SEMESTER – II
C-14&15
Pedagogy of Science-II
Total Marks: 50 (Theory: 40 + Internal Assessment: 10)

COURSE CONTENT

UNIT-I

1. Learning Beyond the classrooms: Importance, planning and organising co-curricular activities – Science clubs, Science museum, Science fair, Excursions.
2. Science Text books - need and importance, criteria for selection, use of Reference books,
Journals, Teacher manuals in science teaching
3. e-learning: concept, and use of e-books and e-journals in science.

UNIT-II

1. Practical work in Science - Need, Importance and Organization.
2. Science kits and Improvisation of science apparatus.
3. Planning of Science Laboratory- White House Plan, Laboratory equipment and material- selection, purchase, maintenance and First Aid in Laboratory.

UNIT-III

1. Instructional Media: Meaning, Importance, Classification, Principle of Selection and use of ICT, Chalk board, Models, specimens .
2. Lesson planning in science –Meaning, importance, steps (Herbartian, Constructivist approach).
3. Science teacher: Professional growth, teacher as a community of learners, collaboration of schools with Colleges/Universities.

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UNIT-IV

1. Reflection and Refraction- laws and its applications.
2. Structure of Atom- Bohr's model.
3. Nutrition and its modes.
4. Environmental Problems- Global warming, greenhouse effect, acid rain, ozone layer depletion.

UNIT-I

1. LEARNING BEYOND THE CLASSROOMS: IMPORTANCE, PLANNING AND ORGANISING CO-CURRICULAR ACTIVITIES –

Co curricular Activities

The meaning of co-curricular activities revolves around its different feature and characteristics. For the overall development of a child, curriculum is not only the single criteria. The holistic growth as well as to develop the various facets of **personality development** of children; classroom teaching should be supplemented with co-curricular activities. These out of class activities affect all domains of life such as cognitive (intellectual), emotional, social, moral, cultural and aesthetic. Co-curricular activities meaning are more focused upon cognitive aspects thereby help in intellectual development. Competitiveness, excellence, quality achievements, creativeness and enthusiasm are few of the ethics of extra-curricular activities and also strengthen the meaning of co curricular activities in school.Non-academic activity in the form of co-curricular one provides support to students to venture into professional fields like fashion, music, painting, art, acting, photography, printing and many more. That's why students need co-curricular activities, which helps in enhancing many skill developments.Importance of co curricular activities have increased manifold in modern life. However, co-curricular meaning varies to little bit as per place, time and space.

SCIENCE CLUB

A science club is an out-of-school-hours club that offers children the chance to do science-related activities that extend and enhance the science they experience in the classroom.

Each science club is different, as the club programme reflects the interests of the children, the club organiser and the facilities available. Most clubs use the opportunity to explore areas of science not covered by the curriculum and to give the club members plenty of opportunities to do practical science.

A science club can be run in a lunch break or after school. Some organisations are able to offer special Saturday clubs.

A science club session typically lasts for about 45 minutes. In this time, the members might complete a challenge, plan a science project or have a special scientific visitor.

Who runs clubs?

To start a science club, you need at least one, preferably two or more organisers. This way, you can share the planning and delivery of the club, and your club will be more adventurous and creative, as you bounce ideas off each other.

Remember, it's just as important that the organisers enjoy the club, as it is that the children enjoy the club.

Science club organisers can come from many backgrounds, within and without school. You don't need to be a super scientist in order to run a club, and there are sets of resources designed with that in mind. It can be an opportunity for the club organisers to extend their knowledge and skills, in a less pressured setting.

Club organisers and helpers can be found in many places:

- interested parents
- local university postgraduates or graduate students
- retired scientists or engineers
- teachers and
- classroom assistants

When do science clubs run?

As you have heard and read, science clubs run in a variety of ways, at a variety of times. It is most common for the club to run for 30-45 minutes during the lunch break. However, other clubs run after school, or even at weekends.

Some clubs run weekly all through the year, some run for a term, or even for a short period, such as during National Science and Engineering Week. What is important is that the children and their parents and carers know what is happening and when.

It is advisable to produce a termly programme or newsletter. This can also help you to recruit new volunteer helpers!

How should I set up my room?

In most clubs, the children work together in groups. The groups can either be working on the same problem or activity, or on a set of related activities, or on completely different projects.

Each group needs a table to work on, and chairs. There should be enough room around the tables for children to get up and move safely.

Equipment can either be prepared, and set up on each table prior to the club, or placed on a separate resources table.

It is a good idea to have a club notice board in the room, or in a nearby corridor. This can be used to remind the children when and where to meet, whether they need to bring in any special equipment and to display their work.

SCIENCE MUSEUM,

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

The mission statements of science centers and modern museums vary, but they are united in being places that make science accessible and encourage the excitement of discovery. They are an integral and dynamic part of the learning environment, promoting exploration from the first "Eureka!" moment to today's cutting-edge research. However, the negative impacts of science and technology, or the uneven development of its various disciplines, may or may not be explored by some organizations.

SCIENCE FAIR, EXCURSIONS.

What is a Science Fair?

Science fair is an opportunity for students to apply the scientific method to conduct independent research. The results of each student's research is presented in a school wide science fair--or sponsored local science fair-- where the student's efforts are displayed and where students are interviewed to determine scientific merit. Students who have been judged to have used the scientific method properly and who have demonstrated thoroughness in their studies and effort are awarded prizes and are advanced to compete in regional, state, national and international science fairs.

Preparation for a science fair should begin early in the fall semester with the selection of a topic which will lead to a problem that the student will wish to research. The student should explore various sources of information in order to gain a thorough understanding of the topic that he or she has chosen. Besides traditional sources such as library books, the student should research current periodicals, journals, Internet sources and interview professionals who are working within the same field of study. The student should learn “what research has already been done and what has been concluded regarding [the student's] question and also something about the procedures and rules of evidence in [the student's] particular field” (Manning-Schwartz, 1997). In other words, a complete study of the topic so that the student can design an intelligent and meaningful experiment. The research--or literature review--should account for at least half of the student's effort on the project; incomplete research on the selected topic is the most common grounds for science fair judges to disqualify projects for advancement.

The next task for the student is to form a hypothesis which tentatively answers his/her problem. Students should begin the experimental portion of their projects no later than the beginning of the spring semester so that they can be prepared to compete in local science fairs which usually begin in late March. The hypothesis should be testable in such a way that the student can design an experiment which will support or reject it.

Once the student designs the experiment, data are collected and analyzed according to their procedure which will be presented in a written report.

Promotion of Students to Science Fairs

Local science fairs are usually held and sponsored by public and private primary and secondary schools to give the students within those schools the opportunity to do independent research and to decide which of their students' research is good enough to represent their school at the regional fair. The judges for local science fairs can be teachers, parents or volunteers from the community. Most regional fairs have a junior division (grades 6-8) and a senior division (grades 9-12), and include participants from public and private schools as well as science clubs from within the regional boundary--usually county wide. Science fairs, such as the Los Angeles County Science Fair, can have nearly 1000 participants competing in 16 categories of science: Behavioral and Social Science; Biochemistry; Botany; Chemistry; Computers; Earth Science; Engineering Applications; Engineering Research; Environmental Science; Mathematics; Microbiology; Pharmacology; Physics and Astronomy; Physiology; Zoology; and Team Projects.

2. SCIENCE TEXT BOOKS - NEED AND IMPORTANCE, CRITERIA FOR SELECTION,

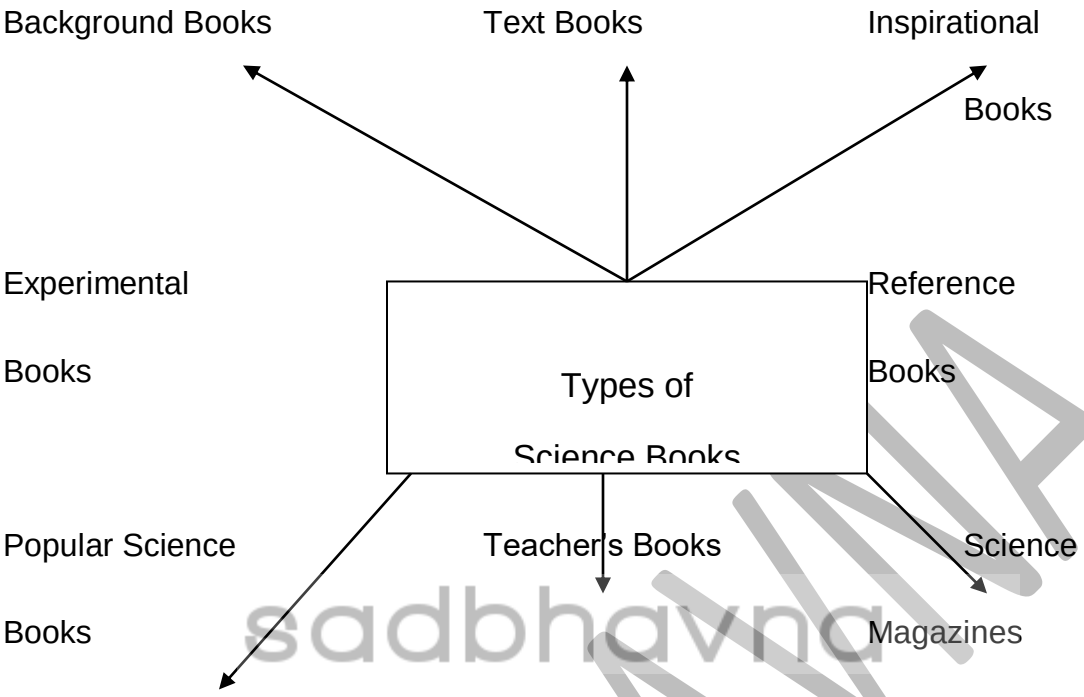
Introduction : The text book is one of the imp. aids in the teaching learning process and has occupied a pivotel role in educating the children. The process of education in most of the schools in India and abroad can be summed up in one phrase. By using it as a teaching and learning aid it affects methods and reflects the rising standards of scholarship, expends the scope and size to meet the changing conceptions, which is considered educationally sound and desirable.

Definitions :

1. **Views of shuttle** : “A text book is an indespensible tool to most teachers primarily because teaching materials are not available in most schools.”

2. **Acc. to International Encyclopeadia of Education** : “Books are the most important resources which teachers and schools have, as they do their work of educating, that the core work of all schooling consists in developing the skills and attitudes associated with the mastery of the Ideas and Information carried out by books.”

Types of the Science Text Books : Science books can be divided into various categories like :



Dig-showing types of Science books

Characteristics of good text books of science :

Science text book is used to supplement class room instructions. It serves as a determinant of what science should be taught. It supplements or enriches the science syllabus which may have been developed by faculty committee working in conjunction with science education specialists. It helps the students to look up additional information. It indirectly cultivates reading habit. A science text book is necessary for home study by the pupils after the topic is done in the class. It also helps the pupils to prepare assignments and in revision of the course.

1. **The Author** : Everybody and any body should not be encouraged to write text books. Only such persons who have long experience of teaching the subject and possess requisite qualification should be allowed to become the authors. Often it is seen that college lectures write school books. This is also a bad practice. Certain minimum qualifications and experience for author should be laid down by the authorities NCRET is doing something in this regard.

2. **The Ge up** (a) The quality of paper, binding and type of letters used should be fine and appealing.

(b) The science book must be profusely illustrated with diagrams and sketches.

3. **The subject matter** :

1. There must be proper selection and organization of the subject matter.

2. Subject matter should develop in psychological sequences.

3. The book should follow the aims of science teaching.

4. It should serve as a guide for demonstration and individual experiences.

5. The subject matter should be written in very simple, clear and lucid language.

6. Since the text books are in regional languages, the scientific terminology should also be given in English within brackets.

7. Only standard terminology in regional languages evolved by the Central Ministry of Education and state Governments should be used.

8. Each chapter should begin with a brief introduction and end with a summary.

9. At the end of each chapter there should be assignments concerning :

a) Applications to life situations.

b) New type tests

c) Suggestions for further reading.

d) Numerical questions, where necessary.

e) Suggestions for experimental work and projects individual and group projects.

10. Heading and sub-headings should be in bold type.

11. The book should contain a detailed table of contents in the beginning and an index at the end.

12. At the end of the book there should be glossary of scientific terms with their English equivalents.

13. There should be suggestions for improvising science apparatus and experiments.

14. Provision should be available to correlate science with other school subjects and life situations.

15. Sufficient emphasis should be given on making use of community resources.

16. To facilitate learning, some memory aids should be given, wherever possible.

17. Each text book should be accompanied by a laboratory manual.

18. For the help of the teacher, there must be a Teacher's Guide Book for each text-book.

Importance of science text books : Good science text books are necessary for following purposes :

1. The supplement the class work.

2. To provide understanding of scientific concepts, principles and laws.

3. To develop scientific temper and attitudes.

4. To cultivate social, ethical, moral and aesthetic values which exalt and refine the life of individual.

5. To develop concern for a clear environment and preservation of the eco-system.

6. To give a balanced picture of the life of man and interaction b/w man and environment.

7. To help in the realization of specific objectives of teaching science in the class.

8. To make into consideration the objectives of teaching science at secondary stage and to provide for the needs.

9. To generate educational interaction in the class room.

10. For home study after demonstration lesion in class.

11. For doing home work and preparatory part of assignment.

12. For a systematic and speedy revision.

13. To develop open mindness, training in scientific method, concepts and principles of science.

14. To help the pupils from correct understanding of basic concepts.

15. To develop particular skills, which may later on.

16. To encourage class room discussion for arriving at accurate conclusions.

17. To assist the teacher to plan his daily lesson prepare assignment and organize class activities.

18. To help the students to reinforce learning, to do home assignments, to prepare for the examination as well.

Conclusion : So we can say, science text books plays an very important role in our daily life. By using these books as a teaching and learning aid its affects methods and reflects the rising standards of scholarships. The most imp. thing is the quality of paper, binding and type of letters used should be fine subject matter should develop in psychological sequences.

USE OF REFERENCE BOOKS,

A **reference work** is a book or periodical (or its electronic equivalent) to which one can refer for confirmed facts. The information is intended to be found quickly when needed. Reference works are usually *referred* to for particular pieces of information, rather than read beginning to end. The writing style used in these works is informative; the authors avoid use of the first person, and emphasize facts. Many reference works are compiled by a team of contributors whose work is coordinated by one or more editors rather than by an individual author. Indices are commonly provided in many types of reference work. Updated editions are usually published as needed, in some cases annually . Reference works
include dictionaries, thesauruses, encyclopedias, almanacs, bibliographies, and catalogs (e.g. catalogs of libraries, museums or the works of individual artists). Many reference works are available in electronic form and can be obtained as application software, CD-ROMs, DVDs, or online through the Internet.
In comparison, a **reference book** or reference-only book in a library is one that may only be used in the library and may not be borrowed from the library. Many such books are reference works (in the first sense), which are, usually, used briefly or photocopied from, and, therefore, do not need to be borrowed. Keeping them in the library assures that they will always be available for use on demand. Some reference-only books are too valuable to permit borrowers to take them out. Reference-only items may be shelved in a reference collection located separately from circulating items. Some libraries consist entirely, or to a large extent, of books which may not be borrowed.

JOURNALS, TEACHER MANUALS IN SCIENCE TEACHING

3. E-LEARNING: CONCEPT,

E-learning Notes

Electronic Learning is also called as E-learning. It is also called as Computer Oriented Learning.

E-learning is used in many ways. It is more related to Advanced Learning Technology. Technology and
learning methods are included in E-learning. Computer network and multi-way technology is used in it.
Since 2006, thousands of students participated the online learning in higher education institutions. It was
started in Britain. E-learning is called as online learning. Today, online learning is organized in many
higher education institutions. Online learning services are provided to individual students. It is found
in research studies that generally, all students are satisfi ed with E-learning. E-learning is more effective
as compared to traditional learning system. This learning system is mostly used in private institutions
because this system is comparatively economical. Trained persons are selected in online learning.
Assistance of trained persons is also required for computer online and internet services. Today, online
education is developing more rapidly. Even arrangements of online instruction are organized for research
studies. Research students are managed by developed research institutions and open universities.
Communication media are being related to the communities. The basic learning of community learning
provides model. Some necessary activities are required to be edited which is organized in the class. The
level of class teaching can be developed by using technology. In current circumstances, many activities
and resources are required in class for learning.

Meaning of E-Learning

E-Learning is a new concept of Education. In this Internet technology is used for the presentation and
communication of learning contents. With the help of this technology, an appropriate environment for
teachers and students can originated for learning. E-learning improves a lifelong process. It provides
learning facilities to the society and community.

Meaning of E-learning is—

1. E-learning is a new concept of education which is different from traditional learning. It provides a
new arrangement for learning.
2. The main characteristic of E-learning is that the presentation and communication of learning contents
is done through Internet system. We can say that – what is E-learning or what it is not?
3. The learning environment is expanded by using internet in E-learning. The learning environment
of teachers and students is expanded by using Internet. This environment is student-centred while
learning environment is teacher-centred in traditional education.
4. E-learning - the new concept of education, prepares environment for lifelong education. It provides
opportunities to society for actual learning.

E-learning is a wide concept. The type of learning is edited by computer and Internet. The communication
of this learning is provided to everyone at any place through network.

E-learning is not an alternative system of education but is a system of new education which provides
opportunities of education or learning to all. It is an economical system of higher education. E-learning

is a more wide and important education system. Mastery of learning contents is developed through this.

Its effectiveness is similar to that of traditional education.

Instructional format of E-learning is complete because teaching principle are used in it for many years.

It has been used in distance education, adult education, continuing education and vocational education

in many countries of the world.

Some other words are related to E-learning. These are included in E-learning.

(*i*) Online learning (*ii*) Online education

(*iii*) Distance education (*iv*) Technology based training

(*v*) Web based training (*vi*) Distance learning and

(*vii*) Computer based training (CD ROM)

E-learning is a more wide concept. This type of learning is organized in terms of computer. E-learning

is included in the technical dictionary.

E-learning has been developed rapidly in China as a new system but this development is of different type in western countries. E-learning is mostly used in higher education because this type of learning is more required in higher education.

Definitions of E-learning

There are many defi nition of E-learning, some of them explained here—

E-learning is used in including effective teaching and learning processes due to which regional

communities and geographical communities get the opportunity to learn.

According to **Tom Kelly** and **Cisco**—"E-learning is about information, communication, education and

training. Regardless of how trainers categorize training and education, the learner only wants the skills

and knowledge to do a better job or to answer the next question from a customer."

—***Tom Kelly, Cisco***

According to **Brandon Hall**—"Instruction that is delivered electronically, in part or wholly *via*
a Web browser, (...) through the Internet or an Intranet, or through multimedia platforms such
CD-ROM or DVD." —***Brandon Hall***

Brandon Hall argues that, as the technology improves, e-learning has been identifi ed primarily with
using the web, or an intranet's web. Increasingly—as higher bandwidth has become more accessible—it
has been identifi ed primarily with using the Web, or an intranet's web, forcing the visual environment
and interactive nature of the web on the learning environment.

According to **Learning Circuits**—"E-learning covers a wide set of applications and processes such as
web-based learning, computer-based learning, virtual classrooms and digital collaboration. It includes
the delivery of content via the Internet, Intranet/extranet, audio and videotape, satellite broadcast,
interactive TV and CD-ROM." ***—Learning Circuits***

According to **Rosenberg**—"E-learning is used in internet system. Contents are delivered through
internet technology, which improves the knowledge and the achievements of student get improved."

Rosenberg has given three criteria of e-learning—

1. E-learning consists of network. There is collaboration of information and storage of information.
2. Certifi ed techniques of internet are used for communication in E-learning.
3. Transmission is the goal of e-learning. The solutions of this learning is more meaningful and effective

than traditional systems.

“E-learning provides the potential to provide the right information to the right people at the right times

and places using the right medium.”

E-learning is a new concept in education and education is also a new dimension. Following characteristics

have been discussed by the above defi nitions and meaning –

The main characteristics of E-learning are—

1. In this learning, students are provided the opportunity to learn at their pace. It can also be called as

self-learning.

This learning is self-directed. Students selects the courses according to his needs. Learning medium **Notes**

is also selected according to his needs.

3. Multimedia is used in E-learning. Different types of communication and broadcasting methods are

used.

4. E-learning is student-centred.

5. E-learning has the solutions of geographical problems and there is also provision for open education.

6. A large number of students are included in E-learning, there are large number of students in the

class.

7. This learning is organized online. Student can use it according to his needs.

8. This learning is developed by computer. Internet system is used in it.

9. E-learning is economical and rapid to E-learning.

10. E-learning develops Computer and Internet skills .

11. Students get more opportunity to interact.

12. Communication media and methods are collectively used in E-learning.

Characteristics of E-learning

"Good teaching is good teaching, no matter how it is done."

Expansion of Internet also infl uenced our educational system. E-Learning is a result of it. In fact, online
education has played an important role for providing education by reducing the distance. In such cases,

Virtual Class is used in place of traditional class. Many universities of India has the facilities of online
education. Indira Gandhi National Open University and Sikkim Manipal University are the leading
universities. The characteristics of e-learning are displayed as under—

1. You can do any course from any university in the country or foreign through E-learning while sitting
at home. For this, registration process is done online. Now, even exams are taken online.
2. Various techniques are used in online education system such as E-mail, video conferencing, blogs
bulletin boards, discuss boards etc.
3. You can improve you skills through online courses when employed due to which becomes easy to
update yourself. You can read study material whenever you want. Study material is always available
on Internet.
4. This system is more useful for economically weak and remote students. It is very useful to learn
through this.
5. Now a days, you can do practical work through virtual lab while sitting at your home. The craze of
virtual lab has increased very much.

6. In online education, course content can made interesting and effective with the use of graphics,
animation and multimedia.
7. Various course from certifi cate to degree are available online.

Media Used in E-Learning

E-learning is used in the entire world with the help of web or CD ROM. It is similar to distance learning.

Media are used in it. Communication is made with the help of media. Following media are used in it –

1. Print Media—Contents, books and E-gins are used in it.

2. Video Media—Visual tape, Cable, Visual fl ow, Satellite publishing, television etc. are used in it.

3. Communication Media—This is divided into two categories

(a) Asynchronous Media—It includes E-mail, listening, discussion etc.

(b) Synchronous Media—It includes Internet, virtual seminar and tele-conferencing.

Advantages of E-Learning

There are many advantages of E-learning. Some of them are described below—

1. Convenience and Portability

(*i*) To reach course according to programme

(*ii*) Attendance is not necessary in online learning

(*iii*) Learning is done by self-pacing

(*iv*) No boundation of time limit

(*v*) No limit of time.

(*vi*) Learning can be done online or by any means

2. Cost and Section

(*i*) Courses are selected from wide areas

(*ii*) There are degree, certifi cates and vocational programmes.

(*iii*) Continuing education is organized.

(*iv*) Instruction are available for individual course.

(*v*) This approach is more wide and economical.

(*vi*) Can visit universities for higher education.

(*vii*) There is online education facility for artistic disciplines and scientifi c topics. It is mostly used

in distance education.

3. Flexibility

(*i*) Options are included in online learning, optional subjected are selected.

(*ii*) Instruction is selected for self study.

(*iii*) The known subjects can be omitted.

(*iv*) Can use best tools for learning according to our needs which makes learning simple.

USE OF E-BOOKS AND E-JOURNALS IN SCIENCE.

An **electronic book** (variously: **e-book**, **eBook**, e-Book, **ebook**, **digital book** or **e-edition**) is a book-publication in digital form, consisting of text, images, or both, readable on computers or other electronic devices. Although sometimes defined as "an electronic version of a printed book", many e-books exist without any printed equivalent. Commercially produced and sold e-books are usually intended to be read on dedicated e-readers. However, almost any sophisticated electronic device that features a controllable viewing screen, including computers, tablets and Smartphone can also be used to read e-books.

UNIT-II

1. PRACTICAL WORK IN SCIENCE - NEED, IMPORTANCE AND ORGANIZATION.

By 'practical work' we mean tasks in which students observe or manipulate real objects or materials - for themselves (individually or in small groups) or by witnessing teacher demonstrations.

Practical work can:

2. motivate pupils, by stimulating interest and enjoyment
3. teach laboratory skills

4. enhance the learning of scientific knowledge
5. give insight into scientific method and develop expertise in using it
6. Develop 'scientific attitudes', such as open-mindedness and objectivity

As with all classroom activities, the effective teacher plans practical work with specific learning objectives in mind. Different practical tasks have different learning objectives and may be more or less successful in achieving the intended learning outcomes.

For some practical tasks, the learning is about objects and observables. Students are expected to recall what they have observed. Other tasks involve making links between observables and scientific ideas. Students generally find the latter harder, as they involve thinking as well as seeing and doing.

Ideas do not 'emerge' automatically from manipulating and observing objects and materials. Most of the learning comes from students talking about what they have done and seen.

Practical Work of Science

Learning by doing can be achieved only by doing experimentation. Any course of Science which does not period opportunities for lab work is incomplete from the point of view of efficient teaching.

Equipments of Practical Work: -

On every practical turn, a student must carry with him the following things to the laboratory so that he is well equipped to perform various type of experiments-

1. Scale, 2. Eraser, 3. A pencil, 4 Auxiliary notebooks and 5. Laboratory note-books.

Important of Practical work-

Following are the importance of practical work of science:

1. Learning by doing:

Practical work follows the basic principle of Learning by doing. The students gets an opportunity to activity participate in the learning process.

2. Training for adjustment:

When students know elementary things about electricity, electronics, sanitation etc. they depend less on others for minor repairs.

3. Scientific knowledge and Scientific Outlook:

Practical work helps in acquiring of scientific knowledge and scientific outlook, the twin main objectives of teaching science.

4. Handing of Objects:

By doing experiments students learn how to handle and operate apparatus etc.

5. Development of good habits:

Through practical work the students learn many good habits like resourcefulness, initiative, co-cooperation etc.

6. Satisfaction of curiosity:

Validity of the concepts learned by the students can be tested by experimentation. This satisfies basic human desire of knowledge of what, how and why of things.

7. Development of Scientific attitude:

Lab work develops scientific attitude and scientific temper.

8. Motivation:

By doing experiments, students are motivated to know more and more of science.

Administration of Practical-Work:

1. Procedure of Laboratory work:

The science teacher should check the availability of the apparatus required for particular experiments. Afterwards he should assure that the apparatus is ready and working condition before the students enter the laboratory. The broken apparatus is noted down in the breakage register.

2. Grouping:

In some schools, same experiment is done by all the students at the same time. The teacher gives general instructions to the whole class at one instant and can cyclise form where the number of students in a class is much more each group is allotted a different experiment. The experiments are cycled in groups. This method had following limitations-

a. There is every possibility that weaker students may copy the results of the brighter students.

b. It may become difficult to correlate .theory and practicals for all students.

c. Supply different apparatus and chemicals to different groups.

3. Guideline rules:

In order to make practical work effective, the laboratory should be made a place of learning by doing. Guideline should be laid down by the teacher about the laboratory rules such as the following-

a. Work area must be cleared.

b. Strict attention should be paid to own work.

c. Reagent stoppers should not be left on counter tops.

d . Wastage of water, gas, electricity should be strictly avoided.

e. Directions should be read and followed very carefully.

f. Teachers should allow the student's entry in lab in his/her presence.

g. Only those experiments should be done which are recommended by the teacher-incharge.

2. SCIENCE KITS AND IMPROVISATION OF SCIENCE APPARATUS.

Science is a broad and multi-faceted subject that can be difficult for some children to grasp. Schools only have time to focus on so much before moving on to other subjects and concepts. For kids who struggle with science or those who have a strong interest in a particular scientific idea, science kits can be an invaluable tool for building skills and expanding knowledge.

1. Kits Provide a Hands-On Learning Experience

Being actively involved in their own educations helps kids stay engaged longer and retain more information. Science kits put kids right in the middle of the scientific process, encouraging them to take charge of their own learning experiences. Kids tend to remember hands-on activities more than lectures or reading assignments, making experiential learning a vital part of development. When teachers and parents add learning through experience to traditional education, they provide children with a real, practical way to gain understanding of new concepts.

2. Science Fosters Curiosity

When a child opens up a science kit, he or she is opening up a whole new world of possibilities. No matter what the focus of the kit is, kids immediately begin to explore the different components, look over instructions, and ask questions. Projects offered by kits allow kids to find answers to their questions through active processes that keep young minds engaged. Each step gives a new opportunity for investigation. As kids work through the kit and try new experiments, they continually encounter fresh concepts that stimulate both logical and creative thought. The ability to think creatively helps kids approach a variety of problems at any age.

3. Kids Learn to Make Predictions

Being able to look at data and draw conclusions is an essential part of all science. Kits give kids a starting point for experimentation that they can use to learn how to predict outcomes. As they set up experiments or prepare to build models, kids are gathering information about the task they're working on. Parents can ask questions to stimulate discussion about the results. This helps kids gain a deeper understanding of what they're doing and helps them learn to incorporate all available information when solving problems. Considering data and using it to predict outcomes teaches children a constructive way to approach not only science but also other academic subjects. This helps to give them an edge in all areas of education.

4. Kits Require Kids to Follow Instructions

Scientists and aspiring scientists need to be able to follow instructions. Whether conducting experiments, building equipment, or analyzing data, there is a method for all scientific endeavors. Science kits teach children how to pay attention to directions in order to reach a specific conclusion or goal. Chemistry sets require diligence when mixing chemicals to generate reactions. Model kits won't come together correctly if children don't follow steps. Working through science kits shows kids how to be patient as they complete each part of a task. The more kids do this, the better they become at focusing on problem solving as a series of steps. Science kits help teach the value of this kind of diligence by showing kids that working slowly and steadily can be more gratifying than racing through something to get to the end.

5. Critical Thinking is Strengthened Through Science

Critical thinking skills are essential to many parts of life. Kids need to be able to approach problems in school and in life with clarity and objectivity. Science kits provide a solid foundation for this type of thinking. Working with a kit gives kids a specific focus and causes them to ask critical questions about the process and outcome of what they're doing. Instead of reacting to results on an emotional level, kids learn to take each step as it comes and work through it in a logical way. This goes hand in hand with following instructions as kids begin to recognize how steps fit together and what they can do to reach a conclusion that makes sense.

6. Science Teaches Observation

In order to understand the outcome of an experiment, kids have to pay attention during the entire process. Science of all kinds requires careful observation, which can be a challenge for kids with high energy levels or those who don't usually feel engaged by the material. Science kits make observing experiments fun by actively involving kids in every part of the process. Kids also learn to take notes and gather data as an experiment progresses. This information can be compared to earlier predictions to see how the actual outcome compares to what kids thought would happen. All together, these skills allow kids to see how experimentation works and why it's important to pay attention throughout the entire process.

7. Kits Help to Teach Responsibility

Many science kits include chemicals or small parts that kids have to be careful with. When working with chemicals, kids learn proper safety techniques during experiments and the correct way to clean up afterwards. Building kits have parts that need to be kept track of in order for the final model to look right and function properly. It's important for parents to keep these factors in mind when choosing kits for their children. Most will have a suggested age range listed somewhere on the box, making it easy to find something age-appropriate.

8. Experiments Foster Creativity

Though most science kits come with specific instructions, there is plenty of room for kids to get creative. As they become familiar with the processes involved in scientific experimentation, kids of all ages gain confidence in planning, predicting, and working through each step. With a little help from parents or teachers, kids can then begin creating their own experiments. This requires using concepts that were used when working through the original kit instructions, thereby giving kids a way to apply what they've been learning.

9. Themed Kits Supplement Traditional Education

Many science kits feature a theme that allows kids to explore a specific science concept in more detail. Since science time is limited in school, there isn't often an

opportunity to visit any one idea in-depth. No matter what facet of science kids are interested in, chances are there's a kit they can use to learn more. Anatomy, nature, electricity, astronomy, geology, and chemistry are just a few of the concentrations that science kits focus on. Some are even more specific, offering kids the opportunity to build a volcano, grow crystals, or observe small organisms such as sea monkeys or ants.

10. Scientific Knowledge Has Life Applications

Creative and critical thinking, organization, gathering data, and the ability to make predictions all have real-life applications as kids grow older. Research and note-taking skills are invaluable when writing papers in high school and college. Skill in predicting outcomes helps kids and adults to be more prepared in stressful situations, especially in the workplace. The organizational skills that kids can learn from using science kits will serve them well in all areas of life. Additionally, learning to be a critical thinker at a young age helps kids to stay focused and on task no matter what kinds of problems they face in life.

3. PLANNING OF SCIENCE LABORATORY- WHITE HOUSE PLAN, LABORATORY EQUIPMENT AND MATERIAL- SELECTION, PURCHASE, MAINTENANCE AND FIRST AID IN LABORATORY.

UNIT-III

1. INSTRUCTIONAL MEDIA: MEANING, IMPORTANCE, CLASSIFICATION, PRINCIPLE OF SELECTION AND USE OF ICT, CHALK BOARD, MODELS, SPECIMENS .

INSTRUCTIONAL AIDS:

Instructional Materials as the name suggests, are materials of visual,audio and audio - visual category that helps to make concepts abstracts and ideas concrete in the teaching/learning process1. They are also materials which the teacher uses in supplementing his teachings2.Instructional Materials include materials used to facilitate

learning for better results. Likewise, it is the use of the chalkboard, charts, models, overhead projectors, films, television and computers in teaching process3. Hence, it isnot just the' use of tools of technology alone but a systematic, integrated organization of machines hard wares and soft wares and man tothe solution of problems in education.In order to ensure an effective teaching learning process, it is important for the teacher to be thoroughly acquainted with the teaching resources and services available to him. The components of instructional materials available to teachers and students are in large numbers and also vary according to the functions of each of them.Pictures (motion and still) graphics, maps, radio - recording and play backand the equipment used to get some of these utilized can be regarded as the components of Audio Visual Aids, or Instructional Aids. Examples ofinstructional materials are charts, maps, diagrams, comics, models, globes, slides, film strips, television, radio cassettes, video, recorders, cinema, public address system, laboratories and museums, flash Cards, flannel boards, card boards, Calendar, Computers, etc.

Classification of Instructional Materials

The Instructional Materials could best be Classification in to three forms: audio, visual and audiovisual aids.

The audio (deal with sound only)

The visual (as in sight) and

Audio-visual (a combination of audio and visuali.e. sound and vision) for instance:

AUDIO: These include such things as Radio, Record players cassettes gramophone etc. These aid teaching through the sense of hearing. They can be used in teaching of Tajwid, Islamic songs, and at the same time Islamic programmes can be expertly presented via them.

VISUAL: The category of this consist of maps, Film steps, specimen, pictures, charts, Blackboard, posters etc. This category appeals to the pupils through the sense of sight, the saying that seeing, is believing applies to some extent in this context. Until facts are presented in form of visual aid, pupils may not readily grasp the meaning of ideas, concepts and facts.

AUDIO-VISUAL: As have said already, this group consists of acombination of both audio and visual materials. They are therefore thingslike Television films and projector etc, the use of these aids learning greatly.The Significance of Instructional MaterialsMany educationists agree that instructional materials bring aboutimprovement in the teaching/learning process as well as permit teachers and students to interact as human beings in a climate where people control their environment for their own best purposes

Factors Guiding the Selection of Instructional Materials

The teacher who wants to use instructional materials should considerthe following variables to guide him in the selection of the types to be usedin the teaching learning exercise.

1 Availability

The teacher should ensure that the instructional materials to be usedare easily available for use before the date of use. It means that the materialsshould be in store and the teachershould look at it and test it before the dayof the lesson. If the teacher has to prepare it himself, he should do so at leasta day before the lesson. No instructional materials that are not available ornot easy to prepare should be noted by the teacher in his lesson plan.

2 Accessibility

It is the duty of the teacher to ensure that thematerials to be used asinstructional materials are not only available but also accessible to him. Ifthey are already made materials they should be within reach of the teacheron the date and time of use. There should be no excuse that the materials arereadily available but locked up in the store because the store-keeper is nowhere to be found or the keys to the store have been misplaced.

3 **Affordability**

The instructional materials to be used should not be expensive thecost should be such that either the teacher or the school can afford. It is nouse to say that something is available but not affordable due to high cost.There should be a budget for instructional

materials and when this is donethe cost should not be outrageous it should be within the budget of theschool.

4 Suitability

The teacher using the instructional materials should ensure theappropriateness of the materials for his intended learners. The materialsshould be suitable for their age, experience and intelligence. The legal, safetyand ethical aspects of the materials to be used should equally be considered.The materials should not portray any anti-social attitude. They should alsobe free from any bias, distortion or prejudice. If the materials would needelectric power then an alternative should be sought to avoid disappointment from Electricity.

5 **Simplicity**

The instructional materials to be used should be simple to operate ormanipulate. The teacher should test the materials and ensure theirworkability before the actual date of use. There should not be any technicalproblem and where electricity is to be used provision should be made for analternative power. No teacher should use electric failure as an excuse for nonperformance. In a situation where an instrument demands the hands of atechnician, he (the technician) should be on hand and the teacher shouldhave an insight into the operation of the instructional materials.

6 Qualitative

The instructional materials selected for teaching by the teachershould be of good quality. Teachers should avoid the idea of "managing"with poor quality materials because he might not achieve the desired aim.

7 Recency

The instructional materials should be the best or nearest to the best itshould not be out of date. The instructional materials should reflect currentand original thought.

USE OF INSTRUCTIONAL MATERIAL IN TEACHING

FILMS: Educational films as ateaching device is a primary audio visual aid, supplement to or substitute for verbal description. communicating through sound and sight simultaneously, educational films affect the while climate of instruction. it blames

pictures, words, colour, objects and graphs to suit its purpose. Films is getting very popular as an instructional aid.

Classification of films

1. **Basic teaching films:** These are basically meant for teaching learning.
2. **supplementary teaching films:** Supplementary teaching films are of three types i.e documentary films which represent factual real life events. sponsored films giving a representative picture of an event.

Advantages of teaching aids

1. **Hieghtens reality:** Educational film heightens reality by eliminating distractions and by pointing out relationship that might be overlooked.
2. **Attention compeller education:** Educational films is the best attention compeller. It provides an intense experience, sometimes of high emotional quality.
3. **Variety of instruction:** Educational films brings variety to the method of instruction by means of their movement.
4. **True life experience:** Though the films we can see and hear recorded experiences from anywhere and everywhere in the world.
5. **Past and Present:** The films can bring the distant past and present into the classroom. old historical events can be reconstructed through the films.
6. **Modification of interests and attitudes:** Films on factories, mines and cultivation can arouse our sympathy for the workers in these fields. A five year plans, multi purpose projects, community projects can help a lot in increasing the faith of the people in the future of the country.
7. **Developing thoughts and action:** Films develop continuity of thought and action.

<u>TELIVISION</u>

The role of television in the present day world is becoming more and more important as a teaching aid. In it the advantages of radio and films are combined. These day U.G.C programmes are regular feature on **Door Darshan.**

Television, with its two fold engagement of the eye and the ear like the motion pictures, can bring us into contract with events in an exciting and clarifying way. It is a means by which teachers, parents and children may show a common experience all the same time.

1. The teacher should make him familiar with the telecast programme and their schedules on the different channelsbeforehand.
2. He should guide the students by telling them how they can be benefitted and what important points they have to observe and remember.
3. He should keep in mind the number of students to be accomodable on the basis of natures of telecast.
4. There should be adequate arrangement for lighting, ventilation and seating.
5. He should take care of the proper environment in the classroom.

COMPUTER

Computer is an aid to provide learning material is the modern arrival in the field of education. It is one of the most powerful and exciting invention that man has made. A computer is essentially a device for storing large amount of information and handling this information in specified ways in extreme short of time. The computer presents information and also supported by sound in case of multimedia, to the learner.The learner interacts with this information for which adequate instructions are provided on the screen.

Uses of computer:

1. Teacher can make the students more productive and creative in terms of their outcomes.
2. A lesson if not understood once can be repeated number of times and thoroughly understood by even an average students.
3. Students can get every type of guidance and answers of their questions. Their curiosity can be easily satisfied.
4. It helps the teacher to provide current information.
5. It can be used to develop problem solving ability among the students.

6. It helps in classification of children according to their abilities and evaluating their performance.
7. It helps the teacher in providing immediate feedback all students for better interaction and motivation.
8. It allocates learning resources and materials according to individual needs and interest.

|

CHARTS

A chart is a simple flat pictorial display material and if used appropriately conveys the displayed information in a highly effective manner. The word chart is used to indicate several different types of illustrated material 1. Charts employing diagrams which show how a cooperation, a city govt, or an economy is organised 2. Charts listing parallel columns devoted to countries, events or persons arranged in chronological order. 3. Various diagram which the student prepares.

According to wittich and schuller, " Charts may be defined as combination of graphic and pictorial media designed for the orderly and lgical visualizing of relationship between key facts or ideas."

Types of charts:

1. **Tree chart:** the figure drawn in these charts resembles a tree while the several roots of this tree leading into single trunk represents the origin of an organisation or concept.
2. **Time chart:** These are used to indicate the time sequence of a series of events to arrange chronological all the happenings important to the development of process, organization, or nation etc. we can also call them chronological chart.
3. **Pictorial chart:** In these charts the subject matter is illustrated through pictures, diagram and sketches etc.
4. **Issue chart:** Such charts are especially meant for highlighting the contrasing view of individual or organisation on important topic or issue.

5. **Flow chart:** These charts are used to show the flow of different social organisation different social views development procedures and classification in a systematic way.
6. **Classification chart:** It is used to present classification
7. **Flap chart:** This type of chart has flaps, which can be opened to disclose the message underneath. They can be prepared by using two charts papers or more.
8. **Circle chart:** This can be used to represent the data in the form of a circle.

Purposes of Charts: Charts serve the following purpose:

1. For showing relationship by means of facts, figures and statistics.
2. For presenting materials symbolically.
3. For summarizing information.
4. For showing continuity in process.
5. For presenting abstract ideas in visual form.
6. For showing development of structure.
7. For creating problems and stimulating thinking.
8. For encouraging utilization of other media of communication.
9. For motivating the students.

Graph

Graph as used in teaching of commerce are a combination of quantitative concepts and factual information of business significance. They are designed to show comparisons, developments, main ideas or relationships clearly so that they can be read and understood quickly.

Well prepared graphs are easy, can cire attractive and limited to most significant facts.

The main type of graph

1. Pictorial Graph
2. Bar graph
3. Line Graph

4. Circle graph

MODEL

Models are three dimensional visual aids. they represent real things in all respects except size and shape. They may be regarded as a step beyond pictures toward reality while the pictures is merely a one dimensional representation viewed from a particular point. Models may be simple sectional or working. They can be solid hollow or may just show the outline for demonstrating the external features of the real things. The model is a miniature reproduction that corresponds in detail with the original.

Qualities of a good model:

1. **Simplicity:** The model should not be complicated it should have the necessary quality of simplicity.
2. **Utility**: The model must help in the process of illustrating some definite facts. It should be light and handy for these will lead to its effectiveness.
3. **Solidity**: The reality and effectiveness of a good model will rest on solidity i.e its inherent strength to resist.
4. **Accuracy**: A model must be accurate.

2. LESSON PLANNING IN SCIENCE –MEANING, IMPORTANCE, STEPS (HERBARTIAN, CONSTRUCTIVIST APPROACH).

Introduction : Lesson plan is actually a plan of action. It is the core, the heart of effective teaching. It entails hard work, plain hard work. It is potentially rewarding. A teacher without lesson plans ends his day tired from his efforts to keep proper discipline in the class and feels discouraged with his failures, a teacher with good plans is also tried, but his tiredness is tempered with the joy of satisfaction.

Definitions

1. **Carter V. Good** : A lesson plan may be defined as a teaching outline of the imp. points of a lesson arranged in an order in which they are to be presented. It may include objectives, points to be asked, assignments etc.

2. **Acc. to Binning & Binning** : Daily lesson plan is a plan which involves defining the objectives, selecting and arranging subject matter and determining the method or procedure.

Types of Lesson Plans :

1. Knowledge Lessons
2. Skill Lesson
3. Appreciation lesson

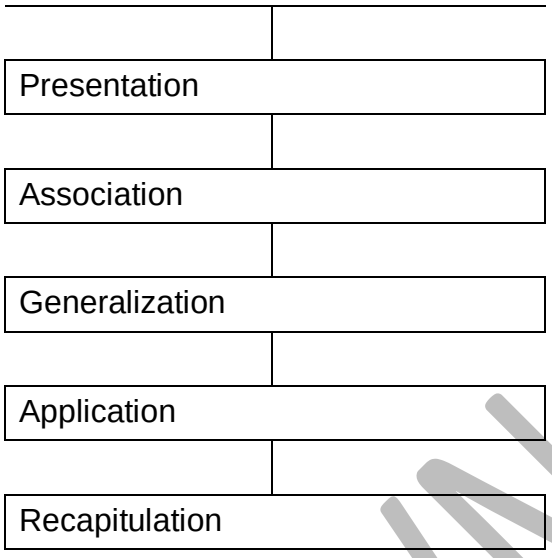
1. **Knowledge lesson** : The lesson dealing with the acquisition of knowledge is called as the knowledge lesson. Such a lesson aims at providing some knowledge to the pupils. Acquisition of the knowledge is an imp. and indispensable aspect of education.

2. **Skill lesson** : The lesson dealing with the acquisition of skill is called the skill lesson such a lesson aims at teaching some skills to the pupils. Lesson in which they are taught how to do science practicals, how to make improvised apparatus, how to develop teaching aids, are some of the examples of skill lessons.

3. **Appreciation lesson** : The lessons in which knowing and doing are the appreciating beauty is called as Appreciation lesson. This lesson aims at the development of aesthetic sense in the pupil. Schools which only aim at developing the intellect.

Steps involved in Lesson Planning

Preparation



Characteristics/principles of lesson planning

1. **Written lesson plan** : A good lesson plan should be written. It should not remain at the oral or mental stage only. When the teacher writes it, the salient features of the lesson are fixed in his mind.

2. **General and Specific Aims** : Both general and specific aims should be clearly written in a good lesson plan.

3. **Properly framed** : The lesson plan should be properly framed. All the imp. steps and procedures should be clearly written.

4. **Contents of the lesson** : The contents of the lessons should be selected according to intellectual level of the students and the nature and extent of their previous experience.

5. **Methods and Techniques** : The lesson plans should indicate the teaching techniques and method to be used in the lesson and the questions to be asked at various stages.

6. **Teaching aids** : The aids to be used should be closely related to pupil's experiences. If they are so different and strange which can n't be easily understood.

7. **Correlation** : Subject matter should be correlated with various subject and life situation.

8. **Language used** : The language used should be simple, familiar and free from ambiguous words.

9. **Application stage** : The application stage in the subject of science should be well defined. There should be a clear distinction b/w the presentation and application stage.

10. **Black Board work** : The imp. of a good black board summary should never be under rated. A good black board summary will serve to prevent the teacher from wandering away from his scheme.

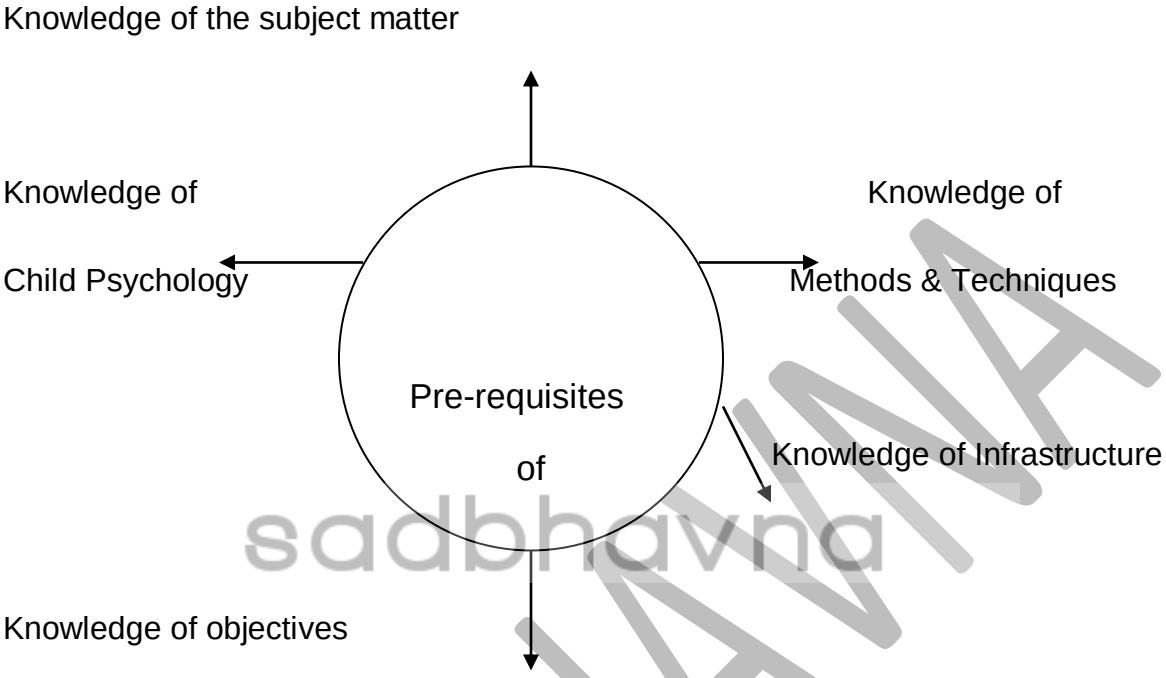
Diagrams shows Need/Imp. of Lesson Planning

Need & Imp. of Lesson Planning

A light house for teacher
For systematic planning
Division of the course
Confidence and self reliance
Proceed with particular aim
Time saving
Clear goal
Prevention of wastage
Continuity in teaching process
Stimulates the teacher
Makes teacher a perfect soldier
Improves the study habits of teacher

Home work

Diagram : Pre requisites of Lesson Plan



HERBARTIAN APPROACH OF LESSON PLANNING

John Fredric Herbart was a great European educationist and philosopher of 19th century he advocated that teaching should be planned actively if we intend to make it efficient He applied the knowledge of psychology regarding the Learning process.
Herbartian approach is based on apperceptive mass theory of learning. The main thing in that theory is that the learner is like a clean slate and all the knowledge is given to him from outside. If new knowledge is imparted by linking with old knowledge of the student it is acquired easily and is retained for a longer period. The contents should be presented into units and those units should be arranged in a logical sequence.

Based upon Educational psychology Herbart's educational ideology advocated the following four elements for a successful teaching.

1. **Interest**. The teaching process should be interesting. When the interest of pupils is crated in some subject, their attention is attracted towards it. They acquire the new knowledge very easily.

2. **Apperception**. The entire knowledge is provided to the pupils from outside. Apperception of this external knowledge occurs in the unconscious mind of the pupils. By relating new knowledge to the previous knowledge of the pupils, their learning is simplified. Hence, in order to make the learning process effective, the teacher should move from known to unknown.
3. **General Method**. Learning activity occurs in a definite sequence. Hence, the activities of the unit should be edited in a definite sequence and in a logical order.
4. **Correlation**. Knowledge is one unit. All the subjects should be studied after correlating each other in the form of one unit. All the subject of the curriculum should be taught by correlating them with History.

Steps of Teaching Approach

1. **Clarity**. The teacher should present the subject-matter with clarity. The subject-matter to be taught is broken into various facts so that pupils pay attention to each fact or element.
2. **Association**. The new knowledge of the pupils is related to their previous knowledge.
3. **System.** New knowledge or thought should be organized in sequence on the basis of logic. The specific are separated from the generals which may enable the pupils to view the mutual relations between various fact or elements so that they may gain the knowledge of 'whole'.
4. **Method**. The pupils apply the gained knowledge to the new situations.

HERBARTIAN FIVE STEPS TEACHING

While Herbart emphasized only four steps his followers modified the above four steps. Ziller , a disciple of Herbart, divided the first step i.e., clarity into two introduction and presentation. Ryan incorporated one more step termed as 'Statement of Aim' in between these two. Still other disciples of Herbart changed the names of other three steps. The term comparison was used in place of association, generalization in place of system and application in place of method. Thus, resulted five steps in place of four. These five steps are termed as Herbartian five steps of teaching.

Preparation/ Introduction-. Some question are asked from the pupils in order to test their previous knowledge so that curiosity may arouse in them for learning of new knowledge. By testing their previous experiences the pupils are prepared for acquiring new knowledge.

1.

- **Statement of Aim**

  -. Here, the topic becomes clear to the pupils and the teacher himself is supposed to write the topic on the black-board in clear words.

- **Presentation**. The lesson is developed with the cooperation of the pupils. Opportunities are provided to pupils to learn themselves by stimulating their mental activity. The teacher tries to receive most of the points from the pupils by questioning so that the new knowledge may get related to the previous knowledge.
- **Comparison and Association**-. In this, the facts, events and application taught are related mutually by comparison to enable the pupils to understand the taught material. The teacher establishes a relationship between two subjects and also between the facts and events of one subject and the facts and events of the other subject. He compares them so that the new knowledge may get stabilized and clarified in the minds of the pupils.
- **Generalization**-. Herbart termed this step as 'system' After explaining the main lesson, the pupils are provided with opportunities to think. They formulate such principles and rules which may be used in various situations of the future life.
- **Application-**. In Application it is observed whether the acquired knowledge may be applied to the new situations. The teacher verifies this by asking recapitulate questions or by providing opportunities to apply the acquired knowledge in the new saturations. This stabilizes the new knowledge and validity of the rules may also be proved.

HERBARTIAN LESSON PLAN MODEL

Date……. Class…… Period……..

Subject……. Topic……

1. 1. **General Objectives**. These objectives are formulated by the teacher in his subject keeping in view the entering behaviors of the learners. For example: 1. To develop the knowledge of grammar among the students…
2. **Specific Objective**. These objectives are formulated on the basis of general objectives and considering the nature of the topic and level of students. These are specified in terms of knowledge, skill or appreciation. These objectives are written in behavioral terms. For Example: (i) Students will be able to recall the definition of noun. (ii) Students will be able to enumerate the examples of noun….
3. **Introduction.** Here, the teacher employs his insight and experiences for liking new knowledge with the previous knowledge of the students. The topic is not introduced directly but it is usually emitted by the student's responses by asking introductory questions.
4. **Teaching Aids**. Audio-visual aids are selected according to the proposed topic.
5. **Previous knowledge**. Students' previous knowledge is mentioned. For example: Students are familiar with figure of speech. They know that nouns are naming words.
6. **Statement of Aim**. The teacher gives his statement of teaching topic by incorporating the student's responses. For Example: "Today, we will study about the noun and its kinds."
7. **Presentation**. The teacher prepares the developing questions after introducing the topic. The question are arranged in logical sequence, i.e., from simple to complex, considering the structure of the topic.
8. **Explanation**. The teacher is supposed to explain the answers of the given developing question. as whole of the content-matter is in the question-answer form.
9. **Black –board Summary**. The teacher has to prepare the black-board summary of his teaching point and explanations.
10. **Review Questions**. The purpose of these questions is to practice the student's learning and to evaluate their performance whether they have comprehended the teaching unit or not. These review questions are asked only after rubbing the black-

board summary. For example: Q.1. What is the definition of 'Noun'? Q.2. Give some examples of Noun…..

11. **Home assignments**. At the end of the lesson plan, home assignment is given to the students on the same teaching unit. The purpose of home work is to practice, to organize and to study the topic for better understanding and retention.

Advantages

1. **Organized Teaching**. Each step has been organized in a logical order which provides an opportunity to the fresh teacher to become aware of future mistakes. Originality is never affected and the teaching goes on in a very organized way.
2. **Acquiring thoughts as apperception** . Herbart believed that when the new thought related to the thoughts lying in unconscious mind of the pupils are presented, the thoughts of unconscious mind come to the conscious mind, establish relationship with the new thought and again go to the unconscious mind. Herbart termed this material process of acquiring thoughts as apperception.
3. **Use of Inductive and Deductive Methods**. While presenting the new knowledge, help of various examples is sought through 'generalization' and rules are derived. it is an inductive method. In the step application, these rules are to be executed, this is a deductive method. Thus, both indicative and deductive methods are used in this five steps approach.
4. **Recapitulation**. Such question are asked while recapitulating which, on answering, result in the learning and application of the acquired knowledge in new situations.
5. **Correlation Possible**. Herbart considered entire knowledge as a single unit. The knowledge of the pupils is acquired in a single unit. This allows to establish a correlation between previous and new knowledge and between all subject of the curriculum.

Limitations

1. **Mechanical Method of Teaching**. The use of the these steps takes away the freedom of the teacher as he cannot incorporate his independent thought in any

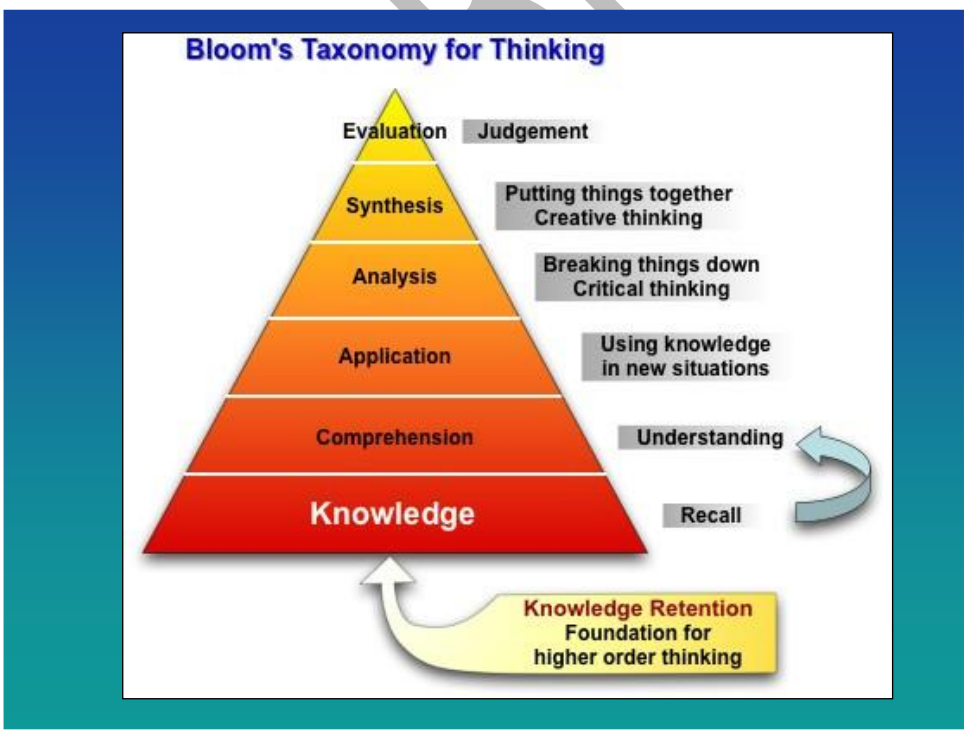
step. This reduces his originality. Hence, Herbartian approach is a mechanical method of teaching.

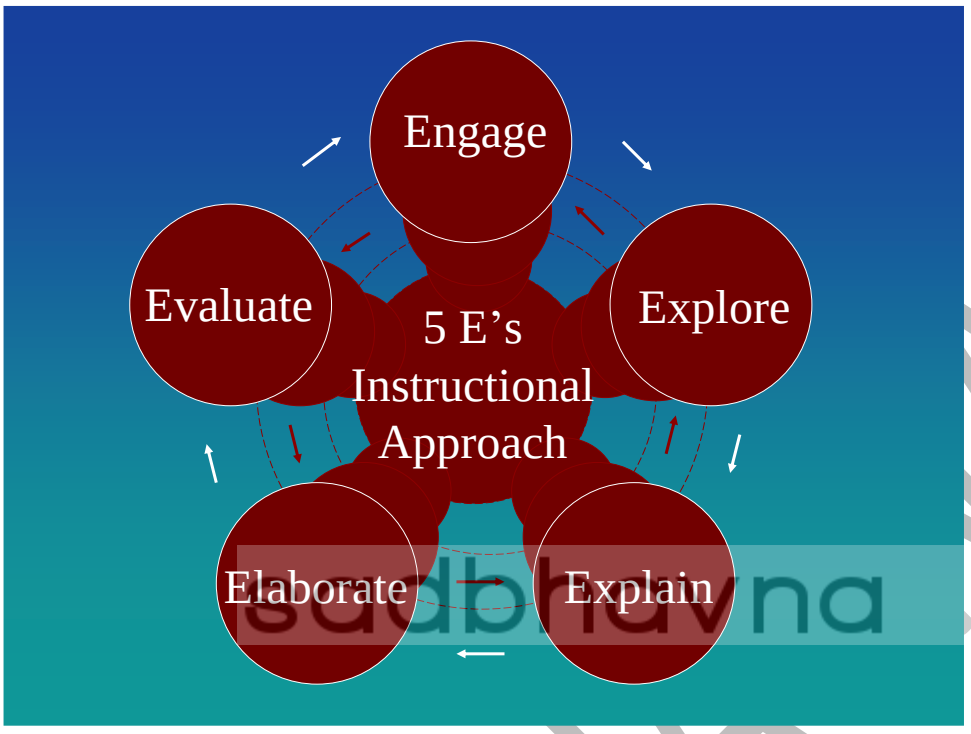
2. **No Place for Individual Differences**. While using Herbartian approach. Similar questions are asked to the entire . This overlooks individual differences.
3. **Useful in Knowledge Lesson only**. Herbartian approach is useful in the knowledge lesson only, not in appreciation and skill lessons.
4. **Teacher More Active**. In Herbartian approach, the teacher has to be more active. It is more desirable if the pupils remain more active than the teachers. As this teaching method is not activity-centered, pupils don't' get any motivation for learning.
5. **No need of Generalization**. Generalization is not needed while teaching language, geography, history, music and arts etc. Thus, all the five steps are not needed while teaching.
6. **Uninteresting**. This approach stresses upon the teaching of all the subjects of curriculum in a similar sequence overlooking the interests, attitudes, abilities, and capacities of the pupils according to their mental development. The entire teaching become monotonous. The pupil does not show any interest in acquiring new knowledge . Thus, Herbart's teaching method is not interesting
7. **Difficulty of Correlation.** Considering the knowledge as a complete unit, Herbart emphasized correlation between different subjects for the unity in the mental life of the pupils, But following these five steps teachers impart the knowledge of different subjects to the pupils differently. They seek to establish a correlation between various subjects in order to bring integration in the mental life of the pupils which is essentially difficult, if not impossible.

CONSTRUCTIVIST APPROACH

Introduction

It seems that every 3 to 5 years a new idea surfaces in the educational community. The topic has been researched, discussed, and argued in institutions of higher learning; however, when it eventually filters down to the teachers in elementary and high school, there is little time invested in explaining and understanding the new theory - they are told, "Just do it!" The latest educational buzzword is constructivism. Teachers are being asked to support this philosophy of teaching and learning, and design instruction accordingly. What does this mean? This WebQuest will help you go beyond the basic definition of constructivism: individuals building their own understanding, to a more thorough explanation of the theory and its various aspects. Examples are provided via the 5 E learning cycle. The 5 E model for designing science lessons is just one method of instruction that supports constructivist teaching/learning. After investigating these resources, you can make your own decision as to the value of the constructivist theory.





Engagement

`5Es	Suggested Activity	What the Teacher Does	What the Student Does
Engage	❖ Demonstration ❖ Reading ❖ Free Write ❖ Analyze a Graphic Organizer ❖ KWL((Know already ~ Want to know ~ Learn)) ❖ Brainstorming	❖ Creates interest. ❖ Generates curiosity. ❖ Raises questions. ❖ Elicits responses that uncover what the students know or think about the concept/topic.	❖ Asks questions such as, Why did this happen? What do I already know about this? What can I found out about this? ❖ Shows interest in the topic.

Exploration

`5Es	Suggested Activity	What the Teacher Does	What the Student Does
Explore	❖ Perform an Investigation ❖ Read Authentic Resources to Collect Information ❖ Solve a Problem ❖ Construct a Model	❖ Encourages the students to work together without direct instruction from the teacher. ❖ Observes and listens to the students as they interact. ❖ Asks probing questions to redirect the students' investigations when necessary. ❖ Provides time for students to puzzle through problems.	❖ Thinks freely but within the limits of the activity. ❖ Tests predictions and hypotheses. ❖ Forms new predictions and hypotheses. ❖ Tries alternatives and discusses them with others. ❖ Records observations and ideas. ❖ Suspends judgement.

Explanation

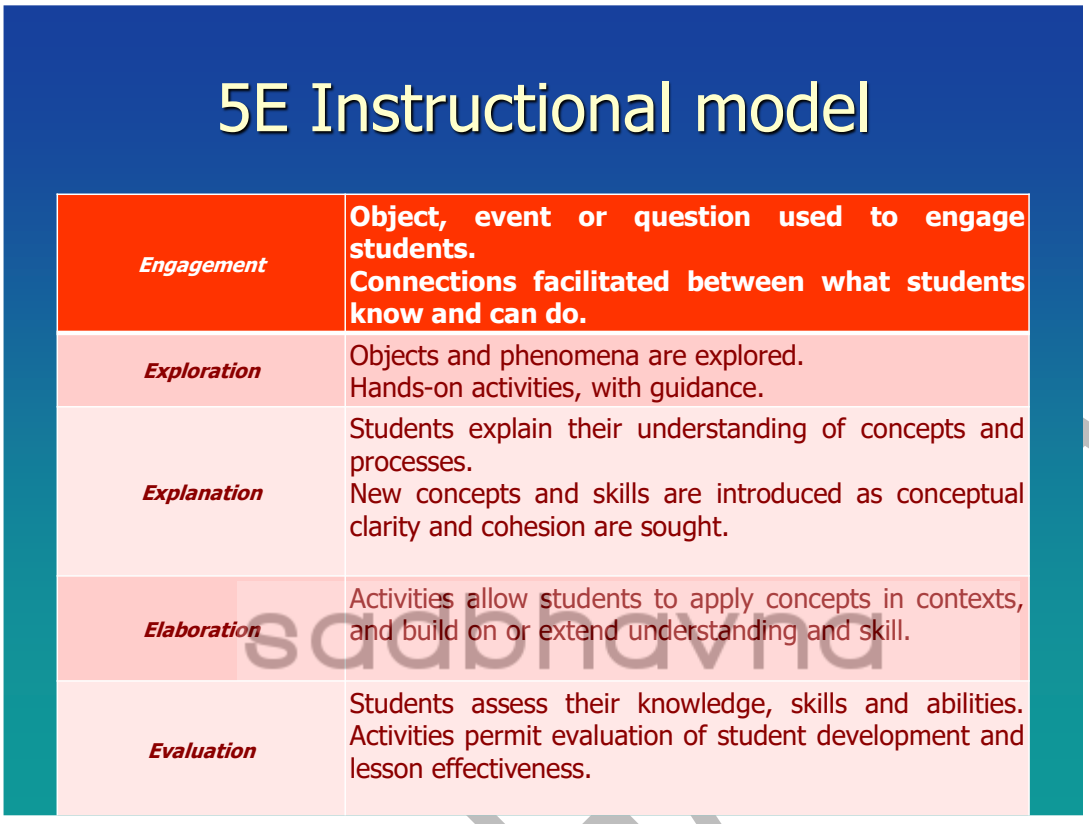
`5Es	Suggested Activity	What the Teacher Does	What the Student Does
Explain	❖ Student Analysis & Explanation ❖ Supporting Ideas with Evidence ❖ Structured Questioning ❖ Reading and Discussion ❖ Teacher Explanation ❖ Thinking Skill Activities: compare, classify, error analysis	❖ Encourages the students to explain concepts and definitions in their own words. ❖ Asks for justification (evidence) and clarification from students. ❖ Formally provides definitions, explanations, and new labels. ❖ Uses students' previous experiences as basis for explaining concepts.	❖ Explains possible solutions or answers to others. ❖ Listens officially to others' explanations. ❖ Questions others' explanations. ❖ Listens to and tries to comprehend explanations the teacher offers. ❖ Refers to previous activities. ❖ Uses recorded observations in explanations.

Elaborate

`5Es	Suggested Activity	What the Teacher Does	What the Student Does
Elaborate	❖ Problem Solving ❖ Decision Making ❖ Experimental Inquiry ❖ Think Skill Activities: compare, classify, apply	❖ Expects the students to use formal labels, definitions, and explanations provided previously. ❖ Encourages the students to apply or extend the concepts and skills in new situations. ❖ Reminds the students of alternative explanations. ❖ Refers the students to existing data and evidence and asks, What do you already know? Why do you think…? ❖ Strategies from Explore apply here also. ❖	❖ Applies new labels, definitions, explanations, and skills in new, but similar situations. ❖ Uses previous information to ask questions, propose solutions, make decisions, and design experiments. ❖ Draws reasonable conclusions from evidence. ❖ Records observations and explanations. ❖ Checks for understandings among peers.

Evaluation

`5Es	Suggested Activity	What the Teacher Does	What the Student Does
Evaluate	❖ Any of the Above ❖ Develop a Scoring Tool or Rubric ❖ Test ❖ Performance Assessment ❖ Produce a Product ❖ Journal Entry ❖ Portfolio	❖ Observes the students as they apply new concepts and skills. ❖ Assesses students' knowledge and/or skills. ❖ Looks for evidence that the students have changed their thinking or behaviors. ❖ Allows students to assess their own learning and group-process skills. ❖ Asks open-ended questions, such as: Why do you think...? What evidence do you have? What do you know about x? How would you explain x?	❖ Answers open-ended questions by using observations, evidence, and previously accepted explanations. ❖ Demonstrates an understanding or knowledge of the concept or skill. ❖ Evaluates his or her own progress and knowledge. ❖ Asks related questions that would encourage future investigations.



3. SCIENCE TEACHER: PROFESSIONAL GROWTH, TEACHER AS A COMMUNITY OF LEARNERS,COLLABORATION OF SCHOOLS WITH COLLEGES/UNIVERSITIES.

Introduction : Quality of science education cann't be improved and raised without active participation of teacher. An efficient and resourceful science teacher can perform his duties quite efficiently even with inadequate science facilities. It is the said part of this profession that it is worst paid, the salary scales which always keep teachers below the margin of livelihood have all combined to bring abt a sense of frustration among science teachers.

Definition :

Acc. to Henry Van Duke : "And what of teaching? Ah, there you have the worst paid and best reward of all the vocations. Dare not to enter it unless you love it for the vast

majority of men and women it has no promise of wealth or frame, but they to whom it is dear for its sake are among nobility of mankind. I sing the praise of unknown teachers.

Qualification of a Science Teacher : A teacher should possess the basic qualifications :

T → Truthfulness / Tolerance

E → Enthusiasm / Efficient

A → Accuracy / Aptitude / Affectionate

C → Commitment / Confidence / Cheerful

H → Humour / Honesty / Hardwork

E → Empathy / Eager

R → Regular / Resourceful / Rational thinking

Besides having the personal qualities, a teacher should have also fulfill the following broad requirements :

- Academic Qualification
- Professional Education or Training in the modern methods & techniques.
- Practical knowledge of child psychology and process of learning.

1. **Academic Qualifications** : The basic academic qualifications laid down by the education departments of different states is atleast B.Sc. to teach Middle & High classes and M.Sc. for the senior secondary classes.

2. **Professional Education** : Besides possessing basic academic qualification, a teacher must be familier with modern methods and techniques of teaching. Therefore every teacher of science must have undergone teacher training course

i.e. B.Ed. or B.T. from a recognized university. This training helps the teacher to know methods of evaluation, improvision of science apparatus and equipments, conducting practical work in the laboratory etc. It is therefore essential that the science teacher should be trained in.

1. Lesson and unit planning.
2. Science club activities and district and state science fairs.
3. Preparation of instructional material.
4. Laboratory management and organization.
5. Latest method of teaching.
6. Maintenance and use of science libraries.
7. Care, maintenance, repair & improvisation of science apparatus and equipment.
8. Evaluation technique.

3. Practical knowledge of child psychology & the process of learning

Every science teacher should be able to deal with the students according to their needs. It should follow the psychological principle that 'No two individuals are alike.' He must be able to cater to individual differences in his class. He should be able to lead the students according to their capabilities, interests. He should also be ready to help them whenever and wherever necessary. Besides this, a science teacher should have great patience and the ability to switch from one aspect to another. A science teacher should frequently evaluate his teaching for improving and identifying his weak areas.

Professional Growth of Science Teacher : In the ancient days, great prestige, respect and honour was given to Guru. He was considered to be a man of 'simple living and high thinking.' He had sound knowledge of the subject and continually renewed it. A No.

of programmes have been started by different agencies to help in the professional growth and development of science teachers but equally imp. is the personal effort of the teacher. In order to be in touch with the latest development in the field of science and science education the teacher should take the following steps :

1. He should familiarize himself with the National Policy on education 1986 and 1992 and the thrust area be identified.

2. He needs to upgrade the knowledge and understanding of the subject.

3. He should pursue for higher qualifications like M.Sc., M.Ed., M.Phil, Ph.D. etc.

4. He should master teacher skills eg.

   - Conducting experiments
   - Preservation of specimens
   - Construction of models

5. He should develop his own style of teaching based on psychological principles.

6. There should be exchange of teaching position, either in same should or through exchange programmes.

7. He should be active participant in various science activities like science club, science excursion.

8. He should visit other schools to study various methods of teaching followed by different teachers.

9. He should acquire professional efficiency.

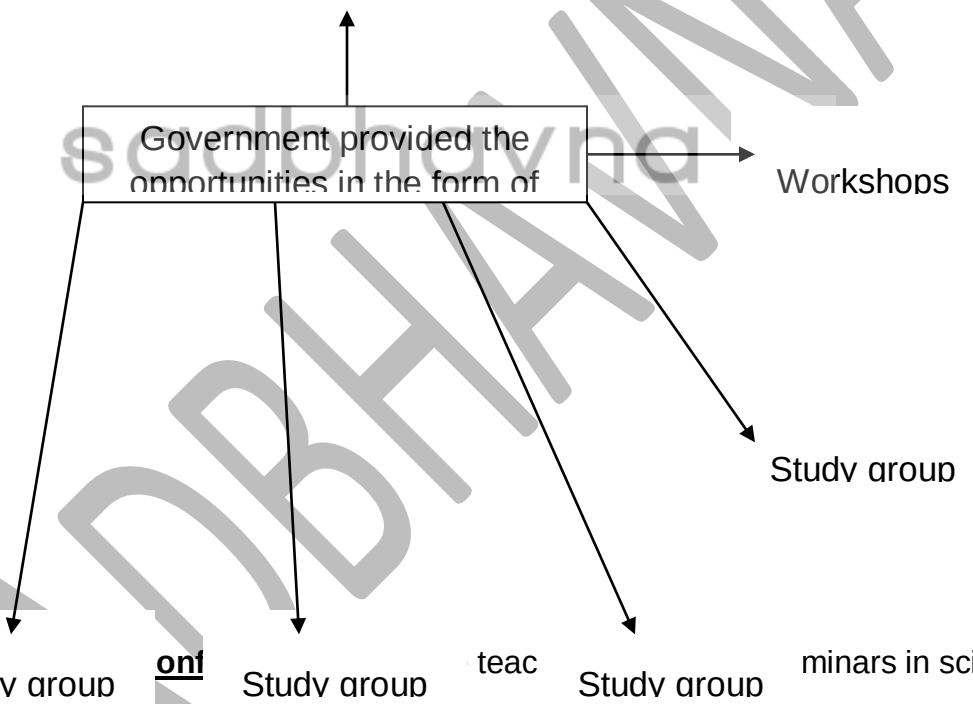
10. He should follow problem solving approach.

11. He should participate in refresher course to get acquainted with latest developments in the field.

12. The impact of verbal interaction of a teacher is everlasting.

To keep the teachers alive to new developments, problems, concepts, a No. of opportunities are provided by the Government in the form of Seminars & Conferences, Workshops Refresher Courses, Summer Institutes, Professional Writings, study group.

Seminars of Conferences



1. **onf** teac minars in science and other subjects. The seminar may be arranged on some particulars topic or it can be on various problems. A working paper is prepare before hand which is circulated among the participants. Different committees are formed to discuss different problems on various issues. The seminars may be held on new techniques of teaching, teaching-learning process, teaching of special children, improvement of science curriculum, science practicals of different classes etc. Seminars widens the professional outlook of science teachers.

2. **Workshops** : There are different from seminars. The approach taken in workshops is practical. These can be arranged on lesson planning, curriculum, evaluation systems etc. The work is distributed among various participants dividend in groups and these groups discuss it and come to conclusions.

3. **Refresher Courses** : The refresher courses are arranged for the science teachers so that they acquire the knowledge about latest developments and researches in their field. The experts are invited and lectures are delivered by them on their respective subjects.

4. **Summer Institutes** : Various types of summer institutes have been started to refresh and update the knowledge of teachers of Science & Mathematics in secondary schools as well as in teacher training colleges. The different types of summer institutes are :

   - Unitary Institutes
   - Sequential Institutes
   - Special Institutes
   - Project Technology Institutes

5. **Professional Writings** : The teachers are encourage to study various publication of NCERT.

6. **Study Goups** : Various agencies encourage the teachers to form study gps. These can be formed from various schools of district at the level. The teachers can share their experiences on different activities, teaching – learning processes, difficulties they face during teaching

UNIT-IV

1. REFLECTION AND REFRACTION- LAWS AND ITS APPLICATIONS.

Law of Refraction

The law of refraction, which is generally known as *Snell's law*, governs the behaviour of light-rays as they propagate across a sharp interface between two transparent dielectric media.

Consider a light-ray incident on a plane interface between two transparent dielectric media. The law of refraction states that the incident ray, the refracted ray, and the normal to the interface, all lie in the *same plane*. Furthermore,

$$n_1 \sin\theta_1 = n_2 \sin\theta_2,$$

2.

where θ_1 is the angle subtended between the incident ray and the normal to the interface, and θ_2 is the angle subtended between the refracted ray and the normal to the interface. The quantities n_1 and n_2 are termed the *refractive indices* of media 1 and 2, respectively. Thus, the law of refraction predicts that a light-ray always deviates more towards the normal in the optically denser medium: *i.e.*, the medium with the higher refractive index. Note that $n_2 > n_1$ in the figure. The law of refraction also holds for non-planar interfaces, provided that the normal to the interface at any given point is understood to be the normal to the local tangent plane of the interface at that point.

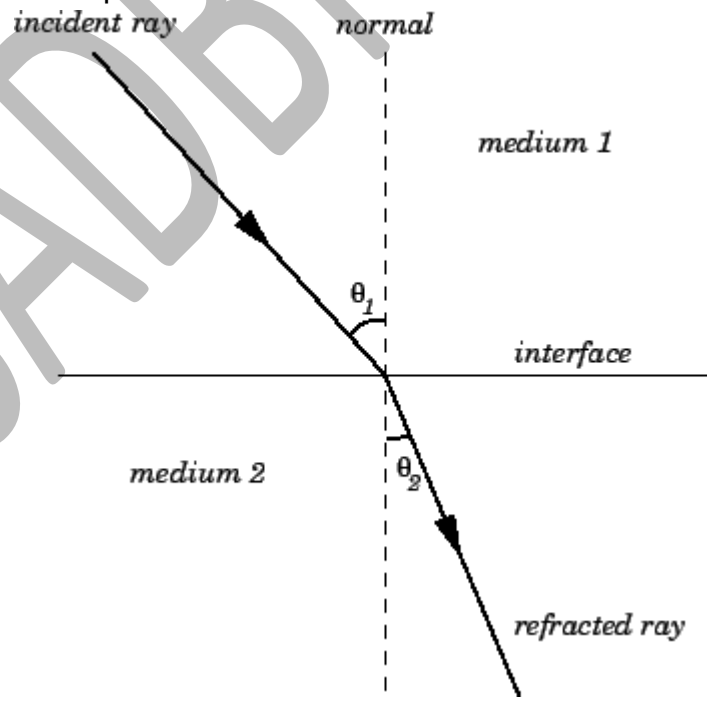


Figure 57: *The law of refraction.*

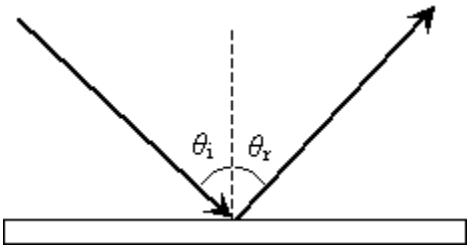
By definition, the refractive index n of a dielectric medium of dielectric constant K is given by

$$n = \sqrt{K}.$$

Reflection and Refraction

Our study of geometrical optics will center on the application of two basic laws: one for reflection and one for refraction.**Reflection** is just as you might imagine: rays of light that are deflected by a surface (perhaps being sent back toward their source) are reflected. If you've ever looked in a mirror, you've looked at light that has been reflected by a surface (the mirror).**Refraction** is a slightly less intuitive concept, but it has an effect on everyday life. If you've ever noticed that a straw in a glass of water looks (from certain angles) like it is bent, or if you've ever seen a mirage on the road, then you've seen the effects of refraction. Refraction is the "bending" of light rays resulting from changes in the characteristics of the medium through which the rays are traveling. Two very simple formulas govern reflection and refraction in geometrical optics.

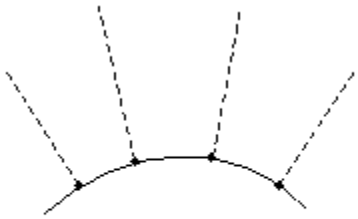
First, we consider reflection, as shown in the diagram below for a light wave striking a surface. We identify the incoming ray as the incident ray and the outgoing ray as the reflected ray. Concomitantly, the angle θ_i that the incoming ray makes with a line (dashed in the diagram) normal to the surface is called the**angle of incidence.** The angle θ_r for the reflected ray is called the **angle of reflection.**



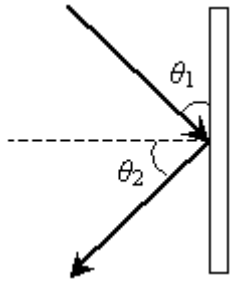
The **law of reflection** states that the angle of incidence is equal to the angle of reflection, or, stated mathematically,

$$\theta_i = \theta_r$$

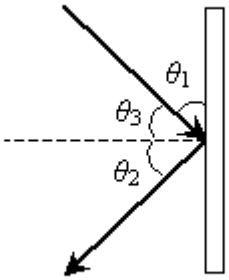
Although this relation is simple, you must always be careful to find the correct normal line that intersects the point of incidence. Although this is easy for a flat surface (it is just the line that is perpendicular to the surface), it is slightly more complicated for curved surfaces. Nevertheless, the same principle applies: the normal line is the line perpendicular to the surface at the point of incidence. Several normal lines are shown for different points on the curved surface below.



Practice Problem: A ray is incident on a mirror as shown below, where the dashed line is normal to the surface. What is the angle θ_2 in terms of θ_1?



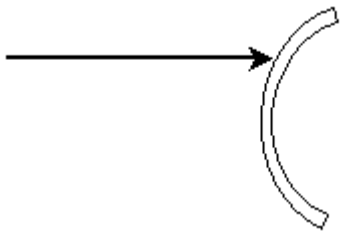
Solution: The law of reflection states that the angle of incidence is equal to the angle of reflection (where both angles are measured from the normal line to the surface). The normal line is shown as the dashed line in the figure. Let's add angle θ_3 to the figure; note that this angle is 90° - θ_1.



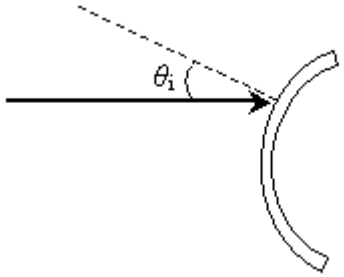
The law of reflection tells us that $\theta_2 = \theta_3$; on the basis of this and our conclusion about the relationship of θ_1 and θ_3, we can express θ_2 in terms of θ_1 as follows.

$$\theta_2 = 90° - \theta_1$$

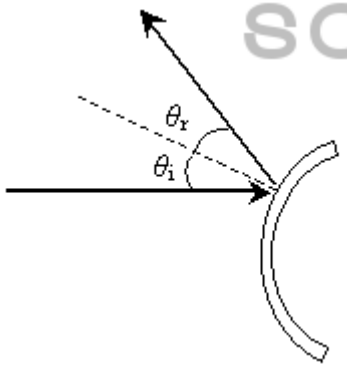
Practice Problem: Complete the diagram to show (approximately) the path of the ray upon reflection by the mirror shown below.



Solution: Earlier we learned that the angles of incidence and reflection are equal when measured from the line that is normal to the surface at the point of incidence. The first step to completing the diagram is to draw this normal line, thus allowing us to determine the angle of incidence, θ_i. Because the problem asks us to find the *approximate* path of the reflected ray, we need not use a compass or other tool to perform an exact construction--we can simply "eyeball" the normal line and then the reflected ray.



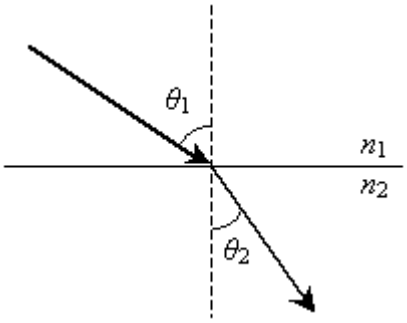
Now, let's draw the reflected ray.



Using this technique, we can trace rays as they interact with multiple mirrors.

Next, we consider refraction. Refraction is the bending of light owing to a change in the characteristics of the material as the ray passes from one medium to another. The diagram below shows an example of a refracted ray with the angle of incidence θ_1 in the first material and θ_2 in the second material. (As with reflection, these angles are

measured from the normal line to the surface.) Also, the first material has a so-called **index of refraction** n_1, and the second material has an index of refraction n_2.



The **law of refraction** states the following:

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

The law of refraction also states that the refracted ray is in the same plane as the incident ray. Thus, for instance, the refracted ray shown above cannot have a component of its direction that is into or out of the surface of the page. Before applying this law by way of practice problems, we shall briefly discuss the nature of the index of refraction, *n.* Recall that a vacuum has material parameters ε_0 (the permittivity of free space) and μ_0 (the permeability of free space). A material generally has a permittivity ε and permeability μ, where $\varepsilon = \varepsilon_r \varepsilon_0$ and $\mu = \mu_r \mu_0$. (These different material parameters have an important effect on the speed of light; generally, the speed of light in a material with permittivity ε and permeability μ is $\frac{1}{\sqrt{\varepsilon\mu}}$.) For a vacuum, the **relative**

permittivity ε_r is unity, as is the **relative permeability** μ_0. These relative material parameters determine the index of refraction, *n:*

$$n = \sqrt{\varepsilon_r \mu_r}$$

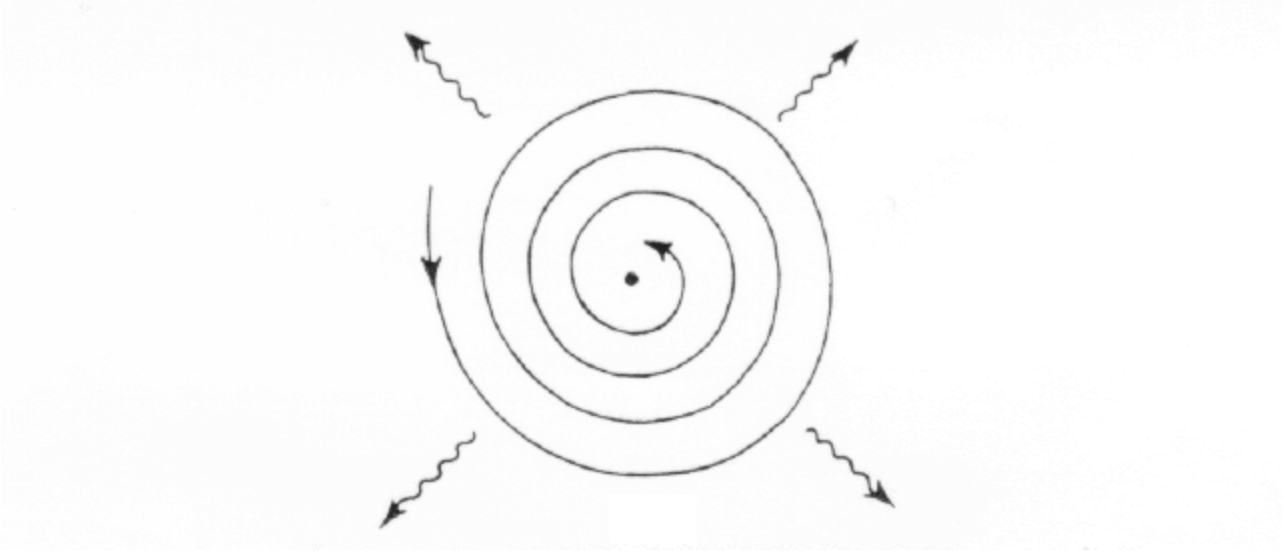
(Note, then, that the speed of light in a medium of index *n* is $\frac{c}{n}$.) Thus, we further see that wave phenomena (rays, in this case) are closely linked to the electric and magnetic fields by way of these material parameters.

3. STRUCTURE OF ATOM- BOHR'S MODEL.

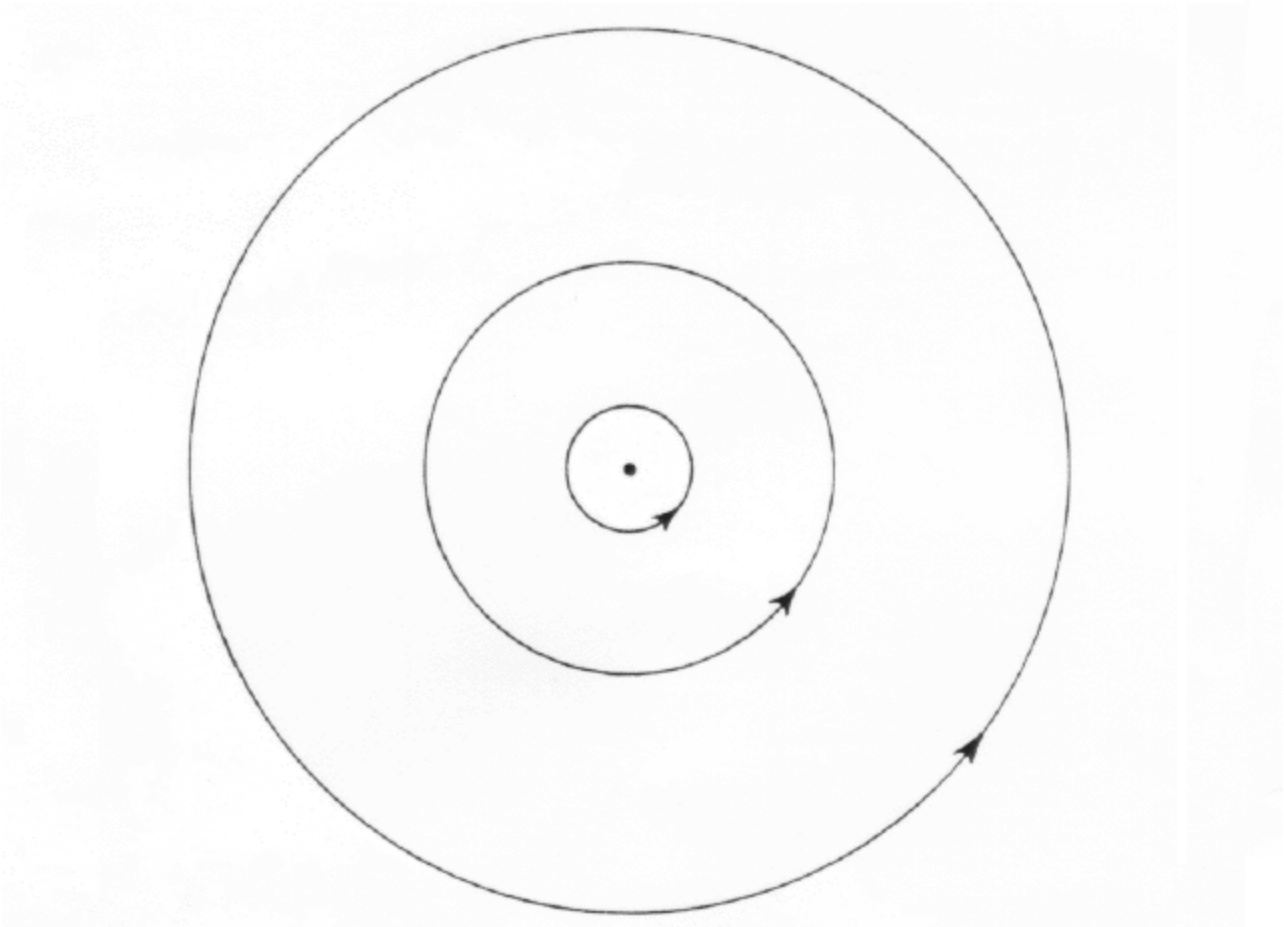
Bohr Atomic Model :

In 1913 Bohr proposed his quantized shell model of the atom to explain how electrons can have stable orbits around the nucleus. The motion of the electrons in the Rutherford model was unstable because, according to classical mechanics and electromagnetic theory, any charged particle moving on a curved path emits electromagnetic radiation; thus, the electrons would lose energy and spiral into the nucleus. To remedy the stability problem, Bohr modified the Rutherford model by requiring that the electrons move in orbits of fixed size and energy. The energy of an electron depends on the size of the orbit and is lower for smaller orbits. Radiation can occur only when the electron jumps from one orbit to another. The atom will be completely stable in the state with the smallest orbit, since there is no orbit of lower

energy into which the electron can jump.



According to classical physics, an electron in orbit around an atomic nucleus should emit electronmagnetic radiation (photons) continuously, because it is continually accelerating in a curved path. The resulting loss of energy implies that the electron should spiral into the nucleus in a very short time (i.e. atoms can not exist).



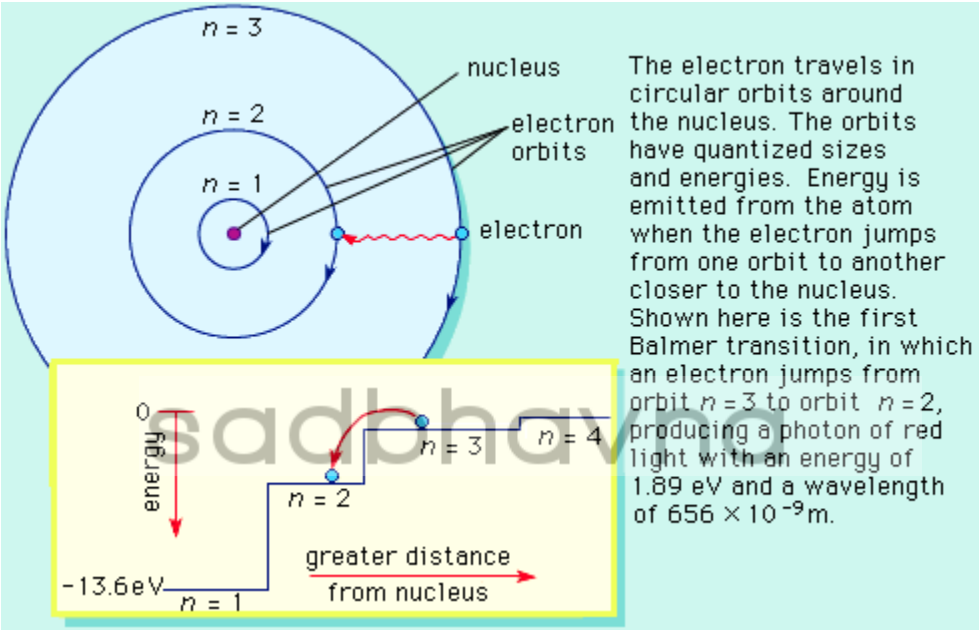
Bohr proposed that electrons are restricted to certain fixed (quantized) orbits. An electron can jump, suddenly, between these orbits by absorbing or emitting a photon with the appropriate precise wavelength.

Bohr's starting point was to realize that classical mechanics by itself could never explain the atom's stability. A stable atom has a certain size so that any equation describing it must contain some fundamental constant or combination of constants with a dimension of length. The classical fundamental constants--namely, the charges and the masses of the electron and the nucleus--cannot be combined to make a length. Bohr noticed, however, that the quantum constant formulated by the German physicist Max Planck has dimensions which, when combined with the mass and charge of the electron, produce a measure of length. Numerically, the measure is close to the known size of atoms. This encouraged Bohr to use Planck's constant in searching for a theory of the atom.

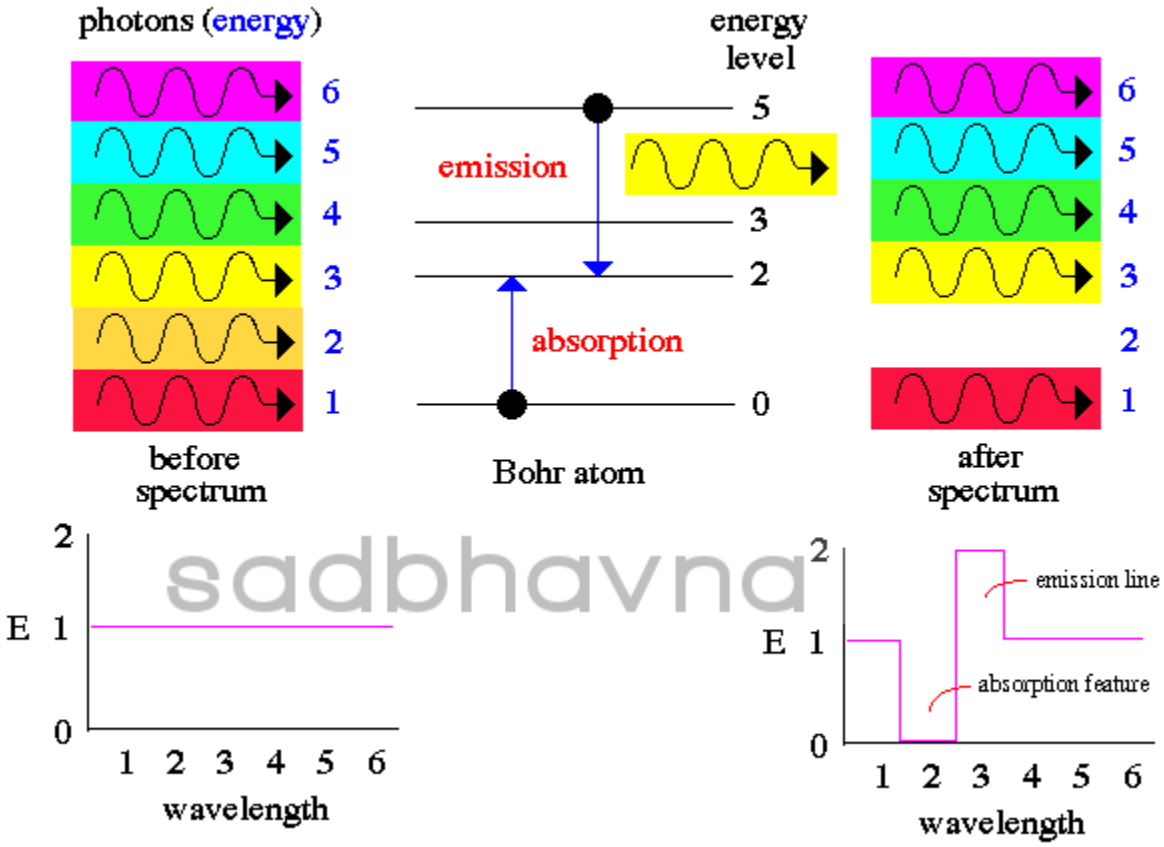
Planck had introduced his constant in 1900 in a formula explaining the light radiation emitted from heated bodies. According to classical theory, comparable amounts of light energy should be produced at all frequencies. This is not only contrary to observation but also implies the absurd result that the total energy radiated by a heated body should be infinite. Planck postulated that energy can only be emitted or absorbed in discrete amounts, which he called quanta (the Latin word for "how much"). The energy quantum is related to the frequency of the light by a new fundamental constant, h. When a body is heated, its radiant energy in a particular frequency range is, according to classical theory, proportional to the temperature of the body. With Planck's hypothesis, however, the radiation can occur only in quantum amounts of energy. If the radiant energy is less than the quantum of energy, the amount of light in that frequency range will be reduced. Planck's formula correctly describes radiation from heated bodies. Planck's constant has the dimensions of action, which may be expressed as units of energy multiplied by time, units of momentum multiplied by length, or units of angular momentum. For example, Planck's constant can be written as $h = 6.6 \times 10^{-34}$ joule seconds.

Using Planck's constant, Bohr obtained an accurate formula for the energy levels of the hydrogen atom. He postulated that the angular momentum of the electron is quantized--i.e., it can have only discrete values. He assumed that otherwise

electrons obey the laws of classical mechanics by traveling around the nucleus in circular orbits. Because of the quantization, the electron orbits have fixed sizes and energies. The orbits are labeled by an integer, the quantum number n.

4. 

With his model, Bohr explained how electrons could jump from one orbit to another only by emitting or absorbing energy in fixed quanta. For example, if an electron jumps one orbit closer to the nucleus, it must emit energy equal to the difference of the energies of the two orbits. Conversely, when the electron jumps to a larger orbit, it must absorb a quantum of light equal in energy to the difference in orbits.



3. NUTRITION AND ITS MODES.

Methods of procuring food or obtaining food by an organism are called modes of nutrition. Depending on the mode (or method) of obtaining food, all the organisms can be classified into two groups: autotrophic and heterotrophic.

There are mainly two modes of nutrition:

1. **Autotrophic**
2. **Heterotrophic.**

Autotrophic Mode of Nutrition: The word 'auto' means 'self' and 'trophe' means 'nutrition'. Thus, autotrophic means 'self nutrition'. Organisms, which utilize carbon

dioxide as their sole source of carbon for the formation of organic food (like glucose, etc.) by the process of photosynthesis are called autotrophs. In addition to carbon dioxide, autotrophs require water and several inorganic ions. The green plants have an autotrophic mode of nutrition. Non–green plants are, however, not autotrophs. Certain bacteria called 'autotrophic bacteria' are also autotrophs.

HETERTROPHS DEPEND ON AUTOTROPHS FOR THEIR NUTRITION. An organism that cannot synthesize its own food and is dependent on complex organic substances for nutrition.

Heterotrophic Mode of Nutrition: The word 'heteros' means 'others' and 'trophe' refers to 'nutrition'. Thus, 'heterotrophic' means 'nutrition obtained from others'. Organisms, which are incapable of photosynthesizing, obtain certain organic compounds from other autotrophs directly or indirectly and they are called heterotrophs and this type of nutrition is referred to as heterotrophic nutrition.

A heterotrophic organism (or heterotroph) can obtain its food from other organisms in three ways. So, the heterotrophic mode of nutrition is of four types:

- **Parasites**
- **Saprophytes**
- **Insectivorous Plants**

Parasites are organisms obtain food from other living organisms (the host), with the host receiving no benefit from the parasite. A saprophyte is an organism that obtains its nutrition from assimilating organic matter. Like the fungi, the saprophyte is a heterotroph, meaning that it does not make its own food. Insectivorous plants (Carnivorous plants) are said to be partly autotrophic and partly heterotrophic. These autotrophs supplement their nutritional requirements by trapping and digesting insects and other small animals.

3. ENVIRONMENTAL PROBLEMS- GLOBAL WARMING, GREENHOUSE EFFECT, ACID RAIN, OZONE LAYER DEPLETION.

1. Pollution: Pollution of air, water and soil require millions of years to recoup. Industry and motor vehicle exhaust are the number one pollutants. Heavy metals, nitrates and

plastic are toxins responsible for pollution. While water pollution is caused by oil spill, acid rain, urban runoff; air pollution is caused by various gases and toxins released by industries and factories and combustion of fossil fuels; soil pollution is majorly caused by industrial waste that deprives soil from essential nutrients.

2. Global Warming: Climate changes like global warming is the result of human practices like emission of Greenhouse gases. Global warming leads to rising temperatures of the oceans and the earth' surface causing melting of polar ice caps, rise in sea levels and also unnatural patterns of precipitation such as flash floods, excessive snow or desertification.

3. Overpopulation: The population of the planet is reaching unsustainable levels as it faces shortage of resources like water, fuel and food. Population explosion in less developed and developing countries is straining the already scarce resources. Intensive agriculture practiced to produce food damages the environment through use of chemical fertilizer, pesticides and insecticides. Overpopulation is one of the crucial current environmental problem**.**

4. Natural Resource Depletion: Natural resource depletion is another crucial current environmental problems. Fossil fuel consumption results in emission of Greenhouse gases, which is responsible for global warming and climate change. Globally, people are taking efforts to shift to renewable sources of energy like solar, wind, biogas and geothermal energy. The cost of installing the infrastructure and maintaining these sources has plummeted in the recent years.

5. Waste Disposal: The over consumption of resources and creation of plastics are creating a global crisis of waste disposal. Developed countries are notorious for producing an excessive amount of waste or garbage and dumping their waste in the oceans and, less developed countries. Nuclear waste disposal has tremendous health hazards associated with it. Plastic, fast food, packaging and cheap electronic wastes threaten the well being of humans. Waste disposal is one of urgent current environmental problem**.**

6. Climate Change: Climate change is yet another environmental problem that has surfaced in last couple of decades. It occurs due to rise in global warming which occurs due to increase in temperature of atmosphere by burning of fossil fuels and release of harmful gases by industries. Climate change has various harmful effects but not limited to melting of polar ice, change in seasons, occurrence of new diseases, frequent occurrence of floods and change in overall weather scenario.

7. Loss of Biodiversity: Human activity is leading to the extinction of species and habitats and and loss of bio-diversity. Eco systems, which took millions of years to perfect, are in danger when any species population is decimating. Balance of natural processes like pollination is crucial to the survival of the eco-system and human activity threatens the same. Another example is the destruction of coral reefs in the various oceans, which support the rich marine life.

8. Deforestation: Our forests are natural sinks of carbon dioxide and produce fresh oxygen as well as helps in regulating temperature and rainfall. At present forests cover 30% of the land but every year tree cover is lost amounting to the country of Panama due to growing population demand for more food, shelter and cloth. Deforestation simply means clearing of green cover and make that land available for residential, industrial or commercial purpose.

9. Ocean Acidification: It is a direct impact of excessive production of CO2. 25% of CO2 produced by humans. The ocean acidity has increased by the last 250 years but by 2100, it may shoot up by 150%. The main impact is on shellfish and plankton in the same way as human osteoporosis.

10. Ozone Layer Depletion: The ozone layer is an invisible layer of protection around the planet that protects us from the sun's harmful rays. Depletion of the crucial Ozone layer of the atmosphere is attributed to pollution caused by Chlorine and Bromide found in Chloro-floro carbons (CFC's). Once these toxic gases reach the upper atmosphere, they cause a hole in the ozone layer, the biggest of which is above the Antarctic. The CFC's are banned in many industries and consumer products. Ozone layer is valuable

because it prevents harmful UV radiation from reaching the earth. This is one of the most important current environmental problem.

11. Acid Rain: Acid rain occurs due to the presence of certain pollutants in the atmosphere. Acid rain can be caused due to combustion of fossil fuels or erupting volcanoes or rotting vegetation which release sulfur dioxide and nitrogen oxides into the atmosphere. Acid rain is a known environmental problem that can have serious effect on human health, wildlife and aquatic species.

12. Water Pollution: Clean drinking water is becoming a rare commodity. Water is becoming an economic and political issue as the human population fights for this resource. One of the options suggested is using the process of desalinization. Industrial development is filling our rivers seas and oceans with toxic pollutants which are a major threat to human health.

13. Urban Sprawl: Urban sprawl refers to migration of population from high density urban areas to low density rural areas which results in spreading of city over more and more rural land. Urban sprawl results in land degradation, increased traffic, environmental issues and health issues. The ever growing demand of land displaces natural environment consisting of flora and fauna instead of being replaced.

14: Public Health Issues: The current environmental problems pose a lot of risk to health of humans, and animals. Dirty water is the biggest health risk of the world and poses threat to the quality of life and public health. Run-off to rivers carries along toxins, chemicals and disease carrying organisms. Pollutants cause respiratory disease like Asthma and cardiac-vascular problems. High temperatures encourage the spread of infectious diseases like Dengue.

15. Genetic Engineering: Genetic modification of food using biotechnology is called genetic engineering. Genetic modification of food results in increased toxins and diseases as genes from an allergic plant can transfer to target plant. Genetically modified crops can cause serious environmental problems as an engineered gene may

prove toxic to wildlife. Another drawback is that increased use of toxins to make insect resistant plant can cause resultant organisms to become resistant to antibiotics.