PEDAGOGY OF SCIENCE AT UPPER PRIMARY STAGE

National Council of Educational Research and Training

Overview of the Module

The module is for teachers teaching Science at Upper Primary Stage and following points have been covered in this module –

- ✓ Learning objectives
- ✓ What is science?
- ✓ Curricular expectations
- ✓ Learning outcomes in science at upper primary stage (Classes VI, VII & VIII)
- ✓ Suggestive pedagogical processes for achieving the learning outcomes
- ✓ Examples from NCERT, Science Textbook at upper primary stage
- ✓ Suggested Activities for KRPs/Teachers
- ✓ Evaluation Tasks

LEARNING OBJECTIVES

- ✓ **Have basic understanding of science** as a **subject** at Upper Primary Stage
- ✓ How to appreciate science as a **process of inquiry** and **knowledge construction**
- ✓ How to integrate **content, pedagogy** and **assessment** during teaching learning process
- ✓ Design various **learning situations** for students to **facilitate learning**

WHAT IS SCIENCE?

In this section we have discussed

- **nature of science, scientific inquiry**
- how important is **experimentation** in validating own beliefs
- how to apply knowledge of science to solve **day to day problems**
- **appreciate use of technology in everyday life**

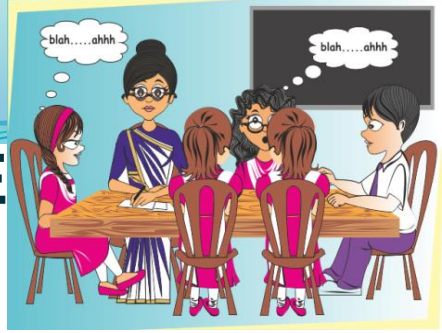
Curricular Expectations at the Upper Primary Stage

- At this stage, children get their first exposure to **'Science'** as a **discipline**.
- There is a gradual transition from **Environmental Studies** to the **elements of science**
- Concepts of science at the upper primary stage are not governed by **disciplinary approach**.
- The child should be **engaged** in **working with hands** to design simple technological units and models.

CURRICULAR EXPECTATIONS AT THE UPPER PRIMARY STAGE……..Contd.

- Science curriculum at the upper primary stage is intended to develop
  - ✓ **scientific temper** and **scientific thinking**
  - ✓ **process skills** which includes
    - ➢ observation(s)
    - ➢ posing question(s)
    - ➢ searching various resources of learning
    - ➢ planning investigations
    - ➢ hypothesis formulation and testing
    - ➢ collecting, analyzing and interpreting data
    - ➢ supporting explanations with evidences and justifications
    - ➢ critically thinking to consider, weigh and compare alternative explanations
    - ➢ reflecting on their own thinking

Curricular Expectations at the Upper Primary Stage…. Contd.



- **Sensitivity** towards **environmental** concerns
- **Respect** for **human dignity** and **rights**, **gender** equity
- **Values** of **honesty**, **integrity, cooperation, concern** for **life** and **public property.**

THEMES

The **science curriculum** at the **upper primary** has been organized around the following t**hemes-**

- Food
- Materials
- The World of the Living
- How Things Work
- Moving Things, People and Ideas
- Natural Phenomena
- Natural Resources

LEARNING OUTCOMES- LEARNERS

Class VI	Class VII	Class VIII
identifies materials and organisms	identifies materials and organisms	differentiates materials and organisms
differentiates materials and organisms	differentiates materials and organisms	classifies materials and organisms
classifies materials and organisms	classifies materials and organisms	conducts simple investigations to seek answers to queries
conducts simple investigations to seek answers to queries	conducts simple investigations to seek answers to queries	relates processes and phenomenon with causes
relates processes and phenomenon	relates processes and phenomenon with causes	explains processes and phenomenon
explains processes and phenomenon	explains processes and phenomenon	writes word equation for chemical reactions
measures physical quantities and expresses in SI units	writes word equation and chemical reactions	measures angles of incidence and reflection
draws labelled diagrams/ flow charts	measures and calculates temperature, heartbeats etc	prepares slides
constructs models using materials from surroundings and explains their working	draws labelled diagrams/ flow charts	draws labelled diagram/ flow charts

Class VI	Class VII	Class VIII
applies learning of scientific concepts in day-to-day life	plots and interprets graphs	constructs models using materials from surroundings and explains their working
makes efforts to protect environment	constructs models using materials from surroundings and explains their working	applies learning of scientific concepts in day-to-day life
exhibits creativity in designing, planning, making use of available resources	discusses and appreciates stories of scientific discoveries	discusses and appreciates stories of scientific discoveries
exhibits values of honesty, objectivity, cooperation, freedom from fear and prejudices.	applies learning of scientific concepts in day-to-day life	makes efforts to protect environment
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Suggestive Pedagogical Processes for Achieving the Learning Outcomes

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.
- analyse recorded data, interpret results and draw inference/ make generalisations and share findings with peers and adults

Suggestive Pedagogical Processes for Achieving the Learning Outcomes … Contd.

- exhibit creativity presenting novel ideas, new designs/patterns, improvisation, etc.
- internalize, acquire and appreciate values such as cooperation, collaboration, honest reporting, judicious use of resources, etc.

The pedagogical processes listed are suggestive and intended to give directions to teachers to design various learning situations and engage students in the practice of science and construction of knowledge. It is expected that teachers will design appropriate learning situations as per the experiences of the students and availability of resources.

Examples Upper Primary Stage (Classes VI-VIII)

- It is expected that teachers will use locally available material while transacting concepts
- Various resources such as Science Kits, Information and Communication Technology (ICT) , Art Education, etc., may be judiciously employed to enrich teaching - learning of science
- **Three examples are discussed**

  - Physical properties of metals and non-metals
  - Diversity exists in plant world
  - How sound is produced!

METALS AND NON-METALS

KEY CONCEPT: PHYSICAL PROPERTIES OF METALS AND NON-METALS

Learning Outcomes

The learner

- conducts simple investigations
- classifies elements into metals and non-metals on the basis of their properties
- explains processes
- draws labeled diagram
- applies learning of scientific concepts in day to day life
- exhibits honesty, cooperation and creativity
- makes effort to keep surrounding clean

To Begin With …….

A **conscious attempt** has been made to **address** the relevant **social concerns**, which have found their **natural place** in this example. These are:

- the concern for people with special needs
- issue of gender discrimination
- care for environment
- the approach of this module is activity based
- students are required to construct knowledge from these activities themselves
- students will get an opportunity to think and explore and some what beyond the textbooks

KNOW YOUR STUDENTS

- The **availability of resources** is a matter of **great concern**
- **Try to manage** by taking **help of students**
- **Students proved** to be one of the **greatest resources.**
- **Plan students' involvement** in various **activities** during teaching-learning process.
- If **students involved themselves,** this means they have involved in the learning **process of science**.
- In the given examples efforts have been made to **integrate, content, pedagogy and assessment** in meaningful way.

GLIMPSES .....

Activity 3

The teacher now asks students to recall how they made an electric circuit in their previous class. She motivates them to complete a circuit with one of the materials, which they have collected and some provided by the teacher; such as, iron nail, copper wire, aluminium wire, piece of coal, sulphur, pencil lead, wires, battery, bulb etc; and observe if these materials allow current to flow in the circuit or not. She encourages them to record their observations in the Table1 and also draw labeled diagram (Fig. 3).She provides embossed diagram to student 1 to observe by touching and encourages him to participate in the discussion.

Students start doing the activity in groups of three to four. Teacher makes sure that groups are heterogeneous in nature with children from different backgrounds and abilities She notices that some students are patiently doing the activity, some are helping others. Students are discussing among themselves.

Fig.3: *Simple electric tester*

Table 1 – Electrical Conductivity of Materials

S.No	Materials	Bulb glows	Bulb doesn't glow
1.	Iron nail		
2.	Copper wire		
3.	Aluminum wire		
4.	Piece of coal		
5.	Suphur		
6.	Pencil lead		

- **Students –**On placing **i**ron nail, aluminum wire, copper wire and pencil lead, bulb start glowing; whereas, by placing coal and sulphur bulb does not glow.
- **Student 1 with the help of peers could feel the bulb glowing by touching as it was little warmer than before.**

After discussion they could conclude that iron nail, aluminum wire, copper wire and pencil lead are good conductors of electricity, whereas coal and sulphur are poor conductors of electricity.

Using ICT for further exploration

- Teacher may also allow students to interact with simulations/videos/animations related to the concept and explore the concept further. One such link of a simulation for electric circuit is given for the reference:

  http://nroer.gov.in/55ab34ff81fccb4f1d806025/page/5b4d793e16b51c01e4ec660a

- Teacher – (i) Where do you find use of copper and aluminum wires?
  (ii) Can wires be made up of coal?

Teacher is amazed to see the discussion going on among students. She observes that students are placing the materials at their original places and taking care of cleanliness.

(Learning Outcome: Conducts simple investigations: provides explanation; draws labeled diagram; exhibits honesty by recording and interpreting data; exhibits cooperation and makes effort to keep surrounding clean).

- **Teacher-** (i). Can you guess why metallic pans are usually provided with plastic or wooden handle (Fig.4)?
- (ii). Why do we find wooden/ plastic handles less hot than metallic utensils?

Fig.4*: Cooking in metallic utensil*

- Students start discussing about this. Teacher tries to listen to the discussion going in the class. After having a discussion, they collectively arrive at a conclusion that metals are good conductors of heat.

Once the discussion is over, **Student 7** comes up with a Poem/ Riddle

“I am 1600 years old
My hometown is in Delhi
My Guardian is Chandragupta II
I am 7 meters tall
And my weight is 6.5 tonnes
My body is made up of a metal
I am still standing erect
and not turned into a pile of rust
Who am I?
Who am I? ”

- *Teacher encourages the **student 7** to read the Riddle loudly so that **student 1 (visually impaired)** can also participate. She motivates other students also to compose poem, song, riddle, etc.*

(Learning Outcome: Applies learning of scientific concepts in day to day life; exhibits corporation, creativity by posing a riddle).

*Once students have understood the properties of metals and non-metals along with their exceptions, teacher encourages them to do **role play** to strengthen the concept in joyful way. She may also show them the **video** to know about important metals that we use in our day to day lives and have discussion about them. The **link** of one such video is given below:*

http://nroer.gov.in/55ab34ff81fccb4f1d806025/file/58871312472d4a1fef810dbc

INVOLVING COMMUNITY/ PARENTS

- Students can be **suggested to visit** with her/his parents to a **blacksmith or a goldsmith** where tools or ornaments are made or school can **arrange** a visit to a shop of a goldsmith/ black smith.
- A **skilled blacksmith** or a **goldsmith** may request to visit the school and interact with students.

ACTIVITY

Key concept: Diversity exists in plant world

Learning Outcomes

The learner:

- ✓Appreciates and recognises the diversity of plants in their locality
- ✓classifies plants into herbs, shrubs and trees
- ✓measures height of plants
- ✓draws labeled diagram of their observation
- ✓exhibits care and concern for plants
- ✓exhibits creativity by planning, drawing and making cards using paper
- ✓exhibits values of honesty, objectivity and cooperation
- ✓discusses and appreciates diversity of plants around the world

Eliciting Prior Understanding And Introducing The Topic Before The Activity

- ✓ The teacher may introduce the topic of plant through some questions to understand students' prior knowledge and lead them to the concept. For example, whether some plants were small throughout their life and some plants keep growing? Whether the plants were similar or different? In what ways they were similar or different? Whether they thought about the reasons for the similarities or differences?
- ✓ The teacher appreciates all the answers and takes special care to give opportunity to students who are otherwise non-responsive or shy or introvert. Since this is a common topic, they will have no problem to share their views.
- ✓ After a few discussions on the topic, the teacher will now let the students do the following activities.

ACTIVITY

The teacher may divide the class into groups. Each group may consist of about 5 students each. All the groups are asked to explore their school campus to observe the different plants that grow.

In this process the teacher may give clear instruction to students not to disturb the plants as far as possible and not to uproot the plants, break the stem or pluck the leaves or flowers.

The teacher may ask the students to

✓ observe and note down the different plants based on various categories such as height, whether they grow horizontally on the ground or they climb on other plants/walls/other structures, etc., texture of leaves and stem, flowers, smell, color of flower and stem, from where the branches grow, etc.

✓ come up with as many different categories as they can think of to collect the information.

Students within a group may differ in opinion about what they observe. They discuss, listen to each others' point of view and come up with a consensus.

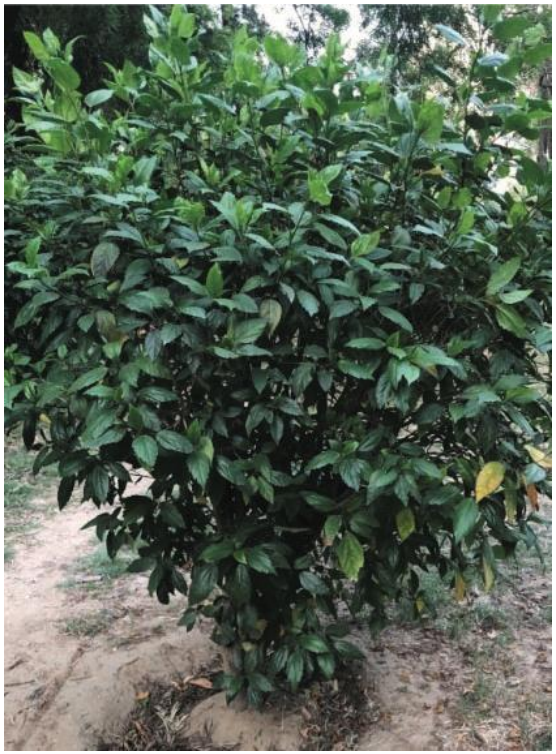
The teacher may ask the students to prepare a table and fill them. Students may be asked to add more columns based on their observations. Students may also compare their tables with their friends in other groups and discuss.

Teacher may note some confusion in grouping trees as shrubs or trees since the plants have not fully grown. The teacher may clarify those confusions.

ACTIVITY: CATEGORIES OF PLANTS

Plant name	Column 1 Height of a fully grown plant	Column 2 Stem				Column 3 Where do the branches appear		Column 4
		Green	Tender	Thick	Hard	At the base of the stem	Higher up on the stem	Category of plant

Herb



Shrub

Tree

The teacher may ask students to compare their observations with other groups. The teacher may also ask different groups to share their observations in the classroom. This can also form part of the assessment.

Learning outcome: Appreciates and recognises the diversity of plants in their locality; classifies plants into herbs, shrubs and trees; measures height of plants; exhibits care and concern for plants; exhibits creativity by planning; exhibits values of honesty, objectivity and cooperation.

(**Note:** This activity may be given as a project to be done by students at home before the class, especially if the school campus does not have plants around. In such case, it will be an individual activity).

ACTIVITY

Key concept: How Sound is produced!

Learning Outcomes

The learner:

✓Conducts simple investigation to find the ways of producing sound

✓Relate process and phenomena with causes

✓Applies learning of scientific concepts in day to day life

✓Exhibits creativity in making use of available resources

ACTIVITY

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

✓share **their experiences about sound in their surroundings.**

✓**make a list of sounds they hear in their surroundings (of persons, animals, birds, breeze**, rivers, mobile, school bell, transports, gadgets, etc.).

✓name some musical instruments they have seen in the music room of the school or at other places.

Activity 1:
Different Ways of Producing Sound.

Students may be arranged in groups for doing this activity. All the groups may be asked to explore different methods for producing sound. Students may come out with different ways of producing sounds, such as by hitting a table, by plucking a rubber band, by scratching a rough surface, by blowing, etc.

Teacher may help them in grouping different ways in broader groups such as, sound produced by hitting, by plucking, by scratching, by blowing, etc. After grouping some of the ways she may involve students in completing the following table.

S.No.	Method of producing sound	Examples given by the students
1	By hitting	By hitting a table with duster, …….
2	By plucking	By plucking a string of sitar, …….
3	By Blowing	……..
4	By Scratching	…….
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ACTIVITY 2 : TO SHOW SOUND IS PRODUCED BY A VIBRATING OBJECT

Teacher may involve students in arranging materials for performing the activity. Students may be asked to bring objects producing sound in the classroom.

Materials Required:

- ✓ Metal plate, steel spoon
- ✓ Take a metal plate and place it as shown
- ✓ 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?
- ✓ Strike the rim of the metal plate again. 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.

ACTIVITY 3 : ASSESSMENT

Teacher encourages students to discuss among themselves and note down the vibrating part of various musical instruments in Table 4. As per the context of the student, musical instruments given may be added or replaced.

(Learning outcome: Identification and classifying of sound producing objects)

Table 4

S.No.	Musical Instruments	Vibrating part producing sound
1.	Veena	Stretched string
2.	Tabla	Stretched membrane
3.	Flute	Air-column
4.	Guitar	---
5.	Ektara	---
6.	---	----

Teacher may motivate students to prepare simple musical instrument using locally available resources.

(Learning outcome: Exhibits creativity in making use of available resources; applies learning of scientific concept in day to day life).

Let us Sum Up!

Know Your Student

Pose/Encourge Questions

Process Skills

Learning Resources

Pedagogy to Adopt

Assessment/Reflection of Students

Learning Outcomes Achieved

Yes

Reflection of Teacher

No

Reflection of Teacher

Revisit

Additional Inputs

ACTIVITIES FOR KRPS /TEACHERS

Teacher may **design** a plan for **transacting** one or two **concepts** of his /her interest from Science topic at upper primary stage focusing on:

- learner centric approach
- using local resources
- linking with learning outcomes
- in built assessment
- enhancing gender sensitivity, inclusion and sensitivity towards environment

Teachers may also take up **planning** of **any one** of the **given task** during the training programme**:**

- **Performing activities/ Demonstrations**
- **Project work**
- **Cross-word puzzles**
- **Quiz**
- **Science exhibitions**
- **Field trips**
- **Science journals**
- **Role plays**
- **Creative writing**

EVALUATION

Evaluation may be done on the basis of following points:

- A **performa** may be given to the teachers for **self evaluation**
- A **concept** may be asked to **transact** and **observations** can be made
- An **assignment** can be given to test the understanding of the concepts
- A task may be given to prepare the **test items**.

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THANK YOU