PEDAGOGY OF LIFE SCIENCE

B.ED SEMESTER-1

UNIT-I: BACKGROUND FOR TEACHING OF LIFE SCIENCE

a) Life science :concept, importance and impact on daily life, correlation (intradisciplinary, inter-disciplinary and with day to day life

By the beginning of the 20th century the challenges in the life sciences were at least more clearly defined. These are too numerous to list in full but the major problems were to understand the nature of heredity, the control of cell growth and differentiation, the biochemical processes which maintain the life of cells and organisms, and the processes which enable specialized systems such as the nervous system to operate. Human ability to manipulate these processes for medical or other purposes was so limited that ethical questions were almost entirely philosophical. At the beginning of the 21st century there are few controversies concerning the basic mechanisms operating in areas of former ignorance or the likely directions of future advances. The main challenge to investigators is how to order the vast amount of information generated by the greatly expanded scientific enterprise.

Complete mapping of the human genome has opened the still more complex field of proteomics which seeks to categorize and explain the actions and interactions of the huge range of proteins transcribed from the genome. This task would be impossible without the simultaneous advances in computing techniques and the mathematical handling of experimental data. This reality emphasizes the interdependence of all branches of the natural sciences.

A related challenge is the daunting range of ethical issues generated by advances in scientific techniques, particularly when applied to medicine and agriculture. The ethical difficulties are compounded by the social issues. A century ago, scientific progress was understood and debated by a privileged coterie of savants. Even politicians were largely indifferent unless the advance had military applications or was likely to increase national prestige. Today the practical application of most scientific advances is likely to provoke public debate and progress depends on a dialogue between scientists, politicians, and appropriately educated laymen.

Biological Sciences is the study of life and living organisms. It is also called as “Biology”. The Greek word ‘bio’ means life and ‘logos’ means study of. In the late 1700s Pierre-Antoine de Monet and Jean-Baptiste de Lamarck coined the term biology.

Earlier study of living things was restricted to the pure Science like Botany and Zoology that together comprise the Biology. But as the time passed new branches evolved, new technologies developed in pure subjects as well as in applied fields, which gave rise to a very broad science called Biological Sciences.

Biological Sciences is an extensive study covering the minute workings of chemical substances inside living cells, to the broad scale concepts of ecosystems and global environmental changes. It is also concerned with the physical characteristics and behaviors of organisms living today and long ago, how they came into existence, and what relation they possess with each other and their environments. Intimate study of details of the human brain, the composition of our genes, and even the functioning of our reproductive system are dealt in Biological science. Today it is also called by new name- Life sciences.

The life sciences can be defined as “a systematic study of living beings or study of nature”. Teaching of life Science basically deals with providing information about the latest developments in the field of Biological sciences all over the world.

The knowledge of Biological Sciences helps the student:

1. To develop the individual’s sensitiveness to nature and make him feels at home with it.

2. To understand all living beings on the earth emerged from one being to another which inculcates ‘onenesses of all living beings.

3. Develops scientific outlook.

4. Develops respect towards nature to protect it.

5. Removes ‘dogmatic approach’.

6. To explain the living world in terms of scientific principles and appreciating all organisms which behave indifferent ways.

7. Show capabilities, which differ from one another.

8. 9. Generate interest about his surroundings.

Man is curious by his nature. This curiosity has driven them to explore the world around them. Over the time, manipulating and controlling nature for the benefit of the mankind has become an object of exploration. Initially the pace of exploration was slow, but with the result of industrial revolution in the west, the pace of exploration has increased manifold. Exploration became a tool for not only modifying and controlling the nature but also for preserving the natural resources.

Over the course of human history, people have developed interconnected and validated ideas about the physical, biological, phychological and social worlds. Those ideas have enabled successive generations to achieve an increasingly comprehensive and reliable understanding of human species and environment. Human exploratory activities have resulted in the accumulations of a vast source of knowledge called ‘natural science’.

In natural science, we study about nature which means the entire Universe. For the convenience of the study the knowledge is organized in several disciplines. This knowledge is the outcome of inquiry, observation, logical reasoning testable by experimentation or facts. We call science as domain of inquiry. Satisfy the curiosity of the students.Human knowledge of biology began with prehistoric man and his experiences with plants and animals and also through the instincts and efforts to explore the nature. The information was verbally passed on from one generation to another. The history of science therefore can be said to have begun with the history of human existence.

During early period, people knew about medicinal and poisonous plants and knew that a heartbeat meant that someone or some animal was alive. They also had the idea that the conception of babies is in some way connected with sexual reproduction.

Records of advances made in the field of medicine as well as some other branches were biological sciences during the early civilization are available.

Developments in the Field of Medicine:

Medical science has made enormous strides during the last 150 years.

1. Rene Laennec is world renowned for his invention of the stethoscope.

2. With the aid of the microscope, Robert Koch discovered the germs, which caused cholera and tuberculosis.

3. Emil Von Behring enabled the protection of children from diphtheria by introducing vaccination.

4. Walter Reed, an American doctor, found that mosquitoes spread yellow fever.

5. Sir James Young Simpson discovered the anesthetic properties of chloroform.

6. Sir Joseph Lister, a world-renowned English surgeon of Glasgow University, is considered to be the father of antiseptic surgery.

7. Sir Alexander Fleming demonstrated that Penicillin is a miracle drug in treating diseases like pneumonia, syphilis, peritonis, tetanus and other illnesses.

8. The first successful heart transplant was performed by Dr. Christian Barnard.

3. Objectives of Biological Science:

Learning objectives guide you to take the required actions to bring those changes and help you to make your learning meaningful. Learning objectives help you to find the answers for the questions like, how will you focus the attention of your students on the expected learning activities?

The type of teaching learning strategies to be planned? The ways and means by which the student constructs and re•constructs the knowledge? How can you help yourself and the learner in self-assessment? And facilitate to perform and plan out work systematically.

Meaning of Learning Objectives- Are Learning Objectives External?

The aims of education, which can be achieved in a school, are called as objectives. An objective is a part of an aim. It indicates an end point of possible achievement. Objectives are immediate attainable goals. They vary from subject to subject and they are specific, precise and clearly defined and become meaningful to the students and teachers in a teaching-learning situation.

Objectives make a teaching programme meaningful. They indicate the behavioral changes in the pupil after completion of instruction. It is the expected terminal behavior or a learning outcome of the pupil at the end of teaching-learning process.

Objectives of Teaching Biology:

1. Providing Practical knowledge of the content.

2. Providing Advanced information.

3. Developing skills, remembering, understanding, interests, and appreciation, application and analysis through the teaching of life science.

4. Stimulating the spirit of investigation and invention.

5. Improving the power of observation and experimentation.

6. Developing the problem solving capacities.

7. Understand the utility of biological science to the modem life.

8. Inculcating the ideals like truthfulness, open-mindedness and reflective thinking in the learner.

9. Inculcating the values of democracy, freedom, equality and fraternity.

Is Learning Objectives External?

It is the responsibility of the teacher to provide learning experiences and opportunities to each learner. So, that they learn to the best of their ability and become potential learners. Identifying certain noticeable changes in terms of remembering, understanding, applying and analyzing etc., need to be brought out in the learner before transacting a particular unit/topic in the class.

These desired objectives of remembering, understanding, applying and analysis for a particular topic/unit in terms of perceived learning are broadly known as 'learning objectives'. This desirability should be viewed from the perspectives of the existing knowledge and background of the learner not of the teachers.

In other words learning objectives are the statements in specific and observable term that tell what the learner is expected to achieve as a result of engaging them in teaching-learning process.

For example, write two characteristics that distinguish between unicellular and multi cellular organisms.

The aims of learning biological science like knowledge, understanding of science, nurturance of process skills, development of scientific attitude, scientific temper, nurturance of curiosity, creativity and aesthetic sense, imbibing values, developing problem solving and relating biological science education with nature, social environment, technology and society are common at all educational processes. It is also emphasized that achieving aims of biological science should be a continuous effort of a teacher.

Developing Learning Objectives and Features of Well-developed Learning Objectives:

Learning objectives of biological sciences should be consistent with the aims of biological sciences as well as cognitive abilities of the learner. While developing the learning objectives the nature of science, in general and the topic in particular, the scope of the content to be transacted, to the learner, the context in which learning is taking place, and needs, abilities and learning difficulties of the learner are to be kept in mind.

Understanding how to develop learning objectives will help us to structure the teaching and learning and assessment processes and optimize learning. The learning objectives should be aligned with three major components of teaching learning process- the objectives, teaching learning activities and assessment. Whether the objectives are realized or not is known by assessment of learners.

Accordingly teaching learning activities are modified to realize the objectives. Thus, the three components are objectives framed in accordance with the academic standards, based on these the

teaching learning activities are designed and assessment will be helpful to know whether the academic standards are realized or not. Thus, three components are consistent with each other. If the three components are congruent, teaching learning is meaningful.

Features of Well-developed Learning Objectives:

A well written learning objective can be easily understood by the learner as well as teachers. Learner can fore see what is expected from them as a result of a teaching learning process and can negotiate with the teach regarding it. The following are certain focal points to be kept in mind while writing the learning objectives.

The learning objectives should be learner centred be explicit and understandable facilitate in getting of learning evidences be observable by observing performance of the learners.

Some of the aims of teaching-learning science are:

(i) To develop scientific temper, attitude and outlook.

(ii) To develop open-mindedness, objectivity, honesty, national integration, international understanding concern for environment and democratic, socialistic and secularistic values.

(iii) To respect others view and opinion, to develop gender equity.

(iv) To promote research in the field of science and technology.

Science is practiced by people who are often sensitive to the needs and interests of the world around them.

Vaccines for example are developed by scientists who are sensitive to the current needs of the society.

Society supports science because of simple curiosity and because of the satisfaction that comes from knowledge of the world around us. However, the awe, perspective, and perhaps even serenity derived from that knowledge is very valuable to many of us.

The sense of interconnectedness that comes from such knowledge enriches our understanding of our world, and of our lives, in a very valuable way. It's no wonder that most modern societies support scientific research for the improvement of our understanding of the world around us.

5. Biological Sciences for Environment:

Environment may be defined as everything present in the universe, which includes air, water, soil, plants, animals, rivers, mountains, the sun, the moon and space.

Environment covers the four segments i.e. atmosphere, hydrosphere, lithosphere and biosphere. Due to the increased activities of man (pollution) and surplus exploitation of natural resources there is a danger of ecological imbalance and destruction of the environment. In such a situation the only rescue for the survival could come from the intervention of science.

A new branch of chemistry, namely ‘green chemistry’ has developed to prevent environmental degradation. Green chemistry is about utilising existing knowledge and principles of chemistry and other sciences to reduce the adverse impact of human activities on the environment.

The study of the effect of contaminants (physical, chemical, biological) on the environment has also become part of science. Scientists started working on the prevention of pollution of water, air, soil, noise, and that caused by radioactivity. For example, Compressed Natural Gas (CNG) as a fuel is preferred to petroleum and diesel to reduce the level of CO_2 in air.

Also alternative sources of energy like wind, solar, nuclear, biogas, tides and geothermal etc., have been explored and their use is growing. These measures will surely decrease pollution and the global warming. Thus, science is essential for study of environment and its improvement.

Unscientific life styles have resulted in greater amount of waste material generation. Change in attitude also has a role to play, with more and more things we use, becoming disposable. Change in packing has resulted in much of our waste becoming non-biodegradable.

Disposable Cups in Trains:

There were at times when tea in train was served in pots and ceramic cups. The introduction of disposable cups was hailed as a step forward for reasons of hygiene. No one perhaps thought about its impact caused by disposal of millions of these cups on a daily basis.

Some time back, kulhads i.e. disposable cups made of clay were suggested as an alternative and practiced in few states. Making these kulhads on a large scale would result in the loss of the fertile top soil. Now disposable paper cups are been used. Scientific understanding leads to protection of environment in which we survive.

Biological Sciences for Health:

The progress of any society takes place only when its members are healthy. Science has served the humanity to a greater extent to make its members healthy and free from diseases. Science made innumerable contributions in the field of medicine for improving our health.

It provided medicines for almost all the known major and minor diseases and helped in inventing different operational implements for the surgeons to operate on the patients. Awareness about personal hygiene and sanitation is possible due to the knowledge of science.

The outcomes of medical research and development like lasers, mechanical cardiac assist devices, mechanical valves, automatic internal defibrillators have saved many lives. Science and technology will expand the current frontier of medical knowledge. Armed with this new knowledge, we may identify the causes and eliminate most of the effects of the diseases that plague mankind.

In ancient times, Indian society was quite alert to the physical and mental health of its members. Indian medical tradition dates back to Vedic times. Ayurveda perhaps the most ancient medical system, orginated in India by Charak who lived in 2nd or 3rd century BCE, is considered as the king of physicians in India.

He was acquainted with all branches of medicine, including surgery and psychotherapy. His works are compiled in 'Charak Samhita'. In this volume 100,000 plants along with their medicinal properties were included. He stressed importance of diet and physical activity on the mind and body Unani is also practiced from ancient times.

Magnetism in Medicine:

An electric current always produces a magnetic field. Even the weak ion, current that travel along the nerve cells in our body also produces magnetic fields. When we touch some things, our nerves carry an electric impulse to the muscles we need to use. This impulse produces a temporary magnetic field.

Two main organs in the human body where the magnetic field produced is significant are the heart and the brain. The magnetic field inside the body forms the basis of obtaining the images of different body parts. This is done using a technique called Magnetic Resonance Imaging (MRI). Analysis of these images helps in medical diagnosis. Magnetism has, thus, got important uses in medicine.

Biological Sciences for Peace:

The scientific knowledge should always strive for promoting peace and harmony in the society. One of the indicators of peace is absence of violence. Students should be encouraged to appreciate and use the scientific and technological knowledge for the betterment of the society. Students should be made aware of various scientific issues in global and economic contexts so that they can form wider perspectives of justice, peace and non-violence.

However, scientific knowledge and its developmental enterprises must be used for the welfare of human kind which in turn brings peace in the society.

Biological Sciences for Equity – Gender and Science, Science for Inclusion:

Science learning should empower the students to fight against the prejudices related to gender, caste, religion and region. Equity in education helps to ensure that all students experience the highest levels of academic achievement possible, economic self-sufficient and social mobility.

Taking the example of properties of elements, where, though all elements have different identities, but have some common characteristics based on it are placed in different groups in the periodic table. Thus diversity should be valued in school and each individual should be respected.

Researches showed that both boys and girls performed well in science learning. Parents should be motivated to encourage their girl children to opt for science. Teachers, teacher educators, educational planners, textbook writers and educational administrators must be made sensitive to gender related issues. Scientific differences of domestic work like chemistry in kitchen, problems, exercises and realities of women's life should be included in the science curriculum.

Science teacher should develop in all students including those with special educational needs the ability to analyze the options available and to facilitate the possibility of making informed decisions. E.g. Availability of books written in Braille to visually challenged students.

The science teacher should make use of various ICT and web tools to bridge the social divide and equalize the opportunity. Science teacher should use inclusive language which is simple and using the words both from urban and rural areas.

6. Values Imbibed through Biological Science:

There is an increasing demand for science education in the society as we are living in an era of science and technology. Science education is very important for the individual benefits and for the development of the society on the whole. Science is also very important in our day-to-day lives.

Science education not only develops knowledge and competence in the subject but also helps in developing values of life. Knowledge of science prepares the individual to face the challenges of the ever-changing modern world. We can inculcate a number of values in the students through Biological Sciences education.

The most important values among them are:

1. Intellectual Value:

Biological Sciences develops our thinking and reasoning skills. It gratifies our intellectual instincts and makes us aware of our surroundings and ourselves. It increases our understanding of the complex issues existing around us. The primary aim of science education is the development of intellectual ability. Biological Sciences education inculcates the knowledge of facts, the spirit of enquiry, the technique of assumption, the power of observation, and value judgment in the students.

It helps in developing logical thinking, reasoning, analysis, and creativity in the students. It develops the scientific attitudes and provides training in scientific methodology. It develops rational thinking in an individual and prepares him to face the challenges of the modern world with a scientific outlook.

It sharpens our minds and makes us intellectually honest and critical in our observation and reasoning. We usually tend to arrive at conclusions without any bias in the light of science. Some of the important scientific attitudes, which are appreciated with science knowledge, are open-mindedness, curiosity, systematic thinking and reflective thinking.

Biological Science helps in understanding and solving many problems like social, economic, political or cultural. A tree does not have any partiality towards a particular person belonging to a caste, community, region, religion, nation etc. The same intellectual values develop among child and human beings at large.

2. Utilitarian Value:

Biological Sciences has a number of applications in our everyday life. Development of Biological Sciences can be related with the development of human race. The advances in the fields of medicine, improvement in the health and hygiene thereby improving the lifespan of human beings, are due to the enormous developments in scientific knowledge.

Science has influenced the lives of people so much that today we cannot imagine our lives without the involvement of science. Biological Sciences has a major impact in the field of medicines and health, preventing and curing number of diseases. The increased production of

food for the ever- increasing population of the world is also the gift of Biological Sciences for the survival of man.

3. Vocational Value:

Biological Sciences is a multi-disciplinary subject and creates a lot of awareness about many aspects of modern development. As a subject it has helped in generating a number of vocations. It has many applications and the students fit better into any vocation as they have a basic knowledge of science.

Advancement and applications of biological Sciences led to Dairy, Poultry, Agriculture, Veterinary, Microbiological, Bio-chemical, Biotechnological and Paramedical fields. Biological Sciences graduates may enter teaching, or enter industries related to Bio-products. The knowledge of science develops a number of skills like reasoning, analysis; critical thinking.

It helps individuals to become technically competent and professional in their attitudes. It helps them to become self-sufficient. Scientific hobbies motivate the students to become creative in their outlook. In every vocation scientific is required and hence basic science education is a must for every student.

4. Moral Value:

Biological Science as a process and product based on values of truth, beauty and goodness. Scientific experimentation is based on truthfulness and honesty. We can say that science is truth. Success in science is purely dependent on the truthfulness. A student working on scientific

procedures should inculcate the values like patience, perseverance, truthfulness, honesty and determination. He should be rational in outlook and should accept critical feedback from others.

A person who is pursuing science is considered as a seeker of truth. No success is achieved without being truthful. Thus, science not only develops scientific thinking skills but also develops moral values in students. Plant kingdom protects human beings. Many animals live together. Protecting the other living, togetherness values can be imbibed through Biological Sciences.

5. Aesthetic Value:

Nature is beautiful. Ours is a beautiful universe with many unfolding mysteries in it. As a part of this beautiful universe we should be able to appreciate our mother nature. Aesthetic sense has its origin in nature. Biological Science helps us in unfolding the mysteries of this universe. A Science student appreciates the nature in a better way. Nature exhibits an order, which is governed by general laws and thus possesses a beautiful harmony.

Einstein called it as “the pre-established harmony” We all know that the discovering of such beautiful harmonies is the concern of science. A tree waves, A bird flies in blue sky, Sun rising and setting is beautiful. Thus, Biological Sciences recognize the beauty of nature, appreciate the nature and make our lives worth living.

6. Cultural Value:

Biological Sciences plays an important role in the civilization of man. From ancient civilization to the present modern world science has become part and parcel of our everyday life. Science has a great impact on the culture of man in any society. Its application to the material and maintenance system brought a drastic evolution in the culture.

The study of science inculcates scientific attitudes and methodology in the individuals. This affects the way of thinking and the way of living of the individuals. Science has aided the growth of our consciousness by developing awareness about the various facts, concepts, beliefs, customs and traditions of the world.

This has heightened our intellectual abilities and helped in refining, understanding and discriminating the facts of life. Science develops cultural value as it forms an integral part of one's life and influences our social heritage. The knowledge of science has a major influence in bringing about a renaissance in our culture and traditions.

The scientific knowledge helps in bringing about a cultural balance between the traditions of the past and the advances of the present, as they are undergoing constant change due to the practical applications of the scientific discoveries. The development of our society or civilization or culture is wholly dependent on scientific progress. Thus, science is an integral part of our cultural treasure. Biological products are useful in protecting our cultural treasures.

7. Creative Value:

The Instinct of science is creativity. Creativity is defined as an activity resulting in new products of a definite social value. It is the ability to think, create or do something new or original. It includes a series of actions, which create new ideas, thoughts and physical objects.

We can say that science is also a product with social value, which is due to creative thinking of many scientists over a period of time. Science develops creativity in students. Students learn new concepts, identify new techniques and perform innovative experiments.

They observe the processes, conduct experiments successfully and even develop alternative methods of study. These develop the creativity in the learners. All products useful to man are creation, of science e.g. a hybrid seed. Building a hut and ship, equipment and gadgets for differently abled children.

8. Disciplinary Value:

Science brings mental and physical discipline in the life of the individual. Problem solving, decision-making, critical thinking, perseverance and commitment to tasks are some of the mental disciplines, which a student develops by the study of science.

The study of science teaches the student to undertake physical work like practical experimentation for long hours in the laboratory, collect the data, record, analyze and interpret the data and arrive at conclusions. All these activities result in development of self-discipline in the students.

9. Development of Scientific Attitudes:

The knowledge of science results in the development of attitudes like critical observation, open-mindedness, unbiased thinking and judgment. It frees individuals from the superstitious beliefs

and improves their rational thinking. Science brings a positive change in the attitudes of individuals, which improve the life of the individual and help in satisfying the basic instincts of curiosity, creativeness, self-assertion, self-expression etc.

The development of scientific attitude has a great impact on an individual's psychology i.e., the way of thinking. Scientific attitudes develop based on scientific laws, principles and theories. Law of conservation of mass says no matter can be created. Hence, nature is existing by itself, this is the attitude one develops from science. So on and so forth.

10. Training in Scientific Method:

The study of science trains the students to solve the problems by applying the scientific principles. They approach the problem using a definite scientific procedure called scientific method. Explanation or problem-solving scientifically is called as scientific methodology.

With the help of scientific method, one can easily solve any problem comfortably. Therefore, it is a necessary that the students are taught and trained in these scientific methods so that they can attack the problem instead of escaping from it.

The students make a survey of the problem, collect the data, formulate the hypothesis, analyze the result, draw the conclusions and give the generalizations. Once the student is familiar with all the scientific methods, they can solve any type of problem even in their real life. Taxonomy states that every plant is unique, in spite of its similarities with other plants.

11. Value of Proper Utility of Leisure Time:

It is very important for the students' to utilize their leisure time in a proper manner. The knowledge of Biology should create interest and motivate the students to use their leisure in an appropriate manner. The leisure time should be used to take up small time projects, or hobbies like collection of specimens of plants or insects and preserving them.

The teacher may take the students to plant nurseries or poultry or dairy farms to develop the knowledge about the growth and development of plants and animals. The students may be asked to write articles for the newspapers or school magazines. They may also take up science club activities or take part in science fairs and make the best use of their leisure for enhancing their knowledge of biology.

12. Value of Science as a Basis for Better Living:

The explosion of scientific knowledge has lead to much advancement in the field of science and technology. This made the human beings to lead a more peaceful, healthy and happy life. The developments in the field of medicine, health, industry, food and nutrition, environment and sanitation and also electronics and communication have revolutionized the world. They made this world a happier and pleasurable place to live.

The Delor's Commission (1996) of UNESCO in its report entitled 'Learning- the treasure within', advocates the need to cultivate core universal values like human rights, sense of social responsibility, social equity, democratic participation, tolerance, cooperative spirit, creativity, environmental sensitivity, peace, love, truth, non-violence etc. within the learner.

Education for human values is an important area that needs to be promoted at all stages of education. Science offers many opportunities for value inculcation. For example while teaching the concepts such as the states of matter you can discuss the values of coordination, unity and staying together based on the bonding and forces of attraction between the molecules. How freedom of molecules is a gas given different shapes to it. Hence, Freedom delivers creativeness.

While teaching the properties of a magnet we can discuss the sociable, acceptable nature of the child in whatever group they may be present like the attraction of iron fillings to the magnet.

The following values can be developed through teaching-learning of science:

1. Patience – While conducting the experiment we wait for the end result.

2. Perseverance – Repeating the experiments until the expected result is got.

3. Cooperation – Sharing the equipment, material and distribution of work.

4. Honesty – In collecting, compiling and analyzing the data.

5. Integrity – Whose work can be relied upon?

6. Concern for life – Caring for the welfare and hygiene of the mankind.

7. Preservation of environment – Cleanliness of the surroundings, cares for plants and animals, adequate use of water and electricity.

The values through science teaching can be inculcated by the following strategies:

1. Conducting activities and experiments- Scientific activities allow one to observe, verify and inquire.

2. Drawing analogies of concepts- Identifying the value in each and every concept taught. For example, cooperation with each other develops a strong relationship like the covalent bond is formed by sharing of electors.

3. **Narrating the biography of great scientists**- The narration of biographies of great scientists inspires to imbibe scientific value among the students.

E.g. Madam Marie Curie, the first person and only woman to win twice the Nobel prize, and was a part of the Curie family legacy of 'five Nobel prizes'.

4. **Teaching-learning the content of science-** The human values hidden in science concepts are to be identified and practiced by the students.

5. **Working as role models-** Teacher should be a role model and create a congenial environment with scientific, democratic, social and moral values.

The Major Aims and Objectives

Harmonious development of child's personality and social efficiency etc. are the general aims of education. If science teaching is to be made effective, then its aims should be in consonance with the general aims of education. We deal with the following main objectives of science teaching.

A. Knowledge. This aim has received the top priority as compared to other aims. Pupils studying general science should acquire the knowledge of:

(i) Fundamental principles and concepts useful in daily life.

(ii) Facts for science study.

(iii) Inter-dependence and relationship of different branches of science.

(iv) Knowledge of plants and animals.

(v) Natural phenomena going on.

(vi) Knowledge of general rules of health and human body etc.

B. Skills.

Science students should acquire skills in experimentation,, construction, observation, drawing etc. Experimentation and construction skills include handling, arranging, preserving, and repairing scientific instruments.

C. Abilities.

The general science teaching should develop certain abilities such as ability to

(i) Sense a problem (ii) organize and interpret

(iii) Analyse

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(iv) Generalise

(v) Predict

(vi) Organise exhibitions, excursions and fairs

(vii) Discuss, argue and express scientific terminology

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(viii) Improvise and manipulate instruments using his acquire knowledge.

D. Attitudes.

Science teaching directly inculcates the scientific attitudes among the students. So the students should be taught directly and systematically and every individual should be paid

heed to ascertain that he develops the desired attitudes and practices them. A man with the scientific attitude is

(a) Critical in observation and thought

(b) Open-minded

(c) Respectful of others' view point and is ready to discuss his problems with others and accepts what appears correct.

(d) In search of the answers to 'What's' and 'Whys' and 'How's' of the things he observes and accepts the natural things as such.

(e) Objective in his approach to problems.

(f) Not a believer of superstitions and misbelieves.

(g) Follower of cause and effect relationship.

(h) Truthful in his experimentation and conclusions.

(i) Impartial and unbiased in his judgments.

(j) Adopts planned procedure in solving a problem.

E. Reflective Thinking.

With the above attitudes developed, a science student will handle a problem scientifically. He will sense a problem, define it, collect evidence, organize and interpret the data, formulate the hypothesis, test its validity and finally draw conclusions impartially. The training in the scientific method should be one of the important aims of teaching science.

F. Habits.

Certain socially desirable habits like honesty, truth, tolerance, self-confidence, self-reliance etc. should be inculcated through the science teaching.

G. Interests.

The teaching of science should also aim at developing some interests in reading scioentific literature, in scientific hobbies, in activities of clubs, excursions, in natural phenomena; in drawing, in leadership, etc. The motivational techniques like rewards and punishments, praise and blame, rivalry and emulation etc. should be implied by the teacher.

H. Appreciation.

The appreciation of natural beauty, scientific inventions, scientists, endeavour is the outcome of science teaching. For the purpose the teacher should arrange outings, should relate the life histories of scientists and should keep the students in touch with the new inventions in science.

I. Providing Work for Leisure.

As the empty mind is devil's workshop, a science student should not while away his leisure. He can prepare inks, soaps, boot polishes and other daily useful things or he can keep hobbies of stamp collecting, coin collecting, photography, drawing, gardening, study of plants and animals or of minerals etc. He can learn to improvise certain instruments, learn to play for musical instruments along with its construction knowledge.

J. Training for Better Living.

A science student should know the ways and means of prevention and eradication of diseases to maintain good health, and should be able to adjust himself with his own domestic, social environment and economic and cultural conditions.

K. Forming Basis for Career.

The attitudes and interests of the students should well be adjudged by the science teachers and they should impart them the knowledge accordingly so that they may prosecute the desired professions. An artist can never be a doctor. So nothing should be forced into the

minds of the students. Acceleration should be provided in his own direction to get a suitable vocation and fit himself well in society and prove an asset to it.

The aims and objectives differ a bit at different stages. Preliminary knowledge of objectives is required at early stages while complete and complex objectives are needed at higher stages. So capabilities of pupils should be kept in mind.

The aims and objectives of Teaching Science at different stages have been summarized in the proceedings of the All India Seminar on the Teaching of Science in Secondary Schools, published by Ministry of Education in 1956. They are as follows:

1. Primary Level

The aims and objectives of Teaching Science at Primary School level should be

1. Arousing and maintaining interest in nature and in the physical and social environment, arousing love for nature and its sources.

2. Developing the habit of observation, exploration, classification and systematic way of thinking.

3. Developing the child's powers of manipulative, creative and inventive faculties.

4. Developing neat and orderly habits.

5. Inculcation of habits of healthful living.

2. Middle School Level

In addition to the above, the following aims and objectives are suitable for inculcation at the Middle School, level.

1. Acquisition of a kind of information concerning nature and science which may also serve as the basis for a late General Science Course.

2. Developing the ability to reach generalisation and to apply them for solving every problem.

3. Understanding the impact of science upon one way of life.

4. Developing interest in scientific hobbies.

5. Inspiring children by stories about scientists and their discoveries.

3. High and Higher Secondary Levels

At the high and higher secondary stage, the aims of General Science teaching should be,

1. To familiarize the pupil with the world in which he lives and to make him understand the impact of science on society so as to enable him adjust himself to his environment.

2. To acquaint him with the 'scientific method' and to enable him to develop the scientific attitude.

3. To give the pupil a historical perspective, so that he may understand the evolution of the scientific development.

.M. Kothari Commission (1964-66)-10+2 Pattern

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

1. Lower Primary Stage

(i) At the lower primary stage the accent should be on the child's environment-social, physical and biological.

(ii) In classes I and II, the accent should be on cleanliness and formation of healthy habits.

(iii) Development of power of observation.

(iv) In classes III and IV the study should also include personal hygiene and sanitation.

(v) In classes IV and V children should be taught the roman alphabets. This is essential as the internationally accepted symbols for the units of the scientific measurement and the symbols for chemical elements and compounds are written in the Roman alphabet.

(vi) Developing proper understanding of the main facts, concepts, principles and processes in the physical and biological environment.

2. Higher Primary Stage

(i) At this stage emphasis may shift to the acquisition of knowledge together with the ability to think logically, to draw conclusions and to make decisions at a higher level.

Hi) Science should be taught as physics, chemistry, biology, and astronomy. A disciplinary approach to science learning instead of general science would be more effective in providing the necessary scientific base to young people.

3. Secondary stage

(i) At the secondary stage science should be taught as a discipline of the mind and a preparation for higher education.

(ii) At the lower secondary class's physics, chemistry, biology and earth sciences should be taught as compulsory subjects.

(iii) At the higher secondary stage there should be diversification of courses and provision for specialization.

Main objectives of science curriculum upto secondary level is to make learners

'scientifically literate" as science is a compulsory component of the curriculum upto secondary level. Focus should be on "developing awareness among the learners about the interface of science, technology and society, sensitizing them, especially to the issues of environment and health, and enabling them to acquire practical knowledge and skills to enter the world of work." (NCF-2005).

Emphasis is more on acquiring process skills so that learners are able to deal with every changing and expanding world of science. Keeping these key points in mind, science curriculum at different level has been organized.

At the primary level, emphasis is on engaging the learners in joyfully exploring the world around and harmonizing with it. The objectives at this stage are:

• to nurture the curiosity of the child about the world (natural environment, artifacts and people),

• to have the child engage in exploratory and hands on activities to acquire the basic cognitive and psychomotor skills through observation, classification, inference, etc.;

• to emphasize design and fabrication, estimation and measurement as a prelude

to development of technological and quantitative skills of later stages; and

• to develop the basic language skills: speaking, reading and writing not only for science but also through science.

At this level, Science and social science have been integrated as 'Environmental

Studies'.

At the upper primary level, the emphasis is on engaging the learner in learning principles of science through familiar experiences, working with hands to design simple technological units and modules and continuing to learn more on environment and health through activities and surveys.

As a science teacher, you will agree that scientific concepts are learnt better if learners explore them through activities and experiments. Learners should be given opportunity to explore science in their everyday experiences. You should engage learners (preferably in groups) in meaningful investigations –particularly of the problems they perceive to be significant and important.

As a science teacher, you should encourage discussions with the teacher and peers. You can ask your learners to gather information from newspapers, knowledgeable persons in the neighbourhood, and from easily available sources and discuss about them in class with peers and teachers.

Role play, skits, cooperative learning strategies should be adopted to ensure larger participation and sharing of learning outcomes. It is advised that biographical narratives of scientists and inventors can be used. You should keep in mind that efforts should be continued for development of the process skills of science.

It is suggested that at the secondary stage, you should engage your learners in learning science as a composite discipline. As a science teacher at this level, you should provide them opportunity to engage in activities and analysis on issues surrounding environment and health.

Aims and Objectives of Science Teaching-Learning

As secondary stage, systematic experimentation is suggested as a tool to discover/ verify theoretical principles, and working on locally significant projects involving science and technology.

Concepts, principles and laws of science should be introduced at this level with an emphasis on comprehension and not on mere formal definitions. At this stage, those concepts, which are beyond direct experience, should also be introduced and learners should make understand that all scientific phenomena are not directly observable; science also relies on inference and interpretation.

You should use experimentation as an important tool to discover/verify theoretical principles at this stage. At this level, you should organize co-curricular activities like some small group projects on local issues and use problem-solving approach.

At the higher secondary stage, curriculum has adopted disciplinary approach with rigour and depth. There is strong emphasis on experiments, technology, and investigative projects. You should organize co-curricular activities at this stage by adopting a problem-solving approach on local issues involving science and technology; encouraging participation of learners through creative/ investigative projects in national science fairs and participation in science

Olympiads. You should provide opportunity to your learners for participation in debates and discussions on issues at the interface of science, technology and society.

At the higher secondary stage, a transition from general science to discipline based curriculum takes place. Physics, Chemistry and Biology are being offered as an elective subject. At this stage, the learners choose any discipline, with apurpose of pursuing their future careers in basic sciences or professional courses like medicine, engineering, technology and studying courses in applied areas of science and technology at tertiary level. Hence, at this level, the learners should be provided with sufficient conceptual background of disciplines which would eventually make them competent to meet the challenges of

academic and professional courses after the higher secondary stage. At this level, focus is on:

• developing conceptual competence among the learners and making them realize and appreciate the interface of Physics, Chemistry or Biology with other disciplines;

• exposing the learners to different processes used in industrial and technological applications;

• developing process-skills and experimental, observational, manipulative, decision-making and investigatory skills in the learners;

• promoting problem-solving abilities and creative thinking to develop interest in the learners in the study of various disciplines;

• helping learners to understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of different science disciplines towards the improvement of quality of life and human welfare;

Teaching-learning of various science subjects at the higher secondary stage enables the learners to comprehend the contemporary knowledge and develop aesthetic sensibilities and process skills. The experimental skills and process-skills

Understanding Science developed together with conceptual knowledge prepare the learners for more meaningful learning experiences and contribute to the significant improvement of quality of life. The learners would also appreciate the role and impact of science and technology, and their linkages with overall national development.

Before starting discussion on new taxonomy, let us have a look at original Bloom's Taxonomy. In Bloom's taxonomy, there were 6 categories under cognitive domain i.e. Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Except Application, all other 5 main categories were further divided into subcategories. It was a hierarchical structure where categories were arranged from simple to complex and concrete to abstract. It was assumed that attainment of one category is a prerequisite for next category.

KNOWLEDGE Science Teaching-Learning

• Knowledge of specifics o Knowledge of terminology o Knowledge of specific facts

• Knowledge of ways and means of dealing with specifics o Knowledge of conventions o Knowledge of trends and sequences of Knowledge of classifications and categories o Knowledge of criteria o Knowledge of methodology

• Knowledge of universals and abstractions in a field o Knowledge of principles and generalizations o Knowledge of theories and structures

COMPREHENSION

• Translation

• Interpretation

• Extrapolation

APPLICATION

ANALYSIS

• Analysis of elements

• Analysis of relationships

• Analysis of organizational principles

SYNTHESIS

• Production of a unique communication

• Production of a plan, or proposed set of operations

• Derivation of a set of abstract relations

EVALUATION

• Evaluation in terms of internal evidence

• Judgments in terms of external criteria

Bloom's Taxonomy of Cognitive Domain

If you recall the objective statements, you will find that there were two major components of an objective: a) Some subject matter content (A Noun or Noun phrase) b) A description of what is to be done with or to that content (A verb or verb phrase) For example, "a learner will be able to define motion." In this objective statement the noun phrase is "motion" and the verb is "define." In original taxonomy, noun and verb aspects was part of knowledge dimension.

In the revised taxonomy, first change is that noun and verb dimensions are separate. The noun is providing the basis for the Knowledge dimension and the verb is forming the basis for the Cognitive Process dimension. The Knowledge Dimension The new knowledge dimension contains four categories i.e. factual, conceptual, procedural and metacognitive. Metacognitive Knowledge involves knowledge about cognition in general as well as awareness of and knowledge about one's own cognition.

FACTUAL KNOWLEDGE

– The basic elements that learners must know to be acquainted with a discipline or solve problems in it. • Knowledge of terminology

• Knowledge of specific details and elements

B) CONCEPTUAL KNOWLEDGE – The interrelationships among the basic elements within a larger structure that enable them to function together.

• Knowledge of classifications and categories

• Knowledge of principles and generalizations

• Knowledge of theories, models, and structures

C) PROCEDURAL KNOWLEDGE – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.

• Knowledge of subject-specific skills and algorithms

• Knowledge of subject-specific techniques and methods

• Knowledge of criteria for determining when to use appropriate procedures

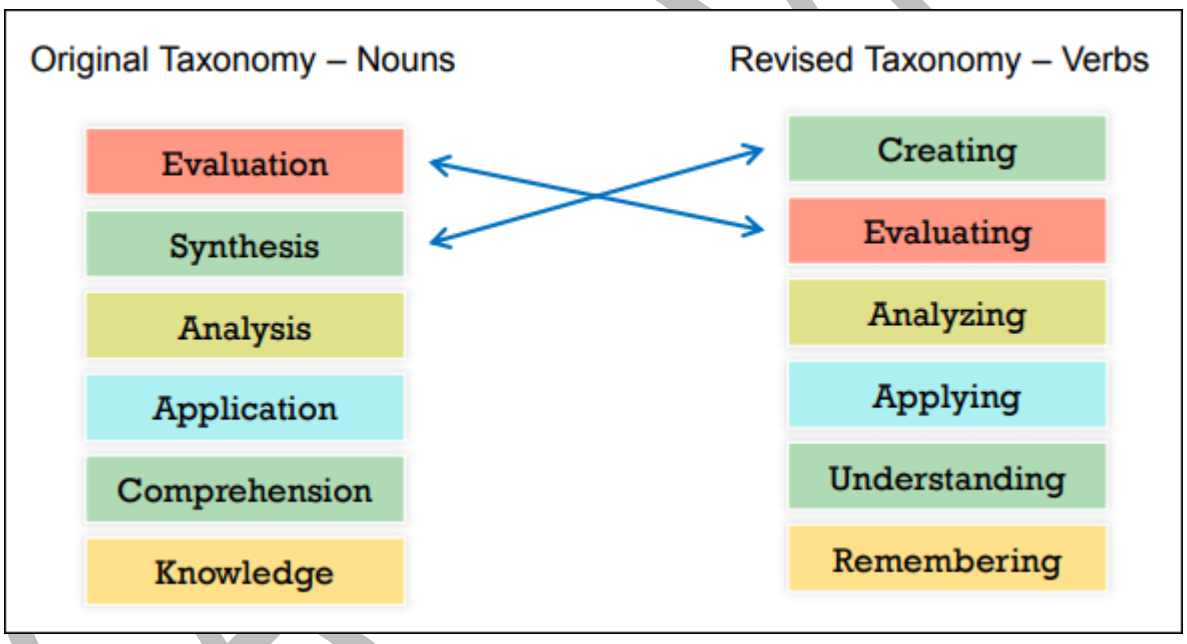
D) METACOGNITIVE KNOWLEDGE – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.

• Strategic knowledge

• Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge

• Self-knowledge

The Cognitive Process Dimension In this dimension, like the original taxonomy, same number exists in the revised taxonomy also. Let us see the following table to understand the changes in revised taxonomy



In above table, you can see that 'knowledge' category is renamed as 'remember', 'comprehension' is renamed as 'understand', 'Application, Analysis and Evaluation' are retained but in their verb form i.e. 'apply, analyze and evaluate'. Evaluation was last category in original taxonomy but here it is at 5th place and 'synthesis' is replaced by a new category named as 'create'. All these 6 categories are further divided into 19 subcategories and renamed as cognitive processes. Let us have an overview of these cognitive processes. Another very important aspect of revised taxonomy is that here every objective is represented in a "two

dimensional table". The Knowledge dimension forms the vertical axis, whereas the Cognitive Process dimension forms the horizontal axis. See the following table:

Let us examine following objectives:

1) Learners will be able to define the term speed.

2) Learners will be able to measure intervals of time in a wall clock.

3) Learners will be able to derive relationship between different units of speed.

Main objectives of science curriculum upto secondary level is to make learners 'scientifically literate" as science is a compulsory component of the curriculum upto secondary level. Focus should be on "developing awareness among the learners about the interface of science, technology and society, sensitizing them, especially to the issues of environment and health, and enabling them to acquire practical knowledge and skills to enter the world of work." (NCF-2005).

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• to develop the basic language skills: speaking, reading and writing not only for science but also through science. At this level, Science and social science have been integrated as 'Environmental Studies'. At the upper primary level, the emphasis is on engaging the learner in learning principles of science through familiar experiences, working with hands to design simple technological units and modules and continuing to learn more on environment and health

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Understanding Science developed together with conceptual knowledge prepare the learners for more meaningful learning experiences and contribute to the significant improvement of quality of life. The learners would also appreciate the role and impact of science and technology, and their linkages with overall national development.

Objectives of teaching at a Secondary Stage:

- To work according to the students' science method and developed the scientific views.

- To impart the knowledge to the students about the world, the importance of Science and its effects on society and its environment and give them the knowledge of the role of the environment so that learners can utilize the correct methods of the uses of the environment.
- To use scientific method i.e. problem, hypothesis, experiment, a conclusion in decision making.
- To develop the competency to apply his knowledge to the solution of the problems around him he or she has an understanding of the technological processes so that he or she can use it in his or her surrounding.
- He or she should develop desirable scientific attitudes and values like cooperation, team, spirit, fellow feeling, leadership, courage, truthfulness, honesty, and sincerity.

Instructional Objectives:

- Teachers accept the general objectives in the form of desired goals but his or her goals are not clear and not helpful in teaching for removing these demerits classify the human behavior in 1948 which are related to student's behavioral change.
- A teacher has to make some definite and specific objectives of a particular lesson, unit or subunit of the subject like science before the teaching-learning process for attending within a specified classroom period and resources and in hand through these so specific classroom teaching-learning objectives known as instructional objectives.
- A teacher tries to bring desired changes in the behavior of students so the term instructional objectives are defined as a group of statements formulated by the teacher for describing what the students are expected to do all will be able to do once the process of classroom instruction is over.
- In fact, instructional outcomes are the teaching-learning product in the form of behavioral changes in the students that a teacher expects as a result of his or her instruction related with a particular lesson, unit or subunit of the subject.
- instructional objectives are the descriptions of the students terminal behavior expected out of the ongoing classroom instruction.

Relationship of instructional objectives with general Aims and Objectives:

- In comparison to the general aim and objectives of teaching biological science instructional objectives are quite narrow and specific.
- Both are definite, precise, functional and tangible.
- Both are predetermined.
- They must be predictable
- They are therefore termed as teaching-learning objectives for behavioral objectives the main purpose of these objectives is to provide statements of skills, concepts or behaviour students are expected to demonstrate after going through particular instruction.
- They are more specific and define than the general in circles but less specific and much wider than the classroom instructional objectives.
- Their attainment is quite possible within the educational structure and means.

- According to Robert Mager (1962), instructional objectives are best described in terms of the terminal behavior expected from the learners. He recommends the following things for the writing of the objectives;
- 1. Identification of the terminal behavior or performance and its naming
- 2. Description of the important conditions under which the behavior is expected to occur
- 3. Specification of the criteria of acceptable performance (desired terminal behavior) by describing how good a learner's performance must be for being acceptable.
-
- Mager's approach has adopted Bloom's taxonomy as starting base for the writing of objectives. He has sought the help of the associated action verbs for stating the different objectives. The verbs help in describing the outcomes of learning or the terminal behavior of the learner in a well-defined way (observable and testable)

Knowledge Objective

Students state or will state (behavior) at last five (performance) fundamental rights out of the fundamental rights presented in the text (condition).

Skill Objective

Using a pencil, colored pencil and an outline map of Haryan (conditions), each students will mark (behavior) all the districts of the state (performance)

Affective Objective

Students will describe (behavior) the two advantages/values (performance) derived from a pollution-free environment during the visit to an ideal village (condition)

Let us illustrate it by writing objectives of teaching a particular topic/unit (duties citizens) of the subject social studies related to the affective domain.

Instructional objectives - Writing in behavioral terms of the affective domain

Receiving - Students accept their duties as a citizen of the country

Responding - Students write or list out the duties of citizen

Valuing - Students demonstrate the duties of a citizen in their behavior

Organization - Students establish relationship between various duties

MILLER'S APPROACH

For meeting the requirement of writing psychomotor objectives he forward his scheme based on skill analysis by outlining the following procedure:

1. Description of the indicator, indicating the relevant activity.

2. Descriptiong of the indication or stimulus that calls for a response.

3. Controlling of the object that is to be activated.

4. Desription of the activity to be performed.

5. The indication of the adequacy of responses or feedback.

R.C.E.M APPROACH

The four categories of objectives (knowledge, understanding, application, creativity), have been divided into 17 mental processes or abilities. These processes or abilities are used for the necessary outline of the 17 frames or statements as follows:

1. Knowledge objectives

The learner is able to recognize...

The learner is able to recall...

2. Understanding objectives

The learner is able to see relationship between...and...

The learner is able to cite example of...

The learner is able to classify...

2.5 The learner is able to interpret...

3. Application objectives

The learner is able to reason out...

The learner is able to formulate hypothesis for...

The learner is able to infer about...

4. Creativity objectives

The learner is able to analyze

The learner is able to synthesize...

The learner is able to evaluate...

How to write objectives in R.C.E.M. Approach

1. Have in mind the entry behavior of the learner.

2. Think again the element of content or topic to be given to the learner.

3. Think again the teaching objective(s)

4. In view of the entry behavior, element of content and the particular objective, try to select appropriate mental process for writing the objective in question.

5. Make use of the 17 frames of the R.C.E.M. approach and fill in the blanks in view of the entry behavior of the learner and learning experiences given to him.

Example 1: Topic: Duties of a Citizen

1. Students are able to recall at least five duties of a citizen (knowledge)

2. Students are able to discriminate between rights and duties (understanding)

3. Students are able to infer about the duties of a citizen through their daily life activities (application)

4. Students are able to evaluate the contribution of the society or education in acquainting them with the duties of a citizen (creativity)

Conclusion Regarding Writing of Instructional Objectives

The discussion held so far may help the pupil teachers in the task of formulating the desired instructional objectives related to the topics or sub units of their daily lessons. The question, however, arises in actual practice and conditions available for teachers training what type of behavioral changes part really expected in the behavior of the students through the teaching of the leassons in a particular subject. These changes falling in different domains of their behavior may generally be summarized as follows:

1. Students may acquire the knowledge and understanding of the facts,principles and ideas related to the topics and units of different branches of a particular subject of the school curriculum.

2. They may learn about the various skils related to the process and products of the subject like drawing skill, surveying skill, computational skill,etc.

3. They may be able to utilize the knowledge, understanding and skills related to the subject in their daily life.

4. They may develop proper positive attitude for the learning.

5. They may develop proper interest and appreciation for the facts related to the study of that subject.

Planning for Daily Lesson (Objectives)

1. Knowledge and understanding

2. skill

3. application

4. attitude

5. interest and appreciation

An Illustrationof Writing Instructional Objectives

Topic: Our Solar System

Knowledge and understanding objectives

1. The pupils recall the names of the planets of the solar system.

2. The pupils tell the name of the planets whivh lie at the nearest and furthest distance from the earth.

3. The pupils recognize the name of planets and satellites.

4. The pupils recognize the position of the planets, moon, sun, and other members of the solar system in a amp of the solar system.

5. The pupils identify planets and satellites.

Skill Objectives

1. The pupils draw accurate and neat diagram showing the solar system and the occurrence of the solar or lunar eclipses.

2. The pupils calculate the time taken by the light from the members of the slar systems to reach earth and also their relative distances from the earth.

Attitude Objectives

1. The pupils don't accept the mythical stories for giving the reasons of lunar or solar eclipse.

2. The pupils accept his mistake in judging planets and other stars as small as they appear from earth.

Interest and appreciation objectives

1. The pupils how keen interest in visiting planetarium.

2. The pupils build a model of solar system.

3. The pupils write an article on solar system and eclipses in the school bulletin.

4. The pupils read relevant literature concerning solar system and universe in the library.

5. The pupils derive pleasure in knowing the solar system and its place in universe.

Students demonstrate (or will demonstrate) the following typesof behavior after studying the topic "Our Solar System"

After saying so we can then write the various objectives as

-recall the names of the planets of the solar system

-explain the difference between a planet and a satellite

-draw a neat diagram showing the solar system.

UNIT-II: METHODS AND TECHNIQUES

a) Lecture cum demo method, scientific method, discussion method, project method, concept mapping

Characteristics of lecture method:

● The teacher instructs or gives lecture on a topic for all most the complete time in the period.

● The teacher provides information, concepts, facts, events, theories, laws, principles etc.

● Sometimes he/she uses blackboard during his / her lecture and asks questions to the students. Students are passive listeners. Their activities during the lecture period, at best, is taking down some notes and responding to occasional questions of the teacher.

● Within a single period, the teacher may unwittingly present more information than students can absorb, and the method provides no accurate means of checking student progress. Teacher presents the subject matter at his own speed.

● Content is presented as a whole and the students learn through listening and memorization.

This method can be successfully used in imparting factual information, explaining the theoretical points which cannot be demonstrated, summarizing and recapitulating certain topics etc. in

higher classes. But this method seems to be not relevant for teachers and students of elementary classes.

Demonstration Method

Demonstration method is a teacher- centred method as the teacher demonstrates the pictures/ charts/models/experiments and explains the principles, concepts involved in these demonstrated materials or processes. The students observe the demonstration shown by the teacher and some of them participate in answering the questions asked by the teacher and draw conclusions.

Steps involved in the demonstration method : a. Planning b. Introduction c. Demonstration d. Blackboard usage e. Concepts compilation For successful demonstration, several criteria are to be followed in each of these steps. ● Planning: – Ensure whether the lesson is suitable for this method. – Collect necessary tools, equipments, and materials for demonstration. – Rehearse the experiment before demonstrating before the class as it will help to build confidence to demonstrate. – Be ready with explanatory notes and questions to be used during and after the demonstration.

Introduction: – Motivate the students to arouse interest in observing the experiment keenly and to accept new concepts after the demonstration. – Introduce the lesson as a 'problem' or an issue, so that the students understand the importance of the lesson. ● Demonstration: – Keep the curiosity of the students alive during the demonstration. – Take care to ensure that the students are able to follow the demonstration. – Relate the demonstration with the life experiences of the students. – Handle the instruments safely, and arrange them in their respective places for the demonstration. ● Blackboard Usage: – Write the objectives clearly on the black board to make the students understand the significance of the demonstration method – Draw relevant pictures and write the key concepts and the results of the demonstration immediately on the black board. – Ask the students to write the key points, draw the diagram and finally the results in their notebooks. – Check their notebooks while they are writing.

Besides the above mentioned points, you need to take care of the following aspects: ● Do tell the purpose of the demonstration to the students but do not tell the inferences or conclusions in advance. ● Seek the help of students in arranging, and performing the experiment. Quality of demonstration is better when you along with your students actively participate in it. ● Be well

versed in the handling of apparatus and arrange those for the demonstration in a definite order which the students can clearly observe. ● Check that the demonstration is clearly visible to all students in the class. ● Ensure that the demonstration is simple and according to the mental level of the students. ● Supplement the demonstration with other teaching aids to make it more real and interesting. ● Ask reflective questions to stimulate the interest of the students.

Usefulness of Demonstration Method: Demonstration method is one of the most preferable methods of teaching because of its multiple benefits. ● It is cost effective. As the teacher demonstrates, it becomes more economical and time saving. ● The teacher explains the concepts during the experiment and so the students clearly understand the concepts of the lesson. ● During the demonstration the doubts of the students are cleared by the teacher then and there. ● During the demonstration, students get opportunities for the following: ■ Observation ■ Note making ■ Questioning ■ Drawing ■ Involving in Experiments ● It reduces distraction and promotes sustained attention among the students and paves way for useful learning. ● It stimulates learning and attempts to retain student interest.

Project Method

According to John Alford Stevenson, “A project is a problematic act carried to the completion in its natural settling”. Ballord defines, “A project is a bit of real life that has been imported into the school”, while Dr. William Head Kilpatrick defines that, “A project is a whole hearted purposeful activity proceeding in a social environment”. In other words we can say that: A project is an educational method where students working individually or in small groups analyze and develop “real-life” problem or tackle a present day theme within a preset time limit, working independently and with the division of tasks clearly defined. From these definitions you can observe that ● A project is a task or an activity. ● It has some purpose. ● It is conducted in social and natural situation. Characteristics of Project Method: The project method has the following characteristics: Problematic: Every project is intended to solve at least one problem which is perceived by the student(s). Becoming aware of the problem is the beginning of the formulation of the project. Objective: The success of Project Method lies in the students understanding of its objectives. The objectives with which the students pursue the project are intimately associated with their real life situation and would be fulfilling some of their cherished desires. Activity: After defining the objectives, it is your duty to create a learning environment. Students begin to

learn through self planning, group discussion and group activities. Reality: It is necessary to create real life activities for effective learning. Liberty: In Project Method, learning takes place naturally. So, students perform activities freely. Utility: The learned knowledge must serve the immediate needs of the students in their present life. It is necessary that the project method must be useful to the present needs. Integration: Since a project is based on the real life problems, real experiences for carrying out the project and no real experience involves the knowledge of only one subject. One has to combine the knowledge of many subjects appropriately for successful completion of the project. Integration of subjects learnt in the classroom is the basic requirement in a project work.

Democratic values: While conducting a project, the students working in a group need to cooperate with each other, respect each other, value others opinion, assume and share responsibility. Inculcation of such characteristics leads to development of democratic values. According to Kilpatrick, this is the best method in a democracy.

Some examples of Project: ● By visiting various public institutions the students can prepare a report on various functions of those institutions i.e. Post Office, Hospital, Bank. Police Station etc. ● They can prepare a report on the occupations of the people in their locality. ● They can prepare a report on the food habits of the people in their locality.

Advantages of Project Method ● The project method is based on the principles of active learning. The student gets totally involved in the activity which helps in enhancing his/her knowledge, understanding and skills in real life situation and ultimately in developing a holistic personality. ● Since all the activities of a project are related to the real life experiences, each of such activities is meaningful to the student. Therefore, meaningful learning is always associated with the project method.

The student enjoys full freedom in conducting a project. This develops selfconfidence to act and also promotes a sense of responsibilities among the students.

● The student gets acquainted with the types of work which he/she is expected to perform in future. Thus, the project method helps the student in his/her preparation for a future life.

● The student gets the scope to imbibe several social qualities like cooperation, and team work, group affinity, and sacrifice through project work.

● Interest and motivation for the project activities are spontaneously created and no external persuasion or force is needed to attract the students toward learning.

● Completion of the project gives individuals a sense of accomplishment which in turn encourages the student for further learning.

Methods are the ways of teaching. Effective learning of children depends on the method the teacher adopts.

● The methods of learning and teaching can be of two types: instructional methods and student friendly methods.

● Instructional methods are mostly teacher directed, whereas the student friendly methods are dominantly student-centric.

● Lecture, demonstration, and induction- deduction are some of the examples of instructional methods.

● Play-way, project, problem-solving, and discovery are some of the examples of student friendly methods.

● In the lecture method the teacher explains facts, information concepts laws etc. at his own pace. There is no assurance whether the students are attentive and understanding all what the teacher is saying.

● Inductive method proceeds from specific to general, concrete to abstract, whereas deductive method proceeds from general to specific, from abstract to concrete.

● In demonstration method the teacher performs an experiment or shows the chart, models etc. in the class and goes on explaining what he does.

● Children learn various concepts through playing games. Teacher has to organise the concepts in such a manner that the children learn those concepts informally by playing the game so that learning becomes permanent.

● In project method the teacher provides a situation so that the children choose a project from that situation and they plan, execute, evaluate the project themselves and lastly they prepare a report on the project.

● In problem solving method the teacher asks a question which is a problem for the students to solve. They solve the problem by collecting relevant data, formulating hypotheses, testing the hypotheses and drawing conclusion. As this method involves reflective thinking and reasoning it is useful for students of upper primary level. 89 Methods of Learning and Teaching Block 1 : Learning and Teaching Process Notes

● Discovery method can be applied where the students have to find out a scientific cause. The teacher assigns a problem to the students and the students find out the cause by collecting data through putting questions or by going through reference materials, then interpreting the data, formulating tentative hypotheses and arriving at conclusion.

● A concept can be taught by folowing different methods individually. Some concepts can be taught by the combination of different methods simultaneously.

Introduction to Concept Mapping

Used as a learning and teaching technique, concept mapping visually illustrates the relationships between concepts and ideas. Often represented in circles or boxes, concepts are linked by words and phrases that explain the connection between the ideas, helping students organize and structure their thoughts to further understand information and discover new relationships. Most concept maps represent a hierarchical structure, with the overall, broad concept first with connected sub-topics, more specific concepts, following.

Definition of a Concept Map

A concept map is a type of **graphic organizer** used to help students organize and represent knowledge of a subject. Concept maps begin with a main idea (or concept) and then branch out to show how that main idea can be broken down into specific topics.

Benefits of Concept Mapping

Concept mapping serves several purposes for learners:

- Helping students brainstorm and generate new ideas
- Encouraging students to discover new concepts and the propositions that connect them
- Allowing students to more clearly communicate ideas, thoughts and information
- Helping students integrate new concepts with older concepts
- Enabling students to gain enhanced knowledge of any topic and evaluate the information

How to Build a Concept Map

Concept maps are typically hierarchical, with the subordinate concepts stemming from the main concept or idea. This type of graphic organizer however, always allows change and new concepts to be added. The Rubber Sheet Analogy states that concept positions on a map can continuously change, while always maintaining the same relationship with the other ideas on the map.

- **Start with a main idea, topic, or issue to focus on.**

  A helpful way to determine the context of your concept map is to choose a focus question—something that needs to be solved or a conclusion that needs to be reached. Once a topic or question is decided on, that will help with the hierarchical structure of the concept map.

- **Then determine the key concepts**

  Find the key concepts that connect and relate to your main idea and rank them; most general, inclusive concepts come first, then link to smaller, more specific concepts.

- **Finish by connecting concepts--creating linking phrases and words**

  Once the basic links between the concepts are created, add cross-links, which connect concepts in different areas of the map, to further illustrate the relationships and strengthen student's understanding and knowledge on the topic.

Concept Maps in Education

When created correctly and thoroughly, **concept mapping** is a powerful way for students to reach high levels of cognitive performance. A concept map is also not just a learning tool, but an ideal evaluation tool for educators measuring the growth of and assessing student learning. As students create concept maps, they reiterate ideas using their own words and help identify incorrect ideas and concepts; educators are able to see what students do not understand,

providing an accurate, objective way to evaluate areas in which students do not yet grasp concepts fully.

Inspiration Software®'s Inspiration®, Kidspiration® and Webspiration Classroom™ service all contain Diagram Views that makes it easy for students to create concept maps; students are able to add new concepts and links as they see fit. Inspiration, Kidspiration and Webspiration Classroom also come with a variety of concept map examples, templates and lesson plans to show how concept mapping and the use of other graphic organizers can easily be integrated into the curriculum to enhance learning, comprehension and writing skills.

Since students might not know how to create a concept map, it is beneficial to model the process in class. Once students understand the process, you can use concept maps in the following ways:

- **Use as an in-class pre-assessment.** Prior to discussing a topic, ask students to create a concept map. Then, as you discuss the information, they can add to or modify their map to reflect their understanding about the topic.
- **Do as a small group activity.** Give your students a problem, case study, or question about a key concept. Divide them into small groups of 4-5 students. Have each group create a concept map as they analyze and synthesize previously learned information into this new scenario. Have the groups present their conclusions.
- **Do as a whole class activity.** As a class, create, a concept map and use it as a springboard to discuss relationships among the concepts and ideas listed in the map.
- **Fill in the blanks.** Before class, create a concept map of the material you want to cover in class. Then, remove some of the concepts and labels. Show the partially completed map to the class and have them fill in the blank spots and label the relationships.
- **Organize your research.** Use a concept map to build and organize your ideas, layer details, and find connections and relationships that might never have occurred to you before.

There are several benefits of using concept maps. A concept map:

- Helps visual learners grasp the material (however all learners benefit from the activity)

- Helps students see relationships between ideas, concepts, or authors
- Utilizes the full range of the left and right hemispheres of the brain
- Helps memory recall
- Helps to clarify and structure ideas
- Aids in developing higher-level thinking skills (create, analyze, evaluate)
- Helps students synthesize and integrate information, ideas and concepts
- Encourages students to think creatively about the subject
- Lets students do self-evaluation of beliefs, values, socialization, etc.
- Helps students evaluate assumptions.

b) Approaches: Inductive and deductive , Problem solving Approach, Cooperative Learning Approach, Experiential Learning Approach

Inductive and deductive language teaching and learning are very important in education. They are two distinct and opposing instructional and learning methods or approaches. Both require the presence of a teacher/instructor and a student/learner. The biggest differences between the two methods are the focus and flow of information as well as the roles of the teacher and student.

Inductive teaching and learning means that the direction of the flow of information is from specific to general. In terms of teaching, the lesson is started with activities or experiments. It is mostly focused on the students and their capacities and abilities, rather than on the teacher.

There are many advantages of inductive teaching and learning; knowledge is acquired naturally by exposure, and students are encouraged to utilize their reasoning skills, prior knowledge,

intelligence, and mental focus. This method also measures how a student makes connections based on the information presented.

Since inductive teaching and learning involves the student's perspective, it is easier for the student to learn the concept. Concepts under this method can be personalized and easily remembered and understood. This is a method of discovery and can be time consuming as well as demanding of a student's imagination and creativity. Inductive teaching is perfectly suited for a small group of students with a competent and experienced teacher who knows how to make adjustments throughout the lesson.

The counterpart of inductive teaching and learning is deductive teaching and learning. In this method, the role of the teacher is prominent as he/she is the person who gives and disseminates all information. The flow of information in this method is from general to specific. The deductive method is the traditional method of teaching and learning. Knowledge is taken from a general reference or source and then communicated to the learner.

The usual flow of information begins with the concept's introduction and presentation followed by activities. Information is based on facts, statements, and pre-determined logic. The method is easy to apply, leaves little room for mistakes, and the information being taught is valid. There is also a clear and defined scope; the method requires little preparation on the part the teacher.

However, deductive teaching also has its disadvantages, which include a very structural and predictable flow. This method also leaves little room for interaction, which makes is most effective for larger groups of students. In terms of application in language, both methods are applied in different language modes, concepts, and instances. For example, the inductive method is applied in developing a story or work. On the other hand, the deductive method can be useful in explaining literary work.

Summary:

1. Deductive and inductive methods of teaching and learning differ in many aspects.
2. In inductive learning, the flow of information is from specific to general, and it is more focused on the student.
3. On the other hand, the deductive method's information flow moves from general to specific, and it is more focused on the teacher.
4. The deductive method introduces a concept and its process before applying it in a test or activity. Meanwhile, in the inductive method, the activity or test is introduced first before a discussion of the concept is initiated.
5. The deductive method is used in a large classroom setting, while the inductive method is effective when used on small groups of students.
6. The deductive method is traditional, structured, and predictable, while the inductive method is personalized, and the concepts are easily remembered and understood.
7. The deductive method is a method of verification where information comes from a specific source and is delivered to students directly, while the inductive method is an approach of discovery and relies on a student's perspective or understanding of a concept.

Principles for teaching problem solving

Model a useful problem-solving method. Problem solving can be difficult and sometimes tedious. Show students by your example how to be patient and persistent and how to follow a structured method, such as Woods' model described here. Articulate your method as you use it so students see the connections.

Teach within a specific context. Teach problem-solving skills in the context in which they will be used (e.g., mole fraction calculations in a chemistry course). Use real-life problems in

explanations, examples, and exams. Do not teach problem solving as an independent, abstract skill.

Help students understand the problem. In order to solve problems, students need to define the end goal. This step is crucial to successful learning of problem-solving skills. If you succeed at helping students answer the questions "what?" and "why?", finding the answer to "how?" will be easier.

Take enough time. When planning a lecture/tutorial, budget enough time for: understanding the problem and defining the goal, both individually and as a class; dealing with questions from you and your students; making, finding, and fixing mistakes; and solving entire problems in a single session.

Ask questions and make suggestions. Ask students to predict "what would happen if …" or explain why something happened. This will help them to develop analytical and deductive thinking skills. Also, ask questions and make suggestions about strategies to encourage students to reflect on the problem-solving strategies that they use.

Link errors to misconceptions. Use errors as evidence of misconceptions, not carelessness or random guessing. Make an effort to isolate the misconception and correct it, then teach students to do this by themselves. We can all learn from mistakes.

Woods' problem-solving model

Define the problem

The system. Have students identify the system under study (e.g., a metal bridge subject to certain forces) by interpreting the information provided in the problem statement. Drawing a diagram is a great way to do this.

Known(s) and concepts. List what is known about the problem, and identify the knowledge needed to understand (and eventually) solve it.

Unknown(s). Once you have a list of knowns, identifying the unknown(s) becomes simpler. One unknown is generally the answer to the problem, but there may be other unknowns. Be sure that students understand what they are expected to find.

Units and symbols. One key aspect in problem solving is teaching students how to select, interpret, and use units and symbols. Emphasize the use of units whenever applicable. Develop a habit of using appropriate units and symbols yourself at all times.

Constraints. All problems have some stated or implied constraints. Teach students to look for the words only, must, neglect, or assume to help identify the constraints.

Criteria for success. Help students to consider from the beginning what a logical type of answer would be. What characteristics will it possess? For example, a quantitative problem will require an answer in some form of numerical units (e.g., $/kg product, square cm, etc.) while an optimization problem requires an answer in the form of either a numerical maximum or minimum.

Definition of Cooperative Learning

Students' learning goals may be structured to promote cooperative, competitive, or individualistic efforts. In every classroom, instructional activities are aimed at accomplishing goals and are conducted under a goal structure. A learning goal is a desired future state of demonstrating competence or mastery in the subject area being studied. The goal structure specifies the ways in which students will interact with each other and the teacher during the instructional session. Each goal structure has its place (Johnson & Johnson, 1989, 1999). In the ideal classroom, all students would learn how to work cooperatively with others, compete for fun and enjoyment, and work autonomously on their own. The teacher decides which goal structure to implement within each lesson. The most important goal structure, and the one that should be used the majority of the time in learning situations, is cooperation.

Cooperation is working together to accomplish shared goals. Within cooperative situations, individuals seek outcomes that are beneficial to themselves and beneficial to all other group members. Cooperative learning is the instructional use of small groups so that students work together to maximize their own and each other's learning. It may be contrasted with competitive (students work against each other to achieve an academic goal such as a grade of "A" that only one or a few students can attain) andindividualistic (students work by themselves to accomplish learning goals unrelated to those of the other students) learning. In

cooperative and individualistic learning, you evaluate student efforts on a criteria-referenced basis while in competitive learning you grade students on a norm-referenced basis. While there are limitations on when and where you may use competitive and individualistic learning appropriately, you may structure any learning task in any subject area with any curriculum cooperatively.

Types Of Cooperative Learning

Formal Cooperative Learning

Formal cooperative learning consists of students working together, for one class period to several weeks, to achieve shared learning goals and complete jointly specific tasks and assignments (Johnson, Johnson, & Holubec, 2008). In formal cooperative learning groups the teachers' role includes (see Figure 4):

1. **Making pre-instructional decisions.** Teachers (a) formulate both academic and social skills objectives, (b) decide on the size of groups, (c) choose a method for assigning students to groups, (d) decide which roles to assign group members, (e) arrange the room, and (f) arrange the materials students need to complete the assignment. In these preinstructional decisions, the social skills objectives specify the interpersonal and small group skills students are to learn. By assigning students roles, role interdependence is established. The way in which materials are distributed can create resource interdependence. The arrangement of the room can create environmental interdependence and provide the teacher with easy access to observe each group, which increases individual accountability and provides data for group processing.

2. **Explaining the instructional task and cooperative structure.**Teachers (a) explain the academic assignment to students, (b) explain the criteria for success, (c) structure positive interdependence, (d) structure individual accountability, (e) explain the behaviors (i.e., social skills) students are expected to use, and (f) emphasize intergroup cooperation (this eliminates the possibility of competition among students and extends positive goal interdependence to

the class as a whole). Teachers may also teach the concepts and strategies required to complete the assignment. By explaining the social skills emphasized in the lesson, teachers operationalize (a) the social skill objectives of the lesson and (b) the interaction patterns (such as oral rehearsal and jointly building conceptual frameworks) teachers wish to create.

3. **Monitoring students'** learning and intervening to provide assistance in (a) completing the task successfully or (b) using the targeted interpersonal and group skills effectively.While conducting the lesson, teachers monitor each learning group and intervene when needed to improve taskwork and teamwork. Monitoring the learning groups creates individual accountability; whenever a teacher observes a group, members tend to feel accountable to be constructive members. In addition, teachers collect specific data on promotive interaction, the use of targeted social skills, and the engagement in the desired interaction patterns. This data is used to intervene in groups and to guide group processing.

4. **Assessing students'** learning and helping students process how well their groups functioned. Teachers (a) bring closure to the lesson, (b) assess and evaluate the quality and quantity of student achievement, (c) ensure students carefully discuss how effectively they worked together (i.e., process the effectiveness of their learning groups), (d) have students make a plan for improvement, and (e) have students celebrate the hard work of group members. The assessment of student achievement highlights individual and group accountability (i.e., how well each student performed) and indicates whether the group achieved its goals (i.e., focusing on positive goal interdependence). The group celebration is a form of reward interdependence. The feedback received during group processing is aimed at improving the use of social skills and is a form of individual accountability. Discussing the processes the group used to function, furthermore, emphasizes the continuous improvement of promotive interaction and the patterns of interaction need to maximize student learning and retention.

Informal Cooperative Learning

Informal cooperative learning consists of having students work together to achieve a joint learning goal in temporary, ad-hoc groups that last from a few minutes to one class period (Johnson, Johnson, & Holubec, 2008). During a lecture, demonstration, or film, informal cooperative learning can be used to focus student attention on the material to be learned, set a mood conducive to learning, help set expectations as to what will be covered in a class session, ensure that students cognitively process and rehearse the material being taught, summarize what was learned and precue the next session, and provide closure to an instructional session. The teacher's role for using informal cooperative learning to keep students more actively engaged intellectually entails having focused discussions before and after the lesson (i.e., bookends) and interspersing pair discussions throughout the lesson. Two important aspects of using informal cooperative learning groups are to (a) make the task and the instructions explicit and precise and (b) require the groups to produce a specific product (such as a written answer). The procedure is as follows.

1. Introductory Focused Discussion: Teachers assign students to pairs or triads and explain (a) the task of answering the questions in a four to five minute time period and (b) the positive goal interdependence of reaching consensus. The discussion task is aimed at promoting advance organizing of what the students know about the topic to be presented and establishing expectations about what the lecture will cover. Individual accountability is ensured by the small size of the group. A basic interaction pattern of eliciting oral rehearsal, higher-level reasoning, and consensus building is required.

2. Intermittent Focused Discussions: Teachers divide the lecture into 10 to 15 minute segments. This is about the length of time a motivated adult can concentrate on information being presented. After each segment, students are asked to turn to the person next to them and work cooperatively in answering a question (specific enough so that students can answer it in about three minutes) that requires students to cognitively process the material just presented. The procedure is:

a. Each student formulates his or her answer.

b. Students share their answer with their partner.

c. Students listen carefully to their partner's answer.

d. The pairs create a new answer that is superior to each member's initial formulation by integrating the two answers, building on each other's thoughts, and synthesizing.

The question may require students to:

a. Summarize the material just presented.

b. Give a reaction to the theory, concepts, or information presented.

c. Predict what is going to be presented next; hypothesize.

d. Solve a problem.

e. Relate material to past learning and integrate it into conceptual frameworks.

f. Resolve conceptual conflict created by presentation.

Teachers should ensure that students are seeking to reach an agreement on the answers to the questions (i.e., ensure positive goal interdependence is established), not just share their ideas with each other. Randomly choose two or three students to give 30 second summaries of their discussions. Such individual accountabilityensures that the pairs take the tasks seriously and check each other to ensure that both are prepared to answer. Periodically, the teacher should structure a discussion of how effectively the pairs are working together (i.e., group processing). Group celebrations add reward interdependence to the pairs.

3. Closure Focused Discussion: Teachers give students an ending discussion task lasting four to five minutes. The task requires students to summarize what they have learned from the lecture and integrate it into existing conceptual frameworks. The task may also point students toward what the homework will cover or what will be presented in the next class session. This provides closure to the lecture.

Informal cooperative learning ensures students are actively involved in understanding what is being presented. It also provides time for teachers to move around the class listening to what students are saying. Listening to student discussions can give instructors direction and insight into how well students understand the concepts and material being as well as increase the individual accountability of participating in the discussions.

Cooperative Base Groups

Cooperative base groups are long-term, heterogeneous cooperative learning groups with stable membership (Johnson, Johnson, & Holubec, 2008). Members' primary responsibilities

are to (a) ensure all members are making good academic progress (i.e., positive goal interdependence) (b) hold each other accountable for striving to learn (i.e., individual accountability), and (c) provide each other with support, encouragement, and assistance in completing assignments (i.e., promotive interaction). In order to ensure the base groups function effectively, periodically teachers should teach needed social skills and have the groups process how effectively they are functioning. Typically, cooperative base groups are heterogeneous in membership (especially in terms of achievement motivation and task orientation), meet regularly (for example, daily or biweekly), and last for the duration of the class (a semester or year) or preferably for several years. The agenda of the base group can include academic support tasks (such as ensuring all members have completed their homework and understand it or editing each other's essays), personal support tasks (such as getting to know each other and helping each other solve nonacademic problems), routine tasks (such as taking attendance), and assessment tasks (such as checking each other's understanding of the answers to test questions when the test is first taken individually and then retaken in the base group).

The teacher's role in using cooperative base groups is to (a) form heterogeneous groups of four (or three), (b) schedule a time when they will regularly meet (such as beginning and end of each class session or the beginning and end of each week), (c) create specific agendas with concrete tasks that provide a routine for base groups to follow when they meet, (d) ensure the five basic elements of effective cooperative groups are implemented, and (e) have students periodically process the effectiveness of their base groups.

The longer a cooperative group exists, the more caring their relationships will tend to be, the greater the social support they will provide for each other, the more committed they will be to each other's success, and the more influence members will have over each other. Permanent cooperative base groups provide the arena in which caring and committed relationships can be created that provide the social support needed to improve attendance,

personalize the educational experience, increase achievement, and improve the quality of school life.

Experiential learning is an active process which engages the learner, not a passive process that happens to the learner. In 'experiential learning' the experience provides the platform for learning, whilst the careful analysis and reflection of the experience develops the learning. Individuals are encouraged to work things out for themselves, they are guided to and through their learning rather than being taught. The learning individuals develop is appropriate for them: it is implicit in the approach that there are no 'right ways of thinking', 'set rules, or 'perfect behaviours' that anyone has to learn and apply. The commitment developed by the learner to make best use of their learning: they are central to the learning process, it is their learning.

Experiential learning focuses on learners reflecting on their experience of doing something, so as to gain conceptual insight as well as practical expertise. Kolb's experiential learning model suggest four stages in this process:

- active experimentation;
- concrete experience;
- reflective observation;
- abstract conceptualization.

Today, we take almost for granted that laboratory classes are an essential part of teaching science and engineering. Workshops and studios are considered critical for many forms of trades training or the development of creative arts. Labs, workshops and studios serve a number of important functions or goals, which include:

- to give students hands-on experience in choosing and using common scientific, engineering or trades equipment appropriately;
- to develop motor skills in using scientific, engineering or industrial tools or creative media;

- to give students an understanding of the advantages and limitations of laboratory experiments;
- to enable students to see science, engineering or trade work ‘in action’;
- to enable students to test hypotheses or to see how well concepts, theories, procedures actually work when tested under laboratory conditions;
- to teach students how to design and/or conduct experiments;
- to enable students to design and create objects or equipment in different physical media.

One major criticism of traditional educational labs or workshops is that they are limited in the kinds of equipment and experiences that scientists, engineers and trades people need today. As scientific, engineering and trades equipment becomes more sophisticated and expensive, it becomes increasingly difficult to provide students in schools especially but increasingly now in colleges and universities direct access to such equipment. Furthermore traditional teaching labs or workshops are capital and labour intensive and hence do not scale easily, a critical disadvantage in rapidly expanding educational opportunities.

Because laboratory work is such an accepted part of science teaching, it is worth remembering that teaching science through laboratory work is in historical terms a fairly recent development.

At the same time, scientific and engineering progress since the nineteenth century has resulted in other forms of scientific testing and validation that take place outside at least the kind of ‘wet labs’ so common in schools and universities. Examples are nuclear accelerators, nanotechnology, quantum mechanics and space exploration. Often the only way to observe or record phenomena in such contexts is remotely or digitally. It is also important to be clear about the objectives of lab, workshop and studio work. There may now be other, more practical, more economic, or more powerful ways of achieving these objectives through the use of new technology, such as remote labs, simulations, and experiential learning

c) Scientific Attitude: Concept, characteristics and role of science teacher in its development

As said earlier that science is a practical subject, for which, provision of educational trips and tours should be made from time to time. All the students should be encouraged to get participate in such tours. At uniform intervals, provision of science exhibitions should be made in the schools and the responsibility of making all arrangements of such functions should be laid on the shoulders of students.

Through this, quality of performing various functions independently will get developed in the students. Experts and teachers from other schools or institutions should be invited and science conferences should be organised in the schools by which scientific attitudes can get developed among them easily and quickly

For developing scientific attitudes among the students, it is necessary that classroom in which science information is imparted, laboratories where various kinds of experiments are being conducted and other places where scientific activities are being conducted be equipped with a sense and spirit of scientific environment.

Students should be provided with complete freedom to carry out their own devised experiments in the well-equipped laboratory. In permitting the extent of freedom, teacher must make use of his discrimination, as in absence of this; chances of occurrence of various kinds of accidents will get increased.

Various reference books are published by prominent authors in addition to the text books. Teachers should make use of such books in the classroom and he should encourage the students to make use of such books to maximum possible extent. In the school libraries, there should be provision of extra science books; as such literature will help in prompting scientific attitude among the students.

No science teacher can play effective role in developing scientific attitudes among the students unless and until he does not possess such kind of attitudes. It is therefore one of an important duties of science teacher to adopt scientific attitude in himself and to make use of various scientific methods for imparting information of various scientific facts and concepts. In such kind of situation, children will try to become like their own teacher and they will try to follow the path which their teacher will show them.

As said that development of scientific attitudes among the students or learners is one of the main objective of science teaching, because of which various experts have put forwarded their views regarding the methods by which this objective can be fulfilled. Majority of experts consider that this objective can be fulfilled by making use of following things or keeping following points in the mind.

As known that even till now, a large number of people in our nation have not freed themselves from the clutches of superstitions and wrong beliefs. In this kind of situation, children are more bound to get infected by such beliefs as they have very tender kind of mind.

But it is not possible for any teacher to develop scientific attitudes among the students without eradicating such beliefs and notions from the minds of students. However, it is not as simple as it seems. It should be understood by the teacher that just by talking about superstitions and unfounded beliefs in the classroom and calling them bad and out of date will not bring any kind of change in the impressionable minds of the children.

Any effective change in this direction will take place only when science teacher will encourage the students to investigate some common superstitions and beliefs practically. All the students should be engaged in works which are intended to find out the bases on which such myths or wrong beliefs are based.

For instance it is believed in various parts of the nation that one can get blind by viewing solar eclipse with naked eyes as the sun rays are produced by some evil spirit. But the students should be taught by the teacher that although by viewing sun rays in solar eclipse one can become blind, but the main reason is that such rays consist of more harmful rays as a result of which such incidences can take place.

However, if one make use of black goggles or x-ray films, then chances of occurrence of such incidences can be reduced to minimum. Another instance of this fact is that it is believed by majority of people in our nation that one should not sleep under trees at night as souls of dead persons exist on them, however, the fact is that during night, trees absorb oxygen and exhale carbon dioxide because of which human beings will find an unhealthy environment.

For this, students should be asked to analyze the condition of any animal spending night beneath the tree at their houses. Thus, it is only through practical functions or works that the students can be freed from the clutches of superstitions, otherwise, teacher will find it very difficult to install or to get developed scientific attitudes among the students, especially in rural areas.

Students consider teacher as their role model and try to imitate him in every possible respect. Teacher should make use of scientific methods for imparting information regarding scientific facts and concepts. Not only this, he should make use of his personal experiences during the teaching process.

Majority of the experts are of the view that tendency to copy elders is found among the children because of which teacher will generate his own type of students. As known4hat scientific attitudes can get developed in a person who is free from all kinds of biases and prejudices and who possess the ability to take decisions on the basis of various valid and true proofs.

Therefore, it is necessary that science teacher himself must be free from biases and prejudices of all kinds while dealing with the students. He should not give more importance and consideration to any student or group of students. All the students should be provided with equal opportunities by him and he should not make his judgements on the basis of other's views and beliefs.

He should have an open-mind and before making any kind of decision, should invite all the students or parties involved to put forward their views. He should respect other's opinions and should not perform any act based on partiality. To solve out various problems getting arise during teaching process, he should make use of scientific methods and should not take decision in hurry or hastily.

Thus, it can be said that his approach to everyday life's problems should be truthful and simple. He should not be believed on accepting those things for which there are no evidences found. He should be of such mind-set that everything or incidence happen with a specific cause and he should get indulged in trying to find out the cause of every happening. It is only after finding out the cause, that efforts should be made by him to find out the solution of the problem.

Teacher should make use of obtained time in such a way that students can get opportunities to get involved in various experimentation processes conducted in the laboratory of the school. Science teacher should understand the fact that as science is a practical subject, thus, laboratory period can offer various opportunities for the students to learn certain elements of scientific attitude in them.

Science teacher should ensure that all the students are getting such opportunities equally. Not only this, the function to ensure that all the students are utilising available opportunities to fuller extent, also rests on the shoulders of science teacher.

To get the students indulged in the experimentation processes is not a very simple task. Before letting the students to begin their function, teacher should make it ensure that problem of the experiment is clearly stated to all the students and they have understood it properly.

Teacher will also make it sure that hypothesis on basis of which students are expected to base their conclusions are also presented in beyond them clearly and proper methods of testing are being used by the students. Students should be informed about the time period for which they can carry out their experiment work.

After cessation of this period, students should be asked about the conclusions they have drawn from their experiment. This function should be first performed individually, i.e., results obtained by all the students should be analyzed by teacher individually, but later, this function should be done collectively, i.e., results obtained by all the students should be discussed in the form of group discussion.

Students should be asked about the kind of conclusion they have drawn and the teacher should ask the reason or the basis on which they have based their conclusion. Other students should be asked to judge out whether the bases on which that student have based his or her conclusion are valid or not. Through this, students will become able to accept or to suspend judgement of their own and judgements of others if sufficient evidences are not found.

teacher should encourage the students to read supplementary and reference books written on the science. This can only be done in case there is a separate Science Library in the school. As said earlier that students imitate their teacher to greater extent.

Thus, science teacher should have love for reading such kinds of books, then only he can transfer in the students this love for reading and inculcate the ability to use and to understand the information provided through such sources.

Such teacher should be appointed to impart science education in the schools who keeps on growing professionally, reads new titles and does not come to the end of his subject but likes to share his joy of reading new book and information with his students and reference certain suitable books to them by which they can get more information of the present developments taking place in the subject.

The thinking pattern of the students can be diversed towards the inculcation of certain attitudes if internal setting of the class is properly arranged and the room is decorated in such a manner which helps in contributing to development of proper atmosphere in which information regarding scientific facts and concepts can be imparted.

In developing a desirable and appropriate kind of atmosphere in the classroom, science teacher plays a very important and significant role. Teacher should encourage spirit of friendly criticism of procedures, hypotheses and results among the students.

While imparting knowledge, he should make sure that all the students are giving due consideration to information provided by him and they are playing an active role in getting more and more information by asking various kinds of intelligent questions.

If teachers will not take any interest in giving response to the questions asked by students, then they will be discouraged to do so. In such a condition, it will be very difficult to create an appropriate kind of atmosphere in the classroom, because of which teachers should understand the fact that by responses or answers to the questions asked by the students, he is not wasting his time in any way, but encouraging the students to take participation in his own function and thus helping him in conducting his function in more effective and desirable way.

Thus, by making use of all the functions discussed above, a science teacher can get scientific attitudes developed among the students. It should be properly understood by the science teacher that his duty does not get finished or completed with imparting information provided in the text books to the students, but he should make all the efforts through which students can get new informations or developmental processes taking place in this area.

For this purpose, teacher should get himself engaged with the new sources and should try to expand his level of knowledge, as without it, he will not be able to develop level of student's existing knowledge to considerable extent.

At last it can be said that without developing scientific attitudes among the students, a science teacher's function cannot come to an end and all the efforts made by him will be considered to be wastage of time and money if he cannot get such attitude developed among the students.

Thus, all efforts should be made by him to do so. During teaching process, he should analyze whether he is getting success in developing such kind of attitudes or not. If he finds level of success to be unsatisfactory then he can change his method of teaching and material used by him at proper time, by which his efforts can be saved from becoming wastage.

UNIT-III: LEARNING RESOURCES AND INSTRUCTIONAL AIDS

a) Learning Resources in Life Science: Text books, reference books, journals, community resources.

The purpose of learning and teaching resources is to provide a source of learning experiences for students. They should be able to facilitate interaction among students and teachers during the learning/ teaching process, as well as to help students to learn, broaden students' learning

experiences and meet different learning needs. If used effectively, learning and teaching resources can help students to construct knowledge for themselves and develop effective learning strategies, generic skills, values and attitudes, thus laying a solid foundation for life-long learning.

Types of Learning and Teaching Resources

Learning and teaching resources are not confined to textbooks and are available in many other forms such as reference books, workbooks, worksheets, audio-visual teaching aids, web-based learning materials, computer software packages, structured courseware delivered by electronic learning management systems, Internet and media, as well as libraries, learning communities and resources in the natural environment

Textbook

Textbooks have a positive role to play and should provide the core elements of learning in the subjects recommended by the Curriculum Development Council. Textbooks should also be designed to develop students' critical and creative thinking and other generic skills through the information and activities that they provide.

Quality textbooks can assist teachers by providing a 'one-stop' shop for materials that will help them to plan the scope and sequence of their teaching.

That textbook should be considered to be good which is designed or written in accordance with the aims and objectives of science teaching. Such books can provide various kinds of help to the teacher and students. By making use of such book, various advantages are obtained by both learner and learned, some of which are as follows:

good science text book functions as a guide while framing the syllabus. Such kind of book becomes part of the syllabus because of its important contents. Generally it is seen that text

books are followed in the situations where other educational aids are not accessible because of different reasons. Thus, course of the science gets a kind of unity through the help of text books.

- b. To design the syllabus of various subjects, committees are being set up by authorities. Likewise, science syllabus is also designed by the committee set up in the school or educational institution. Textbooks play an important role in supplementing or enriching the science syllabus designed by various experts.

- More than one book can be used by science teacher for imparting wide based information and knowledge to the students. Those books which supplement class instructions are recommended by teachers to greater extent in the form of reference books.

- Through this, students can get various kinds of additional information, which is not provided in the text book. Usually students make use of reference books to look up specific information that may not have been understood in the class or which is not described in length in the text books.

- c. By making use of science text books, it becomes possible for the teacher to make students understand fundamental concepts and principles of science easily and quickly. Not only this, text books help in making this function in an effective manner.

- d. Through good science text book, students get acquainted with the wide variety of application of the scientific knowledge as various kinds of exercises are being provided usually at the end of every chapter.

- e. The information which is imparted through the teacher in practical form can be made understood by the students in written form through text books. Not only this, when students acquire information of different kinds from text books, then habit of self-study

gets developed among them, as a result of which, their dependency on teacher gets lower to certain extent.

- f. Text books help the students in retaining the information provided by teachers for a long period of time as various kinds of exercises are provided in them, answers of which are to be provided by the students, through which teacher can also analyse their level of knowledge. Teacher can assign the task of accomplishing such exercise to the home, by which he can provide the students with meaningful and useful homework.

- g. With the help of text books, classroom discussion can be directed towards accurate conclusions.

- h. As all the information provided in the text book exist in the written form, as a result of which they can revive it at any time, with the help of which, students can make revision of any lesson speedily through such books.

Reference books and other printed materials

Teachers are encouraged to use a wide range of other learning and teaching resources, such as reference books or other printed learning materials (e.g. supplementary reading and information materials, newspapers, articles, journals, periodicals, workbooks, exercises) to allow students to explore issues of interest, stimulate enquiry, apply/ consolidate their learning or encourage them to undertake further learning.

Teachers could also make good use of authentic resources (e.g. information leaflets, pamphlets, magazines, songs, posters) that are not written for classroom purposes, but could bring real-world issues into their classrooms.

Teachers should consider factors such as availability, affordability and copyright issues before using reference materials in the classrooms.

Multimedia resources

Multimedia resources, which embrace audio-visual teaching aids, web-based materials, computer software packages, online learning platforms, etc., have the following advantages in helping students' learning:

- Flexibility, adaptability
- Multi-sensory experience
- Possibility of interactivity
- Connectedness

Besides complementing textbooks, multimedia resources may provide opportunities for both students and teachers to gain access to up-to-date information. For example, teachers may select materials that present different sides of controversial issues to help students to develop their critical thinking and to make informed judgements in their daily lives. However, teachers should evaluate whether the online information is authentic, reliable and appropriate for student learning.

School libraries

School libraries and teacher-librarians play a significant and pivotal role in helping students and teachers to gain access to knowledge and information that are needed in the process of learning and teaching.

School libraries should serve as:

Resource centers with ample information in a variety of formats, where teachers and students can read, learn and share;

Favorable physical space equipped with traditional, technological and human resources for students to engage in enjoyable reading and learning; and

Virtual environment in conducting enquiries, using information technology to navigate for information and constructing and co-constructing knowledge.

The school library service has evolved from the traditional services of book purchasing and lending. It is now serving as a resource centre to support learning and teaching. A school library should provide ready-to-use learning and teaching resources (or extended reading materials) and multimedia resources which address overall school curriculum needs. A teacher-librarian should also.

Community resources

The use of community resources includes a combination of people, places, financial resources, websites and materials. Teachers could also make use of public libraries, museums, educational parks and media (including newspaper and TV).

Effective use of community resources not only helps learning and teaching, but also introduces students to many 'resource hubs' in society to further engage in life-long learning after SS education.

School-based Resources Development: Managing and Sharing Learning and Teaching Resources

The following are some suggested practices that help schools to develop, share and manage learning and teaching resources effectively:

Teachers working closely with the school librarian to produce strategic plans for the procurement and development of resource materials based on the needs of learning and teaching.

Setting up a resource bank on the school intranet for the sharing of learning and teaching resources. Schools may provide technical and managerial support to monitor the maintenance and development of the resource bank.

Updating resource materials from time to time and developing an efficient search system and resource bank to facilitate easy access and retrieval.

Reflecting and sharing experiences among teachers on how to use resources effectively.

Devising a review mechanism for evaluating existing resources to further promote learning, teaching and curriculum development.

b) Life science Curriculum: rationale and value, analysis of text books and biology syllabus of NCERT/PSEB at secondary and senior secondary stage.

- **BIOLOGY (CLASSES XI –XII)**
- In the present attempt of the NCERT to revise the Biology syllabus of the Classes XI and XII, several
- documents like 'Learning without Burden', the National Curriculum Framework- 2005, the report of the
- 'National Focus Group on Teaching of Science' as well as reports of several external and internal reviews
- carried out, helped to decide the main focus of the revision. Hence, the revised syllabus aims primarily at
- reducing the information load while ensuring at the same time that ample opportunities and scope for
- learning and appreciating basic concepts of Biology continues to be available within the framework.
- The Biology Syllabus reinforces the ideas introduced in the lower classes while the children learn new
- concepts besides getting an exposure to contemporary areas of Biology. This syllabus aims also at
- emphasising the underlying principles that are common to both animals and plants, as well as highlighting
- the interrelationships of Biology with other areas of knowledge. The format of the syllabus allows a simple,
- clear, sequential flow of concepts without any jarring jumps. The empirical experience gained and practical
- exercises carried out during the course would prepare the student to handle Biology easily at higher levels
- in case she/he opts to continue further studies in this area.
- The revised syllabus stresses the connection of the study of Biology to real life problems-use of

- biological discoveries/innovations in everyday life - in environment, industry, medicine, health and agriculture.
- Since it was important that the quality of Biology education at the higher secondary level was not
- compromised in any way, the reduction in load from the syllabus required a very careful selection of topics
- to be taught. The Committee chose to leave topics out if: the question about why the child needs to study
- the topic at the particular stage could not be answered; if the topic had no direct relevance to the child i.e.
- was not contextual; if the content was repetitive across stages with no change in expected understanding,
- and if any topic was in isolation with no evident horizontal or vertical linkages. The need for a network of
- ideas and cross-linking between the areas being identified was deemed very important. While deciding on
- the units/topics and the depth of each topic for the higher secondary level, a holistic view of the syllabus
- across all stages from the primary to the higher secondary and beyond was taken. Reducing the use of too
- many technical terms and avoiding very large numbers of examples will also help to make the content a
- little lighter. The importance of careful selection of illustrations and their use to make the concepts more
- explicit was stressed; in Biology the quality of illustrations can make or mar any attempt at good textbooks/
- teaching.
- The principal objective at this stage would be to explore the variations amongst the living and developing
- respect for the diversities, and to appreciate that the most complex biological phenomena are also built on

- essentially simple processes. Learning Biology should uncover these elementary aspects and illustrate their
- linkage to more complex phenomena. It was also felt that the contributions of scientists (women scientists
- in particular) that led to critical and important discoveries in Biology should be highlighted, not merely
- through a chronological listing, but through brief biographical discussions, in an effort to bring out the
- processes that led to the discovery of principles and ideas in Biology. These would stimulate critical and
- creative thinking. Besides, the proposed course at the higher secondary stage provides substantial orientation
- to the students to professional/career opportunities available in medicine, agriculture, research, teaching
- and industry.
- The syllabus also takes up issues pertaining to environment, health and other ethical issues that arise
- with any interference of human beings in the natural processes, which have great relevance from the societal
- 2
- point of view. A discussion on these in the prescribed syllabus would help tackle prevalent misconceptions
- and empower the student to playa rational, responsible and informed role in society. The teaching time in
- terms of number of periods available is indicated for each unit (total 180 periods).
- The young student would get an exposure to the various branches of Biology in a more contextual and
- friendly manner as they studied various units in the syllabus; each unit could also provide a glimpse of the
- career opportunities in the particular area. After studying any unit, the child gets an opportunity to think

- more deeply and to form informed opinions. The description of the diverse/various tools and techniques
- used in the study of Biology have not been collated to form a distinct unit in the syllabus. It is envisaged that
- the teachers who teach this syllabus and the textbooks prepared based on it, will discuss techniques in a
- contextual manner rather than distanced from real experimental situations.
- The committee faced a dilemma while considering the topic of animal physiology: whether to deal with
- 'animal' or 'human' physiology. But the moment the focus of discussion shifted - from the 'subject' dictated
- one to the child - and the available time was considered, it was evident that 'human' physiology was more
- appropriate at this stage. The student is closest to herself and is curious about the functioning of the human
- body. The 'science' understood after a study of human physiology could be meaningfully applied to other
- organisms.
- The students should be encouraged to do at least one project, may be in Class XI. The basic objective
- of these projects should be to provide the child with an exposure to what it means to carry out an investigation,
- what research methodologies are, how data is analysed and presented and, how to interpret data and
- draw conclusions. The project should provide space for the child to choose a theme in the area of her
- interest, think independently allow autonomous working and also provide freedom to present the project
- in any format of her/his choice, thus improving her/his communication skills.
- The syllabus committee hopes that the spirit of the exercise is carried forward to the textbook and the

- classrooms, across the country, ultimately meeting our objective of reducing the burden on the child while
- making learning Biology exciting. Teaching should emphasise on ways of acquiring knowledge rather than
- on conveying knowledge.

- **CLASS XI (THEORY)**
- **(Total Periods = 180)**
- **I. Diversity in Living World (Periods 25)**
- What is living?; Biodiversity; Need for classification; Three domain of life; Taxonomy & Systematics;
- Concept of species and taxonomical hierarchy; Binomial nomenclature; Tools for study of Taxonomy–
- Museums, Zoos, Herbaria, Botanical gardens.
- Five kingdom classification; Salient features and classification of Monera; Protista and Fungi into
- major groups; Lichens; Viruses and Viroids.
- Salient features and classification of plants into major groups- Algae, Bryophytes, Pteridophytes,
- Gymnosperm and Angiosperm (three to five salient and distinguishing features and at least two examples of
- each category); Angiosperms- classification up to class, characteristic features and examples.
- Salient features and classification of animals- non chordate up to phyla level and chordate up to
- classes level (three to five salient features and at least two examples).
- II. Structural Organisation in Animals and Plants (Periods 25)
- Morphology and modifications; Tissues; Anatomy and functions of different parts of flowering
- plants: Root, stem, leaf, inflorescence- cymose and racemose, flower, fruit and seed (To be dealt along
- with the relevant practical of the Practical Syllabus).

- Animal tissues; Morphology, anatomy and functions of different systems (digestive, circulatory,
- respiratory, nervous and reproductive) of an insect (cockroach). (Brief account only)
- III. Cell Structure and Function (Periods 40)
- Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cell; Plant cell
- and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles– structure and function;
- Endomembrane system- endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria,
- ribosomes, plastids, microbodies; Cytoskeleton, cilia, flagella, centrioles (ultra structure and function);
- Nucleus–nuclear membrane, chromatin, nucleolus.
- Chemical constituents of living cells: Biomolecules–structure and function of proteins, carbodydrates,
- lipid, nucleic acids; Enzymes–types, properties, enzyme action.
- Cell division : Cell cycle, mitosis, meiosis and their significance.
- IV. Plant Physiology (Periods 45)
- Transport in plants: Movement of water, gases and nutrients; Cell to cell transport– Diffusion,
- facilitated diffusion, active transport; Plant – water relations– Imbibition, water potential, osmosis,
- plasmolysis; Long distance transport of water– Absorption, apoplast, symplast, transpiration pull, root
- pressure and guttation; Transpiration– Opening and closing of stomata; Uptake and translocation of mineral
- nutrients– Transport of food, phloem transport, Mass flow hypothesis; Diffusion of gases (brief mention).
- Mineral nutrition: Essential minerals, macro and micronutrients and their role; Deficiency symptoms;

- Mineral toxicity; Elementary idea of Hydroponics as a method to study mineral nutrition; Nitrogen metabolism –
- Nitrogen cycle, biological nitrogen fixation.
- 4
- Photosynthesis: Photosynthesis as a means of Autotrophic nutrition; Where does photosynthesis
- take place; How many pigments are involved in Photosynthesis (Elementary idea); Photochemical and
- biosynthetic phases of photosynthesis; Cyclic and non cyclic photophosphorylation; Chemiosmotic
- hypothesis; Photorespiration; C3
- and C4
- pathways; Factors affecting photosynthesis.
- Respiration: Exchange of gases; Cellular respiration – glycolysis, fermentation (anaerobic), TCA
- cycle and electron transport system (aerobic); Energy relations – Number of ATP molecules generated;
- Amphibolic pathways; Respiratory quotient.
- Plant growth and development: Seed germination; Phases of plant growth and plant growth rate;
- Conditions of growth; Differentiation, dedifferentiation and redifferentiation; Sequence of developmental
- process in a plant cell; Growth regulators–auxin, gibberellin, cytokinin, ethylene, ABA; Seed dormancy;
- Vernalisation; Photoperiodism.
- V. Human Physiology (Periods 45)
- Digestion and absorption: Alimentary canal and digestive glands; Role of digestive enzymes and
- gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates

- and fats; Calorific value of proteins, carbohydrates and fats (for box item not to be evaluated); Egestion;
- Nutritional and digestive disorders– PEM, indigestion, constipation, vomiting, jaundice, diarrhea.
- Breathing and Respiration: Respiratory organs in animals (recall only); Respiratory system in humans;
- Mechanism of breathing and its regulation in humans– Exchange of gases, transport of gases and regulation
- of respiration, Respiratory volumes; Disorders related to respiration-Asthma, Emphysema, Occupational
- respiratory disorders.
- Body fluids and circulation: Composition of blood, blood groups, coagulation of blood; Composition
- of lymph and its function; Human circulatory system– Structure of human heart and blood vessels; Cardiac
- cycle, cardiac output, ECG; Double circulation; Regulation of cardiac activity; Disorders of circulatory
- system-Hypertension, Coronary artery disease, Angina pectoris, Heart failure.
- Excretory products and their elimination: Modes of excretion – Ammonotelism, ureotelism, uricotelism;
- Human excretory system–structure and fuction; Urine formation, Osmoregulation; Regulation of kidney
- function– Renin-angiotensin, Atrial Natriuretic Factor, ADH and Diabetes insipidus; Role of other organs
- in excretion; Disorders-Uraemia, Renal failure, Renal calculi, Nephritis; Dialysis and artificial kidney.
- Locomotion and Movement: Types of movement – ciliary, flagellar, muscular; Skeletal muscle –
- contractile proteins and muscle contraction; Skeletal system and its functions (To be dealt with the relevant

- practical of Practical syllabus); Joints; Disorders of muscular and skeletal system- Myasthenia gravis,
- Tetany, Muscular dystrophy, Arthritis, Osteoporosis, Gout.
- Neural control and coordination: Neuron and nerves; Nervous system in humans– central nervous
- system, peripheral nervous system and visceral nervous system; Generation and conduction of nerve impulse;
- Reflex action; Sensory perception; Sense organs; Elementary structure and function of eye and ear.
- Chemical coordination and regulation: Endocrine glands and hormones; Human endocrine systemHypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone
- action (Elementary Idea); Role of hormones as messengers and regulators, Hypo-and hyperactivity and
- related disorders (Common disorders e.g. Dwarfism, Acromegaly, Cretinism, goiter, exopthalmic goiter,
- diabetes, Addison's disease).
- Imp: Diseases related to all the human physiology systems to be taught in brief.
- 5
- PRACTICALS
- (Total Periods = 60)
- A. List of experiments
- 1. Study and describe three locally available common flowering plants from each of the following
- families (Solanaceae, Fabaceae and Liliaceae) including dissection and display of floral whorls
- and anther and ovary to show number of chambers. Types of root (Tap and Adventitious); Stem
- (Herbaceous and woody); Leaf (arrangement, shape, venation, simple and compound).
- 2. Preparation and study of T.S. of dicot and monocot roots and stems (primary).
- 3. Study of osmosis by potato osmometer.

- 4. Study of plasmolysis in epidermal peels (e.g. Rhoeo leaves)
- 5. Study of distribution of stomata in the upper and lower surface of leaves.
- 6. Comparative study of the rates of transpiration in the upper and lower surface of leaves.
- 7. Test for the presence of sugar, starch, proteins and fats. To detect them in suitable plant and
- animal materials.
- 8. Separation of plant pigments through paper chromatography.
- 9. To study the rate of respiration in flower buds/leaf tissue and germinating seeds.
- 10. To test the presence of urea in urine.
- 11. To detect the presence of sugar in urine/blood sample.
- 12. To detect the presence of albumin in urine.
- 13. To detect the presence of bile salts in urine.
- B. Study/observation of the following (spotting)
- 1. Study parts of a compound microscope.
- 2. Study of the specimens and identification with reasons- Bacteria, Oscillatoria, Spirogyra, Rhizopus,
- mushroom, yeast, liverwort, moss, fern, pine, one monocotyledonous plant and one dicotyledonous
- plant and one lichen.
- 3. Study of specimens and identification with reasons- Amoeba, Hydra, Liverfluke, Ascaris, leech,
- earthworm, prawn, silkworm, honeybee, snail, starfish, shark, rohu, frog, lizard, pigeon and rabbit.
- 4. Study of tissues and diversity in shapes and sizes of plant and animal cells (e.g. palisade cells,
- guard cells, parenchyma, collenchyma, sclerenchyma, xylem, phloem, squamous epithelium, muscle
- fibers and mammalian blood smear) through temporary/permanent slides.
- 5. Study of mitosis in onion root tips cells and animals cells (grasshopper) from permanent slides.
- 6. Study of different modifications in root, stem and leaves.

- 7. Study and identification of different types of inflorescence.
- 8. Study of imbibition in seeds/raisins.
- 9. Observation and comments on the experimental set up for showing:
- a. Anaerobic respiration
- b. Phototropism

- c. Apical bud removal
- d. Suction due to transpiration
- 10. Study of human skeleton and different types of joints.
- 11. Study of external morphology of cockroach through models.
- **CLASS XII (THEORY)**
- **(Total Periods = 180)**
- I. Reproduction (Periods 35)
- Reproduction in organisms: Reproduction, a characteristic feature of all organisms for continuation
- of species; Modes of reproduction – Asexual and sexual; Asexual reproduction; Modes- Binary fission,
- sporulation, budding, gemmule, fragmentation; vegetative propagation in plants.
- Sexual reproduction in flowering plants: Flower structure; Development of male and female
- gametophytes; Pollination–types, agencies and examples; Outbreedings devices; Pollen-Pistil interaction;
- Double fertilization; Post fertilization events– Development of endosperm and embryo, Development of
- seed and formation of fruit; Special modes– apomixis, parthenocarpy, polyembryony; Significance of seed
- and fruit formation.
- Human Reproduction: Male and female reproductive systems; Microscopic anatomy of testis and
- ovary; Gametogenesis- spermatogenesis & oogenesis; Menstrual cycle; Fertilisation, embryo development

- upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition
- (Elementary idea); Lactation (Elementary idea).
- Reproductive health: Need for reproductive health and prevention of sexually transmitted diseases
- (STD); Birth control- Need and Methods, Contraception and Medical Termination of Pregnancy (MTP);
- Amniocentesis; Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (Elementary idea for
- general awareness).
- II. Genetics and Evolution (Periods 45)
- Heredity and variation: Mendelian Inheritance; Deviations from Mendelism– Incomplete dominance,
- Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic
- inheritance; Chromosome theory of inheritance; Chromosomes and genes; Sex determination– In humans,
- birds, honey bee; Linkage and crossing over; Sex linked inheritance- Haemophilia, Colour blindness;
- Mendelian disorders in humans– Thalassemia; Chromosomal disorders in humans; Down's syndrome,
- Turner's and Klinefelter's syndromes.
- Molecular Basis of Inheritance: Search for genetic material and DNA as genetic material; Structure
- of DNA and RNA; DNA packaging; DNA replication; Central dogma; Transcription, genetic code,
- translation; Gene expression and regulation– Lac Operon; Genome and human genome project; DNA
- finger printing.
- Evolution: Origin of life; Biological evolution and evidences for biological evolution (Paleontological,

- comparative anatomy, embryology and molecular evidence); Darwin's contribution, Modern Synthetic
- theory of Evolution; Mechanism of evolution– Variation (Mutation and Recombination) and Natural Selection
- with examples, types of natural selection; Gene flow and genetic dirft; Hardy- Weinberg's principle; Adaptive
- Radiation; Human evolution.
- **III Biology and Human Welfare (Periods 35)**
- Health and Disease: Pathogens; parasites causing human diseases (Malaria, Filariasis, Ascariasis,
- Typhoid, Pneumonia, common cold, amoebiasis, ring worm); Basic concepts of immunology–vaccines;
- Cancer, HIV and AIDs; Adolescence, drug and alcohol abuse.
- Improvement in food production: Plant breeding, tissue culture, single cell protein, Biofortification;
- Apiculture and Animal husbandry.
- Microbes in human welfare: In household food processing, industrial production, sewage treatment, energy generation and as biocontrol agents and biofertilizers.
- **IV Biotechnology and Its Applications (Periods 30)**
- Principles and process of Biotechnology: Genetic engineering (Recombinant DNA technology).
- Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy; Genetically modified organisms- Bt crops; Transgenic Animals; Biosafety issues– Biopiracy and patents.
- **V -Ecology and environment (Periods 35)**
- Organisms and environment: Habitat and niche; Population and ecological adaptations; Population
- Interactions–mutualism, competition, predation, parasitism; Population attributes–growth, birth rate and death rate, age distribution.
- Ecosystems: Patterns, components; productivity and decomposition; Energy flow; Pyramids of

- number, biomass, energy; Nutrient cycling (carbon and phosphorous); Ecological succession; Ecological
- Services– Carbon fixation, pollination, oxygen release.
- Biodiversity and its conservation: Concept of Biodiversity; Patterns of Biodiversity; Importance of
- Biodiversity; Loss of Biodiversity; Biodiversity conservation; Hotspots, endangered organisms, extinction,
- Red Data Book, biosphere reserves, National parks and sanctuaries.
- Environmental issues: Air pollution and its control; Water pollution and its control; Agrochemicals And their effects; Solid waste management; Radioactive waste management; Greenhouse effect and global warming; Ozone depletion; Deforestation; Any three case studies as success stories addressing environmental issues.
- **PRACTICALS**
- **(Total Periods = 60)**
- **List of Experiments**
- 1. Study pollen germination on a slide.
- 2. Collect and study soil from at least two different sites and study them for texture, moisture content,
- pH and water holding capacity of soil. Correlate with the kinds of plants found in them.
- 3. Collect water from two different water bodies around you and study them for pH, clarity and Presence of any living organisms.
- 4. Study the presence of suspended particulate matter in air at the two widely different sites.
- 5. Study of plant population density by quadrate method.
- 6. Study of plant population frequency by quadrate method.
- 7. Prepare a temporary mount of onion root tip to study mitosis.
- 8. To study the effect of the different temperatures and three different pH on the activity of salivary amylase on starch.
- Study/observation of the following (Spotting)
- 1. Flowers adapted to pollination by different agencies (wind, insect).
- 2. Pollen germination on stigma through a permanent slide.

- 3. Identification of stages of gamete development i.e. T.S. testis and T.S. ovary through permanent slides (from any mammal).
- 4. Meiosis in onion bud cell or grass hopper testis through permanent slides.
- 5. T.S. of blastula through permanent slides.
- 6. Mendelian inheritance using seeds of different colour/size of any plant.
- 7. Prepared pedigree charts of genetic traits such as rolling of tongue, blood groups, widow's peak, colour blindness.
- 8. Exercise on controlled pollination – Emasculation, tagging and bagging.
- 9. Identification of common disease causing organisms like Ascaris, Entamoeba, Plasmodium,
- ringworm through permanent slides or specimens. Comment on symptoms of diseases that they cause.
- 10. Two plants and two animals found in xerophytic conditions. Comment upon their morphological
- adaptations.
- 11. Plants and animals found in aquatic conditions. Comment upon their mo

CLASS-XII

38. PHYSICS

Time: 3 Hrs Theory: 70 Marks

Practical: 20 Marks

C.C.E.: 10 Marks

Total: 100 Marks

STRUCTURE OF QUESTION PAPER (THEORY)

1. There will be one theory paper comprising of 26 questions.

2. Question no. 1 to 8 will be of one mark each.

3. Question no. 9 to 16 will be of two marks each.

4. Question no.17 to 23 will be of four marks each. These will be internal choice in any two questions.

5. Question no. 24 to 26 will be of six marks each. There will be internal choice in them.

6. Distribution of marks over different dimensions of the paper will be as

follows.

LEARNING OUTCOMES	MARKS	PERCENTAGE OF MARKS
KNOWLEDGE	26	36%
UNDERSTANDING	30	44%
APPLICATION	14	20%
Total	70	100%

7. In the category of one mark question there will be question of the objective type such as Yes/No, tick/cross, fill in the blanks, multiple choice, true/false etc.

8. Use of un-programmable calculator is allowed. The log tables can be used.

9. Total weightage of numerical will be 20% i.e 14 marks. There will be three numericals of 2 marks each & 2 numericals of 4 marks each.

UNIT WISE DISTRIBUTION OF MARKS

Unit No.	Title	Marks
UNIT-I	Electrostatics	10
UNIT-II	Current Electricity	07
UNIT-III	Magnetic effects of current and magnetism	09
UNIT-IV	Electromagnetic Induction & current	07
UNIT-V	Electromagnetic waves	03
UNIT-VI	Optics	14
UNIT-VII	Dual nature of matter	05
UNIT-VIII	Atoms and Nuclei	05
UNIT-IX	Electronics devices	07
UNIT-X	Communication Systems	03
Total Marks		70

SCHEMATIC DISTRIBUTION OF MARKS

INSTRUCTION FOR PAPER SETTER

Note:There will be one theory paper consisting of total 26 questions.

1. Question no.1 to 8 will be of 1 mark each.There will be 4 questions of the objective type such as yes/no,multiple choice questions, fill in the blanks.

2. Question no.9 to 16 will be of 2 marks each. There will be 3 numerical questions of 2 marks each.

3. Question no. 17 to 23 will be of 4 marks each. There will be two four marks questions of internal choice. Each of these questions will have one theory question & other part will be numerical from the same unit.These questions should not be lengthy.

4. Question No.24 to 26 will be 6 marks and their will be 100% internal choice in them. These questions must have two parts: part (a) will be of one mark and part (b) will be of 5 marks. Part (a) may cover any topic from same unit as of long 5 marks question of part (b).

5. Questions paper should cover all the syllabus.

6. No question or topic should be repeated in the question paper.

7. Questions in the paper can be asked only from mentioned PSEB syllabus. Questions from any topic which is not mentioned in the syllabus will be considered as out of syllabus question.

8. All 3 sets must be of equal standard and difficulty level questions.

9. At the end of each question, paper setter must write detailed distribution of marks of each sub-question.

10. Vague, many possible answer questions, confusing answer question etc type of question will not be asked in the paper. One mark questions, answer should be of one word or one line only.

11. Language used should be clearly understood & specific.

12. Time and length limit of paper should be kept in mind.

UNIT Title 1 Mark Question 2 Marks Question 4 Marks

Question
6 Marks
Question
Total
Marks
1 Electrostatic - - 1 1 10
2 Current Electricity 1 1 1 - 07
3 Magnetic effects of current &
magnetism
1 1 - 1 09
4 Electromagnetic Induction &
Alternating current
1 1 1 - 07
5 Electromagnetic waves 1 1 - - 03
6 Optics - 2 1 1 14
7 Dual Nature of matter 1 - 1 - 05
8 Atoms & Nuclei 1 - 1 - 05
9 Electronic devices 1 1 1 - 07
10 Communication system 1 1 - - 03
Total Questions 8 8 7 3 26
Total Marks 8 16 28 18 70

13. Time and length limit of paper should be kept in mind while setting the paper.
14. Questions paper should be made to according to knowledge, understanding and applications part marks distribution.
THEORY
Unit-1: Electrostatics
Electric Charges; charging by induction, basic properties of electric charge (addition of charges, quantisation of charges and their Conservation) Coulomb's law-force between two point charges, forces between multiple

charges; superposition principle and cotineous charge distribution.
Electrical field, electric field due to a point charge, electric field due to system of charge, physical significance of electric field, electric-field lines; electric dipole, electric field due to a dipole;(on its axis,on equatorial plane)physical significance of dipoles; torque on a dipole in uniform electric field.Electric field due to continuous charge distribution.
Electric flux, statement of Gauss's theorem proof of Gauss's theorem for a charge enclosed in sphere, and its applications to find electric field due to infinitely long straight wire, uniformly charged infinite thin plane sheet and uniformly charged thin spherical shell (Field inside and outside).
Electric potential, potential difference, electric potential due to a point charge, potential due to an electric dipole with special cases for axis and equatorial plane and system of charges; equipotential surfaces,its properties,relation between field and potential electrical potential energy of a system of two point charges potential energy in external field and of electric dipole in an electrostatic field.
Conductors and insulators, electrostatics of conductors, free charges and bound charges inside a conductor. Electrostatic shielding its uses, Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor, Van de Graaf generator.
Unit-II: Current Electricity
Electric current, flow of electric charges in a metallic conductor, drift velocity, drift of electron mobility and their relation with electric current: Ohm's law, electrical resistance. V-1 characteristics (linear and non linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance and resistivity.Internal resistance of a cell, potential difference and emf of cell, combination of cells in series and in parallel.

Kirchhoff's laws and simple applications of Wheatstone bridge, meter bridge.Potentiometer-principle and its applications to measure potential difference and for comparing emf of two cells, measurement of internal resistance of a cell.

Unit-III: Magnetic Effects of Current and Magnetism

Concept of magnetic field. Oersted's experiment;

Biot-savart law and its application to find mangnetic field on the axis of a current carrying circular loop, Ampere's circuital law (no proof) and its applications to infinitely long straight wire, straight and toroidal solenoids.

Force on a moving charge in uniform magnetic and electric fields.Motion in a magnetic field,motion in combined electric and magnetic field (velocity selector) Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field Force between two parallel current-carrying conductors, definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometersits current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment.

Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (Bar magnet) along its axis and perpendicular to its axis.

Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; magnetism and Gauss’s law; Earth's magnetic field and magnetic elements, magnetisation and magnetic intensity, magnetic properties of materials, Para-, dia-and ferromagnetic substances with examples, Electromagnets and factors affecting their strengths. Permanent magnets.

Unit-IV: Electromagnetic Induction and Alternating Currents

Electromagnetic induction, Faraday's and henry experiments,magnetic flux,Faraday laws, induced emf and current, Lenz's Law and conservation of energy, motional emf, Eddy currents: Self and mutual inductance.

Alternating current, peak and rms value of alternating current/voltage;

reactance and impedances; phasors, ac applied across resistance, ac applied across inductor, as applied across capacitor, ac applied across LCR, LC oscillations, across inductor, ac applied across capacitor ,ac applLC oscillations, (qualitative treatment only), LCR series circuit resonance; power in AC circuit, wattless current.

AC generator and transformer.

Unit-V: Electromagnetic Waves

Need for displacement current, Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves.

Electromagnetic spectrum (Radio waves, Radio-microwaves, infra-red, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

Unit-VI: Optics

Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibers, refraction at spherical surfaces, refraction by lens, lenses, thin lens formula/equation, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact, combination of lens and mirror. Refraction and dispersion of light through a prism. Some natural phenomenon due to sunlight,Scattering of light-blue colour of the sky and reddish appearance of the sun at sunrise and sunset.

Optical instruments:

Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia) using lenses. Microscopes and astronomical tetescopes (reflecting and refracting) and their magnifying powers.

Waves optics :

wave front and Huygens' Principle, reflection and refraction of plane wave at a plane surface using Huygens' Principle, wave fronts. Proof of laws of reflection and refraction using Huygens 'Principle. Interference Young's

double hole experiment and expression for fringe width, coherent sources and incoherent addition of waves and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarisation, polarization by scattering and reflection, plane polarised light -Brewster's law, uses of plane polarised light and Polaroids.

Unit-VII: Dual nature of Matter and Radiation

Electron emission, Photoelectric effect, Hertz and Lenard's observations'; experimental study of photoelectric effect, and wave theory of light, Einstein's photoelectric equation, particle nature of light, the photon, Matter waves-wave nature of particles, de Broglie relation. Davission-Germer experiment (experimental details should be omitted; only conclusion should be explained).

Unit-VIII: Atoms & Nuclei

Alpha-particle scattering experiment; Rutherford's model of atom; Bohar modal of hydrogen atom, expression for radius, velocity and energy of electron in orbit, energy levels, line spectrum of hydrogen atom, atomic spectra,de-Broglie’s explanation of Bohr’ s second postulate of quantization. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivity- alpha, beta and gamma particles/rays and their properties; radioactive decay law, alpha, beta and gamma decay. Mass-energy

relation, mass-defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear force,nuclear reactor, Nuclear energy.

Unit-XI: Electronic Devices

Classification of metal insulator and semiconductor, Energy bands in solids (qualitative idea only) conductor, insulators and Semiconductors;intrinsic and extrinsic semiconductors,p-n junction, semiconductor Diode-1-V characteristics in forward and reverse bias, diode as a rectifier, 1-V characteristics of LED, photodiode, solar cell and Zener diode, Zener diode as a voltage regulator. Junction transistor, transistor action;

characteristics of a common emitter transistor: transistor as an amplifier (common emitter configuration) and oscillator, digital electronics and Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch,integrated circuits.

Unit-X: Communication Systems

Elements of a communication system (block diagram only); basic terminology Used in Electronic Communication Systems, bandwidth of signals (speech, TV and digital data); bandwidth of transmission mediumPropagation of electromagnetic waves in the atmosphere, Sky and space wave propagation. Need for modulation. Production and detection of an amplitude modulated wave.

NOTE:- TOPICS GIVEN BELOW ARE IN PRESCRIBED SYLLABUS OF P.S.E.B BUT NOT MENTIONED IN BOOK SUBSCRIBED BY PSEB. SO THESE TOPICS ARE TO BE DONE WITH STUDENTS AND PAPER WILL INCLUDE THESE TOPICS AND QUESTIONS FROM THESE TOPICS WILL NOT CONSIDERED AS OUT OF SYLLABUS.

1. Electric flux
2. Potentiometer and its applications to measure potential difference
3. Magnetic field intensity due to a magnetic dipole (Bar magnet) along its axis and perpendicular to its axis.
4. Combinations of lens and mirror
5. Poor of laws of reflection and refraction using Huygens 'Principle'.
6. Alpha-beta and gamma particles/rays and their properties.

PHYSICS

STRUCTURE OF PAPER (PRACTICAL)

Time: 3 hrs. Total: 20 Marks

Two experiment 10

Record of Activities 2

Viva on Activities 3

Record of Experiments 2

Viva of Experiments 3

Total 20

- 129 -

PRACTICALS SYLLABUS

Experiments

SECTION-A

1. To determine resistance per unit length of a given wire by plotting a graph of potential difference versus current.
2. To find resistance of a given wire using meter bridge and hence determine the specific resistance of its material.
3. To verify the laws of combination (series/parallel) of resistance using a meter bridge.
4. To compare the emf of two given primary cells using potentiometer.
5. To determine the internal resistance of given primary cell using potentiometer.
6. To determine resistance of a galvanometer by half-deflection method and to find its figure of merit.
7. To convert the given galvanometer of known resistance and figure of merit into an ammeter and voltmeter of desired range and to verify the same.
8. To find the frequency of the A.C. mains using a sonometer and electromagnet.

SECTION-B

1. To find the value of v for different values of u in case of a concave mirror and find their focal length.
2. To find the focal length of a convex lens by plotting graphs between u and v or between 1/u and I/v.
3. To find the local length of a convex mirror, using a convex lens.
4. To find the focal length of a concave lens, using a convex lens.
5. To determine angle of minimum deviation for a given prism by plotting a graph between angle of incidence and angle of deviation.
6. To draw the I-V characteristic curve of a p-n junction in forward bias

and reverse bias.

7. To draw the characteristic curve of a zener diode and to determine its reverse breakdown voltage.

8. To study the characteristics of a common-emitter npn or pnp transistor and to find out the values of current and voltage gains.

9. To determine the reflective index of a glass slab using a traveling microscope.

10. To find refractive index of a liquid by using (i) Concave mirror. (ii) Convex lens and plane mirror.

ACTIVITIES

SECTION-A

1. To assemble the components of a given electrical circuit.

2. To draw the diagram of a given open circuit comprising at least a battery, resistor rheostat, key ammeter and volt meter. Mark the components that are not connected in proper order and correct the circuit and also the circuit diagram.

3. To assemble a household circuit comprising three, bulbs, three (on/off) switches, a – fuse and a power source.

4. To study the variation in potential drop with length of a wire for a steady current.

5. To measure resistance, voltage (AC/DC), current (AC) and check continuity of a given circuit using multimeter.

6. To measure the resistance and impedance of an inductor with or without iron core.

7. To demonstrate

(i) The use of an improvised fuse that melts with the flow of a certain current through it and

(ii) Different kinds of fuses used in everyday life.

8. To demonstrate that a current measuring device has finite non- zero resistonce. (measurement of resistance of an ammeter).

9. To demonstrate that a voltage measuring device has non- infinite resistance (measurement of resistance of an voetmeter).

10. To show that earth's magnetic field has both vertical & horizontal components, by using dip needle.

11. To show the magnetic field lines with the help of iron fillings of bar magnet solenoid.

12. To show the production of induced emf. in a coil due to movement of (i) a magnet towards and away from it (ii) similar coil carrying current towards & away from it.

13. To show that there are two kinds of charges and that like charges repel and unlike charges attract each other.

14. To demonstrate that a large emf is induced when direct current is switched off in an inductive circuit.

15. Make a solenoid for study of its magnetic field.

SECTION-B

1. To identify a diode, an LED, a transistor and 1C, a resistor and a capacity from mixed collection of such items.

2. Use of multimeter to (i) identify base of transistor, (ii) distinguish between npn ad pnp type transistors, (iii) see the unidirectional flow of

current in case of a diode and an LED. iv) Check whether a given electronic component (e.g. diode, transistor or IC) is in working order.

3. To observe refraction and lateral deviation of a beam of light incident obliquely on a glass stab.

4. To study the nature arid size of the image formed by (i) convex lens (ii) concave mirror, on a screen by using a candle and a screen (for different distances of the candle from the lens/mirror).

5. To obtain a lens combination with the specified focal length by using two lenses from the given set of lenses.

6. To observe polarization of light using two Polaroids.

7. To observe diffraction of light due to a thin slit.

8. To study effect of intensity of light (by varying distance of the source) on an D.R.

CLASS-XII

39. CHEMISTRY

Time: 3 Hrs Theory: 70 Marks

Practical: 20 Marks

C.C.E.: 10 Marks

Total: 100 Marks

STRUCTURE OF QUESTION PAPER (THEORY)

1. There will be one theory paper comprising of 26 questions. All questions are compulsory.

2. Question no. 1 to 8 will be of one mark each. All questions are compulsory.

3. Question no. 9 to 16 will be of two marks each. All questions are compulsory.

4. Question no.17 to 23 will be of four marks each.There will be internal choice in two questions.

5. Question no.24 to 26 will be of six marks each. There will be internal choice in them.

6. Distribution of marks over different dimensions of the paper will be as follows.

LEARNING OUTCOMES	PERCENTAGE OF MARKS
KNOWLEDGE	36%
UNDERSTANDING	44%
APPLICATION	20%
Total	100%

7. There will be question of the objective type such as Yes/No, tick/cross, fill in the blanks, multiple choice, true/false and definition etc.

8. Use of un-programmable calculator is allowed. The log tables can be used.

9. Total weightage of numerical will around 20%

UNITWISE DISTRIBUTION OF MARKS

SR.NO	UNIT	TOTAL MARK
1	Solid state	06
2	Solutions	05
3	Electro-chemistry	04
4	Chemical-kinetics	03
5	Surface chemistry	04
6	General principles &process of isolation of elements	02
7	p-block elements	10
8	d &f-block elements	08
9	Coordination number	02
10	Haloalkanes & Haloarenes	06
11	Alcohol, Phenols &Ether	05
12	Aldehyde, Ketons & Carbooxalic acids	05
13	Organic compounds containing Nitrogen compounds	03
14	Biomolecules	03
15	Polymers	02
16	Chemistry in everyday life	02

TOTAL QUESTIONS &TOTAL MARKS T.Q=26 T.M=70

Total Question in paper =26

SCHEMATIC DISTRIBUTION OF MARKS

Note: In above SCHEMATIC DISTRIBUTION OF MARKS

T=Theory and N=Neumerical

Total Question in paper =26 including 5 choice questions

NSTRUCTIONS FOR PAPER SETTER

Note:

1. There will be one theory paper consisting of total 26 questions.

2. Question no.1 to 8 will be of 1 mark each.There will be 4 questions of the objective type such as yes/no,multiple choice questions, fill in the blanks.

Sr. No	UNIT	1 MARK	2 MARK	4 MARK	6 MARK	TOTAL MARK
1	Solid state	-	1 N	1 (2 marks T +2 marks N)	-	06
2	Solutions	1 N	-	1 (2 marks T + 2 marks N) OR (2 marks T + 2 marks N)	-	05
3	Electro-chemistry	-	-	1 (4 marks N) OR (4 marks T)	-	04
4	Chemical-kinetics	1N	1N	-	-	03
5	Surface chemistry	-	-	1	-	04
6	General principles &process of isolation of elements					

- 1 - - 02

7 p-block elements - 1 - 1 08

8 d &f-block
elements
- 1 - 1 08

9 Coordination
number
- 1 - - 02

10 Haloalkanes &
Haloarenes
- - - 1 06

11 Alcohol, Phenols
&Ether
1 - 1 - 05

12 Aldehyde, Ketons &
Carbooxalic acids
1 - 1 - 05

13 Organic
compounds
containing
Nitrogen
compounds
1 1 - - 03

14 Biomolecules 1 1 - - 03

15 Polymers - - 1 - 04

16 Chemistry in
everyday life
2 - - - 02

TOTAL
QUESTIONS
&TOTAL MARKS

T.Q=8

T.M=8

T.Q=8

TM=16

T.Q=7

T.M=28

T.Q=3

T.M=18

T.Q=26

T.M=70

3. Question no.9 to 16 will be of 2 marks each. There will be 3 numerical questions of 2 marks each.

4. Question no. 17 to 23 will be of 4 marks each. There will be two four marks questions of internal choice. These questions should not be lengthy.

5. Question No.24 to 26 will be 6 marks and their will be 100% internal choice in them. These questions must have two parts: part (a) will be of one mark and part (b) will be of 5 marks. Part (a) may cover any topic from same unit as of long 5 marks question of part (b).

6. Questions paper should cover all the syllabus.

7. No question or topic should be repeated in the question paper.

8. Questions in the paper can be asked only from mentioned PSEB syllabus. Questions from any topic which is not mentioned in the syllabus will be considered as out of syllabus question.

9. All 3 sets must be of equal standard and difficulty level questions.

10. At the end of each question, paper setter must write detailed distribution of marks of each sub-question.

11. Vague, many possible answer questions, confusing answer question etc type of question will not be asked in the paper. One mark questions, answer should be of one word or one line only.

12. Language used should be clearly understood & specific.

13. Time and length limit of paper should be kept in mind.

14. Time and length limit of paper should be kept in mind while setting the paper.

SYALLBUS (THEORY)

Unit-I: Solid, State

Classification of solids based on different binding forces:
molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, points defects, electrical and magnetic properties. Band theory of metals, conductors, semiconductors and insulators and n and p type semiconductors.

Unit II: Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties - relative lowering of vapour pressure, Raoults Law, elevation of B.P., depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass. Vant Hoff factor.

Unit III: Electrochemistry

Redox reactions; conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea) dry cell-electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion. Relation between Gibbs Energy change and EMF of cell.

Unit IV: Chemical Kinetics

Rate of a reaction (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction: rate law and specific rate constant, integrated rate equations

and' half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment). Activation Energy, Arrhenious equation.

Unit V: Surface Chemistry

Absorption physiorption and chemisorption; factors affecting adsorption of gases on solids; catalysis; homogenous and heterogeneous, activity and selectivity; enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophillic, lyophobic, multimolecular and macromolecular/colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion-types of emulsions.

Unit VI: General Principles and Processes of Isolation of Elements

Principles and methods of extraction – concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminum, copper, zinc and Iron.

Unit VII: p-Block Element

Group 15 elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen - preparation, properties and uses; compounds of nitrogen- preparation and properties of ammonia and nitric acids, oxides of nitrogen (structure only); Phosphorous-allotropic forms; compounds of phosphorous preparation and properties of phosphine, halides (PCl3,PCl5) and oxoacids (elementary idea only).

Group16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen; preparation, properties and uses; classification of oxides; Ozone. Sulphur - allotropic forms; compounds of sulphur preparation, properties and uses of sulphur dioxide, sulphuric acid, industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only).

Group 17 elements: (General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical

properties; compounds of halogens; preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

Group 18 elements: General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses.

Unit-VIII: d and f Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals-metallic character, ionization, enthalpy, oxidation states, ionic radii, colour, catalytic properties, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of $K_2Cr_2O_7$,and $KMnO_4$.

Lanthanoids - electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and consequences.

Actenoids - Electronic configuration, oxidation states.

Unit-IX: Coordination Compounds

Coordination compounds - introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds, bonding; Werner's theory VBT, CFT, Isomerism (structure and stereo) importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

Unit-X: Haloalkanes and Haloarenes.

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

Halearenes: Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only)

Uses and environmental effects of - dichloromethane, trichlromethane, tetrachloromethane, iodoform, freons, DDT.

Unit –XI: Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary,

secondary and tertiary alcohols; mechanism of dehydration, uses, with special reference to - methanol and ethanol.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit-XII: Aldehydes, Ketones aml Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, and

mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit-XIII: Organic compounds containing Nitrogen

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides - will be mentioned at relevant places in context.

Dizonium Salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit-XIV: Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccaharides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance

Proteins - Elementary idea of amino acids, peptide bond, polypeptides proteins, primary structure, secondary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes.

Vitamins: Classification and functions.

Harmones: Elementary idea (excluding structure)

Nucleic Acids: DNA & RNA .

Unit-XV: Polymers

Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers; natural and synthetic like polythene, nylon, polyesters, bakelite, rubber. Biodegradable and Non- Biodegradable Polymers.

Unit-XVI: Chemistry in everyday life :

1. Chemicals in medicines analgesic, transquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

2. Chemicals in food- preservatives, artificial sweetening agents. Elementary idea of antioxidents.

3. Cleansing agents- soaps and detergents, cleansing action.

CHEMISTRY

STRUCTURE OF QUESTION PAPER (PRACTICAL)

Time: 3.00 hrs. Marks: 20

Volumetric Analysis 6

Mixture Analysis 5

Content based Experiment 5

Class record & viva 4

Total Marks 20

PRACTICAL SYLLABUS

A. Surface Chemistry

a. Preparation of one lyophilic and one lyophobic sol. Lyophilic sol - starch, egg albumin and gum. Lyophobic sol - aluminum hydroxide, ferric hydroxide, arsenious sulphide.

b. Study of the role of emulsifying in stabilizing the emulsions of different oils.

B. Chemical Kinetics

a. Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

b. Study of reaction rates of any one of the following:-

i. Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.

ii. Reaction between potassium iodate, KIO3, and sodium sulphite: (Na2 SO3) using starch solution as indicator (clock reaction).

C. Thermochemistry: Any one of the following experiments

a. Enthalphy of dissolution of copper sulphate or potassium nitrate.

b. Enthalphy of neutralization of strong acid (HCl) and strong base (NaOH)

c. Determination of enthalpy change during interaction (Hydrogen bond formation) between acetone and chloroform.

D. Electrochemistry: Variation of cell potential in Zn/Zn+2IICu+2/Cu with change in concentration of electrolytes (CuSO4 or ZnSO4 at room temperature.

E. Chromatography

a. Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of Rf values.

b. Separation of constituents present in an inorganic mixture containing two cations only (constituents having wide difference in Rf, values to be provided).

F. Determination of concentration/morality of KMnO4, solution by titrating it against a standard Solution of:

a. Oxalic acid.

b. Ferrous ammonium sulphate.

(Students will be required to prepare standard solutions by weighing themselves).

G. Preparation of Inorganic Compounds

a. Preparation of double salt of ferrous ammonium sulphate or potash alum.

b. Preparation of potassium ferric oxalate.

H. Preparation of Organic Compounds: Preparation of any two of the following compounds

a. Acetanilide

b. Di-benzal acetone

c. p-Nitroacetanilide,

d. Aniline yellow òr 2-Napthol aniline dye.

e. Lodoform

I. Test for the functional groups present in organic compounds: Unsaturation, alcoholic, pheholic, aldehydic, ketonic, carboxylic and amino (primary) groups.

J. Study of carbohydrates, fats and proteins in pure form and detection of their presence in given food stuffs.

K. Qualitative analysis: Determination of one catiop and one anion in a given salt.

Cations- Pb2+, Cu2+, As3+, Al3+, Fe3+, Mn

2+, Zn2+, Co2+, Ni

2+, Ca2+, Sr2+,

Ba2+, Mg2+, NH4

+

Anions-

– – – – – ——– – – H ,OC ,PO ,I ,Br ,Cl ,NO ,NO ,SO ,S ,CO 2COOC

2

42

3-

4

1 1

3

1

2

2

3

2 2

3

(Note: Insoluble salts excluded)

PROJECT

Scientific investigations involving laboratory testing and collecting information from other sources.

A few suggested Projects

1. Study of presence of oxalate ions in guava fruit at different stages of ripening.

2. Study of quantity of casein present in different samples of milk.

3. Preparation of soyabean milk and its comparison with the natural milk with respect to curd formation, effect of temperature etc.

4. Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc,)

5. Study of digestion of starch by salivary amylase and effect of PH and temperature on it.

6. Comparative study of the rate of fermentation of following material wheat flour. gram flour, Potato juice, carrot juice etc.

7. Extraction of essential oils present in saunf (aniseed), Ajwain (carum) illaichi (cardamom).

8. Study of common food adulterants in fat, oil, butter, sugar, turmeric powder, chilli powder and pepper.

Note: Any investigatory project, which involves about 10 periods of work, can be chosen with the approval of the teacher.

CLASS-XII

40. BIOLOGY

Time: 3 Hrs Theory: 70 Marks

Practical: 20 Marks

C.C.E.: 10 Marks

Total: 100 Marks

STRUCTURE OF QUESTION PAPER (THEORY)

1 There will be one theory paper comprising of 26 questions.

2 Question no. 1 to 8 will be of one mark each and all are compulsory.

3 Question no. 9 to 16 will be of two marks each and all are compulsory.

4 Question no.17 to 23 will be of four marks each. Question no. 17 to 21 are compulsory (one question from each unit) There will be 100% internal choice in question no 22 & 23. Q no.22 will be from unit III and Q no. 23 will be from unit IV and all are compulsory.

5 Question no.24 to 26 are of six marks each. There will be 100% internal choice in these questions.

6 Distribution of marks over different dimensions of the paper will be as follows.

LEARNING OUTCOMES	MARKS	PERCENTAGE OF MARKS
KNOWLEDGE	25	36%
UNDERSTANDING	31	44%
APPLICATION	14	20%
Total	70	100%

7 Out of eight one mark questions, 4 questions can be of the objective type such as Yes/No, tick/cross, fill in the blanks, multiple choice, true/false etc.Other four should be of statement type.

UNIT WISE DISTRIBUTION OF MARKS

Unit	Title	Marks
I	Reproduction	14
II	Genetics & Evolution	16

III Biology and Human Welfare 13

IV Biotechnology and its applications 13

V Ecology and Environment 14

Total Marks 70

SCHEMATIC DISTRIBUTION OF MARKS

Unit	Chapter	1 mark questions	2 marks questions	4 marks questions	6marks questions	Total marks
Reproduction	1 . Reproduction in organisms	1	-	-	-	1
	2. Sexual reproduction in flowering plants	1	-	-	1 or 1(One question should be from chapter 2 and other choice question should be from chapter 3)	7
	3. Human					

Reproduction

- 1 - 2

- 142 -

4. Reproductive health

- - 1 - 4

Genetics and Evolution

5. Heredity and variation

1 - 1 - 5

6. Molecular bases of inheretance

1 1 1 OR 1 (One question should be from chapter 6 and other choice question should be from chapter 7)

9

7. Evolution - 1 - 2

Biology and Human welfare

8.Human health and diseases

- 1 1 - 6

9. Strategies for enhancement in food production

1 - 1(One question should be from chapter 9 and other choice question should be from chapter 10)

- 5

10. Microbes in human welfare

- 1 - 2

Biotechnology and its applications

BiotechnologyPrinciples and processes

- 1 1 0R 1 - 6

Biotechnology and its applications

1 1 1 - 7

Ecology and environment

13. Organisms and

populations

- 1 - - 2

14. ecosystem 1 - - 1 (One question should be from chapter 14 and other choice question should be from chapter 16)

7

15. Biodiversity and conservation

- - 1 - 4

16. Environmental issues

1 - - - 1

No. Of questions

8 8 7 3

INSTRUCTIONS FOR PAPER SETTER

Note:

1. There will be one theory paper of total 26 questions. The paper setter will set questions according to schematic distributions of marks as given in the table.
2. Questions no.1 to 8 are compulsory and are of one mark each.
3. Question no 9-16 are compulsory and are of two marks each.

4. Questions no. 17-23 are of four marks each. Question no 17 to 21 are compulsory and there should be one question from each unit. Wheres question no 22 and 23 will have 100% internal choice. The paper setter will set question no 22 from unit-III and question no 23 from unit IV.

Internal choice questions should be from same units.

5. Question No.24 to 26 are of six marks each and there is 100% internal choice in these questions.

6. Questions in the paper can be asked only from mentioned PSEB syllabus.

7. Questions in all 3 sets must be of equal standard and difficulty level.

8. At the end of each question, paper setter must write detailed distribution of marks of each sub-question.

9. Vague, questions with confusing answers and questions with many possible answers, will not be asked in the paper. In one mark questions, answer should be of one word or one line only.

10. Language used should be clearly understood & specific.

11. Time and length limit of paper should be kept in mind.

SYLLABUS (THEORY)

Unit I: Reproduction

Chapter 1 Reproduction in organisms:

Reproduction, a characteristic feature of all organism for continuation of species; Modes of reproduction-Asexual and sexual reproduction; Modes – Binary fission, sporulation, budding, gemmule, fragmentation; vegetative propagation in plants.

Chapter 2 Sexual reproduction in flowering plants:

Flower structure; Development of male and female gametophytes; Pollinationtypes, agencies and examples; Outbreedings devices; Pollen-Pistil interaction;
Double fertilization; Post fertilization events-Development of endosperm and embryo, Development of seed and formation of fruit; Special modes-apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.

Chapter 3 Human Reproduction:

Male and female reproductive systems; Microscopic anatomy of testis and

ovary; Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilisation, embryo development upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition (Elementary idea); Lactation (Elementary idea).

- 144 -

Chapter 4 Reproductive health:

Need for reproductive health and prevention of sexually transmitted diseases (STD); Birth control – Need and Methods, Contraception and Medical Termination of Pregnancy (MTP); Amniocentesis; Infertility and assisted reproductive technologies-IVF, ZIFT, GIFT (Elementary ides for general awareness).

Unit II. Genetics and Evolution

Chapter 5 Heredity and variation:

Mendelian Inheritance; Deviations from Mendelism-Incomplete dominance, Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; Chromosome theory of inheritance; Chromosomes and genes; Sex determination-In humans, birds, honey bee; Linkage and crossing over; Sex linked inheritance – Haemophilia, Colour blindness; Mendelian disorders in humans- Thalassemia; Chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

Chapter 6 Molecular Basis of Inheritance:

Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; Transcription, genetic code, translation; Gene expression and regulation- Lac Operon; Genome and human genome project; DNA finger printing.

Chapter 7 Evolution:

Origin of life; Biological evolution and evidences for biological evolution (Paleontological, Comparative anatomy, embryology and molecular evidence); Darwin's contribution, Modern Synthetic theory of Evolution; Mechanism of evolution-Variation (Mutation and Recombination) and Natural Selection with

examples, types of natural selection; Gene flow and genetic drift; HardyWeinberg's principle; Adaptive Radiation; Human evolution.

Unit III. Biology and Human Welfare

Chapter 8 Human Health and Disease:

Pathogens/ parasites causing human diseases (Malaria, Filariasis, Ascariasis, Typhoid, Pneumonia, common cold, amoebiasis, dengue, chickengunia, ring worm); Basic concepts of immunology-vaccines; Cancer, HIV and AID's; Adolescence, drug and alcochol abuse.

Chapter 9 Strategies for Enhancement in Food Production

Improvement in food production: plant breeding, tissues culture, single cell protein, Bifortification, Apiculture and animal husbandary.

Chapter 10 Microbes in human welfare:

In household food processing, industrial production, sewage treatment, energy generation and Microbes as biocontrol agents and biofertilizers, Antibiotics-production.

Unit IV. Biotechnology and its applications

Chapter 11 Biotechnology: Principles and processes:

Genetic engineering (Recombinant DNA technology).

Chapter 12 Biotechnology and its applications

Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy; genetically modified organisms- Bt crops; Transgenic Animals; Biosafety issues-Biopiracy and patents.

Unit V. Ecology and environment

Chapter 13 Organisms and populations

Organisms and environment: Habitat and niche; Population and ecological adaptations; Population interactions-mutualism, competition, predation, parasitism; Population attributes-growth, birth rate and death rate, age distribution.

Chapter 14 Ecosystem:

Patterns, components; productivity and decompositions; Energy flow;

Pyramids of number, biomass, energy; Nutrients cycling (carbon and phosphorous); Ecological succession; Ecological Services-Carbon fixation, pollination, oxygen release.

Chapter 15 Biodiversity and conservation:

Concepts of Biodiversity; Patterns of Biodiversity; Importance of Biodiversity; Loss of Biodiversity; Biodiversity conservation; Hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, National parks and sanctuaries.

Chapter 16 Environmental issues:

Air pollution and its control; Water pollution and its control; Agrochemicals and their effects; Solid waste management; Radioactive waste management; Greenhouse effect and global warming; Ozone depletion; Deforestation; Any three case studies as success stories addressing environmental issues.

BIOLOGY

STRUCTURE OF QUESTION PAPER (PRACTICAL)

Time: 3.00 hrs. Total 20: Marks

1. Experiment and Spotting 12
2. Record of one investigatory and Viva based on the project 4
3. Class record and Viva based on experiments 4

Total 20

SYLLABUS (PRACTICAL)

1. Study of pollen grains on a slide.
2. Study of flowers adapted to pollination by different agencies (wind, insect)
3. Study of pollen germination on a slide.
4. Study and identify stages of gamete development i.e. T.S of testis and T.S of ovary through permanent slides.
5. Study meiosis in Onion bud cell or grasshopper testis through permanent slides.
6. Study of T.S of blastula through permanent slide.
7. Study mendelian inheritance using seeds of different colour/size of any plant.

8. Study prepared pedigree charts of genetic traits such as rolling of tongue, blood groups, window's peak, colour blindness.

9. Exercise on controlled pollination -Emasculation, tagging and bagging.

10. Study analogous and homologous organs in various plants and animals.

11. Collect and study soil from different sites and study them for texture and moisture content.

12. Study the pH and water holding capacity of soil correlate with the kinds of plants found in them.

13. Collect water from different water bodies around you and study them for pH clarity and presence of any living organisms.

14. Study the presence of any suspended particulate matter in air at the two widely different sites.

15. Study of plant population density by quadratic method.

16. Study of plant population frequency by quadrate method.

17. Study of plants and animals found in xerophytes conditions. Comment upon their adaptation ecosystem.

18. Study plants and animals found in aquatic conditions. Comment upon their adaptation ecosystem.

19. To identify common disease causing organnisms like Ascaris, Endameba, Plasmodium, ringworm. Comment on symptoms of diseases that they cause through permanent slides or specious.

Information Sources.

Analysis using Bioinformatics, tools.

PRACTICAL

Time: 3 Hours Marks: 20

List of Experiments

Bacterial transformation using any plasmid.

Multiplication of tobacco by nodal bulb culture.

Data retrieval and database search using internet site NCBI.

Production and estimation of ethanol from microbial culture.

Determination of LCG in Urine (Pregnancy Test).

Isolation of bacterial plasmid DNA and its detection by gel electrophoresis.

Restriction digestion of plasmid DNA and its analysis by gel electrophoresis.

Download a DNA and protein sequence from internal, analysis and comment on it.

Determination of N-terminal of a protein.

Ion-exchange chromatography for proteins.

Reading of DNA sequencing to get and arrive at the sequence.

Project work.

Note: - The subtopics which are printed in the books published by Punjab School Education Board but are not mentioned in syllabus, should be considered as part of syllabus.

b) Instructional aids: Meaning, importance, classification, principles of selection, use of chalk board, Charts, models, LCD projector, computer, EDUSAT

c) 1) Every individual has the tendency to forget. Proper use of teaching aids helps to retain more concept permanently.

2) Students can learn better when they are motivated properly through different teaching aids.

3) Teaching aids develop the proper image when the students see, hear taste and smell properly.

4) Teaching aids provide complete example for conceptual thinking.

5) The teaching aids create the environment of interest for the students.

6) Teaching aids helps to increase the vocabulary of the students.

7) Teaching aids helps the teacher to get sometime and make learning permanent.

8) Teaching aids provide direct experience to the students.

d) Types of Teaching Aids

e)

There are many aids available these days. We may classify these aids as follows-

. Visual Aids

. Audio Aids

. Audio - Visual Aids

1) <u>Visual Aids</u>

The aids which use sense of vision are called Visual aids. For example :- actual objects, models, pictures, charts, maps, flash cards, flannel board, bulletin board, chalkboard, overhead projector, slides etc. Out of these black board and chalk are the commonest ones.

2) <u>Audio Aids</u>

The aids that involve the sense of hearing are called Audio aids. For example :- radio, tape recorder, gramophone etc.

3) <u>Audio - Visual Aids</u>

The aids which involve the sense of vision as well as hearing are called Audio- Visual aids. For example :- television, film projector, film strips etc.

f) Importance of Teaching aids

Teaching aids play an very important role in Teaching- Learning process.
Importance of Teaching aids are as follows :-

1) <u>Motivation</u>
Teaching aids motivate the students so that they can learn better.

2) <u>Clarification</u>
Through teaching aids , the teacher clarify the subject matter more easily.

3) <u>Discouragement of Cramming</u>
Teaching aids can facilitate the proper understanding to the students which discourage the act of cramming.

4) <u>Increase the Vocabulary</u>
Teaching aids helps to increase the vocabulary of the students more effectively.

5) <u>Saves Time and Money</u>

6) <u>Classroom Live and active</u>
Teaching aids make the classroom live and active.

7) <u>Avoids Dullness</u>

8) <u>Direct Experience</u>
Teaching aids provide direct experience to the students

Guidelines for Use of Instructional Aids

The use of any instructional aid must be planned, based on its ability to support a specific point in a lesson. A simple process can be used to determine if and where instructional aids are necessary.

Clearly establish the lesson objective. Be certain of what is to be communicated.

Gather the necessary data by researching for support material.

Organize the material into an outline or a lesson plan. The plan should include all key points that need to be covered. This may include important safety considerations.

Select the ideas to be supported with instructional aids. The aids should be concentrated on the key points. Aids are often appropriate when long segments of technical description are necessary, when a point is complex and difficult to put into words, when instructors find themselves forming visual images, or when students are puzzled by an explanation or description.

Aids should be simple and compatible with the learning outcomes to be achieved. Obviously, an explanation of elaborate equipment may require detailed schematics or mock-ups, but less complex equipment may lend itself to only basic shapes or figures. Since aids are normally used in conjunction with a verbal presentation, words on the aid should be kept to a minimum. In many cases, visual symbols and slogans can replace in-depth explanations. The instructor should avoid the temptation to use the aids as a crutch. The tendency toward unnecessarily distracting artwork also should be avoided.

Instructional aids should appeal to the student and be based on sound principles of instructional design. When practical, they should encourage student participation. They also should be meaningful to the student, lead to the desired behavioral or learning objectives, and provide appropriate reinforcement. Aids that involve learning a physical skill should guide students toward mastery of the skill or task specified in the lesson objective.

Instructional aids have no value in the learning process if they cannot be heard or seen. Recordings of sounds and speeches should be tested for correct volume and quality in the actual environment in which they will be used. Visual aids must be visible to the entire class. All lettering and illustrations must be large enough to be seen easily by the students farthest from the aids. Colors, when used, should provide clear contrast and easily be visible.

The usefulness of aids can be improved by proper sequencing to build on previous learning. Frequently, good organization and natural patterns of logic dictate the sequence. However, use of standardized materials, including a syllabus, is recommended. Sequencing also can be enhanced simply by using overlays on transparencies, stripping techniques on charts and chalk or marker boards, and by imaginative use of magnetic boards. Sequencing can be emphasized and made clearer by the use of contrasting colors.

The effectiveness of aids and the ease of their preparation can be increased by initially planning them in rough draft form. Revisions and alterations are easier to make at that time than after their completion. The rough draft should be carefully checked for technical accuracy, proper terminology, grammar, spelling, basic balance, clarity, and simplicity. Instructional aids should

also be reviewed to determine whether their use is feasible in the training environment and whether they are appropriate for the students.

In practice, the choice of instructional aids depends on several factors. Availability, feasibility, or cost may impose realistic limitations. The number of students in a class and the existing facilities are other considerations. In some school situations, the designers of the curriculum determine the use of instructional aids. In this case, the instructor may have little control over their use. On the other hand, an independent instructor may have considerable latitude, but limited resources. Often, instructors must improvise and adapt to the existing circumstances in order to incorporate quality instructional aids.

Criteria. In selecting instructional materials, the following criteria should be considered:

a. Instructional materials should support the educational philosophy, goals and objectives of the District and the objectives of the curricular offering in which the materials will be used.

b. Instructional materials should be appropriate for the age, emotional and social development, and ability level of the students for whom the materials are selected.

c. Instructional materials should be diverse with respect to levels of difficulty, reader appeal, and should present a variety of points of view.

d. Instructional materials should meet high standards of quality in factual content and presentation.

e. Instructional materials should have aesthetic, cultural, literary, or social value. The value and impact of any literary work will be judged as a whole, taking into account the author's intent rather than individual words, phrases or incidents.

f. Instructional materials should foster respect for men, women, the disabled, and minority groups and should portray a variety of roles and life styles open to people in today's world. Instructional materials should foster respect for cultural diversity.

g. Instructional materials should be designed to motivate students to examine their own attitudes and behaviors and to comprehend their own duties, responsibilities, rights and privileges as participating citizens in a pluralistic society.

h. Instructional materials should encourage students to utilize higher order thinking skills and to become informed decision-makers, to exercise freedom of thought and to make independent judgments through examination and evaluation of relevant information, evidence and differing viewpoints.

i. Instructional materials should be selected taking into account instructional materials already available in the District in order to meet the above criteria and in order to replace materials worn, obsolete or no longer appropriate. Licensed professional staff shall provide for constant and continuing renewal of the collection not only by the addition of up-to-date material, but by the judicious elimination of materials which no longer meet needs or find use.

j. Other criteria as developed by the licensed staff under the supervision of the administrative staff.

Teaching aids are important in how well a student can learn. Teaching aids help Ss to learn and understand materials faster and better. Some of these aids consists of visual aids, audio, blackboard, chalk, chalkboard, poster, picture, student and teacher, etc.

In my opinion, firstly, a wonderful teaching tool that is multifunctional than the others is teacher. This tool is convenient, portable, uses no electricity, can be used effectively in light or dark and is available all the time. Teacher will follow some steps to involve their Ss in classroom such as use body language, movement, eye contact, gesture, facial expression, speech, etc. Therefore, there are many ways to teach in classroom using teacher as a main teaching aid.

Teacher as a model in classroom: teacher use their body to do like a character in any story or they can make sample for their Ss to follow

Teacher as a narrator: teacher retells a story for Ss

Teacher as a singer: teacher sing the song in singing lesson or sing when they want to create exciting atmosphere.

- eacher as a presenter: teacher introduce the lesson and lead the Ss on each activity charismatically and clearly
- Teacher as a dancer: dancing maybe the most difficult but interesting activity in the classroom.
- Teacher as a mother: the class is where not only learning activities but also Ss emotional care activities occurs. The teacher – a mirror has the role of work-ethics for Ss besides teaching them new lesson around their life
- Teacher as a friend: to have a successful lesson, teacher needs to be Ss friend that help he close to his Ss. This connection will be a convenient environment for Ss to accept the new knowledge.
- Teacher as a role-player: teacher can participate in some role play and the S will act other one

Secondly, I want to mention to another tool of teaching activity is chalkboard. Chalkboard is a smooth hard panel, usually black or green. More simply, they are generally a black or a white board and are used to write something with a piece of chalk. They are mainly used for teaching purposes in educational institutions. A chalkboard includes a large writing area, a writing substance and an eraser. There are some ways to use chalkboard as a teaching aid:

- Chalkboard is the most available instructional material which can be used in presenting new lesson
- Chalkboard is very useful to show solutions of the different mathematical problems systematically
- The chalkboard helps T to present more formally prepared lessons or informal sessions that Ss can understand follow more topic
- The T uses the chalkboard to write the important information about the topic. So that lesson's ideas can be clear from facts to concepts, from cognitive to affective learning
- T can use various color chalk or pen to draw on the chalkboard to develop the topic, show part or build association
- T can use chalkboard to draw or illustrate a point-by-point outline of a lesson by a diagram, chart, etc.
- Chalkboard can improve Ss' thinking ability by direct attention on the chalkboard or visualize their own ideas
- Chalkboard can be use to list the ideas or topic suggested in discussion. T can add, delete or put them in final form
- Chalkboard can be used to helps Ss practice their work at one time and get feedback immediately by T and other Ss
- The Ss can use mini-chalkboard combines with looking at teacher and give their own answers

A chart is a good means or aid of teaching. It brings environment to the process of teaching inside the class indirectly. Instead of visiting the actual fields of a lesson in real life, the chart can bring such scene into class to be seen by learners. The purpose is to give life to the theoritical learning.It facilitates the process of presentation in class.

A chart is a useful way to present and display information or instructions, especially in a classroom or other educational situation. It can range in size from a large wall chart to a single piece of paper.

A chart is a group of related fa cts presented in the form of a diagram, table, graph, or other visually organized model.

Here are some kinds of charts used in literacy:

Alphabet chart

Consonant chart

Enlarged primer page

Number chart

Punctuation chart

Song chart

Vowel chart

Benefits:

Charts are an excellent tool that can help students become independent thinkers and problem solvers when working to master the CCSS. And although the standards are complex, when the processes are broken down and displayed for students, they can more easily internalize and master them. Charts don't have to be perfect! They are most successful when they are created by or with students, and modified or altered as students' understanding of the concept changes.

How can teachers create these kinds of charts?

1. Charts should reflect the students' reading level. Smarter Charts recommends that the charts created in the classroom mimic the amount of print on a page, the spacing between words and the number of lines of print that children are used to seeing in their reading. Therefore, first grade charts would look much different from fourth or fifth grade charts.

2. Charts should be created with students so that they have some ownership of what goes on it, and will therefore refer to it. It is not necessary that the entire chart is created together, but it should not be something that is completely pre-made either. Charts should be a work in progress, one that helps students to remember the major points of the mini lessons you teach.

3. There has to be some system in place that helps students to remember to refer to charts when needed. After all, that is why they are created…to help students become independent problem solvers! Systems could include simple things such as having students post-it note the chart they used (or want to use); students can sign charts they have become "expert" on and then other students can go to them for help; teachers could ask students "Which chart could help you with that?" during mini-lessons, after workshop shares or conferences. The idea is to constantly remind students to use the charts and information that is available to them. They are NOT wallpaper!

Characteristics of Charts:

– be clear, easy to understand and easy to find.

– display content that is current and supports complex skills.

– have a clear purpose.

– include steps for how to do specific strategies or procedures.

– have visuals including symbols, pictures, or photos to go with words.

An LCD projector is a type of video projector for displaying video, images or computer data on a screen or other flat surface. It is a modern equivalent of the slide projector or overhead projector. To display images, LCD (liquid-crystal display) projectors typically send light from a metal-halide lamp through a prism or series of dichroic filters that separates light to three polysilicon

panels – one each for the red, green and blue components of the video signal. As polarized light passes through the panels (combination of polarizer, LCD panel and analyzer), individual pixels can be opened to allow light to pass or closed to block the light. The combination of open and closed pixels can produce a wide range of colors and shades in the projected image.

Easier to Connect

The Langwitches, a worldwide group of teachers researching and blogging about quality writing, have found plenty to like about LCD projectors, including that all students in a classroom can see all the information on a computer. In the past, students would have to take turns or crowd around a standard-sized monitor, and some students would complain that it was hard to see.

New Types of Lessons

Though overheads, white boards and chalkboards are able to present the same information to every student, a computer tied into a LCD projector can offer much more innovative displays, such as geography lessons by touring Google Earth, watching live webcams from different parts of the community, or streaming educational videos.

Ease of Use

Connecting projectors with computers used to require the services of an audio/video specialist to learn and present new technology, according to the Journal, a technology-oriented site for the educational community. However, teachers want to learn how to operate the equipment themselves so they can control their lessons and the material they show their students, and they can troubleshoot technical problems if they occur.

Ease of Understanding

Studies of teachers who use projectors say that the projector presents new ways to reach students, according to the Journal. Instead of a teacher just talking at the front of the classroom or writing words on the board, the projector allows the presentation of text, audio, graphics or video. This is more entertaining for the students and improves the likelihood they will comprehend the lessons.

The "EDUSAT" or the Education Satellite was launched by the Indian Space Research Organisation (ISRO) on 20th September 2004 from the SriHarikota Space Research Centre located in Andhra Pradesh, using a G.S.L.V. rocket. The main purpose of this is to provide education to all people, primarily children from remote areas of the country who can not go to schools or colleges. The classes are conducted by various State Education Boards, NCERT, CBSE, Universities etc. in a studio environment using powerpoint presentations as well as the common blackboard. Both interactive as well as non-interactive sessions are offered. As many as 5000 educational institutions participate in this programme and get benefited.

As classes are conducted in a studio environment, it is enough to use the services of a few highly qualified competent teachers and telecast the proceedings to the entire nation. This eliminates the need for a large number of qualified teachers often demanded in other forms of education.

These classes are beamed to predestined areas using EDUSAT similar to regional television programmes on 'Doordharshan'. Students attending the classes could ask questions to the teachers conducting classes through SMS, e-mail or other electronic mode of communication, something similar to a TV talkshow. To enable this, schools / colleges should be having an interactive receiving terminal which is currently being supplied free by ISRO to selected schools / colleges as the whole programme is at an experimental stage. In future when this programme is expanded, schools and colleges will have to purchase this at a subsidized cost of Rs. 3000.

In addition, these classes could be recorded on a CD and converted into computer file and made available on the internet without the interactive session. They will be available from the archives at any later date in future. In a nutshell it could be said that Indian Government is making all out preparations to provide education to all, at a fraction of the present cost using space technology.

Advantages

1. Distance education will get strengthened.

2. Education could be made available at a fraction of its cost to a large number of students.

3. A large number of students can be educated by a very few extremely efficient teachers who can reach them from the studios located in the universities or education boards i.e. it eliminates the demand for a large number of teachers.

4. Education reaches the door steps of students; there is no need for students to go in search of good education.

5. Students can receive education at their own pace and convenience especially in the case of those who are employed.

In short we can say instruction through EDUSAT will give a thrust to Home-schooling.

UNIT-IV: CURRENT TREND IN TEACHING OF LIFE SCIENCE

a) e-learning: meaning, principles, goals, e-resources: e-books, e-journals.

b) e-assessment: concept, importance and methods

c) Web based learning, blended learning, and mobile learning

What is E-Learning

1.
It uses the latest technologies to assist and enhance knowledge distribution, and calls for flexible and active interactions amongst online teachers and students. Learn more in: An Innovative Approach to Training International Students in Workplace Written Communication Skills
2.
Refers to the use of various kinds of electronic media and Information and Communication Technologies (ICT) in education. Learn more in: Administrators' Assessments of Online Courses and Student Retention in Higher Education: Lessons Learned
3.
Learning that is mediated by electronic media. Learn more in: Designing a Distributed Learning Experience
4.
Term used to designate the type of learning that occurs through electronic devices although it is commonly used to refer to distance educational programs that take place over the internet. It is also often found as synonym with several other terms in the educational technology jargon such as distance learning; however the second does not necessarily imply the mediation of electronic devices or the internet. Learn more in: Disruptive Technologies and Education: Is There Any Disruption After All?
5.
A form of learning that takes place when the learner is using electronic technology or learning that happen when the learner takes advantage of learning opportunities offered by any electronic technology. Learn more in: Developing Pedagogical Skills for Teachers: A Learner-Centered Approach for Technology Supported Instructions
6.
A concept that describes the cognitive science principles of effective multimedia learning using electronic educational technology. Learn more in: A Learner Model Based on Bayesian Networks in Adaptive Educational Hypermedia Systems
7.
Any technologically mediated learning using computers, whether from a distance or in face-to-face classroom setting (computer-assisted learning). It can cover a wide set of applications and processes such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. Learn more in: Digital Libraries and Ontology
8.
Learning by using tools and materials available online. Learn more in: Online Academia
9.
Electronic learning Learn more in: The Criticality of an ICT Ethics Backbone for Transformation and Social Equality in E-Learning
10.
E-Learning (or sometimes electronic learning or eLearning) is a term which may be used to encompass all forms of technology-enhanced learning (TEL), or in some cases very specific types of TEL such as online or Web-based learning. That said, the term does not have a universally accepted definition[1] and there are divides in the **e-learning** industry about whether a technology-enhanced system can be called **e-learning** if there is no set pedagogy as some argue **e-learning** is Learn more in: Research Policies for Information and Communication Technologies in Europe
11.
Computer based learning. Learn more in: Cohort Programming
12.
Electronic learning (or **e-Learning** or eLearning) is a type of education where the medium of instruction is related to Information and Communication Technologies. Learn more in: Course Assessment in a Teacher's Learning Community
13.
Access to, and use of, electronic sources of information and communication through a web-accessible device. Learn more in: Major Trends, Issues, and Challenges with Learning Management Systems
14.

Learning activities conducted through Internet or Web-based course materials or activities. Learners engage in this activities alone or in groups. These learning groups could be geographically dispersed. Learn more in: Making E-Training Cost Effective through Quality Assurance

15.

The process, by which the student learns through the content placed in the Internet and/or digital medium. The teacher and/or tutor is at distance, using the Internet to communicate with the students, possibly intermediated with some face-to-face moments. Learn more in: Recent Advances in Intelligent Tutoring Systems: A Case Study

16.

This term is defined as the delivery of instructional content or completion of learning experiences through use of electronic technology. Learn more in: Adapting Adult Learning Theories for Online Learning

17.

This is a process of learning that is facilitated by, delivered by, and supported through information and telecommunications technologies. Learn more in: Using an Information Literacy Program to Prepare Nursing Students to Practice in a Virtual Workplace

18.

The acquisition and the use of knowledge distributed and facilitated primarily by electronic means. This form of learning currently depends on networks and computers but will likely evolve into systems consisting of a variety of channels (e.g., wireless, satellite) and technologies (e.g., cellular phones, PDAs) as they are developed and adopted. **E-learning** can take the forms of courses as well as modules and smaller learning objects. **E-learning** may incorporate synchronous or asynchronous access and may be distributed geographically with varied limits of time. Learn more in: Does E-Learning Improve the Communication Among Students and Lecturers?

19.

Electronic learning which entails the delivery of a learning, program by means of a computer network technology. Learn more in: The Integration of Educational Technology for Classroom-Based Formative Assessment to Empower Teaching and Learning

20.

The use of technology to enable people to learn anytime and anywhere. Learn more in: A Math E-Learning Course to Improve Pupils' Performances

21.

Is the education and training over the Internet. This type of online education allows user interaction with the material using computers. Learn more in: Motivation on Problem Based Learning

22.

According to MSN Encarta, **e-learning** (or electronic learning) is "the acquisition of knowledge and skill using electronic technologies such as computer and Internet-based courseware, and local and wide area networks." In other words, it is learning through electronic means where knowledge and skills are transferred either through the computer networks or through digital media like CD-ROM, DVDs, and so forth. In the Web environment, users may use virtual classrooms, digital collaboration, discussion forums, chat rooms, and so forth, to obtain information and facilitate learning. Learn more in: Usability Evaluation of E-Learning Systems

23.

The medium in which learning takes place via web, where the learners and instructors are physically away from each other. Learn more in: Learners' Perception of Engagement in Online Learning

24.

Learning mode that is delivered exclusively online and is supported by the use of electronic resources. It includes both professional training and formal education courses. Learn more in: Higher Education and Web 2.0: Barriers and Best Practices From the Standpoint of Practitioners

25.

Utilizes electronic technologies to access educational curriculum outside traditional classroom. Learn more in: The Effect of Using Mobile Devices on Students' Performance in Writing

26.

Learning that is facilitated by the use of digital tools and content. Typically, it involves some form of interactivity, which may include online interaction between the learner and their teacher or peers. Learn more in: Environmental Sciences and Distance Education

27.

E-learning implies the use of electronic devices such as computers, tablets, or phones to deliver educational or training content to learners. Learn more in: Original E-Assessment Methods
28.
Is the learning process facilitated and supported through the use of information and communications technology. Learn more in: Evaluation Methods for E-Learning Applications in Terms of User Satisfaction and Interface Usability
29.
Learning using electronic means: the acquisition of knowledge and skill using electronic technologies such as computer- and Internet-based courseware and local and wide area networks. Learn more in: Trends in the Higher Education E-Learning Markets
30.
The use of network technology to plan, deliver, select, manage and expand learning. Usually, the term refers to a training system where the content is transmitted at distance through learning management systems. Learn more in: Blended Learning
31.
E-Learning is electronic learning, and typically this means using a computer to deliver part, or all of a course whether it's in a school, part of your mandatory business training or a full distance learning course. Learn more in: Mobile Devices in the Classroom
32.
Education via the Internet, network, or standalone computer. It is essentially the network-enabled transfer of skills and knowledge. **E-learning** applications and processes include Web-based learning, computer-based learning, virtual classrooms and digital collaboration. Learn more in: Open Source Software Virtual Learning Environment (OSS-VLEs) in Library Science Schools
33.
Learning supported by computers. Most usual **e-learning** technologies are environment supported by continuously evolving, collaborative processes focused on increasing individual and organizational performance. Learn more in: E-Learning: Psycho-Pedagogical Utility, Usability and Accessibility Criteria from a Learner Centred Perspective
34.
The delivery of a learning, training or education program by electronic means. **E-learning** involves the use of a computer or electronic device in some way to provide training, educational or learning material. **E-learning** can involve a greater variety of equipment than online training or education, for as the name implies, “online” involves using the Internet or an Intranet. CD-ROM and DVD can be used to provide learning materials. Learn more in: An Innovative E-Learning Platform for Vocational Training of European Local Police Forces
35.
A learning method that includes numerous media that deliver text, audio, images, animation, videos, and simulation to support the learning process. Technology applications and processes such as audio or video tape, satellite TV, CD-ROM, or Internet-based delivery support learners to access required materials and develop their understanding of topics. Learn more in: Cloud Computing to Improve Agri-Supply Chains in Developing Countries
36.
Learning that includes the use of ICT. Learn more in: The Impact of Technology on School Leadership
37.
Learning in which technology plays a major role in the delivery of content and the communication between instructor and students and between students. Learn more in: The Online Adult Learner: Profiles and Practices
38.
An education system based on the transfer of the instructional content to the digital environment and on the teaching of that content via this digital environment. Learn more in: Digital Storytelling and Creativity through E-Learning
39.
E-learning is a general term used to refer to computer-enhanced learning. It is used interchangeably in so many contexts that it is critical to be clear what one means when one speaks of “**e-learning**” (Wikipedia, 2007). **E-learning** is a form of distance learning or distance education; however, the latter two

are not necessarily **e-learning**…they could be correspondence courses, and so forth. Learn more in: Cross-Cultural Learning Objects (XCLOs)
40.
Learning facilitated and supported through the use of information and communications technology. Learn more in: Comparison of Case Studies in Managing E-Learning Programs
41.
The delivery of content via electronic media, such as the internet, video, interactive TV and CD-ROM. **E-learning** encompasses all learning undertaken, whether formal or informal, through electronic delivery. Learn more in: ICT Support to Those Providing Care to Elderly: Pilot Training Activities in Greece in the Realm of the DISCOVER Project
42.
Any learning conducted via electronic technology (computers, smartphones and the like). Learn more in: Could Educational Technology Replace Traditional Schools in the Future?
43.
It is the acquisition and use of knowledge distributed and facilitated primarily by electronic means. In particular, **E-learning** is the use of internet technology for the creation, management, making available, security, selection and use of educational content to store information about those who learn and to monitor those who learn, and to make communication and cooperation possible. Learn more in: Interoperability Approach in E-Learning Standardization Processes
44.
Learning in which technology plays a major role in the delivery of content and the communication between instructor and students and between students. Learn more in: Improving the Workforce in Kazakhstan through Distance Learning Technologies
45.
Any learning event that is delivered to the learners via the Internet. Learn more in: Research on Cultural Factors in Global E-Learning
46.
The delivery of a learning, training, or education program by electronic means. **E-learning** involves the use of a computer or electronic device to provide training, educational, or learning material. Learn more in: Investing in Multimedia Agents for E-Learning Solutions

E-learning has been developed to cost-effectively provide auxiliary and improved learning experiences beyond those available in the classroom. Students facing economic, family, physical or geographic constraints can take advantage of online learning opportunities. Furthermore, students learning in the classroom can augment their learning outcomes by participating in hybrid or fully online courses.

MATCH TO THE CURRICULUM

The pedagogy should be matched with and aligned to the appropriate curriculum through clear objectives; the relevance of content covered; the appropriateness of student activities; and the nature of the assessment. Learning objectives or learning goals are statements that describe what a learner should be able to do as a result of the learning process. it's learning supports the import of learning objectives from regional standards, district or school standards, or even teacher-defined course goals. Imported learning objectives can be edited and adapted as needed. Teachers can then tie the learning objectives to the various learning activities and assessments in their course. Reports track performance on assignments, and against learning objectives.

INCLUSION

The pedagogy should support inclusive practice seen in terms of different types and range of achievement; physical disabilities that can be particularly supported by e-learning; different

social and ethnic groups; and gender. The pedagogy should engage and motivate learners. This engagement should be evident in an ethos of being both educational and motivating. it's learning provides the means to deliver high quality digital learning applications fully integrated into any course. Students learn by creating text and multimedia content, and by embedding Web 2.0 content in their assignments, discussions and projects. The user interface is friendly and accessible, avoiding confusion or discouragement of students and teachers. Progress reports and task lists keep students fully up-to-date of their status against their goals at all times. it's learning is designed to place the student in charge of their own education. Students can set and work toward their own goals. The it's learning platform supports aids including Braille, magnifying and audio displays and serial navigation used by the blind and the dyslexic. The range of communications approaches provided support the practices of a wide variety of social, ethnic and gender.

LEARNER ENGAGEMENT

The pedagogy should engage and motivate learners. This engagement should be evident in an ethos of being both educational and motivating. it's learning provides the means to deliver high quality digital learning applications fully integrated into any course. Students learn by creating text and multimedia content, and by embedding Web 2.0 content in their assignments, discussions and projects. The user interface is friendly and accessible, avoiding confusion or discouragement of students and teachers. Progress reports and task lists keep students fully up-to-date of their status against their goals at all times.

INNOVATIVE APPROACHES It should be evident why learning technologies are being used, rather than a non-technological approach which achieves the same end as effectively. E-learning should be fit for purpose. it's learning provides the technology, tools and professional development that makes it easy to create a connected, personalized learning environment that challenges students to practice problem-solving, to work together and to use creativity to construct, share, and present their ideas, thinking and learning.

EFFECTIVE LEARNING

This principle can be demonstrated in a variety of ways; for example, by using a range of different approaches in the learning platform that will allow the student to chose one that suits her, or that can be personalized to her, or by satisfying a number of the characteristics of good learning (learner agency; learner autonomy; enabling or encouraging collaboration). Students have a wide variety of learning styles and needs. Language, experience, interests and ability all determine the ability and approach to learning. it's learning supports the needs of the individual students by offering an Individual Learning Plan for every student and by providing data on student performance on every assignment, and on the results of every curriculum and assessment element included.

FORMATIVE ASSESSMENT

The pedagogy should provide formative assessments. it's learning formative assessments provide immediate feedback on performance, supporting learning from the assessment experience. Projects, discussions and various other formats support peer assessment, and students are encouraged to reflect on their progress against their own goals in their personal portfolios

SUMMATIVE ASSESSMENT

The summative assessments must be valid and reliable; comprehensible by teachers, learners and parents; able to deal with a range of achievement levels; and free from adverse emotional impact on the learner. It's learning provides real-time data reporting for assessments and provides tools to develop and deliver valid and reliable summative assessments. Through the Application Program Interface (API), users can also integrate valid outside assessments for delivery through it's learning, or simply import the results in to the Grade Book.

COHERENCE, CONSISTENCY & TRANSPARENCY

The pedagogy must be internally coherent and consistent in the way the objectives, content, student activity and assessment match to each other. It must be open and accessible in its design. it's learning is known for its intuitive user interface. In it's learning technology never stands in the way of learning. The course planner helps teachers' organize courses for maximum impact, and easily structures the learning activities for the period in question and connects resources, tasks, progress, work hours and learning objectives in a single overview for the student. The result is a sophisticated yet easy to use course.

EASE OF USE

E-learning should be transparent in its ease of use. Thousands of students and their teachers use it's learning with virtually no training! Our commitment and dedication to usability has created a long list of schools, colleges and universities with extremely high adoption rates; often exceeding 80% within the first year of implementation. The system is accessible from anywhere, on just about any platform.

Definition and scope E-learning is commonly referred to the intentional use of networked information and communications technology in teaching and learning. A number of other terms are also used to describe this mode of teaching and learning. They include online learning, virtual learning, distributed learning, network and webbased learning. Fundamentally, they all refer to educational processes that utilize information and communications technology to mediate asynchronous as well as synchronous learning and teaching activities. On closer scrutiny, however, it will be clear that these labels refer to slightly different educational processes and as such they cannot be used synonymously with the term e- learning. The term e-learning comprises a lot more than online learning, virtual learning, distributed learning, networked or web-based learning. As the letter "e" in e-learning stands for the word "electronic", e-learning would incorporate all educational activities that are carried out by individuals or

groups working online or offline, and synchronously or asynchronously via networked or standalone computers and other electronic devices.

Individualized self-paced e-learning online refers to situations where an individual learner is accessing learning resources such as a database or course content online via an Intranet or the Internet. A typical example of this is a learner studying alone or conducting some research on the Internet or a local network. Individualized self-paced e-learning offline refers to situations where an individual learner is using learning resources such as a database or a computer-assisted learning package offline (i.e., while not connected to an Intranet or the Internet). An example of this is a learner working alone off a hard drive, a CD or DVD. Group-based e-learning synchronously refers to situations where groups of learners are working together in real time via an Intranet or the Internet. It may include text-based conferencing, and one or two-way audio and videoconferencing. Examples of this include learners engaged in a real- time chat or an audio-videoconference. Group-based e-learning asynchronously refers to situations where groups of learners are working over an Intranet or the Internet where exchanges among participants occur with a time delay (i.e., not in real time). Typical examples of this kind of activity include on-line discussions via electronic mailing lists and text-based conferencing within learning managements systems.

The growing interest in e-learning seems to be coming from several directions. These include organizations that have traditionally offered distance education programs either in a single, dual or mixed mode setting. They see the incorporation of online learning in their repertoire as a logical extension of their distance education activities. The corporate sector, on the other hand, is interested in e-learning as a way of rationalizing the costs of their in-house staff training activities. E-learning is of interest to residential campus-based educational organizations as well. They see e-learning as a way of improving access to their programs and also as a way of tapping into growing niche markets. The growth of e-learning is directly related to the increasing access to information and communications technology, as well its decreasing cost. The capacity of information and communications technology to support multimedia resource-based learning and teaching is also relevant to the growing interest in e-learning. Growing numbers of teachers are increasingly using information and communications technology to support their teaching. The contemporary student population (often called the “Net Generation”, or “Millennials”) who have grown up using information and communications technology also expect to see it being used in their educational experiences.

The flexibility that e-learning technology affords A key attribute of information and communications technology is its ability to enable flexible access to information and resources. Flexible access refers to access and use of information and resources at a time, place and pace that is suitable and convenient to individual learners rather than the teacher and/or the educational organization. The concept of distance education was founded on the principles of flexible access .It aimed to allow distance learners, who were generally adult learners in full or part-time employment to be able to study at a time, place, and pace that suited their convenience. The goal of distance education was to free these learners from the constraints of conventional residential educational settings. They would not be required to live or attend lectures in locations away from where they may be living and working. The printed distance study materials, which each distance learner received, would carry the core subject matter content they

would need including all their learning activities and assessment tasks. Students would be required to complete these tasks, submit their assignments and take their examinations within a set time frame. While these printed study materials allowed distance learners a great deal of freedom from time, place and pace of study, it had its limitations. For one thing, non-printed subject matter content and simulations etc. could not be easily represented in print form.

Assessing learning outcomes is concerned with determining whether or not learners have acquired the desired type or level of capability, and whether they have benefited from the educational experience (i.e., have they learned, and how their performance has changed). A measure of learning outcomes requires learners to complete tasks, which demonstrate that they have achieved the standards specified in the learning outcomes. In order to ascertain the most realistic and valid assessment of performance, these task(s) have to be as similar to on-the-job conditions, that is, as authentic as possible. A major purpose of assessment in education is the improvement of learning. When focusing on the improvement of learning, it is essential to bear in mind the congruency between the learning outcomes of a course and the measures of learning achievement. It is not uncommon to find measures of learning achievement that do not address the learning outcomes of the course. When this is the case, learner motivation in the course and their performance is adversely affected. Learning outcomes of a course must be given careful thought as quite often, insufficient attention is paid to the learning outcomes of a course. Without a clear set of outcomes, it is difficult to determine criteria for ascertaining whether we have arrived at the place for which we set out. While some skills and competencies are easier to assess, there are many others that are more difficult to assess and grade. Therefore a range of measures of achievement is necessary to assess the wide variety of skills and competencies that need to be acquired. In all cases however, the only fair form of assessment is one that is very transparent, with explicitly stated criteria for students. Therefore, it is important to clearly specify and communicate the basis for all assessment measures. When this is the case, assessment can serve as a powerful teaching tool.

In any learning context, a range of assessment methods may be used to determine learning achievement. These may include:

- Actual performance on an authentic site or a simulated condition such as a model.
- Oral responses which comprise verbal and/or visual presentations to questions.
- Written responses which comprise typed or hand-written responses to questions.

However, as learning becomes more collaborative, situated and Distributed in its context, conventional methods of assessment of learning outcomes become inadequate. These have to be replaced with tasks and assessment procedures that can be focused on the processes of learning, perception, and problem solving. Methods that can capture some of these processes are learning logs, critical reflections and portfolios. In situated learning contexts, assessment can no longer be viewed as an add-on to the learning and teaching process, or seen as a separate stage in a linear process of instruction and post- test. Assessment must become a continuous part of the learning process where it serves to promote and support learning.

Assessment that is designed to promote and support learning during the course of the learning and teaching process, may be seen as serving a formative purpose in that it allows skills development to be identified, reflected upon and corrected in a continuous manner. Assessment that seeks to ascertain a final measure of learning capability often at the end of a course, serves as a summative measure. A one- off sampling of students' work is not adequate to make a reliable judgment of the overall quality of their work. We need to examine student's work regularly and continuously without drowning either the students or staff in meaningless tasks.

Advantages or Benefits of E-learning

The adoption of E-learning in education, especially for higher educational institutions has several benefits, and given its several advantages and benefits, e-learning is considered among the best methods of education. Several studies and authors have provided benefits and advantages derived from the adoption of e-learning technologies into schools (Klein and Ware, 2003; Algahtani, 2011; Hameed et al, 2008; Marc, 2002; Wentling et al. 2000; Nichols, 2003). Some studies give advantage of e-learning as its ability to focus on the needs of individual learners. For example Marc (2000) in his book review on e- learning strategies for delivering knowledge in digital age noted that one of the advantages of e-learning in education is its focus on the needs of individual learners as an important factor in the process of education rather than on the instructors', or educational institutions' needs. Some of the advantages that the adoption of e-learning in education, obtained from review of literature includes the following:

1. It is flexible when issues of time and place are taken into consideration. Every student has the luxury of choosing the place and time that suits him/her. According to Smedley (2010), the adoption of e- learning provides the institutions as well as their students or learners the much flexibility of time and place of delivery or receipt of according to learning information.

2. E-learning enhances the efficacy of knowledge and qualifications via ease of access to a huge amount of information.

3. It is able to provide opportunities for relations between learners by the use of discussion forums. Through this, e-learning helps eliminate barriers that have the potential of hindering participation including the fear of talking to other learners. E-learning motivates students to interact with other, as well as exchange and respect different point of views. Elearning eases communication and also improves the relationships that sustain learning. Wagner et al (2008) note that e-Learning makes available extra prospects for interactivity between students and teachers during content delivery.

4. E-learning is cost effective in the sense that there is no need for the students or learners to travel. It is also cost effective in the sense that it offers opportunities for learning for maximum number of learners with no need for many buildings.

5. E-learning always takes into consideration the individual learners differences. Some learners, for instance prefer to concentrate on certain parts of the course, while others are prepared to review the entire course.

6. E-learning helps compensate for scarcities of academic staff, including instructors or teachers as well as facilitators, lab technicians etc.

7. The use of e-Learning allows self-pacing. For instance the asynchronous way permits each student to study at his or her own pace and speed whether slow or quick. It therefore increases satisfaction and decreases stress.

An electronic book, also known as an e-book or eBook, is a book publication made available in digital form, consisting of text, images, or both, readable on the flat-panel display of computers or other electronic devices. Although sometimes defined as "an electronic version of a printed book",[2] some e- books exist without a printed equivalent. E-books can be read on dedicated e-reader devices, but also on any computer device that features a controllable viewing screen, including desktop computers, laptops, tablets and smartphones.

In the 2000s, there was a trend of print and e-book sales moving to the Internet,[citation needed] where readers buy traditional paper books and e-books on websites using e-commerce systems. With print books, readers are increasingly browsing through images of the covers of books on publisher or bookstore websites and selecting and ordering titles online; the paper books are then delivered to the reader by mail or another delivery service. With e-books, users can browse through titles online, and then when they select and order titles, the e-book can be sent to them online or the user can download the e-book. By the early 2010s, e-books had begun to overtake hardcover by overall publication figures in the U.S.

The main reasons for people buying e-books are possibly lower prices, increased comfort (as they can buy from home or on the go with mobile devices) and a larger selection of titles. With e-books, "[e]electronic bookmarks make referencing easier, and e-book readers may allow the user to annotate pages." "Although fiction and non-fiction books come in e-book formats, technical material is especially suited for e-book delivery because it can be [electronically] searched" for keywords. In addition, for programming books, code examples can be copied.

An eBook is an electronic version of a traditional print book that can be read by using a personal computer or by using an eBook reader. (An eBook reader can be a software application for use on a computer, such as Microsoft's free Reader application, or a book-sized computer that is used solely as a reading device, such as Nuvomedia's Rocket eBook.) Users can purchase an eBook on diskette or CD, but the most popular method of getting an eBook is to purchase a downloadable file of the eBook (or other reading material) from a Web site (such as Barnes and Noble) to be read from the user's computer or reading device. Generally, an eBook can be downloaded in five minutes or less.

Although it is not necessary to use a reader application or device in order to read an Ebook (most books can be read as PDF files), they are popular because they enable options similar to those of a paper book

- readers can bookmark pages, make notes, highlight passages, and save selected text. In addition to these familiar possibilities, eBook readers also include built-in dictionaries, and alterable font sizes and styles. Typically, an eBook reader hand-held device weighs from about twenty-two ounces to three or four pounds and can store from four thousand to over half a million pages of text and graphics. A popular feature is its back-lit screen (which makes reading in the dark possible).

Some eBooks can be downloaded for free or at reduced cost, however, prices for many eBooks - especially bestsellers - are similar to those of hardcover books, and are sometimes higher. Most eBooks at Barnes and Noble, for example, are comparable in price to their traditional print versions.

E-Journal

Electronic issues of journals and articles to periodicals the library subscribes in. It consists of Full-text and Bibliographic Databases. Full- text databases contain the whole content of an article such as citation information, text, illustrations, diagrams and tables. Bibliographic databases only contain citation information of an article, such as author's name, journal title, publication date and page numbers. An e-database is an organized collection of information. It supports flexible and in-depth searching of different fields, e.g. journal title, article title, author, abstract, year, etc. We can only search for journal title in the Library Catalogues, but not the title or author of individual articles. Therefore, e-database is extremely useful to find out the articles on particular topics, e.g. Peer assessment in classroom. A particular journal articles can retrieve from e-database, which could not find the same information via the Library Catalogue.

Libraries have been exploring easily to cope up with the problems of ever increasing prices of the journals, space requirements and decreasing level of usage as the journals get older. Nevertheless, libraries are required to maintain back the issues of the journals, usually in bound form. Electronic Journal helps the librarians in addressing these problems to a great extent without significantly affecting the service levels. Electronic journals can be accessed via inter-net from any web enabled PC. Depending on the type of subscription, one or more users can access the service simultaneously, either directly from an independent web enabled PC or in a local area network through a proxy server (IP addresses based access). Electronic journals also offer benefit of full text searching and downloading of articles. Many publishers of electronic journals offer their journals through consortia of libraries at much lower rates. INDEST and INFLIBNET are two such consortia operating in India. Access to articles in electronic journals can also be made through aggregator services which offer searchable databases of contents of e-journals from several publishers, and links to journal site for full text. Emerald, OCLC and J-Gate are some of the example of e-journal aggregator services. The main disadvantage of electronic journal is that libraries cannot physically posses the journal.

Advantages of E-Journals:

E-journals are becoming increasingly in demand both as a means of rapid desktop access to current research materials and as a way to view past volumes. E-journals offer a range of potential advantages to libraries and end-users:

1. **Allows remote access.**
2. **Can be used simultaneously by more than one user.**
3. **Provides timely access and at the rate of 24 X 7 X 365 formula.**
4. **Supports different searching capabilities.**
5. **Accommodates unique features (e.g. Links to related items, reference linking)**
6. **Saves physical storage space.**
7. **Supports multimedia information.**

As a result of the above advantages, libraries today buy licenses for an ever-increasing number of Electronic Journals from a range of different publishers and providers, and use a diverse set of technologies for information delivery.

Web-based learning encompasses all educational interventions that make use of the internet (or a local intranet). There are currently three broad classifications or configurations within WBL: tutorials, online discussion groups, and virtual patients. The distinctions between these configurations are often blurred, and in fact a given WBL intervention might use a combination of two or three, but the implications for teaching warrant a conceptual, albeit at times arbitrary, separation. Online tutorials are similar to face- to-face lectures. They generally consist of information structured by the teacher in a way that will (hopefully) facilitate learning. Tutorials are often enhanced by features such as multimedia (sound, pictures, movies, and animations), links to online resources (full-text journal articles or related websites) and other areas within the course, and self-assessment tools. Effective online tutorials often also make use of patient cases. Online discussion is similar to the face-to-face small group session. As with any small group, there may be an element of didactic teaching from the instructor (eg a brief tutorial) but the heart of the teaching lies in group discussion. Teachers take on the role of facilitators – defining the scope of the discussion, monitoring and guiding the discussion as needed, and providing or helping students to find additional resources. Communication among group members can be asynchronous (delay between sending a message and receiving the response) or synchronous (live).

Virtual patients are computer-based simulations of patient encounters. Depending on the scenario students might query the computerised ‘patient’ to obtain a history, request information about the findings of physical examinations, order and interpret laboratory results and other tests,

and/or institute

therapy. It is also worth noting what WBL is not. The internet has found many functions in medical education in which the primary intent is not an educational intervention designed for web-based delivery. These include archives of face-to-face lectures (eg PowerPoint slides or videotaped lectures) and course syllabi, online administration of tests and course evaluations, and administrative communications. While certainly useful, these functions do not constitute WBL.

Advantages of web-based learning Any advantages and disadvantages of WBL are contingent upon at least two conditions: the nature of the WBL intervention, and the intended setting including the prospective learners. The advantages of a pencil depend on the kind of pencil (wood or mechanical, black lead or coloured, etc) and the use to which the pencil is applied (writing a test, marking a piece of wood, drawing a poster, etc). It is also important (but unfortunately not always considered) that the WBL intervention must be well designed. The elements of well designed WBL are beyond the scope of this article, but have been discussed previously. With these caveats, there exist numerous potential advantages of WBL.

- Distance learning, economies of scale and consistent message
- Individualized learning
- Novel instructional methods
- Flexible scheduling
- Easily updated perpetual resource
- Assessment and documentation

Blended learning is a combination of offline (face-to-face, traditional learning) and online learning in a way that the one compliments the other.

It provides individuals with the opportunity to enjoy the best of both worlds. For example, a student might attend classes in a real-world classroom setting and then supplement the lesson plan by completing online multimedia coursework. As such, the student would only have to physically attend class once a week and would be free to go at their own pace (and without worrying about scheduling issues).

Blended learning is often also referred to as “hybrid” learning, and can take on a variety of forms in online education environments. While some organizations may only use blended learning techniques on rare occasions, others might utilize it as a primary teaching method within their curriculum.

There are two key principles commonly associated with blended learning (which are the "secrets" to its success): students who can share information and work with other students directly in a collaborative setting have a more enriched learning experience, and collaboration between students can be improved upon if group activities rely on information gathered from online resources or lessons. It's also been suggested that students who complete online coursework followed by interactive, face-to-face class activities have richer educational experiences.

A course created in a blended learning model uses the classroom time for activities that benefit the most from direct interaction. Traditional education (especially at the college level) tends to place an emphasis on delivering material by way of a lecture, while in a blended learning model lectures can be videotaped ahead of time so the student can watch on their own t ime. The classroom time is more likely to be for structured exercises that emphasize the application of the curriculum to solve problems or work through tasks.

An individual semester of blended learning may emphasize classroom time at the beginning, then gradually increase the amount of work that students do online or during independent study. Many argue that class discussion boards, for example, are far more useful if the participants have met face-to-face first.

The "flipped" classroom, a more recent coinage, refers to classes that are structured almost exclusively around a reversal of expectations for lectures and homework. Students are expected to watch lectures online at home, and do homework while they are in class.

In some situations, the move to blended learning has inspired educators to redefine traditional roles. The word "facilitator" has emerged as an alternative to "teacher," bringing with it a slightly different focus. The facilitator places an emphasis on empowering students with the skills and knowledge required to make the most of the online material and independent study time, guiding students toward the most meaningful experience possible. Facilitators focus on four key areas:

Development of online and offline course content.

- Facilitation of communication with and among students, including the pedagogy of communicating content online without the contextual clues students would get in person.

- Guiding the learning experience of individual students, and customizing material wherever possible to strengthen the learning experience.
- Assessment and grading, not unlike the expectations for teachers within the traditional framework.
- By putting an emphasis on learning through supervised activities, blended learning has proven to be very adaptable to what some corporations are calling blended training. Trainers can shift their focus from the delivery of knowledge to its application, and companies spend less flying trainers around to oversee all instruction in person.