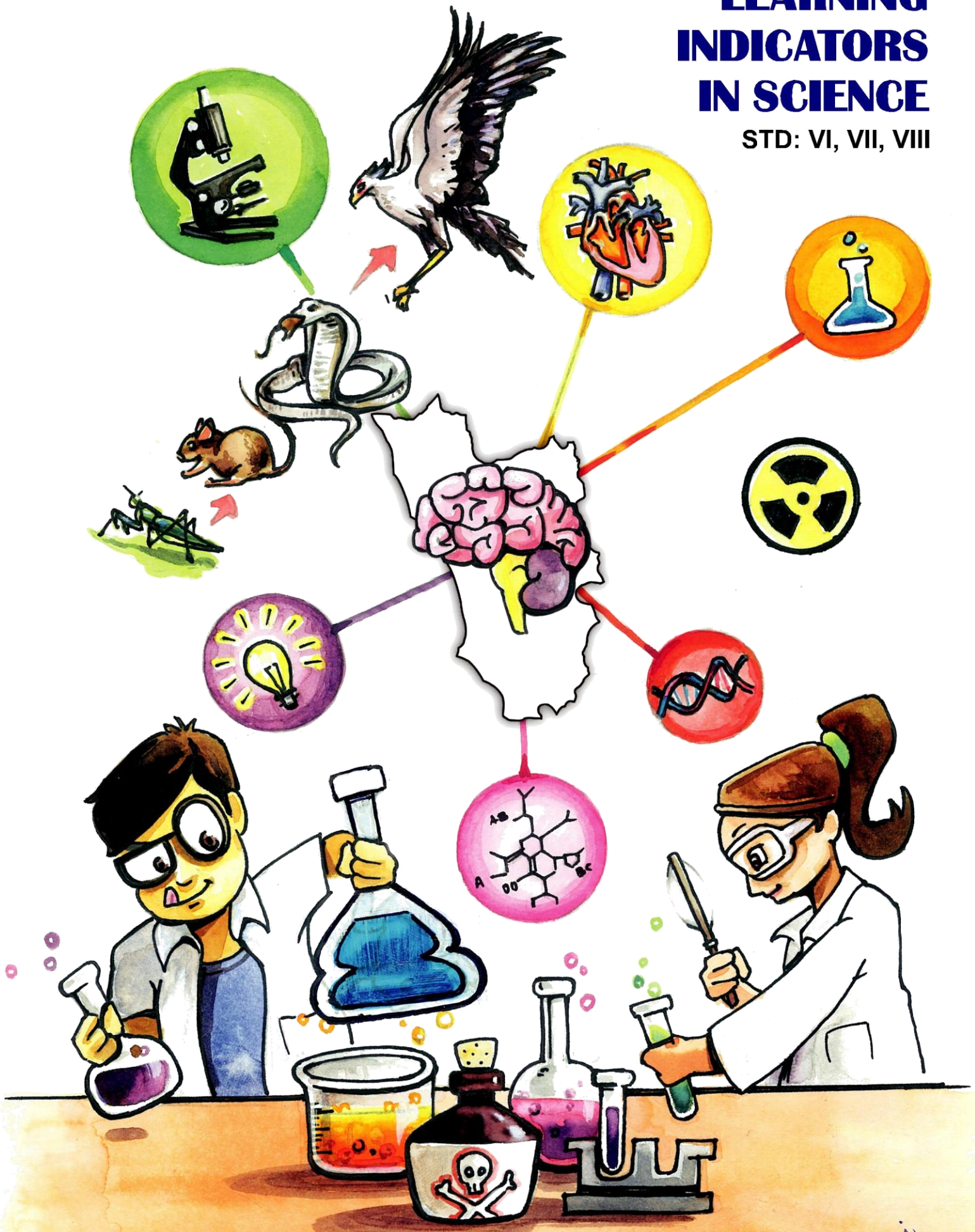
SYLLABUS & LEARNING INDICATORS IN SCIENCE

STD: VI, VII, VIII



GOA SARVA SHIKSHA ABHIYAN

सर्व शिक्षा अभियान

सब पढें सब बढें

GOVERNMENT OF GOA

GOA SARVA SHIKSHA ABHIYAN

PORVORIM GOA

SYLLABUS
AND
LEARNING INDICATORS
IN

SCIENCE
FOR
CLASSES VI, VII & VIII

ADAPTED & APPROVED BY
STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
GOVT OF GOA

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a **SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC** and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

PART - I
SYLLABUS IN SCIENCE
FOR CLASSES VI, VII & VIII

INDEX

PART - II
LEARNING INDICATORS

INDEX

PREFACE

Ministry of Human Resource and Development (MHRD) has approved the following quality improvement programmes for the State of Goa during the current academic year 2014-15:

1. Early Literacy programme for Std: I and II (Language and Mathematics)
2. EVS, English and Mathematics for Std: III, IV and V
3. Mathematics and Science for Std: VI, VII and VIII

NCERT has developed stage-wise learning indicators based on **The National Curriculum Framework (NCF-2005)** and the syllabi along with **stage-wise curricular expectations.**

The state's focussed programme for classes VI to VIII during the year 2014-15 aims to improve learning in Science and Mathematics. About 733 teachers at this stage will be trained for 3 days with a focus on teaching of Science. This training would include amongst others an understanding of learning indicators and assessment and evaluation practices based on learning indicators. Minimum one teacher is identified from each school for this programme during the year 2014-15. State has further committed to conduct studies to measure improvement in learning levels of the students (SLAS). With this Quality Improvement Programme, it is expected to show an increase of 10% over the State's own baseline SLAS survey conducted during the year 2013-14 for Class VII.

The learning outcomes/curricular expectations are generally treated as assessment standards. However, it is necessary to understand clearly that curricular expectations/learning outcomes needs to be achieved to the best possible level irrespective of the fact that these may or may not be used as testable construct.

The learning indicators given in Part II are based on the approved syllabus given in Part I of this handbook. The Learning Indicators have a broad range across the three classes and they aim at improving children's learning at different levels. Guidelines for teachers given at the end of each curricular area will further enhance quality in classroom transactions.

It is hoped that this handbook would provide meaningful insights into the progress and accomplishments of children's overall development from class to

class and finally reach up to the expected learning level at each stage of Science learning.

It is expected that Science teachers would use this handbook as their personal copy; and also note their best practices, student's achievements, children's joyful and wholehearted participation in learning activity, their quality of learning, development of children's understanding etc in the space provided in this booklet. Sharing of this feedback among other teachers would certainly help create quality improvement. The material in this booklet is useful even to the parents in understanding 'growth' of children's understanding of Science.

Place: Porvorim

Dated : 03-10-2014

Minanath T. Upadhye
State Project Director
Goa Sarva Shiksha Abhiyan

PREAMBLE

Why this document?

India's 12th Five Year Plan (2012-2017) notes that the four main priorities of education policies have been **Access, Equity, Quality and Governance**. The document also continues to prioritize these four areas, but places the greatest emphasis on **improving learning outcomes at all levels.** Various educational surveys, educational data over the years indicated that learning achievements of children in various subjects particularly in **Languages, Maths, EVS, Science and Social Sciences** are not satisfactory. The Joint Review Mission's reports of SSA of last few years also mentioned that the learning levels of children are not up to the desirable level in spite of all the efforts being made by the states such as timely availability of textbooks and other learning materials, training of teachers, regular monitoring, etc. It is a fact that many a times, **teachers complete the textbooks but they do not have clear idea what kind of learning they are expecting from children in respective subjects.** Generally teachers use textbooks that would only provide a broad idea as to how to transact the textual material inside and outside the classroom.

The **NPE 1986 and POA 1992** emphasized that the essential levels of learning should be laid down and children's achievement should periodically be assessed so as to keep track of the progress towards the NPE goal of ensuring that all children achieve essential levels of learning. Steps were indeed initiated to put into practice the NPE formulation. **MLLs** were developed class-wise and subject-wise for primary stage in 1992 in the form of competencies. However, over time MLLs appear to have faded away from the educational discourse because the target of educational achievement became the MLLs and not the formation of experimental / critical minds. The development of **class-wise competencies** made this exercise more product and rubric-oriented, rather than focusing on overall development of children.

The National Curriculum Framework (NCF-2005) and the syllabi developed as a follow up for various curricular areas at each level (class) consciously do not provide class-wise learning outcomes/ curricular expectations but talk about **stage-wise curricular expectations.** The learning outcomes or curricular expectations are generally treated as assessment standards. It is therefore necessary to develop clarity that curricular expectations/learning outcomes are

achieved to the best possible way whether these may or may not be used as testable construct.

Broadly, curricular expectations define what each child should to know, able to do and the disposition that should be acquired over a period of time. Curricular expectations are not to be measured class-wise but need to be achieved by the **end of a particular stage** as these are long term targets of the Curriculum i.e. abilities, attitudes, values, etc. **Learning Indicators along with the pedagogical processes will help achieve these curricular expectations.**

The **learning indicators** have been developed for each class i.e. at the end of each class from class I to class VIII. The 'learning indicators' need to lay down the **'essential levels of learning'** as postulated by the NPE;

The Learning Indicators help in a number of ways by:

- Understanding learning as a process
- Focusing and understanding children's learning on a continuum of learning
- Respond positively to diversity and helping all children to participate fully and achieve well.
- Providing a reference point for parents, children and others to understand the learning of every child in a simple way
- Providing a framework for monitoring, learning and reporting progress about the child

The present exercise is aimed to clarify some misconceptions or confusions related to these areas. With the implementation of CCE, teachers are using **CCE as a pedagogic tool.** They are expected to regularly assess children's progress as per their pace of learning and provide feedback. Research is consistent across countries, content area and age groups- show that using assessment for learning improves all student achievement more than external texts or educational reforms. **CCE also provides opportunities to teachers to use it as an assessment tool so that children's knowledge, understanding, various skills, attitudes, values, etc could be developed over a period of time.**

Children construct their knowledge and have different learning styles. Thus learning process needs to be seen as a continuum. As we all know in teaching-learning paradigm whatever we plan (inputs) for expected learning of a child, must be translated and reflected in the child's behaviour. However, the path

Teaching learning strategies have to be planned according to the needs of the children. **For children with disabilities,** sign language, audible books, tactile maps and the likes are required. The teacher will have to determine the needs as she/ he interacts with the child, **while drawing her plan from curricular expectation to transaction and from transaction to attainment.** Without identifying learning indicators it is even more difficult for a teacher or a system to move further or improve learning levels. So there is a need to develop well defined learning indicators to meet the curricular expectations.

Teachers cannot think in isolation to achieve these curricular expectations. **Pedagogical interventions** that are required to achieve these expectations have also been given for each curricular area. These pedagogical processes provide examples which would help the teachers and other users to understand the extent and the nature of learning on the part of the children related to each curricular area.

The present exercise would also encourage the States to lay down learning indicators and learning outcomes through a joint effort of the Centre and States. The States have the full liberty to adopt/adapt these indicators/ outcomes as per their needs. This proposal is made in view of the fact that an important objective of planning in our country has been removal of disparities in achieving the objectives of educational and pedagogic planning.

All children up to the elementary stage irrespective of their abilities/disabilities, social-economic ethnic background or gender, have right to education. **Our school education needs to support our children to develop their knowledge, understanding, range of skills and dispositions to act in the future life as productive citizen.** Children have variations in their abilities, dispositions and personal social qualities. Some children have special needs i.e. physical, communication, sensory and/or emotional needs that affect their learning. Some disadvantages may influence their learning such as gender discrimination at home, development delay, limited experiences in early years. Providing appropriate and enriched experiences and modifying the teaching learning strategies help meet the identified learning needs of our children. **Inclusive approach** not only addresses the diverse needs of children but also provides opportunities to learn from each other. School programmes/activities should coordinate with the community services so as to meet the social, emotional, physical and learning needs of all children including those with special needs.

What does the document include?

NCERT has developed class-wise learning indicators. These have been developed in all the subject areas namely English, Hindi, Urdu, Mathematics, EVS, Science, Social Sciences and Arts Education. Children learn in a spiral way and not in a linear way; therefore the learning indicators have a broad range across the classes and stages and aim to include children learning at different levels. The document follows the nature and its approach to each curricular area as envisaged in NCF-2005. It also provides **guidelines for users** given at the end of each curricular area. Some of the guidelines are common but subject specific guidelines have also been provided. This document would provide useful and meaningful insights into the progress and accomplishments of children at various stages of their overall development and finally reach up to the expected learning level at each stage. This would serve as a useful document to parents and to the system at large about the quality of learning and development of children during the elementary stage of school education.

PART - I
SYLLABUS IN SCIENCE
FOR CLASSES VI, VII & VIII

Introduction:

The exercise of revising the syllabus for Science – or Science and Technology – has been carried out with "**Learning without burden**" as a guiding light and the position papers of the National Focus Groups as points of reference. The aim is to make the **syllabus an enabling document** for the creation of textbooks that are interesting and challenging without being loaded with factual information. Overall, **science has to be presented as a live and growing body of knowledge rather than a finished product**.

Very often, syllabi – especially those in Science – tend to be at once **over-specified and underspecified**. They are over-specified in that they attempt to enumerate items of content knowledge which could easily have been left open, e.g., in listing the families of flowering plants that are to be studied. They are underspecified because the listing of 'topics' by keywords such as 'Reflection' fails to define the intended breadth and depth of coverage. Thus there is a need to change the way in which a syllabus is presented.

The position paper on the Teaching of Science – supported by a large body of research on Science Education – recommends a pedagogy that is **hands-on and inquiry-based**. While this is widely accepted at the idea level, practice in India has tended to be dominated by **chalk and talk methods**. To make in any progress in the desired direction, some changes have to be made at the level of the syllabus. In a hands-on way of learning science, we start with things that are directly related to the child's experience, and are therefore specific. From this we progress to the general.

This means that 'topics' have to be re-ordered to reflect this. An example is the notion of electric current. If we think in an abstract way, current consists of charges in motion, so we may feel it should treated at a late stage, only when the child is comfortable with 'charge'. But once we adopt a hands-on approach, we see that children can easily make simple electrical circuits, and study several aspects of 'current', while postponing making the connection with 'charge'.

Some indication of the activities that could go into the development of a 'topic' would make the syllabus a useful document. Importantly, there has to be adequate time for carrying out activities, followed by discussion. The learner also needs time to **reflect on the classroom experience**. This is possible only if the content load is reduced substantially, say by 20-25%.

Children are naturally curious. Given the freedom, they often interact and experiment with things around them for extended periods. These are valuable learning experiences, which are essential for imbibing the spirit of scientific inquiry, but may not always conform to adult expectations. It is important that any programme of study give children the needed space, and not tie them down with constraints of a long list of 'topics' waiting to be 'covered'. **Denying them this opportunity may amount to killing their spirit of inquiry**. To repeat an oft-quoted saying: **"It is better to uncover a little than to cover a lot."** Our ultimate aim is to help children learn to become **autonomous learners**.

Themes and Format:

There is general agreement that Science content up to Class X should not be framed along disciplinary lines, but rather organised around themes that are potentially cross-disciplinary in nature. In the present revision exercise, it was decided that the same set of themes would be used, right from Class VI to Class X. The themes finally chosen are: **Food, Materials, The World of the Living, How Things Work, Moving Things, People and Ideas, Natural Phenomena and Natural Resources.** While these run all through, in the higher classes there is a consolidation of content which leads to some themes being absent, e.g., Food from Class X.

The themes are largely **self-explanatory** and close to those adopted in the 2000 syllabus for Classes VI-VIII; nevertheless, some comments may be useful. In the primary classes, the 'science' content appears as part of EVS, and the themes are largely based on the children's immediate surroundings and needs: Food, Water, Shelter etc. In order to maintain some **continuity** between Classes V and VI, these should naturally continue into the seven themes listed above. For example, the Water theme evolves into Natural Resources (in which water continues to be a sub theme) as the child's horizon gradually expands. Similarly, Shelter evolves into Habitat, which is subsumed in The World of the Living. Such considerations also suggest how the content under specific themes could be structured. Thus clothing, a basic human need, forms the starting point for the study of Materials. It will be noted that this yields a structure which is different from that based on **disciplinary considerations**, in which materials are viewed purely from the perspective of chemistry, rather than from the viewpoint of the child. **Our attempt to put ourselves in the place of the child leads to 'motion', 'transport' and 'communication' being treated together as parts of a single theme: Moving things, people and ideas.** More generally, the choice of themes – and sub themes – reflects the thrust towards weakening disciplinary boundaries that is one of the **central concerns of NCF 2005**.

The format of the syllabus has been evolved to address the under specification mentioned above. Instead of merely listing 'topics', the syllabus is presented in four columns: **Questions, Key concepts, Resources and Activities/Processes.**

Perhaps the most unusual feature of the syllabus is that **it starts with questions rather than concepts**. These are key questions, which are meant to provide points of entry for the child to start the process of thinking. A few are actually children's queries ("How do clouds form?"), but the majority are questions posed by the adult to support and facilitate learning (provide 'scaffolding', in the language of social constructivism). It should be clarified here that these questions are not meant to be used for evaluation or even directly used in textbooks.

Along with the questions, key concepts are listed. As the name suggests, these are those concepts which are of a key nature. Once we accept that concept development is a complex process, we must necessarily abandon the notion that acquisition of a specific concept will be the outcome of any single classroom transaction, whether it is a lecture or an activity. **A number of concepts may get touched upon in the course of transaction**. It is not necessary to list all of them.

The columns of **Resources and Activities/Processes are meant to be of a suggestive nature**, for both teachers and textbook writers. The Resources column lists not only concrete materials that may be needed in the classroom, but a variety of other resources, including out-of-class experiences of children as well as other people. Historical accounts and other narratives are also listed, in keeping with the current understanding that **narratives can play an important role in teaching science**. The Activities column lists experiments, as normally understood in the context of science, as well as other classroom processes in which children may be actively engaged, **including discussion**. Of course, when we teach science in a hands-on way, activities are not add-ons; they are integral to the development of the subject. Most experiments/activities would have to be carried by children in groups. Suggestions for field trips and surveys are also listed here. Although the items in this column are suggestive, they are meant to give an idea of the unfolding of the content. **Read together with the questions and key concepts,** they delineate the breadth and depth of coverage expected.

The Upper Primary or Middle Stage:

When children enter this stage, they have just completed their primary schooling. **It is important to start with things that are within the direct experience of the child.** The need for continuity within thematic areas, and the effect this has on the structure, has already been mentioned above.

This is the stage where children can and should be provided **plentiful opportunities to engage with the processes of science**:

Observing things closely,
Recording observations,
Tabulation,
Drawing,

Plotting graphs – and, of course,

Drawing inferences from what they observe.

Sufficient time and opportunities have to be provided for this.

During this stage we can expect the beginnings of **quantitative understanding of the world.** However, laws such as the universal law of gravitation, expressed in mathematical form, involve multiple levels of abstraction and have to be postponed to the next stage.

One of the major structural problems that plagues science education at this level is the **lack of experimental facilities**. Children of these classes usually have no access to any equipment, even if the school has functional laboratories for higher classes. While many experiments can be performed with 'zero-cost' equipment, it is unfair to deny children the opportunities of handling, e.g., magnets, lenses and low-cost microscopes. This syllabus is based on the assumption that a **low-cost science kit for the middle classes can and will be designed**. The Syllabus Revision Committee recommends that governments and other agencies make enough copies of such kits available to schools, assuming that children will perform the experiments themselves, in groups. **Until a kit is designed and provided, specific items that are needed should be identified and procured.** Glassware, common chemicals, lenses, slides etc. are items that will be in any such list. Such items are referred to as **'kit items'** in the resources column of the syllabus.

At this stage, many children enter puberty. They are curious about their own bodies and sexuality, while being subject to social restrictions and taboos. **Thus it is important that the topic of human reproduction not be treated merely as a biological process.** Thus the syllabus provides space for addressing social taboos, and for making counselling on these matters part of the classroom process.

Class VI
Science

Questions	Key Concepts	Resources	Activities / Processes
1. Food			**(Periods - 20)**
Sources of food: What are the various sources of our food? What do other animals eat?	Plant parts and animal products as sources of food; herbivores, carnivores, omnivores.	Examples of food from different parts of plants and of food from animal sources.	Germination of seeds such as mung, chick pea etc.; preparing a chart on food habits of animals and food culture of different regions of India.
Components of food: What is our food made up of? Why do we eat a variety of food?	Carbohydrates, fats, proteins, vitamins, minerals, fibres, their sources and significance for human health; balanced diet; diseases and disabilities due to food deficiencies.	Mid Day Meal; Charts, pictures / films of children suffering from food deficiencies and disabilities.	Studying the variety of food in different regions in India; Preparing a menu of balanced diet in the context of the diversity of foods eaten in different parts of the country. Classifying foods according to food components; Test for starch, sugars, proteins and fats.
Cleaning food: How do we separate the grains after harvesting the wheat /rice crop?	Threshing, winnowing, hand picking, sedimentation, filtration.	Talking to some elders about practices after harvesting the crop; kit materials.	Discussion on threshing, winnowing, and picking; Experiments on sedimentation, filtration. Separating mixture of salt and sand.

2. Materials:			**(Periods - 26)**
Materials of daily use:			
What are our clothes made of? How did people manage when there were no clothes?	Different types of cloth materials – cotton, wool, silk and synthetics. Development of clothing materials.	Sharing of prior knowledge with parents and community. Archaeological and historical accounts.	Whole class discussion. Simple activities to distinguish among different types of cloth.
Are some of our clothes made of materials obtained from plants? In what kinds of places do these plants grow? Which parts of the plants are used for making clothes?	Plant fibre, especially cotton and jute; Production of cotton, jute and other locally available plant fibres; Types of soil required for the growth of different fibrous plants.	Sharing of prior knowledge with parents and community.	Whole class discussion. Field survey/ collecting information on locally available plant fibres (coconut, silk cotton, etc.)
Different kinds of Materials:			
What kinds of things do we see around us?	Grouping things on the basis of common properties.	Materials, kit items.	Collecting and grouping things on the basis of gross properties e.g. roughness, lustre, transparency, solubility, sinking/floating using prior knowledge, through experiments.
How things change/react with one another			
In what ways do things change on being heated? Do they change back on being cooled? Why does a burning candle get shorter?	Some changes can be reversed and others cannot be reversed.	Prior knowledge, kit items.	Experiments involving heating of air, wax, paper, metal, water to highlight effects like burning, expansion / compression, change of state.

			Discussion on other changes which cannot be reversed – growing up, opening of a bud, ripening of fruit, curdling of milk.
How much salt can be dissolved in a cup of water?	Solubility, saturated solutions. Amount of substance dissolving varies with temperature. At the same temperature amounts of different substances that dissolve varies.	Salt, sugar and other common substances, kit items.	Experiments for testing the solubility of commonly available substances. Experiments on the effect of heating and cooling on solubility. Comparison of solubilities of different substances using non-standard units (e.g. spoon, paper cone).
3. The World of the Living:			**(Periods - 36)**
Things around us: Are all things around us living? What is the difference between living and non-living? Are all living things similar? Do all living things move? Where do plants and animals live? Can we grow plants in the dark?	Living / non–living characteristics; habitat; biotic, abiotic (light, temperature, water, air, soil, fire)	Recollection of diversity of living organisms and the habitat where they live.	Listing of things around us, listing of characteristics after making observations say on size, colour, shape etc., categorization; observations on habitat; observing germination of seeds, also observing under dark conditions; growth and development of domestic animals, hatching of birds' eggs etc., developing drawing skills.

The habitat of the living: How does habitat affect plants and animals? How do fish live in water?	Habitat varies – aquatic, deserts, mountains etc. – Plants and animals show adaptation; Other plant part modifications like tendrils, thorns etc. Animals in deserts and water.	Potted plants or seeds, pots, etc; thermometer any water plants, any xerophytic plants, Information on desert and aquatic plants and animals.	Listing the diverse set of living organisms around us; Prepare herbarium specimens of different leaves, plants; Studying modifications in plants and animals; Observing how different environmental factors (water availability, temperature) affect living organisms;
Plants – form and Function: What is the structure and function of various parts of the plants - stem, leaf and roots? How do different flowers differ from one another? How does one study flowers?	Morphological structure and function of root, stem and leaves. Structure of the flower, differences.	Plants, flowers, blade, hand lens.	Studying plant parts – types of stems, roots, leaves, seeds; Experiment to show conduction by stem, Activity to show anchorage by roots, absorption by roots. Study of any flower, counting number of parts, names of parts, cutting sections of ovary to observe ovules.
Animals – form and Function: What is inside our bodies? How do animals move? Do all animals have bones in their bodies? How do fishes move? And birds fly?	Structure and functions of the animal body; Human skeletal system, some other animals e.g. fish, bird, cockroach, snail.	Observation of nature; model of skeleton, X-rays of arms or legs, chest, hips, jaws, vertebral column (could be given in the textbook).	Activities to study X-rays, find out the direction in which joints bend, feel the ribs, backbone etc. Observation/ discussion on movement and skeletal system in other

What about snakes, snails, earthworms? **4. Moving Things, People and Ideas:** ***Moving:*** How did people travel from one place to another in earlier times? How did they know how far they had travelled? How do we know that something is moving? How do we know how far it has moved? **5. How things work:** ***Electric current and Circuits:*** How does a torch work?	Need to measure distance (length). Measurement of length. Motion as change in position with time. Electric current: Electric circuit (current flows only when a cell and other components are connected in an unbroken loop) Conductor, Insulator.	Everyday experience; equipment (scale etc.) to measure length. Stories for developing contexts for measuring distances. Torch: cell, bulb or led, wires, key. Mica, paper, rubber,	animals. **(Periods - 12)** Measuring lengths and distances. Observation of different types of moving objects on land, in air, water and space. Identification and discrimination of various types of motion. Demonstrating objects having more than one type of movement (screw motion, bicycle wheel, fan, top etc.) Observing the periodic motion in hands of a clock / watch, sun, moon, earth. **(Periods - 28)** Activity using a bulb, cell and key and connecting wire to show flow of current and identify closed and open circuits. Making a switch. Opening up a dry cell.

Do all materials allow current to flow through them?		plastic, wood, glass metal clip, water, pencil (graphite), etc.	Experiment to show that some objects (conductors) allow current to flow and others (insulators) do not.
Magnets: What is a magnet?	Magnet.	Magnet, iron pieces.	Demonstrating how things are attracted by a magnet. Classification of objects into magnetic/ non-magnetic classes.
Where on a magnet do things stick?	Poles of a magnet.	Magnet, iron pieces, iron filings, paper.	Activity to locate poles of a magnet; Activity with iron filings and paper.
How is a magnet used to find direction?	A freely suspended magnet always aligns in a particular direction. North and South poles.	Bar magnet, stand, thread, compass.	Activities with suspended bar magnet and with compass needle.
How do two magnets behave when brought close to each other?	Like poles repel and unlike poles attract each other.	Two bar magnets, thread, stand.	Activities to show that like poles repel and unlike poles attract.
6. Natural Phenomena:			**(Periods - 26)**
Rain, thunder and Lightning: Where does rain come from? How do clouds form?	Evaporation and condensation, Water in different states. Water cycle.	Everyday experience; kit items.	Condensation on outside of a glass containing cold water; Activity of boiling water and condensation of steam on a spoon. Simple

			model of water cycle. Discussion on three states of water.
Light: Which are the things we can see through?	Classification of various materials in terms of transparent, translucent and opaque.	Previous experience, candle / torch / lamp, white paper, cardboard box, black paper.	Discussion, observation; looking across different materials at a source of light.
When are shadows formed? Do you get a shadow at night – when there is no light in the room, no moonlight or other source of light? What colour is a shadow?	A shadow is formed only when there is a source of light and an opaque material obstructs a source it. A shadow is black irrespective of the colour of the object.	Child's own experience, Candle / torch / lamp, white paper, black paper, coloured objects.	Discussion; observing shadow formation of various objects of different shapes, and of same shape and different colours; Playing and forming shadows with the hands in sunlight, in candle light, and in a well lit region during daytime; Making a pinhole camera and observing static and moving objects.
On what kinds of surfaces can we see images?	Reflecting surfaces; images are different from shadows.	Experience, objects with polished surfaces, mirror etc.	Observing differences between the image and the shadow of the same object.
7. Natural Resources:			**(Periods - 12)**
Importance of water: What will happen to soil, people, domestic animals, rivers, ponds and plants and animals if it does not rain	Importance of water, dependence of the living on water. Droughts and floods.	Experience, Newspaper reports.	Estimation of water used by a family in one day, one month, one year. Difference between need and availability. Discussion.

this year? What will happen to soil, people, domestic animals, plants and animals living in rivers and ponds, if it rains heavily?			Activity: plant growth in normal, deficient and excess water conditions.
Importance of air: Why do earthworms come out of the soil when it rains?	Some animals and plants live in water; some live on land and some live in upper layers of soil; but all need air to breath/to respire.	Experience.	Discussion.
Waste: Do you throw away fruit and vegetable peels and cuttings? Can these be reused? If we dump them anywhere, will it harm the surroundings? What if we throw them in plastic bags?	Waste; recycling of waste products; things that rot and things that don't. Rotting is supported by animals/ animal and plant products.	Observation and experience.	Survey of solid waste generation by households; Estimation of waste accumulated (by a house/ village/colony etc.) in a day, in a year; Discussion on 'what is waste'; Activity to show that materials rot in soil, this is affected by wrapping in plastics.

Class VII
Science

Questions	Key Concepts	Resources	Activities / Processes
1. Food:			**(Periods - 22)**
Food from where: How do plants get their food?	Autotrophic and heterotrophic nutrition; parasites, saprophytes; photosynthesis.	Coleus or any other plant with variegated leaves, alcohol, iodine solution, Kit materials.	Need for light, green leaf for photosynthesis, Looking at any saprophyte/parasite and noting differences from a green plant.
Utilisation of food How do plants and animals utilise their food?	Types of nutrition, nutrition in amoeba and human beings, Digestive system – human, ruminants; types of teeth; link with transport and respiration.	Model of human teeth, charts of alimentary canal, types of nutrition etc., chart and model of amoeba. The story of the stomach with a hole.	Effect of saliva on starch, permanent slide of *Amoeba*. Role play with children.
2. Materials:			**(Periods - 28)**
Materials of daily use: Do some of our clothes come from animal sources? Which are these animals? Who rears them? Which parts of the animals yield the yarn? How is the yarn extracted? What kinds of clothes help us to keep warm? What is heat?	Wool, silk – animal fibres. Process of extraction of silk; associated health problems.	Samples of wool and silk; Brief account of silkworm rearing and sheep breeding. Potassium permanganate, metal strip or rod, wax, common pins, spirit lamp, matches,	Collection of different samples of woollen and silk cloth. Activities to differentiate natural silk and wool from artificial fibres. Discussion. Experiment to show that 'hot' and 'cold' are relative. Experiments to show

What is the meaning of 'cool'/'cold' and 'warm' 'hot'? How does heat flow from/to our body to/from the surroundings?	Heat flow; Temperature.	tumblers, Thermometer etc.	conduction, convection and radiation. Reading a thermometer.
Different kinds of Materials: Why does turmeric stain become red on applying soap?	Classification of substances into acidic, basic and neutral; indicators.	Common substances like sugar, salt, vinegar etc, test tubes, plastic vials, droppers, etc.	Testing solutions of common substances like sugar, salt, vinegar, lime juice etc. with turmeric, litmus, china rose. Activity to show neutralisation.
How things change/react with one another: What gets deposited on a tawa/khurpi /kudal if left in a moist state? Why does the exposed surface of a cut brinjal become black?	Chemical substances; In a chemical reaction a new substance is formed.	Test tubes, droppers, common pins, vinegar, baking powder, CuSO4, etc.	Experiments involving chemical reactions like rusting of iron, neutralization (vinegar and baking soda), displacement of Cu from CuSO4 etc. *Introduce chemical formulae without explaining them.*
Why is seawater salty? Is it possible to separate salt from seawater?	Substances can be separated by crystallisation.	Urea, copper sulphate, alum etc, beaker, spirit lamp, watch glass, plate, petridish etc.	Making crystals of easily available substances like urea, alum, copper sulphate etc. using supersaturated solutions and evaporation.
3. The World of the Living:			**(Periods - 42)**

Surroundings affect the living: Why are nights cooler? How does having winters and summers affect soil? Are all soils similar? Can we make a pot with sand? Is soil similar when you dig into the ground? What happens to water when it falls on the cemented/ bare ground?	Climate, soil types, soil profile, absorption of water in soil, suitability for crops, adaptation of animals to different climates.	Data on earth, sun – size, distance etc, Daily changes in temperature, humidity from the newspaper, Sunrise, sunset etc.	Graph for daily changes in temperature, day length, humidity etc.; Texture of various soils by wetting and rolling; Absorption / percolation of water in different soils, Which soil can hold more water.
The breath of life: Why do we/animals breathe? Do plants also breathe? Do they also respire? How do plants/ animals live in water?	Respiration in plants and animals.	Lime water, Germinating seeds, Kit materials.	Experiment to show plants and animals respire; rate of breathing; what do we breathe out? What do plants 'breathe' out? Respiration in seeds; Heat release due to respiration. Anaerobic respiration, Root respiration.
Movement of Substances: How does water move in plants? How is food transported in plants? Why do animals drink water? Why do we sweat? Why and how is	Herbs, shrubs, trees; Transport of food and water in plants; Circulatory and excretion system in animals; Sweating.	Twig, stain; improvised stethoscope; plastic bags, plants, egg, sugar, salt, starch, Benedicts solution, $AgNO_3$ solution.	Translocation of water in stems, demonstration of transpiration, measurement of pulse rate, heartbeat; after exercise etc. Discussion on dialysis, importance; Experiment on dialysis

there blood in all parts of the body? Why is blood red? Do all animals have blood? What is there in urine? ***Multiplication in plants:*** Why are some plant parts like potato, onion swollen – are they of any use to the plants? What is the function of flowers? How are fruits and seeds formed? How are they dispersed? **4. Moving Things, People and Ideas:** ***Moving objects:*** Why do people feel the need to measure time? How do we know how fast something is moving?	Vegetative, asexual and sexual reproduction in plants, Pollination - cross, self pollination; Pollinators, fertilisation, fruit, seed. Appreciation of idea of time and need to measure it. Measurement of time using periodic events. Idea of speed of moving objects – slow and fast motion along a straight line.	Bryophyllum leaves, potato, onion etc.; Yeast powder, Sugar. Daily-life experience; Metre scale, wrist watch/ stop watch, string etc.	using egg membrane. Study of tuber, corm, bulb etc; budding in yeast; T.S./L.S. ovaries, w.m.pollen grains; Comparison of wind pollinated and insect pollinated flowers; Observing fruit and seed development in some plants; Collection and discussion of fruits/seeds dispersed by different means. **(Periods - 16)** Observing and analyzing motion (slow or fast) of common objects on land, in air, water and space. Measuring the distance covered by objects moving on a road in a given time and calculating their speeds. Plotting distance vs. time graphs for uniform

			motion. Measuring the time taken by moving objects to cover a given distance and calculating their speeds. Constancy of time period of a pendulum.
5. How Things Work: *Electric current and Circuits:* How can we conveniently represent an electric circuit?	Electric circuit symbols for different elements of circuit.	Recollection of earlier activities. Pencil and paper.	**(Periods - 16)** Drawing circuit diagrams.
Why does a bulb get hot?	Heating effect of current.	Cells, wire, bulb.	Activities to show the heating effect of electric current.
How does a fuse work?	Principle of fuse.	Cells, wire, bulb or LED, aluminum foil.	Making a fuse.
How does the current in a wire affect the direction of a compass needle?	A current-carrying wire has an effect on a magnet.	Wire, compass, battery.	Activity to show that a current-carrying wire has an effect on a magnet.
What is an electromagnet?	A current-carrying coil behaves like a magnet.	Coil, battery, iron nail.	Making a simple electromagnet. Identifying situations in daily life where electromagnets are used.
How does an electric bell work?	Working of an electric bell.	Electric bell.	Demonstration of working of an electric bell.
6. Natural Phenomena: *Rain, thunder and Lightning:*			**(Periods - 24)**

What causes storms? What are the effects of storms? Why are roofs blown off? ***Light:*** Can we see a source of light through a bent tube?	High-speed winds and heavy rainfall have disastrous consequences for human and other life. Rectilinear propagation of light.	Experience; Newspaper reports. Narratives/stories. Rubber / plastic tube / straw, any source of light.	Making wind speed and wind direction indicators. Activity to show "lift" due to moving air. Discussion on effects of storms and possible safety measures. Observation of the source of light through a straight tube, a bent tube.
How can we throw sunlight on a wall?	Reflection, certain surfaces reflect light.	Glass / metal sheet / meta foil, white paper.	Observing reflection of light on wall or white paper screen.
What things give images that are magnified or diminished in size?	Real and virtual images.	Convex / concave lenses and mirrors.	Open ended activities allowing children to explore images made by different objects, and recording observations. Focussed discussions on real and virtual images.
How can we make a coloured disc appear white?	White light is composed of many colours.	Newton's disc.	Making the disc and rotating it.
7. Natural Resources: *Scarcity of water:* Where and how do you get water for your domestic needs? Is it enough? Is there enough water for agricultural needs? What happens to	Water exists in various forms in nature. Scarcity of water and its effect on life.	Experience; media reports; case material.	**(Periods - 12)** Discussions. Case study of people living in conditions of extreme scarcity of water, how they use water in a judicious way. Projects exploring

plants when there is not enough water for plants? Where does a plant go when it dies?			various kinds of water resources that exist in nature in different regions in India; variations of water availability in different regions.
Forest products What are the products we get from forests? Do other animals also benefit from forests? What will happen if forests disappear?	Interdependence of plants and animals in forests. Forests contribute to purification of air and water.	Case material on forests. Observation and experience; P Photographs.	Case study of forests.
Waste Management: Where does dirty water from your house go? Have you seen a drain? Does the water stand in it sometimes? Does this have any harmful effect?	Sewage; need for drainage/sewer systems that are closed.		Survey of the Neighbourhood, Identifying locations with open drains, stagnant water, and possible contamination of ground water by sewage. Tracing the route of sewage in your building, and trying to understand whether there are any problems in sewage disposal.

Class VIII
Science

Questions	Key Concepts	Resources	Activities / Processes
1. Food:			**(Periods - 22)**
Crop production: Crop production: How are different food crops produced? What are the various foods we get from animal sources?	Crop production: Soil preparation, selection of seeds, sowing, applying fertilizers, irrigation, weeding, harvesting and storage; nitrogen fixation, nitrogen cycle.	Interaction and discussion with local men and women farmers about farming and farm practices; visit to cold storage, Go-downs; visit to any farm/ nursery/ garden.	Preparing herbarium specimens of some crop plants; Collection of some seeds etc; Preparing a table/chart on different irrigation practices and sources of water in different parts of India; Looking at roots of any legume crop for nodules, hand section of nodules.
Micro-organisms What living organisms do we see under a microscope in a drop of water? What helps make curd? How does food go bad? How do we preserve food?	Micro organisms – useful and harmful.	Microscope, Kit materials; Information about techniques of food preservation.	Making a lens with a bulb; Observation of drop of water, curd, other sources, bread mould, orange mould under the microscope; Experiment showing fermentation of dough – increase in volume (using yeast) – collect gas in balloon, test in lime water.
2. Materials:			**(Periods - 26)**
Materials in daily			

life:			
Are some of our clothes synthetic? How are they made? Where do the raw materials come from?	Synthetic clothing materials. Other synthetic materials, especially plastics;	Sharing of prior knowledge, Source materials on petroleum products.	Survey on use of synthetic materials. Discussion.
Do we use other materials that are synthetic?	Usefulness of plastics and problems associated with their excessive use.	Collection of material from neighbourhood or should be part of;	Testing various materials – for action of water, reaction on heating, effect of flame, electrical conductivity, thermal conductivity, tensile strength.
Do we use cloth (fabric) for purposes other than making clothes to wear? What kind of fabric do we see around us? What are they used for?	There are a variety of fibrous materials in use. A material is chosen based on desired property.	The kit.	
***Different kinds of materials and their reactions*:**			
Can a wire be drawn out of wood? Do copper or aluminium also rust like iron? What is the black material inside a pencil? Why are electrical wires made of aluminium or copper?	Metals and non-metals.	Kit items.	Simple observations relating to physical properties of metals and non-metals, displacement Reactions, experiments involving reactions with acids and bases. Introduction of word equations.
How things change/ react with one another:			
What happens to the	Combustion, flame	"The Chemical	Experiments with

wax when a candle is burnt? Is it possible to get this wax back? What happens to kerosene/natural gas when it is burnt? Which fuel is the best? Why?	All fuels release heat on burning. Fuels differ in efficiency, cost etc. Natural resources are limited. Burning of fuels leads to harmful by products.	History of a Candle", by M. Faraday, 1860. Collecting information from home and other sources.	candles. Collecting information. Discussions involving whole class.
3. The World of the Living: ***Why conserve:*** What are reserve forests/ sanctuaries etc? How do we keep track of our plants and animals? How do we know that some species are in danger of disappearing? What would happen if you continuously cut trees?	Conservation of biodiversity / wild life / plants; zoos, sanctuaries, forest reserves etc. flora, fauna endangered species, red data book; endemic species, migration.	Films on wild life, TV programmes, visit to zoo/ forest area / sanctuaries etc.; case study with information on disappearing tigers; data on endemic and endangered species from MEF, Govt. of India, NGOs .	**(Periods - 44)** Discussion on whether we find as many diverse plants/ animals in a 'well kept area' like a park or cultivated land, as compared to any area left alone. Discussion on depletion of wild life, Why it happens, on poaching, economics.
The cell: What is the internal structure of a plant – what will we see if we look under the microscope? Which cells from our bodies can be easily seen? Are all cells similar?	Cell structure, plant and animal cells, use of stain to observe, cell organelles – nucleus, vacuole, chloroplast, cell membrane, cell wall.	Microscope, onion peels, epidermal peels of any leaves, petals etc, buccal cavity cells, *Spirogyra*; permanent slides of animal cells.	Use of a microscope, preparation of a slide, observation of onion peel and cheek cells, other cells from plants e.g. *Hydrilla* leaf, permanent slides showing different cells, tissues, blood smear; observation of T.S. stem to see tissues; observing diverse types of cells from plants and

			animals (some permanent slides).
How babies are formed How do babies develop inside the mother? Why does our body change when we reach our teens? How is the sex of the child determined? Who looks after the babies in your homes? Do all animals give birth to young ones?	Sexual reproduction and endocrine system in animals, secondary sexual characters, reproductive health; internal and external fertilisation.	Counsellors, films, lectures.	Discussion with counsellors on secondary sexual characters, on how sex of the child is determined, safe sex, reproductive health; observation on eggs, young ones, life cycles. Discussion on Gender issues and social taboo's.
4. Moving things, People and Ideas:			**(Periods - 16)**
Idea of force: What happens when we push or pull anything? How can we change the speed, direction of a moving object? How can we shape the shape of an object?	Idea of force-push or pull; change in speed, direction of moving objects and shape of objects by applying force; contact and non-contact forces.	Daily-life experience, kit items.	Observing and analysing the relation between force and motion in a variety of daily-life situations. Demonstrating change in speed of a moving object, its direction of motion and shape by applying force. Measuring the weight of an object, as a force (pull) by the earth using a spring balance.
Friction: What makes a ball rolling on the	Friction – factors affecting	Various rough and	Demonstrating friction

ground slow down?	friction, sliding and rolling friction, moving; advantages and disadvantages of friction for the movement of automobiles, airplanes and boats/ships; increasing and reducing friction.	smooth surfaces, ball bearings.	between rough/smooth surfaces of moving objects in contact, and wear and tear of moving objects by rubbing (eraser on paper, card board, sand paper). Activities on static, sliding and rolling friction. Studying ball bearings. Discussion on other methods of reducing friction and ways of increasing friction.
Pressure Why needles are made pointed? Why does a balloon burst if too much air is blown into it? Why does an inverted glass / bottle /pitcher resist being pushed down into water? How can air/liquids exert pressure?	Idea of pressure; pressure exerted by air/liquid; atmospheric pressure.	Daily-life experiences; Experimentation – improvised manometer and improvised pressure detector.	Observing the dependence of pressure exerted by a force on surface area of an object. Demonstrating that air exerts pressure in a variety of situations. Demonstrating that liquids exert pressure. Designing an improvised manometer and measuring pressure exerted by liquids. Designing improvised pressure detector and demonstrating increase in pressure exerted by a liquid at greater depths.
Sound: How do we communicate through sound? How is sound	Various types of sound; sources of sound; vibration as a cause of sound; frequency; medium	Daily-life experiences; Kit items; musical instruments.	Demonstrating and distinguishing different types (loud and feeble, pleasant/ musical and

produced? What characterizes different sounds?	for propagation of sound; idea of noise as unpleasant and unwanted sound and need to minimise noise.		unpleasant / noise, audible and inaudible) of sound. Producing different types of sounds. using the same source. Making a '*Jal Tarang'*. Demonstrating that vibration is the cause of sound. Designing a toy telephone. Identifying various sources of noise. (Unpleasant and unwanted sound) in the locality and thinking of measures to minimize noise and its hazards (noise-pollution).
5. How Things Work: ***Electric current and Circuits:***			**(Periods - 14)**
Why do we get a shock when we touch an electric appliance with wet hands?	Water conducts electricity depending on presence/ absence of salt in it. Other liquids may or may not conduct electricity.	Rubber cap, pins, water, bulb or LED, cells, various liquids.	Activity to study whether current flows through various liquid samples (tap water, salt solution, lemon juice, kerosene, distilled water if available).
What happens to a conducting solution when electric current flows through it?	Chemical effects of current.	Carbon rods, beaker, water, bulb, battery.	Emission of gases from salt solution. Deposition of Cu from copper sulphate solution. Electric pen using KI and starch solution.
How can we coat an object with a layer of metal?	Basic idea of electroplating.	Improvised electrolytical cell, CuSO4	Simple experiment to show electroplating.

6. Natural Phenomena:			**(Periods - 26)**
Rain, thunder and Lightning:			
What is lightning? What safety measures should we take against lightning strikes?	Clouds carry electric charge. Positive and negative charges, attraction and repulsion. Principle of lightning conductor.	Articles on clouds and lightning; Kit items.	Discussion on sparks. Experiments with comb and paper to show positive and negative charge. Discussion on lightning conductor.
Light:			
What are the differences between the images formed on a new utensil and an old one? Why is there this difference?	Laws of reflection.	Mirror, source of light, ray source (mirror covered with black paper with a thin slit).	Exploring laws of reflection using ray source and another mirror.
When you see your image in the mirror it appears as if the left is on the right – why?	Characteristics of image formed with a plane mirror.	Plane glass, candle, scale.	Locating the reflected image using glass sheet and candles.
Why don't we see images on all surfaces around us?	Regular and diffused Reflection.	Experience.	Discussion with various examples.
What makes things visible?	Reflection of light from an object to the eye.	Mirrors and objects to be seen.	Activity of observing an object through an object through a straight and bent tube; and discussion. Observing multiple images formed by mirrors placed at angles to each other.
How do we see images of our back in a mirror?	Multiple reflections.	Plane mirror, water.	
Why do we sometimes see colours on oil films on water? What is inside our	Dispersion of light.	Model or chart of the human eye.	Making a kaleidoscope. Observing spectrum obtained on a white sheet of paper/wall using a plane mirror

eye that enables us to see?	Structure of the eye.	Experiences of children;	inclined on a water surface at an angle of 45°.
Why are some people unable to see?	Lens becomes opaque, light not reaching the eye. Visually challenged use other senses to make sense of the world around. Alternative technology available. Role of nutrition in relation to blindness	Case histories. Samples of Braille sheets.	Observing reaction of pupil to a shining torch. Demonstration of blind spot. Description of case histories of visually challenged people who have been doing well in their studies and careers. Activities with Braille sheet.
Night sky: What do we see in the sky at night? How can we identify stars and planets?	Idea about heavenly bodies/celestial objects and their classification – moon, planets, stars, constellations. Motion of celestial objects in space; the solar system.	Observation of motion of objects in the sky during the day and at night; models, charts, role-play and games, planetarium.	Observing and identifying the objects moving in the sky during the day and at night. Observing and identifying some prominent stars and constellations. Observing and identifying some prominent planets, visible to the naked eye, (Venus, Mars, Jupiter) in the night sky and their movement. Design and preparing models and charts of the solar system, constellations, etc. Role play and games for understanding movement of planets, stars etc.
Earthquakes:			

What happens during an earthquake? What can we do to minimise its effects? **7. Natural Resources:** ***Man's intervention in phenomena of nature:***	Phenomena related to earthquakes.	Earthquake data; visit to seismographic centre.	Looking at structures/ large objects and guessing what will happen to them in the event of an earthquake; Activities to explore stable and unstable structures. **(Periods - 12)**
What do we do with wood? What if we had no wood? What will happen if we go on cutting trees/grass without limit?	Consequences of deforestation: scarcity of products for humans and other living beings, change in physical properties of soil, Reduced rainfall. Reforestation; Recycling of paper.	Data and narratives on deforestation and on movements to protect forests.	Narration and discussions. Project- Recycling of paper.
What do we do with coal and petroleum? Can we create coal and petroleum artificially?	Formation of coal and petroleum in nature. (Fossil fuels?). Consequences of over extraction of coal and petroleum.	Background materials, Charts etc.	Discussion.
Pollution of air and Water: What are the various activities by human beings that make air impure? Does clear, transparent water indicate purity?	Water and air are increasingly getting polluted and therefore become scarce for use. Biological and chemical contamination of water; effect of impure water on soil and living beings;	Description of some specific examples of extremely polluted rivers.	Case study and discussion. Purification of water by physical and chemical methods including using sunlight. Discussion on other methods of water

	effect of soil containing excess of fertilisers and insecticides on water resources. Potable water.		purification.

PART - II
LEARNING INDICATORS
in Science at Upper Primary Stage

Introduction:

Science is a human endeavour to understand the world by building-up conceptual models on the basis of their own observations of surroundings and connect it to a meaningful patterns and relations to interact with nature. It involves processes like observations, making hypotheses, performing activities, collecting and analysing data, drawing inferences and making generalisation.

As consistent with the stage of cognitive development, science is being taken as core subject in the curriculum at upper primary stage. At this stage, it is a gradual transition from environmental studies of the primary stage to the elements of science and technology. At this stage, it is important to expand the horizon of child gradually and start with the things that are within the direct experience of the child.

In view of NCF 2005 the syllabi of Upper Primary Stage has been developed following broad curricular expectations:

- At upper primary stage science concepts relate to the everyday experience of children and learnt through hands on activities/experiments utilising local resources.
- The pedagogy of science at this stage reflects an approach that include tasks such as making simple models, meaningful investigations, surveys, peer interactions, field studies and group activities.
- Child at this stage is encouraged to collect, organise and reflect on the information so that science learning becomes meaningful in social context.
- Greater emphasis have been laid on the learning process of science (process skills). These skills include observation, hypothesis, measurement, data collection and analysis, drawing inferences, making generalisations that promote analysis, critical thinking and creativity.

The development of process skills in science enables children to learn by themselves so that they can continue to be creative and develop lifelong learning attitude.

- At upper primary stage learners are encouraged to explore and seek varied resources to facilitate conceptual clarity and to establish relationship with day to day life applications.

Continuous observation of the child's learning is an essential component of a teaching learning process. It gives a teacher an idea that as a facilitator what are necessary

requirements to enhance the teaching-learning process. Teacher adopts several parameters through which she assesses continuously learning progress of the child. These parameters are taken as learning indicators that enable the teacher to identify learning gaps. Thus, learning indicators (LI) facilitate strategies to deliver curriculum and assess learner's progress continuously with a focus on curricular expectations.

The learning indicators in consonance with curricular expectations and pedagogical processes are presented in tabular form namely curricular expectations, pedagogical processes and learning indicators class wise (classes 6, 7 & 8).

Table-1

Curricular Expectations and Pedagogical Processes

Curricular Expectations	*Pedagogical Processes*
Science syllabi at upper primary stage identifies age appropriate content that is being utilised as a vehicle to develop scientific temper and scientific thinking for example: • Develops process skills of science such as **observation, inquiry, constructing hypothesis, collecting data, recording observation, drawing inference** • Making generalisation, proving or disproving hypothesis, developing explanation, communicating and applying. • Imbibes the development of historical perspectives; environmental concerns and sensitivity. Develop and respect for human dignity and rights; gender equity; values of honesty, integrity, cooperation and concern for life. • The content consistent with the cognitive development of learner at upper primary stage. For example: - **Identification of materials on the basis of their properties** - Idea/ experience about exhaustible and inexhaustible natural resources. - Sources and components of food. - Nutrition in plants and animals. - Useful and harmful microorganisms.	• Observes surroundings, natural processes, phenomena through visuals, touch, smell, feel and echo etc, For example Wooden furniture, metallic lunch-box, spoon, pencil, stones , mirror, magnet, eraser, coal, plants, animals, sea breeze, land breeze, storms, cyclones, lightening, night sky. • Shares her observations with others (peers /adults), seeks information and formulate hypothesis on the basis of observations. • Attempts to prove the hypothesis by designing and performing activities/experiments/ surveys. For example - Separating different parts of flower such as sepals, petals, stamens and carpel etc. - cutting with knife, beating of materials with hammer, to check the hardness of materials. - Heating materials to check their conductivity. - Using electric tester to check electrical conductivity of materials. • Observes the changes/ findings during the activity.

- Conservation of plants and animals. - Cell structure and functions of animal and plant. - Sexual and Asexual reproduction in animals. - Idea of Motion, Force and Pressure - Electric current and circuit. - Reflection and dispersion of light. - Ideas about celestial objects.	For example - Distinguishes between different parts of flower on the basis of colour, shape, size, number, etc. - Some materials are easily cut with knife. - Some materials change into flat sheets on beating. - Some materials break down into a powdery mass. - Some materials heat up quickly and some hardly heat up. - The bulb of tester glows in case of some materials and does not glow for others. • Analyses data, interpret results and draws inference For example: - Differentiates between different parts of flowers by comparing with figures/ pictures. - Identifies materials on the basis of hardness, softness, appearance, transfer of heat, flow of electric current.

The learning indicators corresponding to class VI, VII and VIII with respect to the above mentioned curricular expectations involving pedagogical processes is highlighted by taking examples.

Table-2
Class-Wise Learning Indicators

Learning Indicators	Class VI	Class VII	Class VIII
Explore surrounding and shares experiences with others.	**Explores:** - Plants and animals as sources of food such as, wheat, rice, egg, milk, fish etc. - identifies food ingredients, such as Chapati has two ingredients *Atta* and water; *Dal* has more than two ingredient etc; and food components such as potato is rich source of carbohydrates; while eggs and fishes are rich in protein and fats is a component of nuts. - Various plant fibres such as cotton, jute etc - Materials on the basis of physical properties such as soft, hard, soluble, insoluble, appearance, transparency etc.	**Explores:** - Modes of nutrition in plants such as autotrophic in green plants, heterotrophic in nongreen plants and in animals. - Identify various parts of digestive tract in human such as buccal cavity, oesophagus, stomach and intestine etc. - Process of digestion such as saliva breaks down starch into sugar in buccal cavity. Digestive juices break down the proteins into simpler substances. - Various animal fibres such as wool, silk etc. - Changes as physical and chemical such as dissolving sugar in water, setting of curd from milk etc. - Nature of substances as acidic, basic such as lemon, tamarind, baking soda, soap etc. - Flow of heat such as metal spoon kept in hot tea becoming hot.	**Explores:** - Various cropping patterns such as Rabi crops and Kharif Crops. - Various practices of crop production, such as, soil-preparation, irrigation etc. and animal husbandry. - Roles of Microorganisms in our life. - Various synthetic fibres such as artificial silk, nylon etc. - Physical and chemical properties of materials. - Result of application of force on an object such as change in its state of motion or its shape. - Factors affecting friction such as nature of surfaces. - Pressure exerted

	- Changes as reversible and irreversible such as melting of wax, making of chapatti, burning of paper etc. - Types of movement, such as motion of a vehicle on straight road, falling stone, hands of a clock, blade of an electric fan, swing. - Behaviour of magnets such as magnets attract materials like iron, attraction and repulsion between two magnets. - Shadow formation of objects of different shapes, sizes and colours in sunlight and candle light. - Reflection from surfaces such as water of a pool, mirror. - Air and water as a natural resource with focus on components of air, water cycle, loss of water by plants and rain water harvesting.	- Heating effect of electric current such as electric heater or iron becoming hot after switching on electric current. - Magnetic effects of electric current such as electromagnetic crane, electric bell. - Reflection of light from mirrors such as plane mirrors, convex mirrors, concave mirrors. - Issues related to Water Management such as treatment of polluted water, arrangement for sewage disposal, sanitation at public places. - Forest as a resource, deforestation, soil erosion, various products obtained from forest, forest as a life line for the forest dwelling communities.	by fluids such as water in a bottle, air in inflated balloon. - Sources of sound such as stretched strings, membranes, air columns. - Chemical effects of current such as electroplating. - Laws of Reflection and multiple images. - Ways by which air and water gets polluted, green house effect, ways of purification of water.

	- Recycling of waste products, emphasis on recycling of paper and vermin-composting.		
Asks questions leading to investigations.	**For example:** - Is chicken curry / honey an animal product? - Do carbohydrates present in plants sources only? - Why do living things need food? - What are our clothes made of? - Why are we advised to wear cotton cloths in summer? - How do plants / animals get their food? - How does a torch work? - How is magnet used to find directions? - What will happen if it does not rain or rains heavily? - Can fruits and vegetable peels be reused?	**For example:** - Why does pitcher plant feed on insects? - How do animals utilise their food? - Do some of our clothes come from animal sources? - What kind of clothes helps us to keep warm? - Why does turmeric stain become red on applying soap? - What gets deposited on a *tawa / khurpi* if left in a moist state? - How do we know how fast something is moving? - How does a fuse work? - Where and how do you get water for your domestic needs? - What are the products we get from forests?	**For example:** - Why is weeding necessary in agricultural farm? - Why is wheat not cultivated during summer? - How do vegetables and food get spoilt? - What helps make curd? - Do we use clothes (fabric) for purposes other than making clothes to wear? - Why does a burning candle get shorter? - What happens when we push or pull anything? - Why needles are made pointed? - How is sound produced? - Why are ringing bells not made of wood? - What makes

			things visible? - What are the various activities which makes air and water impure?
Performs activities: • Suggests different ways of doing activities. • Selects appropriate materials / tools / instrument. • Collects and assembles materials appropriately for performing activities. • Improvises materials / tools / instruments as per the need. • follows relevant precautions such as handling objects /chemicals/ equipments carefully. • Repeats activities to reproduce results.	**For example:** - Find and list out various food items, their ingredients and their sources, such as, ingredients of idly are rice, *urad dal* and water. - Perform test for starch, protein and fats in various food items. - Materials will be identified by doing various activities such as dissolving materials into water, by compressing or scratching materials, by immersing material into water, by looking through materials by using the available resources. - Measures lengths using hand span, strings, metre scale, etc.	**For example:** - Collect information about plant nutrition from various resources such as news paper, internet etc. - Perform iodine test to confirm the presence of starch stored during the process of photosynthesis in leaves of different colours. - Collect information on structure of digestive tract via books, posters, news paper and internet etc. - Nature of materials in surrounding will be identified by testing with different indicators such as litmus paper, flower indicators. - Studies transfer of heat by conduction, convection and radiation by heating metal strip, water and keeping a hand on top of candle flame. - Measures time period of a pendulum and speed of a ball.	**For example:** - Gather material such as, potted earthen pots, manure, fertiliser, water etc. to carry out activity by adding different manure and fertilizers to the soil of potted plants and comparing it with the plant lacking treatments. - Manages ice-cream cups and germinate seedlings instead of earthen pots. - Uses spatula for using urea and other manure. - Using only a little dose of urea at a time. - Replicate the activity many times. - Physical and chemical properties of materials will be tested by performing various activities

	- Lights up an electric bulb using electric cell and wires. - Using conduction tester identifies materials as good and bad conductors of electric current. - Locates poles of a magnet using iron filings.	- Observes heating effect of electric current by using some metal wires and battery. - Forms images by plane, convex and concave mirrors.	such as beating the material with hammer, burning of metals and non-metals in air reactions of metals and nonmetals with water, acids, bases and salts. - Observes effect of force on speed and direction of moving object. - Performs various activities to study pressure exerted by water on the bottom and walls of container. - Tries out different ways of reducing and increasing friction. - Performs activities to establish that a medium is needed for propagation of sound. - Makes a conduction tester and uses it to test electrical conductivity of liquids.
Reporting and Recording: • Records findings in different ways, such as, table, graph,	**For example:** Records observations of various food items for the presence or absence of carbohydrates,	**For example:** Records observations of iodine test with different coloured leaves and variegated leaves for the present or absence of starch in the tabular form.	**For example:** Records name of various tools and their uses in agricultural practices in tabular form, such as, plough for tilling

figure, etc. • Organizes scientific findings using appropriate tables, charts, graphs, diagrams and symbols. • Identifies relationships in the findings. • Applies appropriate mathematical skills to interpret quantitative data.	protein and fats. - Draws figures of the collected materials and records their properties in a tabular form. - Draws diagram of various parts of flower. For example: relates the observations with the physical properties of materials and differentiates materials as soluble, insoluble, hard, transparent, translucent, conductor, insulator, etc. For example: - counting of floral parts.	- Records. - makes cards/ charts using natural indicators. - records the observations regarding nature of substances in a tabular form. - makes distance-time graphs. - Draws diagram of a simple electric circuit using symbols. For example: identifies the nature of materials as acidic, basic and neutral by observing different colours with indicators.	and loosening the soil, leveller to level the soil etc. - Records effect of green manure and urea on plant growth by recording length, number of leaves etc every day of seven days. - Records the observations related to the physical and chemical properties of materials(metals and non-metals) in a tabular form. - Records the action of force on the state of motion and shape of objects. For example: - differentiates between metals and non-metals by observing their physical and chemical properties. For example: - measures the angle of incidence and angle of reflection of light. For example: - Classifies the materials into

	- Identifies different parts of flowers on the basis of position and structure.		metals and non-metals on the basis of physical and chemical properties. - Liquids exert equal pressure at the same depth. - Friction depends on the nature of surfaces in contact. - Sound is produced by vibrating objects. - Most liquids that conduct electricity are solutions of acids, bases and salts.
Discussion: • Presents logical explanations and arguments. • Communicates conclusions clearly. • Connects scientific concepts to everyday life. • Makes effort to acquire further knowledge. • Displays a sense of interest in science by	**For example:** - Concludes that most of the flowers has four parts. - Concludes that rice has carbohydrates in it but ground nut has fat in it. - Concludes that hard and lustrous materials are usually metals. - Concludes that light travels in straight line. For example: - cooking utensils	**For example:** - Concludes that starch is synthesised only in the green part of variegated leaves. - Communicates that see starch is synthesised in other different coloured leaves too!! - calculates the time period of simple pendulum. - calculates speed of an object For example: - Infers that materials	**For example:** - Concludes that urea and green manure enhances growth of plants. - Metals are used for making aeroplanes, boilers, automobiles etc. whereas non-metals are used in fertilizers and in water purification etc. - Soles of shoes are grooved for better grip.

preparing charts and working models. • Participates enthusiastically in role plays, field trips, science exhibitions, etc. • Responds critically to media coverage of issues. • Shows innovation and creativity. • Shows some problem solving skills.	are made up of metals as they are good conductor of heat. For example: - visit a blacksmith, observe and report how metals are moulded. For example: - Makes pinhole camera, periscope, etc. For example: - Discussion/ role play/ poster presentation on conservation of water. - Survey on waste management. For example: - Issues such as, noise pollution, gender issues. For Example: - Suggest methods of rain water harvesting. - Suggest ways of recycling of paper.	which turns blue litmus red are acidic in nature whereas materials which turns red litmus blue are basic in nature - Concludes that warm air rises up - Concludes that when electric current passes through a wire, it behaves like a magnet - Concludes that white light consists of seven colours For example: - Copper vessels are not used to keep acidic materials. - Convex mirror is used as side view mirror in vehicles. For example: - Visit electric shop to see various types of fuses and MCB	For example: - Visits a commercial electroplating unit. - Finds out the locations of the deposits of iron, aluminium and zinc in India. - Mark these in an outline map of India. Discusses in which form the deposits are found. For example: - Makes kaleidoscope, model of solar system, toy telephone, etc. - Make model of fire extinguisher. - Discussion on recycling of paper. - Discussion on different methods of purification of water. For example: - Hazards of electroplating, noise pollution, disaster management. For example: - discusses on methods of purification of

			water. - discusses on fuel efficiency.
Demonstrates values Imbibed: • Uses resources / materials without wasting. • Records and reports findings honestly. • Takes responsibility and initiative while performing task. • Works cooperatively with peers. • Listens patiently to arguments of others. • Advises the ways for conservation of environment so that changes in environmental conditions will not affect the survival of entire species.	**For example:** - Discusses with peers for not to waste food. - Switches off electrical appliances when not in use, - Avoids wasting water, chemicals etc.	**For example:** - Discusses with peers not to pluck flowers, leaves etc. - Makes sun dial, sand clock, electromagnetic crane, etc For example: - Brings the soil sample from the nearby area and find out the nature of soil. Discusses with gardener if he/she treats the soil in any manner. - Discussion on the judicious use of water. For example: - Do not cut trees!! It decreases rainfall and fertility of soil etc. and increases temperature. For Example: - Discusses on plantation of eucalyptus trees which absorb surplus waste water and release pure water vapour into the atmosphere.	**For Example:** - Discusses the harmful effects of agrochemicals in agriculture. - Discusses on precautions to be taken while using LPG. - Discusses on how to use fire extinguishers. - Steps taken to adopt for conservation of energy. - Discusses about the switching off the engine at traffic lights or at a place where one has to wait.

		- Discusses on vermi processing toilet. - Discusses on preservation of forests	

Guidelines for Users

i. The columns in the Table-1 reflect curricular expectations and pedagogical processes.

The first column, curricular expectations provide learning goals as the child moves from class VI to class VIII through content and themes mentioned in this column are perceived as a vehicle to achieve the goals of science curriculum at upper primary stage. The teaching-learning process or pedagogical process are built along the science content keeping in the mind the cognitive reach of a child. It imbibes active participation of learner and provides opportunity to construct knowledge utilising multiple resources. The major focus of the process is to create learning environment.

ii. The columns in Table-2 highlights learning indicators class wise which reflects the progress of learning. These are suggestive and may be adopted or adapted as per the need and context.

These pedagogical processes and learning indicators would help in implementation of CCE effectively.

Children with special needs require to be taken along with class and it is desired to design alternate activities keeping in view the learning objectives similar to those to the others. The teacher should take into account the specific problem of the child and plan alternate strategies for teaching learning process. A healthy inclusive classroom environment provides equal opportunity to all the students, those with and those without learning difficulties can learn together. The measures to be adopted may include:

- Develop process skills through group activities and use of ICT for simulation, repeated practices and evaluation.
- Assess learning progress through different modes taking cognizance of the learner's response.
- Observation of the child's engagement in multiple activities, through varied ways and levels of involvement.
- Use of adapted equipments/devices (for e.g. Visual output devices should have aural output and vice versa)
- Use of embossed diagram in the pedagogical process and learning progress.

- Use of adapted equipments in observation and exploration.

- Use of multiple choice questions to get responses from children who find difficult to write or explain verbally.

(Instruction to Printer – Please insert the following matter on first and last inside cover pages)

This Handbook is the Personal Copy of Shri/Smt. ……

…….. ……. Science teacher of …….

……. …..…. School, …….

My special efforts towards enhancing Quality of Science Education in my school are as under:

A.	**Five best Activity Based Worksheets prepared by me for pupils' understanding of Concepts in Science syllabus. (Write titles)**
1	
2	
3	
4	
5	
B	**Five pedagogic initiatives/ strategies/best practices adopted by me for improving teaching-learning process in my Science class.**
1	
2	
3	
4	
5	
C	**Five good practices adopted by me for monitoring the progress of pupils' learning in my Science class.**
1	
2	
3	
4	
5	
D	**Five prominent examples in which training inputs are being used by**

	me in my day-to-day interactions with my students for quality improvement in my Science class.
1	
2	
3	
4	
5	
E	**Five examples of professional support I provide to my fellow teachers teaching Science.**
1	
2	
3	
4	
5	

(Last outside cover page)

Whatever you think,
That you will be,
If you think yourselves weak,
Weak you will be,
If you think yourselves strong,
Strong you will be.

- Swami Vivekananda

To ask the 'right' question is far more important than to receive the answers. The solution of a problem lies in the understanding of the problem. The answer is not outside the problem it is in the problem.

- J. Krishnamurti

Live as if you were to die tomorrow,
Learn as if you were to live forever.

- Mahatma Gandhi

The highest education is that which does not merely give us information but makes our life in harmony with all existence.

- Ravindranath Tagore

Time is not measured by the passing of years but by what one does, what one feels, and what one achieves.

- Jawaharlal Nehru