

Draft

Module 1.8



**Teaching of Science
(Upper Primary)**

Teaching of Science (Upper Primary)

1. Learning Objectives

After the completion of this module, the learner is expected to

- have basic understanding of science as a subject and how science should be taught at upper primary stage.
- have basic understanding of curriculum expectations at the upper primary stage for science.
- know how to transact NCERT science textbook for class VI-VIII.
- design a learning situation to be provided to children for some specific concepts.

2. Introduction

Human beings have always been curious about the environment around them. One kind of response from the earliest times has been to observe the physical and biological environment carefully and look for any meaningful patterns and relations, and build conceptual models to understand the world on the basis of observations and thus arriving at theories, laws and principles. This human endeavour is science.

Science is a dynamic and expanding body of knowledge, covering new domains of experiences. In a progressive society, science can play a truly liberating role, helping people escape from the vicious cycle of poverty, ignorance and superstition. People today are faced with an increasingly fast-changing world where the most important skills are flexibility, innovation and creativity. These different imperatives have to be kept in mind in shaping science education. Good science education is true to the child, true to life and true to the discipline.

3. Curricular Expectations at the upper primary stage

At the upper primary stage children are getting their first exposure to 'science'. Science education at this stage should provide a gradual transition from environmental studies of the primary stage to elements of science and technology. Science concepts to be taught at this stage should be chosen so as to make sense of everyday experiences. Activities and experiments should form a part of the learning process.

Science content at the upper primary stage should not be governed by disciplinary approach. Science at this stage should be taught as an integrated subject and it is not to be regarded as a diluted version of secondary stage. The child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and models and continuing to learn more about the environment and health, including

reproductive and sexual health. Scientific concepts are to be arrived at mainly from activities, experiments and surveys. Group activities, discussions with peers and teachers, surveys, organisation of data and their display through exhibitions, etc., in schools and the neighbourhood should be important components of pedagogy. Technological components such as design and fabrication of simple models, practical knowledge about common mechanical and electrical devices and local specific technologies are to be included in science curriculum. It is necessary to recognize that there is a lot of diversity in the nature of technology that children from different areas of the country deal with. The same is true for the state of Tripura. These differences in exposure and interest should be addressed through specific contextualization of content related to the state.

Apart from simple experiments and hands on experiences, an important pedagogic practices at this stage is to engage the students (in groups) in meaningful investigations particularly of the problems they perceive to be significant and important. This may be done through discussions in the class with the teacher, peer interactions, gathering information from newspapers, talking to knowledgeable persons in the neighbourhood, collecting data from easily available sources and carrying out simple investigations in the design of which the students have a major role to play.

Science curriculum at the upper primary stage is intended to develop

- scientific temper and scientific thinking.
- understanding about the nature of scientific knowledge, i.e., testable, unified, parsimonious, amoral, developmental and creative.
- process skills of science which includes observation(s), posing question(s), searching various resources of learning, planning investigations, hypothesis formulation and testing, using various tools for collecting, analysing and interpreting data, supporting explanations with evidences, critically thinking to consider and evaluate alternative explanations, reflecting on their own thinking.
- appreciation for historical aspects of evolution of science.
- sensitivity towards environmental concerns.
- respect for human dignity and rights, gender equity, values of
- honesty, integrity, cooperation and concern for life.

The curriculum has been organised around the following themes that are cross disciplinary in nature:

- Food
- Materials
- The world of the Living
- Moving things, people and Ideas
- How things work
- Natural phenomena
- Natural resources

4. How to use NCERT science textbook

Teaching of Science supported by a large body of research on Science Education—recommends a pedagogy that is hands-on and inquiry-based. In a hands-on way of learning science, we start with things that are directly related to the student's experience, and are therefore specific. From this we progress to the general. Attempt has been made in class VI to VIII science textbooks to include children's own experiences and build concepts around them. This is designed to connect science that they study with their every-day life. Many activities have been suggested to clarify concepts. Some of these activities are so simple that children can perform them on their own. The requirement of the apparatus required for the activities is minimal. Activities should form apart of learning process. It is expected that scientific terms, concepts, theories, laws, etc. are to be arrived through activity. While performing activity children should be given every opportunity to get involve in doing activities. It is also expected that activities should help children in developing skills such as presentation of data in tabular and graphical forms, reasoning and drawing inference from the given data.

To help teachers evaluate children effectively, a large number of exercises have been given at the end of each chapter. The teachers are encouraged to frame additional exercises to test children's understanding.

Further, to prepare children to assume their role as responsible citizens of tomorrow, attempt has been made to sensitise them to the issues concerning gender, religion, environment, health and hygiene, water scarcity and energy conservation.

It is expected that teachers will use locally available material while transacting concepts. Various resources such as ICT, art education, etc may be judiciously employed to enrich teaching and learning of science.

Students at upper primary stage enjoy learning when they are given opportunities to share their experiences, observations and feelings about their surroundings. Therefore teachers' understanding of learners' experiences and existing ideas are very important for designing teaching –learning situations. Students need to be engaged and focused on the learning tasks by asking questions, defining a problem and drawing their attention to an interesting event. Learning is a complex process and it occurs through various exposures and not necessarily through a single exposure. Teacher may craft an environment that is likely to help students develop the idea. When learners are encouraged to share and seek out knowledge from sources other than the textbooks, in their own experiences, in the experiences of their peers homes and surroundings, they realise that knowledge can be sought out, authenticated and constructed.

An example strategy on how to transact sound concept from NCERT class VIII science textbook is given below. This may be treated as one way of transacting the content while a teacher may have other ways of transacting the same concept.

- **Key concepts:**
 1. **Sound is produced by vibrating objects.**

Learning outcomes:

*Conducts simple investigation;
relate process and phenomena with causes;
applies learning of scientific concepts in day to day life;
exhibits creativity in making use of available resources*



Think of an object that produces sound. You must have had various experiences of sound produced by people, automobiles, gadgets, etc. in our daily life.

In this process teacher may ask students to

- a) share their experiences about sound in their surroundings.*
- b) make a list of sounds they hear in their surroundings (of persons, animals, birds, breeze, rivers ,mobile, school bell, transports, gadgets, etc.).*
- c) name some musical instruments they have seen in the music room of the school or at other places.*

Let us try to explore how sound is produced. One way to explain about it is by performing activity or experiment. Let us perform the following activity.

Activity 1:

To show sound is produced by a vibrating object (The activity is to be performed by involving student)

Learning outcome: *Conduct simple experiment*

Teacher may involve students in arranging materials for performing the activity. The activity describe below is one among the many activities that a teacher can perform. Students may be asked to bring objects producing sound in the classroom

Materials Required: metal plate, steel spoon.



Figure: Sound produced by a vibrating metal plate

- ✓ Take a metal plate and place it as shown in the fig 1.
- ✓ Now strike the rim of the metal plate with a steel spoon.
- ✓ What do you observe? Can you hear any sound?
- ✓ Now, strike again the rim of the metal plate again with a steel spoon. As soon as you strike the rim of the metal plate touch the rim of the metal plate with your finger. What do you feel?
- ✓ Do you feel the vibration on touching the steel plate?
- ✓ What can be inferred from the observation?
- ✓ Touch the plate after it stops producing sound. Can you feel the vibration now?

Teacher ask student, which part is vibrating? (Metal Plate) Teacher may help students conclude that sound is produced due to the vibration of the metal plate.

It may be conclude that sound is produced by vibrating objects.

Learning outcome:*Relate process and phenomena with causes*

Teacher may ask students to perform the following activities in group and help them in arriving at the concept by performing Activity 2

Activity 2:

Teacher facilitates a group activity using two rubber bands, two pencils and pencil boxes. Teacher moves around all the groups and observes how they are producing sound. She finds that a group of students is producing vibration in the rubber string by adjusting the pencils at different length. They are also observing difference in sound produce by changing the length of the rubber band between the pencils.



Figure: Plucking the rubber band

Teacher ask student, which part is vibrating? (String)

Teacher encourages students to ask questions. It helps her to get familiarized with students' ideas about the concept. She also observes how students respond and react to others opinions and ideas. She looks at all the sound producing objects that students are bringing. She helps students in identifying different sound producing objects and vibrating part of the object.

Assessment

Teacher asks students to discuss among themselves and note down the vibrating part of various musical instruments.

Learning outcome: *Concept of identifying and classifying of sound producing objects*

S.No.	Musical Instruments	Vibrating part producing sound
1.	Veena	Stretched string
2.	Tabla	Stretched membrane
3.	Flute	Air-column
4.	Guitar	---
5.	---	---

Teacher asks students to prepare simple musical instrument using locally available resource.

Learning outcome:

Exhibits creativity in making use of available resources;

Applies learning of scientific concept in day to day life

Thus while using NCERT textbook, the learner is to be provided with opportunities in pairs/groups/ individually in an inclusive setup and encouraged to—

- explore surroundings, natural processes, phenomena using senses viz. seeing, touching, tasting, smelling, hearing
- pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays, debates, use of ICT, etc.
- record the observations during the activity, experiments, surveys, field trips, etc.
- analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults
- exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc.
- internalise, acquire and appreciate values such as cooperation, collaboration, honest reporting, judicious use of resources, etc.

5. Learning Outcomes

The learning outcomes for class VI-VIII science are appended as Annexure-I at the end of the module.

6. Activities for KRPs/Teachers

a. Make a classroom plan for transacting one or two topics of your interest from NCERT textbook linking with learning outcomes.

d. Develop an activity in which focus should be on enhancing gender sensitivity/inclusion/environmental sensitivity/scientific temper integrating it with subject-specific topic.

Annexure-I

Class VI (Science)

Suggested Pedagogical Processes	Learning Outcomes
<p>The learner is to be provided with opportunities in pairs/groups/individually in an inclusive setup and encouraged to—</p> <ul style="list-style-type: none"> • explore surroundings, natural processes, phenomena using senses viz. seeing, touching, tasting, smelling, hearing • pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays, debates, use of ICT, etc. • record the observations during the activity, experiments, surveys, field trips, etc. • analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults • exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc. • internalise, acquire and appreciate values such as cooperation, collaboration, honest reporting, judicious use of resources, etc. 	<p>The learner—</p> <ul style="list-style-type: none"> • identifies materials and organisms, such as, plant fibres, flowers, on the basis of observable features, i.e., appearance, texture, function, aroma, etc. • differentiates materials and organisms, such as, fibre and yarn; tap and fibrous roots; electrical conductors and insulators; on the basis of their properties, structure and functions • classifies materials, organisms and processes based on observable properties, e.g., materials as soluble, insoluble, transparent, translucent and opaque; changes as can be reversed and cannot be reversed; plants as herbs, shrubs, trees, creeper, climbers; components of habitat as biotic and abiotic; motion as rectilinear, circular, periodic etc. • conducts simple investigations to seek answers to queries, e.g., What are the food nutrients present in animal fodder? Can all physical changes be reversed? Does a freely suspended magnet align in a particular direction? • conducts simple investigations to seek answers to queries, e.g., What are the food nutrients present in animal fodder? Can all physical changes be reversed? Does a freely suspended magnet align in a particular direction? • relates processes and phenomenon with causes, e.g., deficiency diseases with diet; adaptations of animals and plants with their habitats; quality of air with pollutants, etc. • explains processes and phenomenon, e.g., processing of plant fibres; movements in plants and animals; formation of shadows; reflection of light from plane mirror; variations in composition of air; preparation of vermicompost, etc. • measures physical quantities and expresses in SI units, e.g., length • draws labelled diagrams / flow charts of organisms and processes, e.g., parts of flowers; joints; filtration; water cycle, etc.

	<ul style="list-style-type: none"> • constructs models using materials from surroundings and explains their working, e.g., pinhole camera, periscope, electric torch, etc. • applies learning of scientific concepts in day-to-day life, e.g., selecting food items for a balanced diet; separating materials; selecting season appropriate fabrics; using compass needle for finding directions; suggesting ways to cope with heavy rain/drought, etc. • makes efforts to protect environment, e.g., minimising wastage of food, water, electricity and generation of waste; spreading awareness to adopt rain water harvesting; care for plants, etc. • exhibits creativity in designing, planning, making use of available resources, etc. • exhibits values of honesty, objectivity, cooperation, freedom from fear and prejudices.
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Class VII (Science)

Suggested Pedagogical Processes	Learning Outcomes
<p>The learner is to be provided with opportunities in pairs/groups/individually in an inclusive setup and encouraged to —</p> <ul style="list-style-type: none"> • explore surroundings, natural processes, phenomena using senses viz. seeing, touching, tasting, smelling, hearing • pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays, debates, use of ICT, etc. • record the observations during the activity, experiments, surveys, field trips, etc. • analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults • exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc. • internalise, acquire and appreciate values such as cooperation, collaboration, honest reporting, judicious use of resources, etc. 	<p>The learner —</p> <ul style="list-style-type: none"> • identifies materials and organisms, such as, animal fibres; types of teeth; mirrors and lenses, on the basis of observable features, i.e., appearance, texture, functions, etc. • differentiates materials and organisms such as, digestion in different organisms; unisexual and bisexual flowers; conductors and insulators of heat; acidic, basic and neutral substances; images formed by mirrors and lenses, etc., on the basis of their properties, structure and function • classifies materials and organisms based on properties/characteristics, e.g., plant and animal fibres; physical and chemical changes • conducts simple investigations to seek answers to queries, e.g., Can extract of coloured flowers be used as acid-base indicator? Do leaves other than green also carry out photosynthesis? Is white light composed of many colours? • relates processes and phenomena with causes, e.g., wind speed with air pressure; crops grown with types of soil; depletion of water table with human activities, etc. • explains processes and phenomena, e.g., processing of animal fibres; modes of transfer of heat; organs and systems in human and plants; heating and magnetic effects of electric current, etc. • writes word equation for chemical reactions, e.g., acid-base reactions; corrosion; photosynthesis; respiration, etc. • measures and calculates e.g., temperature; pulse rate; speed of moving objects; time period of a simple pendulum, etc. • draws labelled diagrams/ flow charts e.g., organ systems in human and plants; electric circuits; experimental set ups; life cycle of silk moth, etc. • plots and interprets graphs e.g., distance-time graph

	<ul style="list-style-type: none">• constructs models using materials from surroundings and explains their working, e.g., stethoscope; anemometer; electromagnets; Newton's colour disc ,etc.• discusses and appreciates stories of scientific discoveries• applies learning of scientific concepts in day-to-day life, e.g., dealing with acidity; testing and treating soil; taking measures to prevent corrosion; cultivation by vegetative propagation; connecting two or more electric cells in proper order in devices; taking measures during and after disasters; suggesting methods for treatment of polluted water for reuse, etc.• makes efforts to protect environment, e.g., following good practices for sanitation at public places; minimising generation of pollutants; planting trees to avoid soil erosion; sensitising others with the consequences of excessive consumption of natural resources, etc.• exhibits creativity in designing, planning, making use of available resources, etc.• exhibits values of honesty, objectivity, cooperation, freedom from fear and prejudices
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Class VIII (Science)

Suggested Pedagogical Processes	Learning Outcomes
<p>The learner is to be provided with opportunities in pairs/groups/ individually in an inclusive setup and encouraged to —</p> <ul style="list-style-type: none"> • explore surroundings, natural processes, phenomena using senses viz. seeing, touching, tasting, smelling, hearing. • pose questions and find answers through reflection, discussion, designing and performing appropriate activities, role plays, debates, use of ICT, etc. • record the observations during the activity, experiments, surveys, field trips, etc. • analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults • exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc. • internalise, acquire and appreciate values such as cooperation, collaboration, honest reporting, judicious use of resources, etc 	<p>The learner —</p> <ul style="list-style-type: none"> • differentiates materials and organisms, such as, natural and human made fibres; contact and non-contact forces; liquids as electrical conductors and insulators; plant and animal cells; viviparous and oviparous animals, on the basis of their properties, structure and functions. • classifies materials and organisms based on properties/ characteristics, e.g., metals and non metals; <i>kharif</i> and <i>rabi</i> crops; useful and harmful microorganisms; sexual and asexual reproduction; celestial objects; exhaustible and inexhaustible natural resources, etc. • conducts simple investigations to seek answers to queries, e.g., What are the conditions required for combustion? Why do we add salt and sugar in pickles and <i>murabbas</i>? Do liquids exert equal pressure at the same depth? • relates processes and phenomenon with causes, e.g., smog formation with the presence of pollutants in air; deterioration of monuments with acid rain, etc. • explains processes and phenomenon, e.g., reproduction in human and animals; production and propagation of sound; chemical effects of electric current; formation of multiple images; structure of flame, etc. • writes word equation for chemical reactions, e.g., reactions of metals and non-metals with air, water and acids, etc. • measures angles of incidence and reflection, etc. • prepares slides of microorganisms; onion peel, human cheek cells, etc., and describes their microscopic features • draws labelled diagram/ flow charts, e.g., structure of cell, eye, human reproductive organs; experimental set ups, etc. • constructs models using materials from surroundings and explains their working, e.g., <i>ektara</i>, electroscope, fire extinguisher, etc.
	<ul style="list-style-type: none"> • applies learning of scientific concepts in day-to-day life, e.g., purifying water; segregating biodegradable and non-biodegradable wastes; increasing crop production; using appropriate metals and non-metals for various purposes; increasing/ reducing friction; challenging myths and taboos regarding adolescence, etc. • discusses and appreciates stories of scientific discoveries • makes efforts to protect environment, e.g., using resources judiciously; making controlled use of fertilisers and pesticides; suggesting ways to cope with environmental hazards, etc. • exhibits creativity in designing, planning, making use of available resources, etc. • exhibits values of honesty, objectivity, cooperation, freedom from fear and prejudices