text-books and text-book be made available to students on cheap rates.

5. **Review and Revision :** Text-book should be reviewed and revised after obtaining views of class-room teachers and the students. But care should be taken that new revised edition should not be quickly brought about only to make money. Poor students should have the facility to make use of old text-book available in the Book-Banks.

1.4.7. Note-Books : Teaching of science has two components namely (a) theory and (b) practical Theory is discussed in the class-room through lectures and demonstrations, seminars and panel discussions. Students take notes in their note-books which are of different sizes and qualities. A good science teacher should like to use a standard size note-book separate note-books should be introduced for class-work and home-work. It is a good practice to occasionally check the class-work note-book and to give suggestions to students in taking notes and preparing notes. A teacher must take this work as a part of his duty.

Home-work note-books must be checked regularly and students should be told the method of doing home-work and making diagrams and charts. Home-work should be assigned carefully according to some plan so that after every term of three months students have enough material with them to prepare for their examinations. Home-work note-book should not be prepared casually and in a haphazard manner. There are two more type of note-books namely (a) Work-book and (b) Practical Note-book.

1.4.8 Work-Book : These are special note-books in which students record their practical work, their excursion visits to factories and places of scientific interest. Collection of leaves, plants, flowers, soils, insects, pictures of machines, science stories, science quiz etc. are all recorded in work books. The accounts of hobbies like candle making, chalk making, soap making, lac culture, reading of morning and evening temperatures, Maximum and minimum temperatures, sun rise, sun set, astronomical records etc. are recorded in work books. Teacher should encourage the students to develop good work-books on different scientific interests and science subjects. Work-books have a vital role in teaching of science. These work-books after proper editing can find a place of pride in the school library for future learners.

1.4.9. Practical Note-Book : These are special note-books in which students write the account of practicals performed by them in the school laboratory. Some publishers have brought out printed practical note-books in which methods of writing the practicals, are also given. They make the work stereotype and routine bound. Teachers should teach the children how to write the account of practicals performed by them. The paper of these note-books should be of good quality. One side of a page is blank and the other is ruled. Description of experiment is given on the right hand side whereas diagrams and calculations, readings etc. are recorded on the left hand side.

A teacher should take care that students do not indulge in copying. They should take their own readings and record their own observations and it should be made compulsory that practical note book should be completed in the laboratory and the note-book should be checked and signed by the teacher on the day an experiment has been done. Usually the students prepare their note-books in one go when their examination is to take place. Such practice should be discouraged. Unfortunately, note-books are not given the importance they deserve. Teachers are as careless as students. They put their signatures on the note books only one day before the examination and the beauty is that students get 100% marks. No students fails even if he has never attended the laboratory. Teachers are advised not to play this dirty game. In doing so, they are cutting the very roots of science teaching. They are loyal neither to the students, nor to the teaching profession or to themselves or the nation. Rather, science teachers should encourage students to prepare model practical note-books, which should become integral part of science club for display to young students.

Short in Text Questions

1. Differentitate between note book and work book.

   .....

   .....

2. Write any five characteristics of good text book.

   .....

   .....

1.4.10 Science Library : A well equipped, reasonably decorated and a functional library is a primary requisite of every school. There is an opinion favouring a separate science library because in that case it is easier to manage it, augment it, encourage its use and make it more functional. In the library pictures of scientists, science charts and diagrams can be usefully displayed and if need be explained as well. A science library should be set-up at a suitable place preferably near the class rooms and the laboratories close to the botanical garden. It should have adequate equipment in the form of almirahs, shelves and reading tables. Display screens should be available in adequate

quantity.

The purpose of the science library is :

(i) to inculcate love for reading scientific books;

(ii) to supplement class-room teaching;

(iii) to provide referral reading material to prepare assignments, lectures, debates and discussions;

(iv) to acquaint the children with history of development of science;

(v) to develop interest in the study of science;

(vi) to develop scientific attitude;

(vii) to acquaint the students with biographies of great scientists and discoveries;

(viii) to encourage international understanding and role of science in peace and development.

1.4.11 Organisation : A library committee should be formed to frame rules and regulations of the library, which would make purchase of books and journals, pictures and charts, which would collect books from private people and which would take steps to make students library conscious and which would organise science functions connected with school library.

The library should have the following sections :

I. **Prescribed Text-book Section,** which should have at least 4-5 copies of text-books prescribed in different science subjects in different classes.

II. **Supplementary Book Section :** This section should have been which would be able to inspite the students to know the secrets of nature. Books mentioned below may be purchased under this section.

(i) Romance of Chemistry.

(ii) Wonders of Pond life.

(iii) Hindu Science.

Translation of such books can also be purchased.

III. **Back-ground Books :** This section must have books which are able to enrich the scientific background of students. We may purchase books such as given below.

(i) The story of Moon.

(ii) The Human Machine.

(iii) The discovery of pencillin.

(iv) AIDS/HIV Virus.

IV. **Reference Books :** This is a very important section which has classic in it. We can have of the following types.

(i) Common Birds.

(ii) A Dictionary of Science.

(iii) An Encyclopaedia of Science.

(iv) History of Science.

The use of reference books is essential to enrich the teaching learning process, and also for making conceptual learning of science concepts.

V. Science Journals : Modern time has seen the birth of very good magazines and journals of science on general as well as on special topics. Depending upon the need of the students some popular journals can be he had in the library. Some examples.

(i) Vigyan Shikshak (Quarterly, English) Delhi.

(ii) Science Reports (Monthly, English) Delhi.

(iii) Science To-day (Monthly, English) Bombay.

(iv) School Science (Quarterly, English NCERT) Delhi.

(v) Vigyan Lok (Monthly, Hindi), Agra.

Students and Teachers should be encouraged to attempt Punjabi translation of some standard journals also.

It is of use to give here the recommendations of All India Seminar of Science Teachers held in Taradevi in 1958.

1. There should be a separate Science Library in every school.
2. Science book of general interest should be kept in the general library of the school.
3. The reference books in Science should form a separate section in the Science library.
4. The books on Science methodology should form a separate section in the Teachers of the General Library.
5. Active measures be taken to encourage level of reading and ability to use reference books. Pupils should be encouraged to write brief review of the books read by them. Good reviews prepared by the students should be displayed on the Science bulletin board included in the School science magazine.
6. The Science library should be under the charge of the Science teachers.
7. A small committee of students should be elected to assist the Science teacher incharge of the Science library.

Science a good library is a must for the professional growth of science teachers and for students as well as for students to consult reference books, journals etc. for enrichment, it is high time that library should be given a prime place in school. There should be periodic exchange of books for sharing. School library personnel should make arrangements to borrow reference books and encyclopaedia from district/state/public libraries to provide rich reading materials, both to students

and teachers.

1.4.12 SUMMARY

Science teaching and science learning depends upon the use of text-books, library books and journals and also on use of note-books and work-books. For general and supplementary reading, we need a large number of reference books for which a science library be set up in the school. Science Library must have different sections for (i) Text-books (ii) Inspirational books (iii) Background books, (iv) Reference books (v) Experimental books (vi) Biographies, (vii) Popular science journals and (viii) Teacher Methodology books. There should be a small library committee to organise and manage the library which should be housed in a nice room selected properly. The library should be adequately equipped and reasonably furnished. It should be functional and it should aim at inculcating love for reading among children.

A part of the science knowledge which is prescribed for a particular class is called the science syllabus in particular subjects. A special book called the Text-book is prepared on this prescribed syllabus. Text-book is the pivot around which teaching and learning move. It sets the limits of teaching, learning and the examination. It aims at supplementing the classroom teaching and providing exercises and assignments for home work and for application of concepts and principles. A good text-book is written by an experienced and qualified author. It has fine get up, paper and printing are good, binding is durable, the subject matter is well chosen and psychologically and logically presented. Every chapter is well introduced and well summarised at the end. Each chapter contains suitable exercises for revision and testing of students comprehension. Good text-books are revised after every 3-5 years as desired by the teachers and students. A good text-book is a self teaching book written in a simple language and profusely illustrated with pictures and diagrams. A good text-book contains correct information, upto data and modern and also makes suggestions with respect to good reference material. A good text-book is not very costly and is readily available.

Students' should also make use of work-books wherein they should record their observations, description of factories, birds, any animal, excursion to mills and factories, experiments and hobbies etc.

Students practical note-book also needs care and attention. Students should be advised to record their observations, readings etc. as got by themselves, they should not indulge in copying. Practical note-books should be completed and got signed on the day of completion of an experiment in the laboratory. It is a very bad practice to complete the practical note-book in one go, just one day before the day of examination. Rather science teachers should encourage students to complete practical note-books during academic session and display good practical note-books

in science library so that science students develop a habit of neat and correctly completed practicals for better understanding of science concepts.

Science teachers and students should be encouraged to consult reference books, encyclopaedia and science journals for enrichment in teaching-learning process. The library should make necessary arrangement to get such rare and costly reference material from neighbouring district/state/public library.

1.4.13 Key Concepts:

1. Science Reference Book: A Book of facts, such as dictionary or an encyclopedia, that one look at to discover particiular infomation.
2. Journal- A Scholarly publication containing articles writeen by researches, professors and other experts.

1.4.14 Self Check Exercise: True or False

1. A text book should aim at aiding the students in .....what the teacher is teaching.
2. A good..... must have good quality of printing and good appearance.
3. Home work.....must be checked regularly.
4. Students write the account of practicals performed in laboratory on.....note book.
5. Sciences library should be under the charge of.....

Ans: 1. Understanding 2. Text book 3. Note book
4. Practical 5. Science Teaching

1.4.15 SUGGESTED QUESTION

1. What is a Text-book? Show its importance in teaching and learning Science. State the qualities of a good text-book.
2. Bring out the importance of Science Library in a school. How will you proceed to set-up Science library and what steps will you take to make it functional.
3. Write short notes :

(a) Student's Practical Note-book.
(b) Work-books.
(c) Use of Reference books and Science Journals in teaching of Science.

4. What are the different sections you will make while setting up a Science library?

1.4.16 BIBLIOGRAPHY/SUGGESTED READINGS

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Sharma T. R., *Teaching of Science,* Chandigarh, Mohindra Publisher, 1963.

Mandatory Student Feedback Form

https://forms.gle/KS5CLhvpwrpgjwN98

Note: Students, kindly click this google form link, and fill this feedback form once.