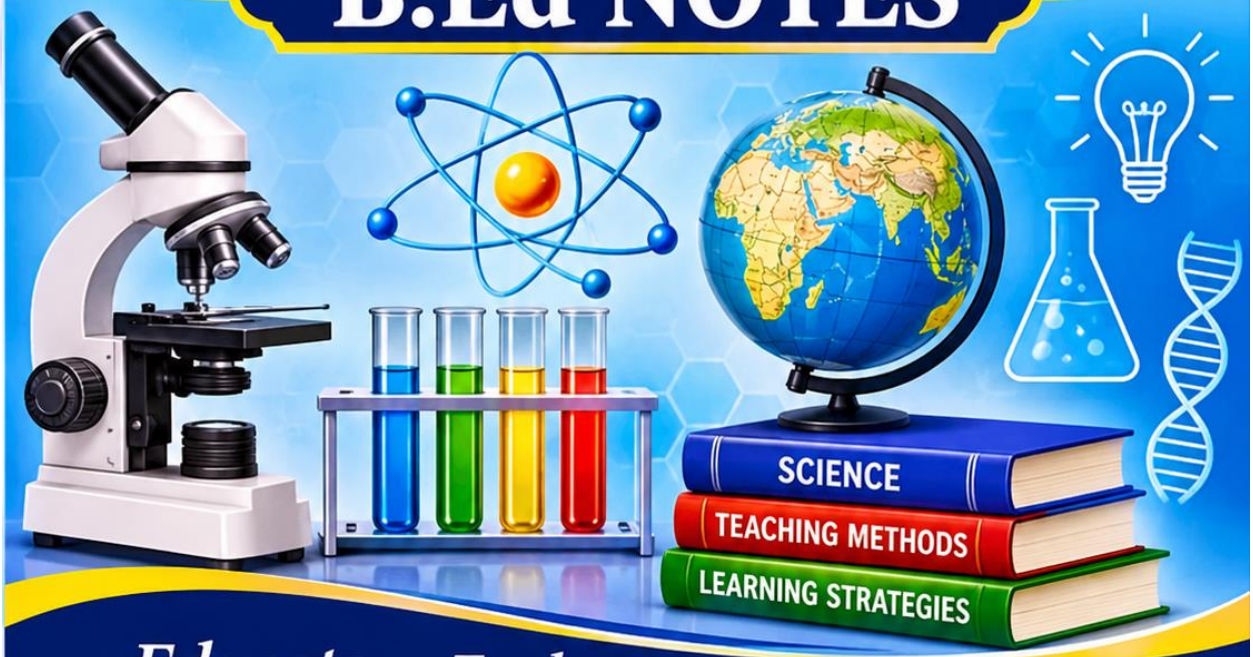
LALA JAGAT NARYAN EDUCATION COLLEGE

JALALABAD WEST

PEDAGOGY OF SCIENCE

B.Ed NOTES



Educate • Explore • Empower

Unit-I:

Introduction a) Meaning, nature and scope of science, impact of science and technology on society.

b) Aims and objectives of Teaching Science - Blooms' Taxonomy of Educational objectives (revised form also), Instructional objectives of teaching science at secondary and senior secondary level

. c) Formulation of specific objectives in behavioral terms (Mager's approach and RCEM approach).

Unit-II:

Methods and Techniques in Science Teaching

a) Methods of Teaching Science- Problem solving method, Lecture cum demonstration method, Project method,

b) Approaches of Teaching Science: Inductive and Deductive approach, Cooperative learning, inquiry based approach. Heuristic approach.

c) Scientific Attitude and its development.

PEDAGOGY OF SCIENCE

B.Ed. Notes – Unit I & Unit II

College: Lala Jagat Naryan Education College, Jalalabad (West)

UNIT – I: INTRODUCTION

(A) Meaning, Nature and Scope of Science and Impact of Science and Technology on Society

1. Meaning of Science

The word Science is derived from the Latin word *Scientia,* which means knowledge.

Science is a systematic study of the natural and physical world through observation, experimentation, investigation and logical reasoning.

Science helps human beings understand different natural phenomena and discover new facts about the universe.

Definitions:

1. **Science is a systematic and organized body of knowledge based on facts and experiments.**
2. **Science is a process of discovering knowledge through observation, experimentation and logical thinking.**

Examples:

- **Studying how plants prepare their food.**
- **Understanding why rain occurs.**
- **Learning how electricity works.**
- **Studying the human body and its organs.**

2. Nature of Science

The nature of science refers to the basic characteristics and features of scientific knowledge.

Main characteristics:

1. Science is Systematic: Scientific knowledge is organized in a proper and systematic manner.

2. Science is Based on Observation: Scientific facts are discovered through careful observation of natural events.

3. Science is Experimental: Scientific ideas can be tested through experiments.

4. Science is Logical: Scientific conclusions are based on reasoning and evidence.

5. Science is Universal: Scientific principles are generally applicable everywhere under the same conditions.

6. Science is Dynamic: Scientific knowledge changes and develops with new discoveries.

7. Science is Objective: Science is based on facts rather than personal feelings and beliefs.

8. Science is Practical: Scientific knowledge is useful in everyday life.

Example: When students want to know which conditions help seeds grow, they can observe and conduct experiments with seeds under different conditions.

3. Scope of Science

Scope of science means the different fields and areas covered by scientific knowledge.



The major branches of science are:

1. Physics

Physics deals with matter, energy, force, motion, light, sound, heat and electricity.

Example: Study of magnets, machines and electric circuits.

2. Chemistry

Chemistry deals with the composition, structure, properties and changes of matter.

Example: Study of acids, bases, salts and chemical reactions.

3. Biology

Biology is the study of living organisms, including plants, animals and human beings.

Example: Study of the human body, photosynthesis and reproduction in plants.

4. Environmental Science

It deals with the relationship between living organisms and their environment.

Example: Pollution, climate change, forests and conservation of natural resources.

5. Astronomy

It deals with planets, stars, galaxies and other objects in space.

Example: Study of the solar system.

6. Earth Science

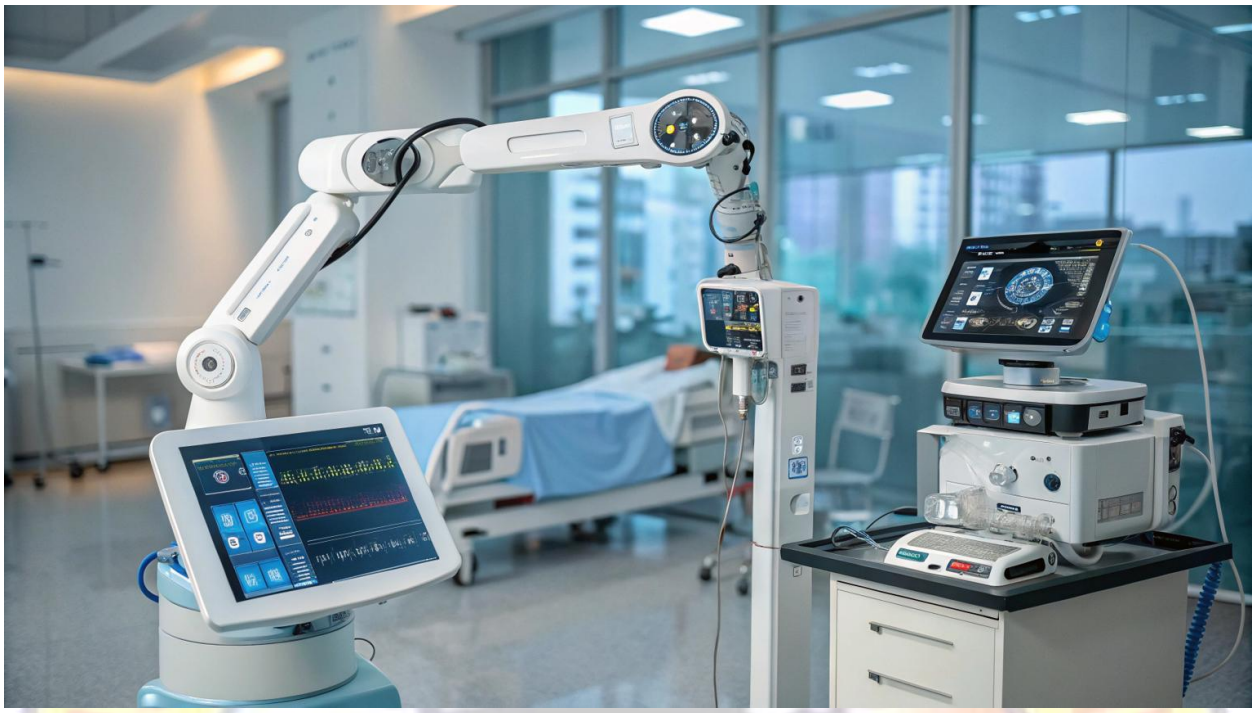
It deals with the study of the Earth, rocks, minerals, weather and natural resources.

Example: Study of earthquakes and volcanoes.

4. Impact of Science and Technology on Society

Science provides knowledge, while technology uses scientific knowledge to develop tools, machines and practical solutions.

Science and technology have changed almost every aspect of human life.



Positive Impact

1. In Education: Smart classrooms, computers, digital libraries and online learning have improved education.

2. In Healthcare: Modern medical equipment, vaccines and diagnostic technologies help in disease prevention and treatment.

3. In Agriculture: Tractors, irrigation systems and improved farming techniques increase agricultural productivity.

4. In Communication: Mobile phones, the internet and video calls make communication faster.

5. In Transportation: Cars, trains, aeroplanes and electric vehicles make travelling easier.

6. In Industry: Machines and automation increase production and efficiency.

7. In Daily Life: Refrigerators, washing machines and other appliances make household work easier.

Negative Impact

1. **Environmental pollution has increased due to industrial activities.**
2. **Excessive use of technology can reduce physical activity.**
3. **Machines and automation may replace some traditional jobs.**
4. **Electronic waste creates environmental problems.**
5. **Excessive dependence on technology can reduce face-to-face communication.**
6. **Improper use of scientific developments can create social and environmental challenges.**

Conclusion: Science and technology are important for social development. They should be used responsibly for the welfare of humanity.

(B) Aims and Objectives of Teaching Science – Bloom's Taxonomy of Educational Objectives

1. Meaning of Aims of Teaching Science

Aims of teaching science refer to the broad purposes that science education wants to achieve in students.

Science teaching helps students develop scientific knowledge, skills, attitudes and values.

2. Aims of Teaching Science

1. Development of Scientific Knowledge

To provide students with knowledge about scientific facts, principles, laws and theories.

Example: Understanding the laws of motion.

2. Development of Scientific Attitude

To develop curiosity, honesty, open-mindedness and a spirit of inquiry.

Example: Students should ask questions and search for scientific explanations.

3. Development of Scientific Skills

To develop observation, measurement, experimentation and problem-solving skills.

Example: Measuring the temperature of water using a thermometer.

4. Development of Critical Thinking

To develop the ability to analyse information and make logical decisions.

Example: Finding reasons for water pollution.

5. Application of Science in Daily Life

To help students apply scientific knowledge in practical situations.

Example: Understanding the importance of boiling drinking water.

6. Environmental Awareness

To develop awareness about environmental protection and conservation.

Example: Saving water and planting trees.

7. Development of Creativity

To encourage students to develop new ideas and scientific models.

Example: Preparing a working model of a water filter.

3. Objectives of Teaching Science

Objectives are specific learning outcomes that students are expected to achieve after teaching.

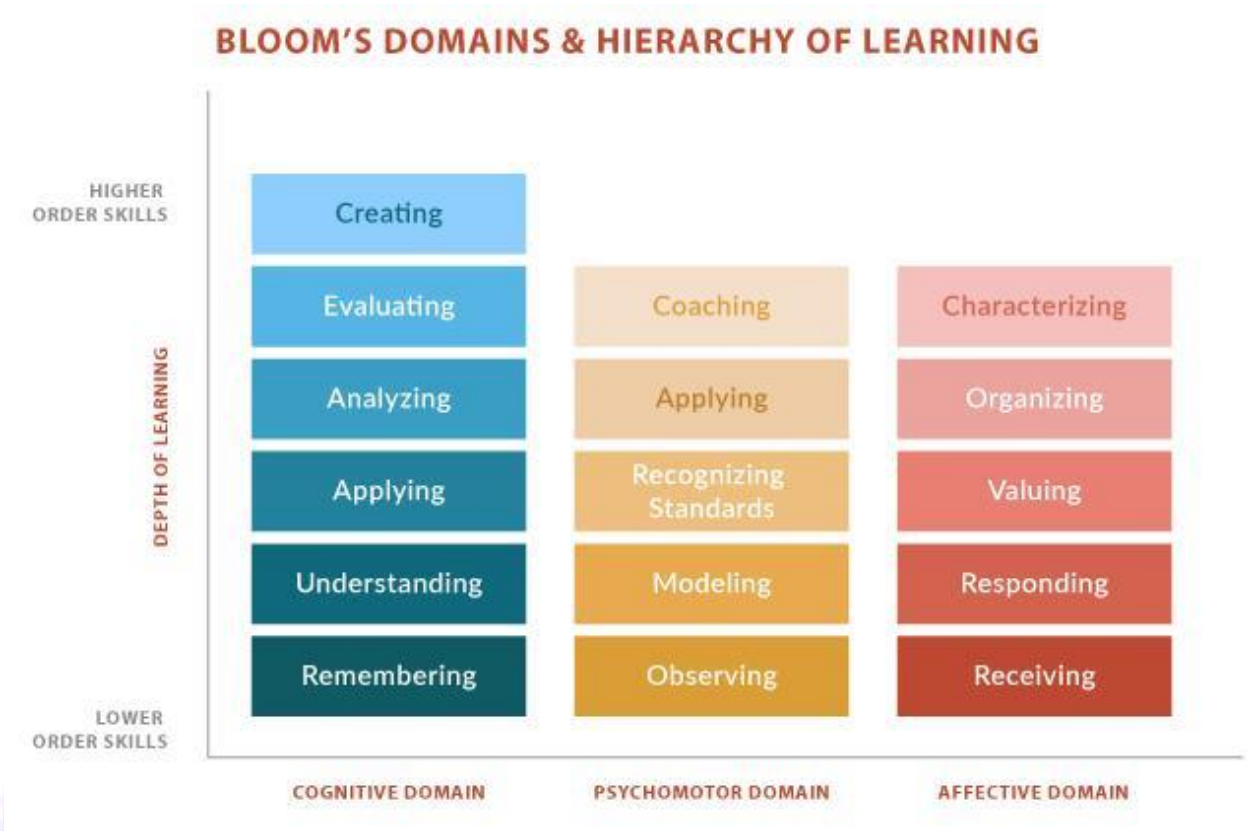
The main objectives are:

- **Knowledge and understanding of scientific concepts.**
- **Development of practical and experimental skills.**
- **Ability to apply scientific principles.**
- **Development of scientific attitudes.**
- **Development of problem-solving ability.**
- **Development of environmental awareness.**

4. Bloom's Taxonomy of Educational Objectives

Bloom's Taxonomy was developed by Benjamin S. Bloom and his colleagues in 1956.

It is a classification of educational objectives into three main domains.



The three domains are:

1. Cognitive Domain (Knowledge and Thinking)

This domain is related to mental abilities, knowledge, understanding and intellectual development.

It includes six levels in the original taxonomy:

1. Knowledge: Remembering facts and information.

Example: Name the planets of the solar system.

2. Comprehension: Understanding the meaning of information.

Example: Explain the process of photosynthesis.

3. Application: Using knowledge in new situations.

Example: Apply the formula of speed to solve a numerical problem.

4. Analysis: Breaking information into different parts.

Example: Analyse the causes of air pollution.

5. Synthesis: Combining different ideas to create something new.

Example: Design a model of a rainwater harvesting system.

6. Evaluation: Making judgments based on evidence.

Example: Evaluate different methods of water conservation.

Revised Bloom's Taxonomy (2001)

The revised taxonomy was developed by Lorin Anderson and David Krathwohl.

It uses action verbs and changes the original categories into six levels.

Bloom's Taxonomy



Level	Meaning	Science Example
1. Remember	Recall facts	Define force
2. Understand	Explain ideas	Explain gravity
3. Apply	Use knowledge	Solve a speed problem
4. Analyze	Examine information	Analyse water pollution
5. Evaluate	Judge or assess	Evaluate energy sources
6. Create	Produce something new	Design a solar cooker model

Important Difference:

Original Taxonomy	Revised Taxonomy
Knowledge	Remember

Comprehension	**Understand**
Application	**Apply**
Analysis	**Analyze**
Synthesis	**Evaluate and Create**
Evaluation	**Highest level in original**

2. Affective Domain (Attitudes and Values)

This domain deals with students' interests, feelings, values and attitudes.

Its five levels are:

1. Receiving: Showing willingness to listen.

Example: Listening carefully to a science teacher.

2. Responding: Actively participating in activities.

Example: Taking part in a science discussion.

3. Valuing: Developing respect for values.

Example: Developing concern for environmental protection.

4. Organization: Arranging values according to importance.

Example: Giving importance to cleanliness and conservation.

5. Characterization: Following values consistently in life.

Example: Regularly practising environmental protection.

3. Psychomotor Domain (Physical and Practical Skills)

This domain is related to physical activities, coordination and practical skills.

Examples:

- **Handling laboratory equipment.**
- **Preparing scientific diagrams.**
- **Using a microscope.**
- **Measuring liquids.**
- **Performing scientific experiments.**

5. Instructional Objectives of Teaching Science at Secondary and Senior Secondary Level

Instructional objectives are the expected learning outcomes of students after completing a particular lesson or unit.

A. Secondary Level (Classes IX–X)

At this level, students should:

1. **Understand basic scientific concepts and principles.**
2. **Develop observation and experimentation skills.**
3. **Understand the importance of health and hygiene.**
4. **Develop awareness about environmental protection.**
5. **Apply scientific knowledge in daily life.**
6. **Develop scientific curiosity and logical thinking.**
7. **Understand basic concepts of physics, chemistry and biology.**

Example: Students should be able to explain the water cycle with a labelled diagram.

B. Senior Secondary Level (Classes XI–XII)

At this level, students should:

1. **Develop a deeper understanding of scientific principles.**
2. **Understand scientific theories and laws.**
3. **Develop advanced laboratory and research skills.**
4. **Interpret scientific data and experimental results.**

5. **Develop analytical and critical thinking.**
6. **Apply scientific knowledge to solve complex problems.**
7. **Develop interest in scientific research and higher education.**

Example: Students should be able to analyse the factors affecting the rate of a chemical reaction.

Difference Between Secondary and Senior Secondary Objectives

Secondary Level	Senior Secondary Level
Basic scientific knowledge	Advanced scientific knowledge
Simple experiments	Detailed experiments
Basic observation skills	Analytical and research skills
Introduction to scientific concepts	Deeper understanding of theories
Simple problem-solving	Complex problem-solving

(C) Formulation of Specific Objectives in Behavioural Terms – Mager's Approach and RCEM Approach

1. Meaning of Specific Objectives

Specific objectives are clear and measurable statements describing what students will be able to do after completing a lesson.

They describe the expected behaviour or performance of students.

Example:

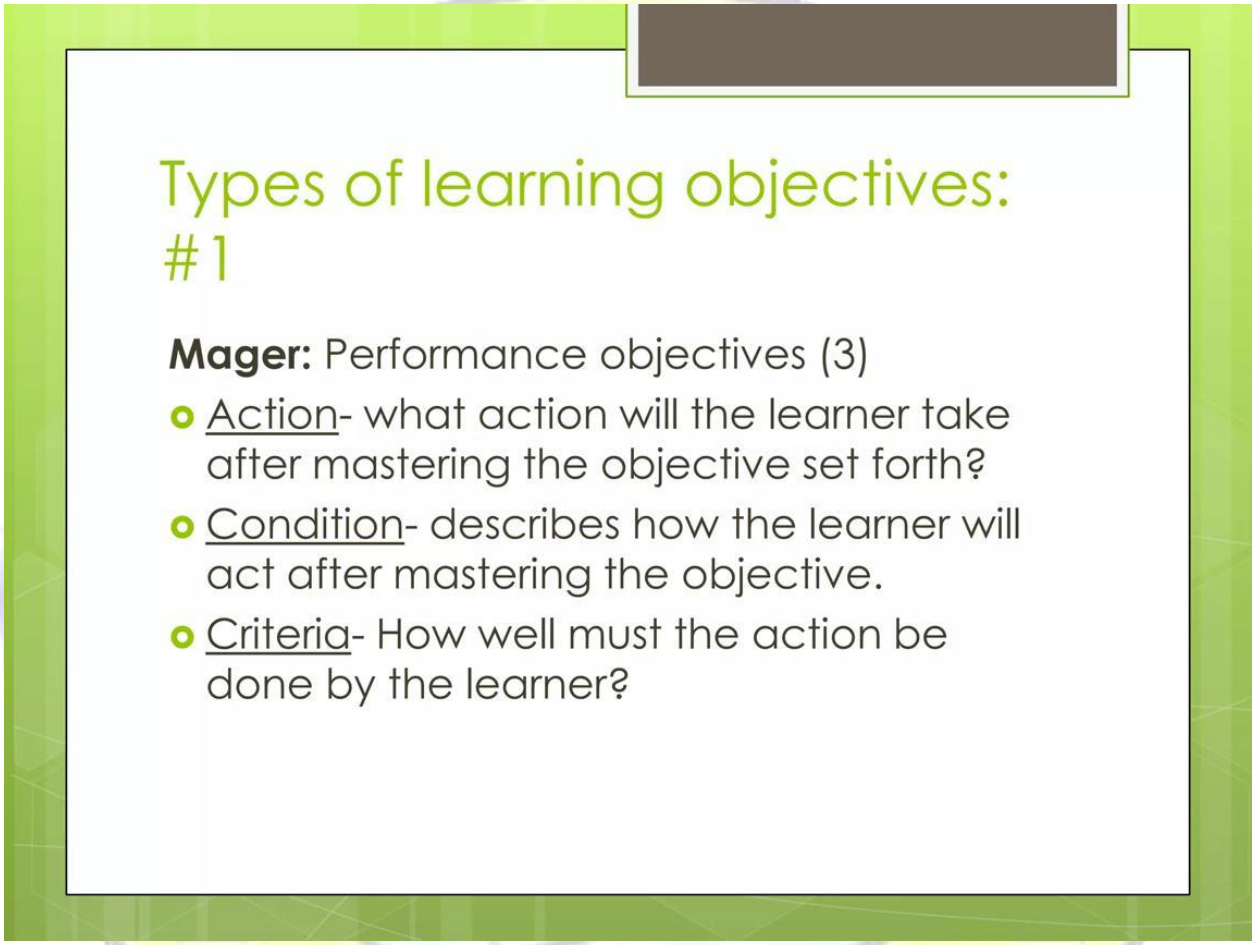
General objective: Students will understand the human digestive system.

Specific objective: Students will be able to draw and label at least five major organs of the human digestive system.

2. Mager's Approach

Robert F. Mager developed an approach for writing instructional objectives in behavioural terms.

According to Mager, a properly written objective should contain three important components.



Three Components of Mager's Approach

1. Performance

It describes what the learner will be able to do after instruction.

Example: Students will identify the parts of a flower.

2. Condition

It describes the conditions or circumstances under which students will perform the activity.

Example: When provided with a labelled or unlabelled flower diagram.

3. Criterion

It describes the acceptable level of performance.

Example: Students will correctly identify at least five parts.

Complete Example:

"After studying the structure of a flower, students will be able to identify at least five parts of a flower from an unlabelled diagram with 90% accuracy."

Here:

- **Performance: Identify the parts.**
- **Condition: From an unlabelled diagram.**
- **Criterion: At least five parts with 90% accuracy.**

Advantages of Mager's Approach

1. **Objectives are clear and specific.**
2. **Learning outcomes can be measured.**
3. **Teachers can evaluate student performance.**
4. **It helps in lesson planning.**
5. **It makes teaching more purposeful.**

3. RCEM Approach

RCEM stands for Regional College of Education Mysore.

It is an approach used for writing specific instructional objectives.

The RCEM approach focuses on the development of observable learning outcomes through different mental processes and abilities.

It gives importance to the relationship between teaching content, learning experiences and evaluation.

Major aspects of the RCEM approach:

1. Knowledge: Remembering scientific facts and information.

Example: Define photosynthesis.

2. Understanding: Explaining scientific concepts in one's own words.

Example: Explain why plants need sunlight.

3. Application: Using scientific knowledge in practical situations.

Example: Apply knowledge of evaporation to explain drying of clothes.

4. Skill: Performing practical activities and scientific procedures.

Example: Prepare a temporary slide of onion peel.

RCEM Approach and Science Teaching

Aspect	Example
Knowledge	Define force
Understanding	Explain the effects of force
Application	Apply force concepts in daily life
Skill	Perform an experiment to demonstrate force

Advantages of RCEM Approach

- **Develops different abilities among students.**
- **Makes instructional objectives more meaningful.**

- **Encourages practical learning.**
- **Helps teachers evaluate learning outcomes.**
- **Connects theoretical knowledge with real-life situations.**

Difference Between Mager and RCEM Approach

Mager's Approach	RCEM Approach
Focuses on behavioural objectives	Focuses on learning outcomes and abilities
Includes performance, condition and criterion	Organizes learning around knowledge, understanding, application and skills
Emphasizes measurable performance	Emphasizes different dimensions of learning
Helps write clear objectives	Helps organize teaching and evaluation

UNIT – II: METHODS AND TECHNIQUES IN SCIENCE TEACHING

(A) Methods of Teaching Science

1. Problem-Solving Method

Meaning:

The problem-solving method is a teaching method in which students learn by identifying problems, collecting information, analysing facts and finding suitable solutions.

It develops logical thinking, reasoning and scientific attitudes.

Steps of Problem-Solving Method

1. Identification of Problem: Students identify a particular problem.

Example: Why are some plants growing slowly?

2. Definition of Problem: Clearly understand and describe the problem.

3. Formulation of Hypothesis: Suggest possible explanations.

Example: Plants may not be receiving sufficient sunlight.

4. Collection of Data: Collect information through observation and experiments.

5. Testing the Hypothesis: Conduct experiments to check the possible explanation.

6. Drawing Conclusions: Analyse the results and identify the correct explanation.

7. Verification: Repeat the experiment, where appropriate, to check the results.

Advantages

- **Develops critical thinking.**
- **Encourages independent learning.**
- **Develops scientific attitude.**
- **Improves decision-making ability.**
- **Connects science with real-life problems.**

Limitations

- **It requires more time.**
- **It needs proper planning.**
- **Some problems may be difficult for younger students.**
- **It requires laboratory materials and resources.**

Classroom Example:

Teacher gives students a problem: "Which material is the best conductor of electricity?"

Students make predictions, observe a safe low-voltage demonstration, record results and identify the best conductor among the tested materials.

2. Lecture-cum-Demonstration Method

Meaning:

Lecture-cum-demonstration is a teaching method in which the teacher explains a scientific topic verbally and demonstrates the related activity or experiment.

It combines explanation with practical demonstration.



Steps

1. Introduction: Teacher introduces the topic and connects it with previous knowledge.

2. Explanation: Teacher explains the scientific concept.

3. Demonstration: Teacher performs an experiment or demonstrates a scientific activity.

4. Observation: Students carefully observe the demonstration.

5. Discussion: Teacher asks questions and discusses the observations.

6. Conclusion: Teacher explains the scientific principle behind the demonstration.

7. Evaluation: Teacher asks questions to check understanding.

Advantages

- **Makes difficult concepts easier to understand.**
- **Saves time and resources.**
- **Develops observation skills.**
- **Combines theoretical and practical knowledge.**
- **Useful for large classrooms.**

Limitations

- **Students may remain passive.**
- **Individual practical participation may be limited.**
- **Demonstration requires proper equipment.**
- **All students may not get a clear view.**

Example:

To teach the expansion of air on heating, the teacher demonstrates an appropriate classroom experiment and explains the changes observed.

3. Project Method

Meaning:

The project method is a student-centred teaching method in which students learn by completing a purposeful practical activity.

It is based on the principle of learning by doing.

This method is associated with William H. Kilpatrick.



Steps of Project Method

1. Providing a Situation: Teacher creates an interesting learning situation.

2. Selection of Project: Students select a suitable project.

3. Planning: Students prepare a plan of work.

4. Execution: Students perform the project according to the plan.

5. Recording: Students collect information, observations and results.

6. Evaluation: Teacher evaluates the completed project.

7. Reporting: Students present their findings to the class.

Examples of Science Projects

- **Preparation of a working model of the solar system.**
- **Rainwater harvesting model.**
- **Study of local sources of water pollution.**
- **Preparation of a simple water filtration model.**
- **Study of different types of plants in the school garden.**

Advantages

- **Encourages learning by doing.**
- **Develops creativity.**
- **Promotes teamwork.**
- **Develops problem-solving skills.**
- **Connects science with everyday life.**
- **Develops self-confidence and responsibility.**

Limitations

- **It requires more time.**
- **Some projects may be expensive.**
- **It requires proper supervision.**
- **All students may not participate equally.**
- **Evaluation can be difficult.**

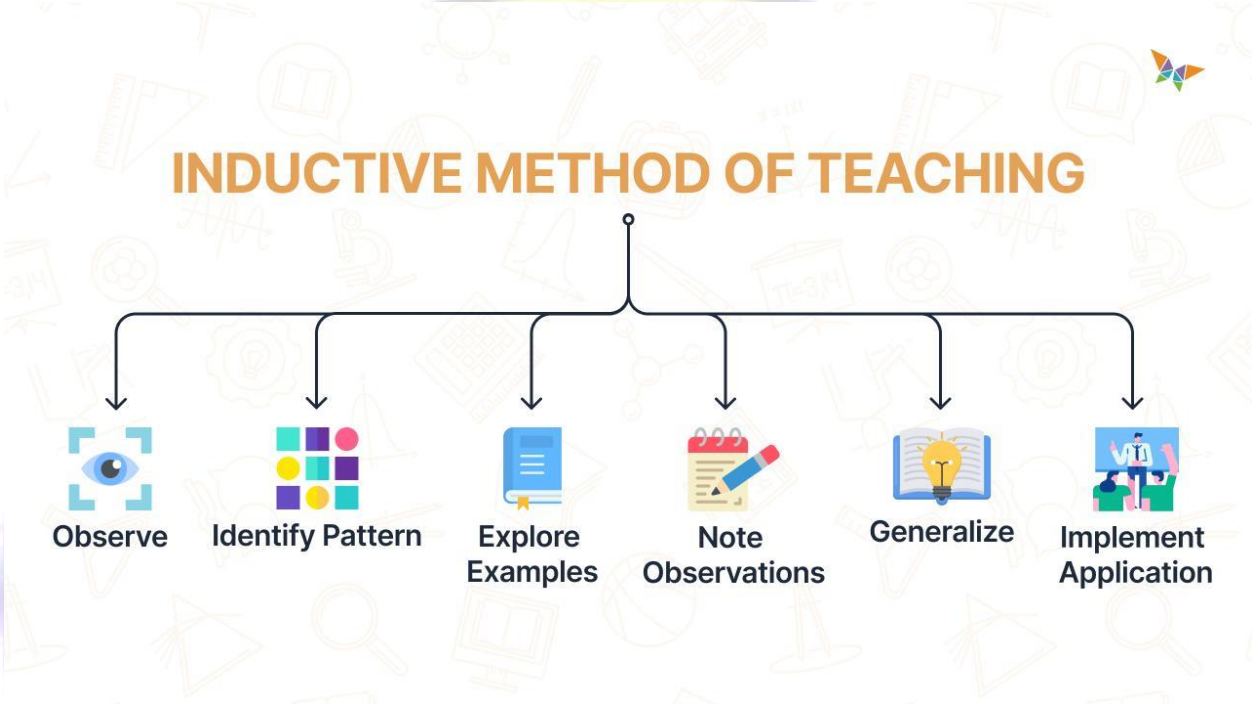
(B) Approaches of Teaching Science

1. Inductive Approach

Meaning:

The inductive approach is a teaching approach in which students move from specific examples and observations towards a general rule or principle.

It is based on the principle of moving from particular to general.



Steps

1. **Observation of specific examples.**
2. **Collection of facts.**
3. **Identification of similarities.**
4. **Comparison of observations.**
5. **Formulation of a general rule.**
6. **Verification of the rule.**

Example:

Teacher shows students different objects made of iron, copper and aluminium.

Students observe that these materials allow electric current to pass through them under suitable conditions.

They conclude that these materials are conductors of electricity.

Advantages

- **Develops observation skills.**
- **Encourages active participation.**
- **Develops logical thinking.**
- **Makes learning interesting.**
- **Helps students discover scientific principles.**

Limitations

- **It is time-consuming.**
- **It requires several examples.**
- **Not every scientific principle can be easily discovered by students.**

2. Deductive Approach

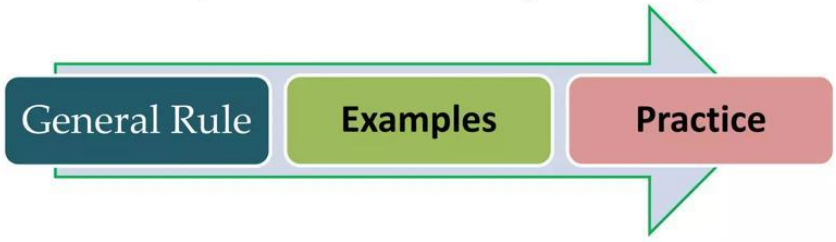
Meaning:

The deductive approach is a teaching approach in which students move from a general rule or principle towards specific examples and applications.

It follows the principle of moving from general to particular.

Deductive vs. Inductive method

- In *deductive* (*rule-driven, top-down*)



- In *inductive* (*example-driven, bottom-up*)



Steps

1. **Presentation of a general rule.**
2. **Explanation of the rule.**
3. **Application to specific situations.**
4. **Solving examples and problems.**
5. **Verification of understanding.**

Example:

Teacher explains the principle that metals generally expand on heating.

After explaining the principle, the teacher gives examples of railway tracks and metal bridges, where expansion must be considered.

Advantages

- **Saves teaching time.**
- **Helps explain scientific laws.**
- **Useful for advanced topics.**
- **Makes application of knowledge easier.**

Limitations

- **Students may become passive.**
- **It may encourage memorization.**
- **It gives less opportunity for independent discovery.**

Difference Between Inductive and Deductive Approach

Inductive Approach	Deductive Approach
Particular to general	General to particular
Begins with examples	Begins with a rule
Students discover rules	Teacher explains rules
Encourages discovery	Encourages application
Usually takes more time	Usually saves time

3. Cooperative Learning Approach

Meaning:

Cooperative learning is an approach in which students work together in small groups to achieve common learning goals.

Every student contributes to the success of the group.



Main Characteristics

1. **Positive interdependence.**
2. **Individual responsibility.**
3. **Face-to-face interaction.**
4. **Social and communication skills.**
5. **Group discussion and teamwork.**
6. **Group evaluation.**

Steps

1. **Divide students into small groups.**
2. **Give each group a common task.**
3. **Assign responsibilities to group members.**
4. **Allow students to discuss and perform activities.**
5. **Encourage sharing of information.**
6. **Evaluate individual and group performance.**

Example:

Teacher divides the class into four groups to study environmental pollution.

- **Group 1: Air pollution.**
- **Group 2: Water pollution.**
- **Group 3: Noise pollution.**
- **Group 4: Soil pollution.**

Each group collects information and presents its findings.

Advantages

- **Develops teamwork.**
- **Improves communication skills.**
- **Encourages active learning.**
- **Develops leadership qualities.**
- **Promotes mutual respect.**
- **Helps students learn from one another.**

Limitations

- **Some students may dominate the group.**
- **Some students may contribute less.**
- **Group activities require proper management.**
- **Evaluation of individual performance can be difficult.**

4. Inquiry-Based Approach

Meaning:

Inquiry-based learning is an approach in which students learn science by asking questions, investigating problems, collecting evidence and drawing conclusions.

It encourages curiosity and scientific investigation.



Steps

1. **Asking questions.**
2. **Identifying a problem.**
3. **Forming a hypothesis.**
4. **Planning an investigation.**
5. **Collecting evidence.**
6. **Analysing information.**
7. **Drawing conclusions.**
8. **Sharing findings.**

Example:

Teacher asks: "Does the amount of sunlight affect plant growth?"

Students:

- **Prepare a question.**
- **Observe plants under different light conditions.**

- **Record their observations.**
- **Compare the results.**
- **Draw conclusions based on evidence.**

Advantages

- **Develops curiosity.**
- **Promotes independent learning.**
- **Develops research skills.**
- **Encourages critical thinking.**
- **Makes science practical and meaningful.**

Limitations

- **Requires sufficient time.**
- **Needs proper guidance.**
- **Requires suitable learning materials.**
- **Some students may find investigations difficult.**

5. Heuristic Approach

Meaning:

The word Heuristic is derived from a Greek word meaning "to discover".

The heuristic approach is a teaching approach in which students discover scientific facts and principles through their own activities, observations and experiments.

In this approach, the teacher acts as a guide rather than simply providing information.

It is associated with H. E. Armstrong.



Principles of Heuristic Approach

1. **Learning by discovery.**
2. **Learning by doing.**
3. **Self-activity of students.**
4. **Independent thinking.**
5. **Scientific investigation.**
6. **Teacher as a guide.**

Steps

1. **Teacher presents a problem.**
2. **Students observe the situation.**
3. **Students plan an investigation.**
4. **Students perform experiments.**
5. **Students collect and analyse data.**
6. **Students discover the scientific principle.**
7. **Teacher verifies and summarizes the findings.**

Example:

Teacher gives students different objects and asks them to find out which objects float and which sink in water.

Students test the objects, record observations and discover that floating and sinking depend on factors such as density and buoyancy.

Advantages

- **Develops self-confidence.**
- **Encourages independent thinking.**
- **Promotes scientific attitude.**
- **Develops experimental skills.**
- **Makes learning permanent.**
- **Encourages learning through discovery.**

Limitations

- **Requires more time.**
- **Needs laboratory facilities.**
- **Not suitable for every topic.**
- **Requires active teacher guidance.**
- **Difficult to apply in very large classes.**

Difference Between Inquiry-Based and Heuristic Approach

Inquiry-Based Approach	Heuristic Approach
Begins with questions and investigation	Emphasizes discovery through self-activity
Students investigate questions	Students discover facts and principles
Teacher provides guidance	Teacher acts mainly as a guide
Evidence-based learning	Discovery-based learning
Develops inquiry and research	Develops independent discovery

skills **skills**

(C) Scientific Attitude and Its Development

1. Meaning of Scientific Attitude

Scientific attitude refers to a way of thinking and behaving based on facts, evidence, logical reasoning and scientific principles.

A person with a scientific attitude does not accept information blindly but tries to understand it through observation and investigation.

Example:

If a student hears that a particular plant grows faster in a certain condition, the student tries to verify this claim through observation and experimentation.

2. Characteristics of Scientific Attitude

1. Curiosity: A scientific person always wants to know the reasons behind different events.

2. Open-mindedness: A person should be ready to accept new ideas and evidence.

3. Objectivity: Decisions should be based on facts rather than personal feelings.

4. Honesty: Scientific observations and results should be reported truthfully.

5. Critical Thinking: Scientific information should be examined carefully.

6. Rationality: Conclusions should be based on logic and reasoning.

7. Patience: Scientific investigation requires time and careful observation.

8. Creativity: A scientific person tries to find new solutions to problems.

9. Respect for Evidence: Scientific conclusions should be supported by reliable evidence.

3. Importance of Scientific Attitude

1. **Develops logical thinking.**
2. **Removes superstitions and blind beliefs.**
3. **Encourages problem-solving ability.**
4. **Develops curiosity and creativity.**
5. **Promotes honesty and objectivity.**
6. **Helps students make informed decisions.**
7. **Develops awareness about health and the environment.**
8. **Encourages students to become responsible citizens.**

4. Development of Scientific Attitude Among Students



1. Through Experiments

Teachers should provide opportunities to perform experiments.

Example: Students conduct an experiment to understand evaporation.

2. Through Observation

Students should be encouraged to observe natural phenomena.

Example: Observing the growth of plants.

3. Through Questioning

Teachers should encourage students to ask questions.

Example: Why does ice melt when kept outside a refrigerator?

4. Through Science Projects

Students should participate in scientific projects and activities.

Example: Preparing a model of the solar system.

5. Through Science Exhibitions

Science exhibitions encourage students to present their ideas and models.

6. Through Science Clubs

Science clubs organize quizzes, discussions, experiments and educational activities.

7. Through Educational Visits

Visits to science museums, laboratories and planetariums develop scientific interest.

8. Through Discussion and Debate

Scientific discussions develop logical thinking and the ability to express ideas.

9. Through Problem-Solving Activities

Students should be given real-life scientific problems to investigate.

10. Through the Teacher's Example

Science teachers should demonstrate honesty, objectivity, open-mindedness and respect for evidence.

Conclusion:

Scientific attitude is an essential outcome of science education. It develops rational thinking, curiosity, honesty and the ability to make decisions based on evidence.

IMPORTANT MIND MAPS – UNIT I & UNIT II

These mind maps provide a quick revision of the complete syllabus.

Mind Map 1: Introduction to Science

SCIENCE

Systematic knowledge based on facts and experiments

Nature

- **Systematic**
- **Logical**
- **Objective**
- **Experimental**
- **Dynamic**

Scope

- **Physics**
- **Chemistry**
- **Biology**
- **Astronomy**
- **Earth Science**

Technology

- **Education**
- **Healthcare**
- **Agriculture**
- **Transport**
- **Communication**

Impact

- **Development**
- **Employment**
- **Pollution**
- **Automation**
- **Lifestyle**

Mind Map 2: Bloom's Taxonomy

BLOOM'S TAXONOMY

Cognitive

Knowledge and thinking

Remember

Understand

Apply

Analyze

Evaluate

Create

Affective

Attitudes and values

Receiving

Responding

Valuing

Organization

Characterization

Psychomotor

Physical skills

Observation

Handling

Measurement

Experimentation

Practical work

Mind Map 3: Mager and RCEM Approaches

SPECIFIC INSTRUCTIONAL OBJECTIVES

MAGER

- **Performance**
- **Condition**
- **Criterion**

RCEM

- **Knowledge**
- **Understanding**
- **Application**
- **Skills**

Mind Map 4: Methods of Teaching Science

METHODS OF TEACHING SCIENCE

Problem-Solving

- **Identify**
- **Hypothesis**
- **Experiment**
- **Conclusion**

Lecture-cum-Demonstration

- **Explain**
- **Demonstrate**
- **Observe**
- **Evaluate**

Project Method

- **Select**
- **Plan**
- **Execute**
- **Evaluate**

Mind Map 5: Approaches of Teaching Science

APPROACHES OF SCIENCE TEACHING

Inductive

Specific → General

Deductive

General → Specific

Cooperative

Group learning

Inquiry-Based

Question and investigate

Heuristic

Self-discovery and learning by doing

Mind Map 6: Scientific Attitude

SCIENTIFIC ATTITUDE

Characteristics

- **Curiosity**
- **Honesty**
- **Objectivity**
- **Open-mindedness**
- **Rationality**

Development

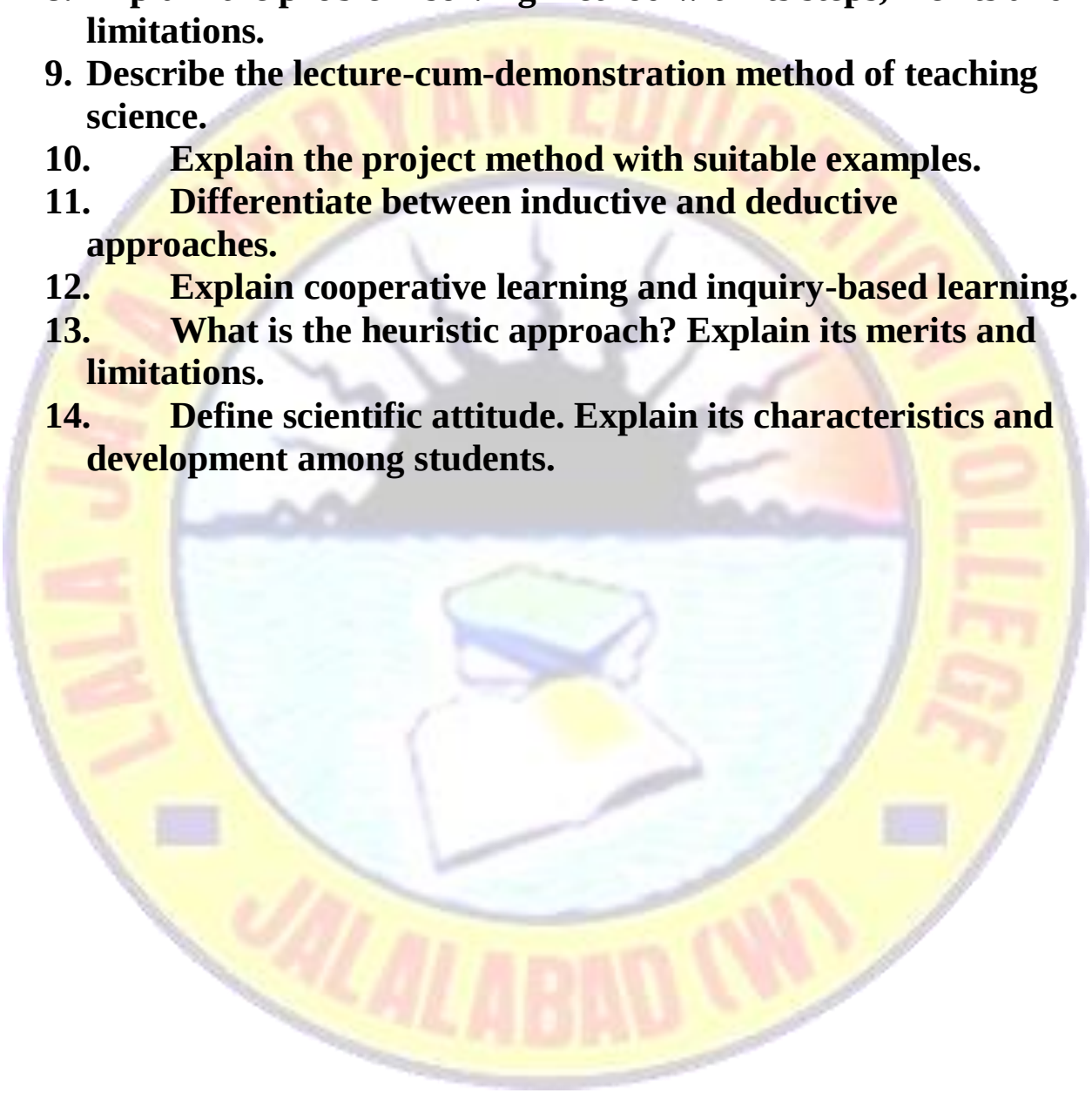
- **Experiments**
- **Observation**
- **Questioning**
- **Science clubs**
- **Projects**

Result: Logical Thinking + Problem Solving + Scientific Temper

Important Questions for B.Ed. Examination

1. **Define science. Explain its nature and scope with suitable examples.**
2. **Discuss the positive and negative impacts of science and technology on society.**
3. **Explain the aims and objectives of teaching science.**
4. **Describe Bloom's Taxonomy and its revised form with examples.**
5. **Explain the instructional objectives of science teaching at secondary and senior secondary levels.**

6. **Explain Mager's approach to formulating behavioural objectives.**
7. **What is the RCEM approach? Explain its importance in science teaching.**
8. **Explain the problem-solving method with its steps, merits and limitations.**
9. **Describe the lecture-cum-demonstration method of teaching science.**
10. **Explain the project method with suitable examples.**
11. **Differentiate between inductive and deductive approaches.**
12. **Explain cooperative learning and inquiry-based learning.**
13. **What is the heuristic approach? Explain its merits and limitations.**
14. **Define scientific attitude. Explain its characteristics and development among students.**



Unit- III: Instructional Material and Aids

a) Instructional resources in Science: Meaning, importance, classification,

b) Principles of selection and use of various instructional aids such as Chalk Board, Charts, Models and animations.

c) E-learning: concept, and use of e-books and e-journals in science.

Unit- IV

: Current Trends in Science Education

a) MOOC platforms for Science Education and their relevance for teachers and students.

b) CBCS: Concept, Need and Significance for discipline-centred as well as interdisciplinary teaching learning in Sciences.

c) Promotion and Innovation in Science Education: Meaning, Importance and Initiatives (Such as KVPY, IISERs, HBCSE, Science Olympiads).

PEDAGOGY OF SCIENCE

UNIT–III: Instructional Material and Aids & UNIT–IV: Current Trends in Science Education

B.Ed Notes | Medium-Detail Explanation in English | With Examples and Mind Maps

UNIT–III: INSTRUCTIONAL MATERIAL AND AIDS

(A) Instructional Resources in Science: Meaning, Importance and Classification

1. Meaning of Instructional Resources

Instructional resources are the materials, tools, equipment and facilities used by teachers to make the teaching-learning process more effective, interesting and meaningful.

In science teaching, instructional resources help students understand scientific concepts through observation, experimentation, demonstration and practical activities.

Definition: Instructional resources are all those materials and devices which help teachers explain scientific concepts and enable students to learn through direct and indirect experiences.

Examples:

- **Textbooks and reference books.**
- **Charts and diagrams.**
- **Models of the human heart and solar system.**
- **Science laboratory equipment.**
- **Computers and projectors.**
- **Educational videos and animations.**
- **E-books and e-journals.**

2. Importance of Instructional Resources in Science

1. Make Learning Interesting: Teaching aids make science lessons attractive and enjoyable.

2. Easy Understanding: Difficult scientific concepts can be explained easily with models, charts and diagrams.

3. Learning by Doing: Laboratory equipment provides opportunities for practical learning.

4. Develop Scientific Attitude: Students develop curiosity, observation, questioning and reasoning abilities.

5. Improve Memory: Visual and practical experiences help students remember concepts for a longer time.

6. Save Time and Energy: Complex processes can be explained quickly through diagrams, animations and videos.

7. Encourage Active Participation: Students become actively involved in classroom activities.

8. Connect Theory with Practice: Students understand how scientific principles are used in daily life.

Example: While teaching the human digestive system, a teacher can use a model of the digestive system to explain the functions of different organs.

3. Classification of Instructional Resources

Instructional resources can be classified into the following categories:



1. Printed Resources

These are materials available in written or printed form.

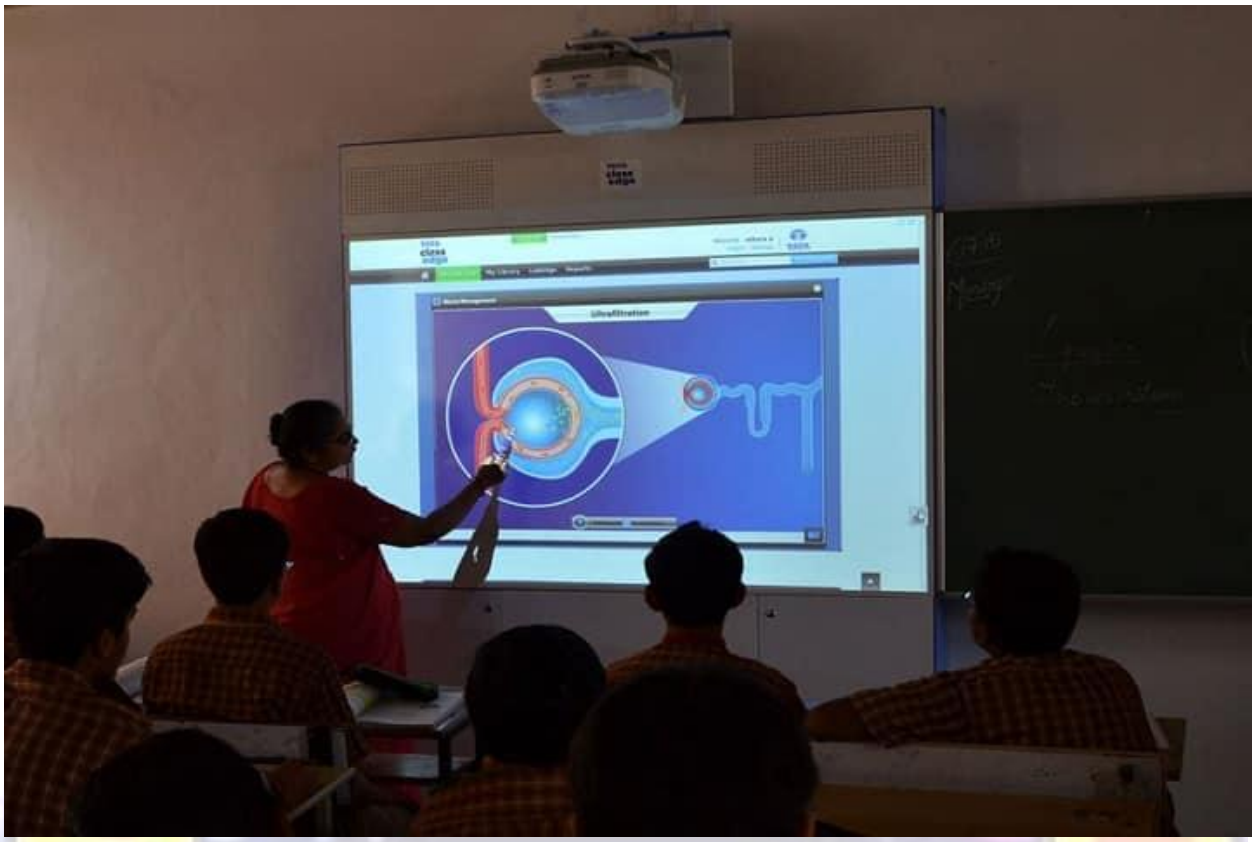
Examples: Textbooks, worksheets, newspapers, magazines and reference books.



2. Visual Resources

These resources help students learn through seeing.

Examples: Charts, maps, pictures, diagrams, models and photographs.



3. Audio-Visual Resources

These resources involve both hearing and seeing.

Examples: Educational films, videos, animations, television and multimedia presentations.



4. Activity-Based Resources

These resources provide practical learning experiences.

Examples: Laboratory equipment, specimens, experiments and science kits.



5. Digital Resources

These resources use modern technology for teaching science.

Examples: Computers, smart boards, e-books, e-journals, websites and digital simulations.

4. Conclusion

Instructional resources play an important role in science education. They make learning practical, interesting, activity-based and student-centred. Proper use of these resources improves the quality of science teaching.

(B) Principles of Selection and Use of Various Instructional Aids

Instructional aids are tools and materials used by teachers to make teaching more effective and understandable.

The main instructional aids used in science teaching are:

1. Chalkboard / Blackboard



Meaning: A chalkboard is a traditional visual teaching aid used by teachers to write important points, draw diagrams, explain concepts and solve scientific problems.

Uses in Science Teaching:

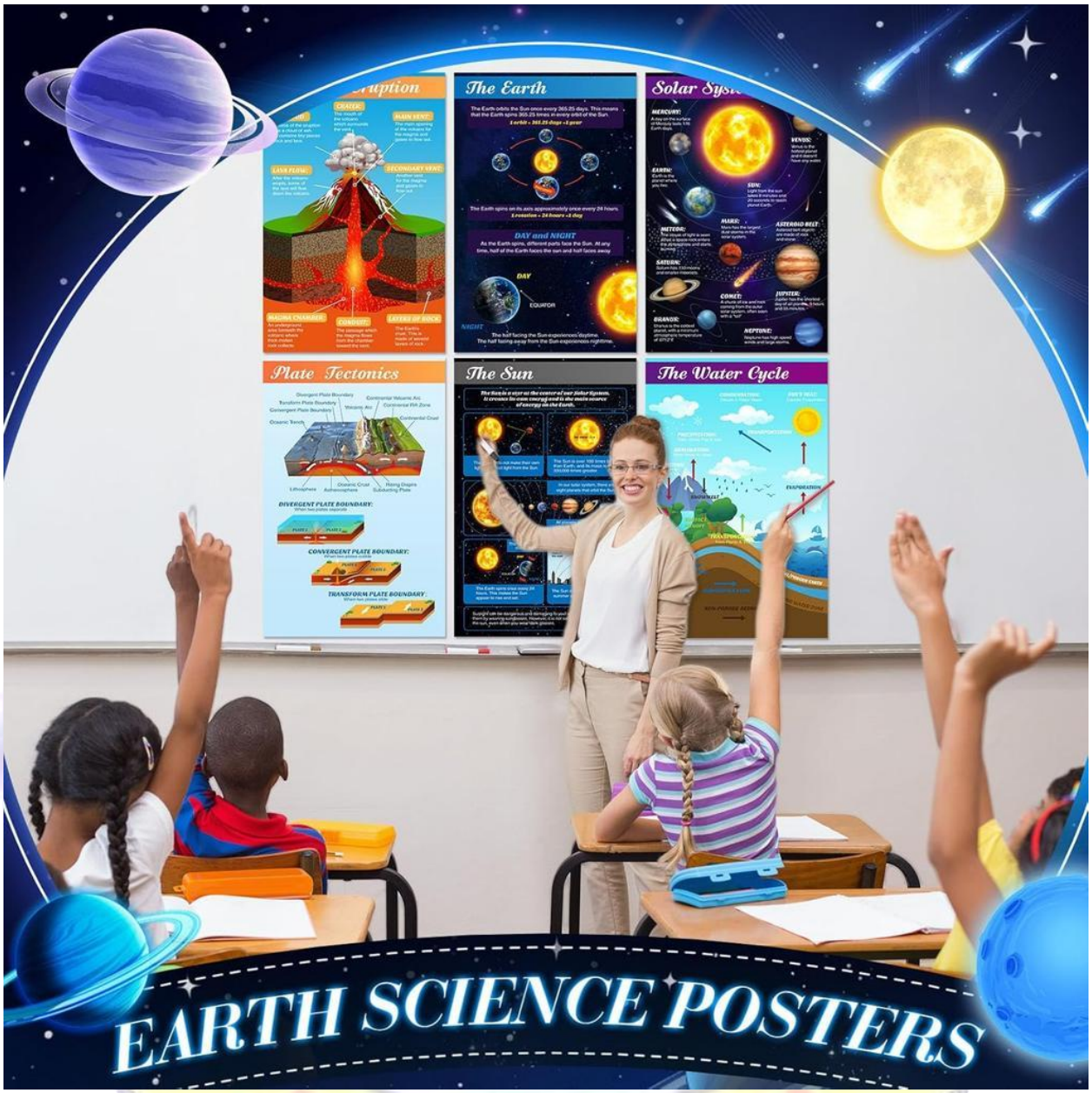
1. **Writing definitions and scientific terms.**
2. **Drawing diagrams of plants and animals.**
3. **Explaining mathematical and scientific formulas.**
4. **Writing important points during classroom discussion.**
5. **Solving numerical problems step by step.**

Principles of Using a Chalkboard:

- **Keep the board clean.**
- **Write clearly and neatly.**
- **Use proper spacing between words.**
- **Divide the board into suitable sections.**
- **Use coloured chalk where necessary.**
- **Write important points in sequence.**
- **Avoid unnecessary writing.**

Example: While teaching photosynthesis, a teacher can draw a diagram of a leaf and write the equation of photosynthesis on the chalkboard.

2. Charts



Meaning: A chart is a visual teaching aid that presents information through pictures, diagrams, symbols, tables and short statements.

Uses in Science Teaching:

1. **To explain the water cycle.**
2. **To show the human body system.**
3. **To explain the classification of animals.**

4. **To show the solar system.**
5. **To explain food chains and food webs.**

Principles of Selecting and Using Charts:

- **The chart should be related to the topic.**
- **It should be simple and clear.**
- **Letters should be large enough to read.**
- **Pictures should be scientifically accurate.**
- **Attractive colours should be used.**
- **The chart should be visible to all students.**
- **It should not contain unnecessary information.**

Example: A teacher uses a water cycle chart to explain evaporation, condensation and precipitation.

3. Models



Meaning: A model is a three-dimensional representation of a real object, structure or scientific process. It helps students understand objects that are difficult to observe directly.

Types of Models:

1. Working Models: Models that demonstrate the working of a system.

Example: A working model of a water pump.

2. Static Models: Models that represent the structure of an object.

Example: A model of the human heart.

3. Scale Models: Models that represent objects in reduced or enlarged proportions.

Example: A model of the solar system.

Uses of Models:

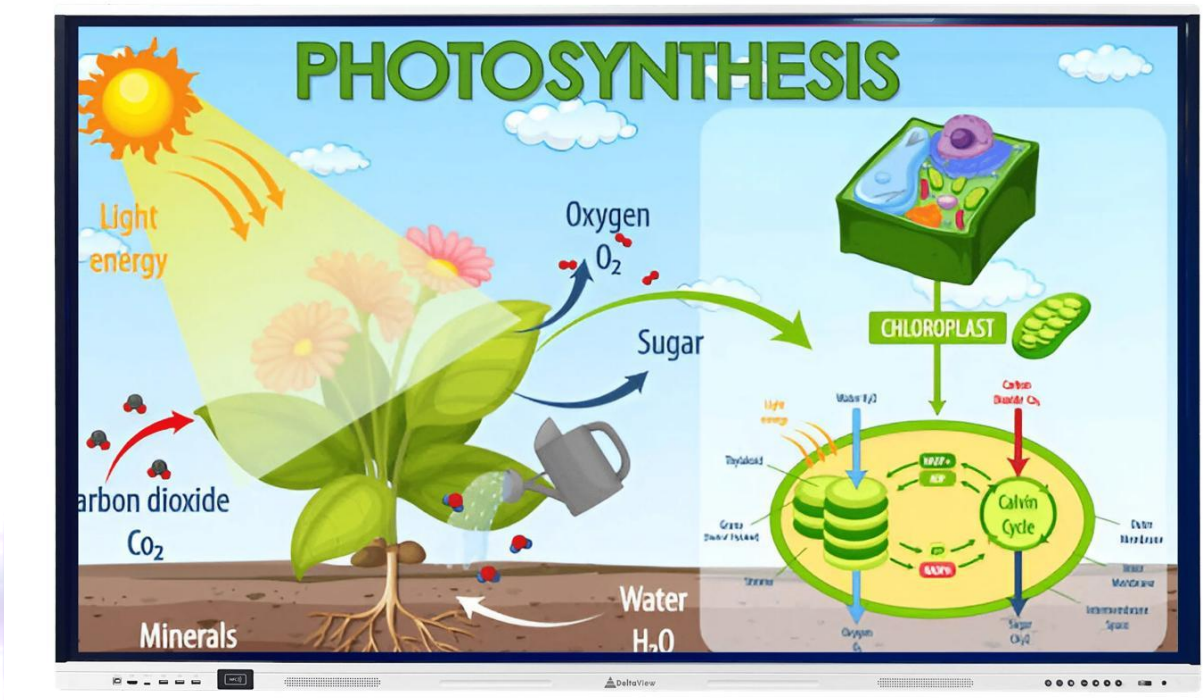
- **To explain complex structures.**
- **To develop imagination and observation.**
- **To make abstract concepts easier.**
- **To provide visual and practical learning.**
- **To increase students' interest in science.**

Principles of Selecting and Using Models:

- **The model should be scientifically correct.**
- **It should be related to the lesson objectives.**
- **It should be strong and durable.**
- **It should be easy to handle.**
- **It should be visible to all students.**
- **The teacher should explain its limitations.**

Example: A teacher uses a human heart model to explain the chambers, valves and circulation of blood.

4. Animations



Meaning: Animation is a digital teaching aid that uses moving pictures, graphics and visual effects to explain scientific processes and concepts.

Animations help students understand processes that cannot easily be observed in real life.

Uses of Animations:

1. **To explain the movement of planets.**
2. **To demonstrate the process of photosynthesis.**
3. **To explain the working of the human heart.**
4. **To show the process of cell division.**
5. **To explain the movement of molecules.**

Principles of Selecting and Using Animations:

- **Animation should be related to the topic.**
- **It should be scientifically accurate.**
- **It should be simple and age-appropriate.**
- **It should not contain unnecessary effects.**
- **The teacher should explain the animation.**
- **It should be of suitable length.**
- **Students should be encouraged to ask questions.**

Example: While teaching the solar system, a teacher shows an animation of planets revolving around the Sun.

5. Comparison of Instructional Aids

Teaching Aid	Main Purpose	Example
Chalkboard	Writing and explaining	Scientific equations
Charts	Visual presentation	Water cycle
Models	3D understanding	Human heart
Animations	Showing movement/processes	Cell division

Conclusion

Instructional aids make science teaching effective and meaningful. Teachers should select aids according to students' age, interests, abilities, lesson objectives and available resources.

(C) E-Learning: Concept and Use of E-books and E-journals in Science

1. Meaning of E-Learning

E-learning means electronic learning. It is a modern method of education in which students use digital devices and the internet to acquire knowledge and skills.

It allows students to learn through computers, smartphones, tablets, online classes, digital books, videos and educational websites.

Examples:

- **Online science classes.**
- **Digital science textbooks.**
- **Educational videos.**
- **Virtual science laboratories.**
- **Online quizzes and tests.**



2. Characteristics of E-Learning

1. **Flexible Learning: Students can learn at different times and places.**
2. **Digital Content: Learning materials are available in electronic form.**

3. **Interactive Learning: Students can participate in quizzes and online discussions.**
4. **Self-Paced Learning: Students can learn according to their own speed.**
5. **Easy Accessibility: Digital resources can be accessed through internet-connected devices.**
6. **Multimedia Learning: It combines text, images, audio, video and animation.**

3. E-books in Science Education

Meaning: E-books are electronic versions of printed books that can be read on computers, tablets, smartphones and other digital devices.

Uses of E-books in Science:

1. **Students can study science topics digitally.**
2. **They provide diagrams, pictures and illustrations.**
3. **Students can search for specific topics easily.**
4. **They help in self-study and revision.**
5. **They reduce the need to carry multiple printed books.**
6. **Some e-books include interactive learning features.**

Example: A student studying the chapter on the human respiratory system can use an e-book containing labelled diagrams and animations.

4. E-journals in Science Education

Meaning: E-journals are electronic academic and research journals available through digital platforms.

They contain scientific research papers, articles, experiments, discoveries and reviews written by researchers and experts.

Uses of E-journals in Science:

1. **Provide updated scientific information.**
2. **Help teachers remain informed about new developments.**
3. **Support students in project work.**
4. **Encourage research-based learning.**
5. **Provide access to scientific discoveries.**
6. **Develop critical thinking and analytical skills.**

Examples of E-journal Platforms:

- **Google Scholar.**
- **PubMed.**
- **JSTOR.**
- **ScienceDirect.**

5. Difference Between E-books and E-journals

E-books	E-journals
Electronic form of books.	Electronic form of academic journals.
Mainly provide detailed subject knowledge.	Mainly provide research and updated information.
Used for learning and studying.	Used for research and academic development.
Usually organised into chapters.	Usually organised into research articles and issues.
Example: Digital science textbook.	Example: Scientific research paper.

6. Advantages of E-Learning in Science

- **Provides access to updated knowledge.**
- **Makes learning flexible.**
- **Supports independent learning.**
- **Provides multimedia explanations.**
- **Encourages research and creativity.**

- **Connects students with scientific resources worldwide.**

7. Limitations of E-Learning

- **Requires digital devices and internet access.**
- **Technical problems may interrupt learning.**
- **Excessive screen time can cause discomfort.**
- **Students may become distracted.**
- **Practical laboratory experience cannot always be replaced by online learning.**

Conclusion

E-learning has changed the teaching-learning process in science. E-books and e-journals provide easy access to scientific knowledge and support independent learning, research and professional development.

UNIT–IV: CURRENT TRENDS IN SCIENCE EDUCATION

(A) MOOC Platforms for Science Education and Their Relevance for Teachers and Students

1. Meaning of MOOC

MOOC stands for Massive Open Online Course.

It is an online course designed for a large number of learners. These courses are generally accessible through the internet and may be free or paid.

MOOCs provide opportunities to learn different subjects, including physics, chemistry, biology, mathematics, environmental science and technology.

Definition: MOOCs are online courses that provide educational content to a large number of students through digital platforms, often with flexible learning opportunities.



2. Characteristics of MOOCs

1. **Massive: A large number of learners can participate.**
2. **Open: Courses are generally open to a wide range of learners, subject to platform requirements.**
3. **Online: Courses are delivered through the internet.**
4. **Flexible: Students can learn according to their convenience.**
5. **Interactive: Discussion forums, assignments and quizzes are often provided.**
6. **Affordable: Many courses offer free learning content.**

3. Important MOOC Platforms for Science Education



1. SWAYAM

SWAYAM stands for Study Webs of Active-Learning for Young Aspiring Minds. It provides online courses in science, technology, education and other subjects.

Example: Students can study physics and chemistry through online courses.



NPTEL

2. NPTEL

NPTEL provides online courses in engineering, science and technology with contributions from IITs and IISc.



Example: Students can study basic physics, chemistry and engineering science.

3. Coursera

It offers online courses from universities and educational institutions around the world.

Example: Courses related to biology, environmental science and data science.



4. edX

It provides courses in science, mathematics, technology and other disciplines.

Example: Students can learn introductory biology and chemistry.



5. Khan Academy

It provides free educational lessons, exercises and videos in science and mathematics.

Example: Students can understand electricity, atoms and human biology through video lessons.

4. Relevance of MOOCs for Students

1. **Access to Quality Education: Students can learn from experienced educators and reputed institutions.**
2. **Flexible Learning: Students can study anytime and anywhere.**
3. **Self-Learning: They can learn according to their own pace.**
4. **Updated Knowledge: MOOCs provide access to modern scientific developments.**
5. **Skill Development: They improve digital, analytical and scientific skills.**
6. **Affordable Education: Many courses are available free of cost.**
7. **Global Exposure: Students can learn from international universities.**

5. Relevance of MOOCs for Teachers

1. **Teachers can update their subject knowledge.**
2. **They can learn modern teaching methods.**
3. **They can improve digital teaching skills.**
4. **They can access new scientific research.**
5. **They can develop innovative classroom activities.**
6. **They can participate in professional development courses.**
7. **They can learn interdisciplinary teaching methods.**

Example: A science teacher can complete an online course on environmental science and use the newly learned information to teach pollution and climate change.

Conclusion

MOOCs have made education more accessible and flexible. They provide valuable learning opportunities for both science teachers and students and promote lifelong learning.

(B) CBCS: Concept, Need and Significance for Discipline-Centred and Interdisciplinary Teaching-Learning in Sciences

1. Meaning of CBCS

CBCS stands for Choice Based Credit System.

It is an educational system that provides students with flexibility to choose courses according to their interests, abilities and academic requirements.

Under CBCS, courses are assigned credits based on learning hours and academic workload. Students earn credits after successfully completing the required courses and assessments.

Definition: CBCS is a flexible education system that allows students to select courses from different subject areas and earn credits according to their academic performance.

2. Main Features of CBCS

1. **Choice-Based Learning: Students get opportunities to select subjects.**
2. **Credit System: Each course carries a specific number of credits.**
3. **Continuous Assessment: Students are assessed through different methods during the course.**
4. **Flexibility: Students can select courses according to their interests and academic needs.**
5. **Skill Development: It encourages practical and professional skills.**
6. **Interdisciplinary Learning: It allows students to study subjects from different disciplines.**

3. Need for CBCS

1. **To provide flexibility in higher education.**
2. **To promote student-centred learning.**
3. **To encourage independent learning.**
4. **To provide opportunities for skill development.**

5. **To reduce the limitations of traditional subject-based education.**
6. **To encourage interdisciplinary knowledge.**
7. **To improve the quality of education.**
8. **To provide opportunities for academic mobility, subject to institutional rules.**

4. Significance of CBCS in Science Education

CBCS is important in science education because it provides opportunities to study different scientific disciplines and develop practical knowledge.

Examples:

- **A physics student may choose a course in environmental science.**
- **A biology student may select a course in computer applications.**
- **A chemistry student may study biotechnology.**
- **A science student may choose a skill-based course in scientific communication.**

5. Discipline-Centred Teaching-Learning in Sciences

Meaning: Discipline-centred teaching focuses on the study of one particular subject or academic discipline in depth.

It provides detailed knowledge of the concepts, theories, principles and methods of a specific subject.

Examples:

- **Physics: Study of force, motion, electricity and energy.**
- **Chemistry: Study of atoms, elements, compounds and chemical reactions.**
- **Biology: Study of plants, animals, cells and living organisms.**

Significance:

1. **Develops subject knowledge.**
2. **Provides deep understanding of scientific concepts.**
3. **Develops subject-specific skills.**
4. **Encourages scientific investigation.**
5. **Builds a strong foundation for higher studies.**

6. Interdisciplinary Teaching-Learning in Sciences

Meaning: Interdisciplinary teaching-learning means combining knowledge and methods from two or more subjects to understand a particular topic or solve a problem.

It connects different disciplines and helps students understand real-life situations.

Examples:

- **Environmental science combines biology, chemistry, geography and social science.**
- **Biotechnology combines biology and technology.**
- **Astrophysics combines physics and astronomy.**
- **Biochemistry combines biology and chemistry.**

Significance:

1. **Develops a wider understanding of scientific concepts.**
2. **Encourages creativity and innovation.**
3. **Promotes problem-solving abilities.**
4. **Connects science with real-life situations.**
5. **Develops research and analytical skills.**
6. **Encourages collaboration between different disciplines.**

7. Difference Between Discipline-Centred and Interdisciplinary Learning

Discipline-Centred	Interdisciplinary
Focuses on one subject.	Combines two or more subjects.
Develops deep subject knowledge.	Develops broad understanding.
Subject-specific approach.	Integrated approach.
Example: Physics.	Example: Environmental science.
Focuses on subject principles.	Focuses on connections between subjects.

8. Conclusion

CBCS provides flexibility and freedom in education. It promotes discipline-centred as well as interdisciplinary learning. It helps science students develop deep subject knowledge, practical skills and wider scientific understanding.

(C) Promotion and Innovation in Science Education: Meaning, Importance and Initiatives

1. Meaning of Promotion of Science Education

Promotion of science education means encouraging students to develop interest, knowledge, skills and positive attitudes towards science.

It aims to develop scientific thinking, curiosity, experimentation and problem-solving abilities among students.

2. Meaning of Innovation in Science Education

Innovation in science education refers to introducing new ideas, teaching methods, technologies, activities and learning experiences to improve science teaching and learning.

It makes science education more practical, creative, interesting and student-centred.

Examples:

- **Smart classrooms.**
- **Virtual laboratories.**
- **Science exhibitions.**
- **Robotics activities.**
- **Science projects.**
- **Experiential learning.**
- **Scientific experiments.**



3. Importance of Promotion and Innovation in Science Education

1. **Develop Scientific Temper: It develops logical thinking and a scientific attitude.**
2. **Encourage Curiosity: Students become interested in discovering new things.**

3. **Develop Creativity: Students get opportunities to develop new ideas and models.**
4. **Improve Problem-Solving Skills: Students learn to identify and solve problems scientifically.**
5. **Promote Research: It encourages students to participate in scientific investigations.**
6. **Connect Science with Daily Life: Students understand the practical applications of science.**
7. **Develop Technical Skills: Students learn to use modern tools and technologies.**
8. **Prepare Future Scientists: It encourages talented students to pursue scientific careers.**

4. Important Initiatives for Promotion of Science Education

1. KVPY – Kishore Vaigyanik Protsahan Yojana



Meaning: KVPY was an Indian government-funded fellowship programme introduced to encourage students to pursue basic science research and careers.

Objectives:

1. **To identify talented students interested in science.**
2. **To encourage students to pursue basic science.**
3. **To develop scientific research interest.**
4. **To provide financial support through fellowships to selected students under the programme.**
5. **To encourage future scientific researchers.**

Importance:

- **Encouraged scientific talent.**
- **Promoted research-oriented learning.**
- **Motivated students towards scientific careers.**
- **Supported the development of scientific knowledge.**

Example: A school student interested in physics and research could be encouraged by programmes such as KVPY to pursue higher studies in basic sciences.

Important Note: KVPY was discontinued as a separate selection programme after the 2021 cycle. Its fellowship programme was subsequently integrated with the INSPIRE programme.

2. IISERs – Indian Institutes of Science Education and Research



Meaning: IISERs are specialised institutions established by the Government of India to promote high-quality science education and research.

Objectives:

1. **To provide quality science education.**
2. **To promote scientific research.**
3. **To develop research skills among students.**
4. **To encourage innovation and scientific discoveries.**
5. **To prepare future scientists and researchers.**

Importance:

- **Provide opportunities for advanced science education.**
- **Promote research-based learning.**
- **Encourage interdisciplinary research.**
- **Develop scientific and analytical skills.**
- **Connect education with scientific innovation.**

Example: Students studying at IISER can participate in research activities related to physics, chemistry, biology and environmental science.

3. HBCSE – Homi Bhabha Centre for Science Education

Meaning: HBCSE is a national centre of the Tata Institute of Fundamental Research (TIFR), Mumbai. It works to improve science and mathematics education in India.

Objectives:

1. **To improve the quality of science education.**
2. **To develop innovative teaching-learning materials.**
3. **To promote scientific and mathematical talent.**
4. **To organise science education programmes.**
5. **To support science teacher training.**
6. **To encourage students to participate in science competitions.**

Importance:

- **Promotes quality science education.**
- **Develops innovative teaching methods.**
- **Encourages scientific talent.**
- **Supports science Olympiad activities.**
- **Provides academic support to teachers and students.**

Example: HBCSE plays an important role in the organisation and academic preparation of students for several national science Olympiads.

4. Science Olympiads



Meaning: Science Olympiads are competitive examinations and academic activities designed to identify and encourage talented students in science and mathematics.

They provide opportunities for students to test their scientific knowledge, logical thinking and problem-solving abilities.

Subjects Covered:

- **Physics.**
- **Chemistry.**
- **Biology.**
- **Astronomy.**
- **Mathematics.**
- **Junior Science.**

Objectives:

1. **To identify talented students.**
2. **To develop scientific knowledge.**

3. **To encourage critical thinking.**
4. **To improve problem-solving abilities.**
5. **To promote interest in science.**
6. **To provide national and international exposure.**

Importance:

- **Develops confidence among students.**
- **Encourages healthy academic competition.**
- **Promotes scientific excellence.**
- **Improves analytical and reasoning skills.**
- **Motivates students towards higher scientific studies.**

Example: A student participating in a Physics Olympiad solves challenging problems related to motion, electricity and energy.

5. Other Important Initiatives

A. INSPIRE – Innovation in Science Pursuit for Inspired Research

It is a programme of the Department of Science and Technology, Government of India.

Its purpose is to attract young students towards science and encourage them to pursue scientific research.

B. Atal Tinkering Labs (ATL)

These laboratories encourage students to develop creativity, innovation, design thinking and problem-solving skills through practical activities.

C. National Science Day

National Science Day is celebrated in India on 28 February every year to recognise the importance of science and promote scientific awareness.

6. Role of Teachers in Promoting Innovation in Science Education

1. Encourage students to ask scientific questions.
2. Organise science exhibitions and competitions.
3. Conduct practical experiments.
4. Use digital teaching aids.
5. Encourage project-based learning.
6. Promote scientific discussions.
7. Develop curiosity and creativity.
8. Connect scientific knowledge with daily life.

7. Conclusion

Promotion and innovation in science education are necessary for the development of scientific knowledge and research. Initiatives such as IISERs, HBCSE, INSPIRE and Science Olympiads encourage students to develop scientific skills, creativity and research abilities.

IMPORTANT MIND MAPPING – UNIT III

INSTRUCTIONAL MATERIAL AND AIDS

UNIT – III

1. Instructional Resources

Meaning

Importance

Classification

Printed, Visual, Digital

2. Instructional Aids

Chalkboard

Charts

Models

Animations

3. Selection Principles

Simple and clear

Accurate

Age-appropriate

Lesson-related

4. E-Learning

E-books

E-journals

Online classes

Digital learning

Result

Effective Science Teaching and Learning

IMPORTANT MIND MAPPING – UNIT IV

CURRENT TRENDS IN SCIENCE EDUCATION

UNIT – IV

1. MOOCs

SWAYAM

NPTEL

Coursera

edX

Khan Academy

2. CBCS

Meaning

Need

Credits

Discipline-centred

Interdisciplinary

3. Promotion

Scientific attitude

Research

Creativity

Innovation

4. Initiatives

KVPY

IISERs

HBCSE

Science Olympiads

INSPIRE

Result

Scientific Temper, Research and Innovation

Important Questions for B.Ed Examination

Short Answer Questions

1. **Define instructional resources.**
2. **Write any four importance of instructional aids.**
3. **What is the meaning of e-learning?**
4. **Define e-books and e-journals.**
5. **What is MOOC?**
6. **Write the full form of CBCS.**
7. **What is interdisciplinary learning?**
8. **What is the meaning of Science Olympiad?**
9. **Write the full form of IISER and HBCSE.**
10. **What is KVPY?**

Long Answer Questions

1. **Explain the meaning, importance and classification of instructional resources in science.**
2. **Discuss the principles of selection and use of chalkboards, charts, models and animations.**
3. **Explain the concept of e-learning and discuss the uses of e-books and e-journals in science education.**
4. **Explain MOOCs and discuss their relevance for science teachers and students.**
5. **Discuss the concept, need and significance of CBCS in discipline-centred and interdisciplinary science teaching.**
6. **Explain the meaning, importance and initiatives for promotion and innovation in science education.**