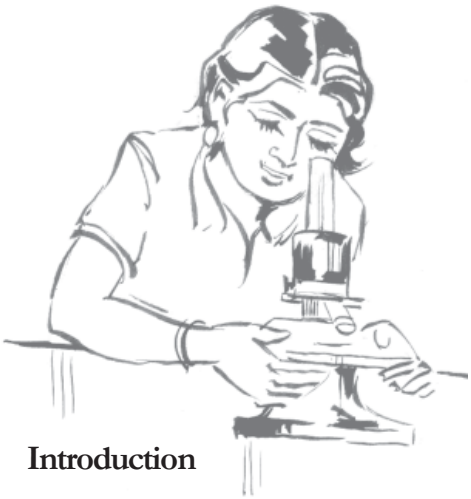

SCIENCE

Class VI

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 overspecified and underspecified. They are overspecified 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 reordered 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 underspecification 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 animals 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, handpicking; experiments on sedimentation, filtration. Separating mixture of salt and sand.
2. Materials			**(Periods - 26)**
Materials of daily use			
What are our clothes	Different types of cloth	Sharing of prior	Whole class discussion.

Questions	Key Concepts	Resources	Activities/ Processes
made of? How did people manage when there were no clothes?	materials – cotton, wool, silk and synthetics. Development of clothing materials.	knowledge with parents and community. Archaeological and historical accounts.	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,

Questions	Key Concepts	Resources	Activities/ Processes
			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 (eg. 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., categorisation; 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	Habitat varies – aquatic, deserts, mountains etc. –	Potted plants or seeds, pots, etc; thermometer,	Listing the diverse set of living organisms around

Questions	Key Concepts	Resources	Activities/ Processes
do fish live in water?	plants and animals show adaptation; other plant part modifications like tendrils, thorns etc. Animals in deserts and water.	any water plants, any xerophytic plants, Information on desert and aquatic plants and animals.	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? What about snakes, snails, earthworms?	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 animals.

Questions	Key Concepts	Resources	Activities/ Processes
4. Moving Things, People and Ideas			**(Periods - 12)**
Moving			
How did people travel from one place to another in earlier times? How did they know how far they had travelled?	Need to measure distance (length). Measurement of length. Motion as change in position with time.	Everyday experience; equipment (scale etc.) to measure length.	Measuring lengths and distances.
How do we know that something is moving?		Stories for developing contexts for measuring distances.	Observation of different types of moving objects on land, in air, water and space.
How do we know how far it has moved?			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.
5. How things work			**(Periods - 28)**
Electric current and circuits			
How does a torch work?	Electric current: Electric circuit (current flows only when a cell and other components are connected in an unbroken loop)	Torch: cell, bulb or led, wires, key.	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?	Conductor, Insulator.	Mica, paper, rubber, 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.

Questions	Key Concepts	Resources	Activities/ Processes
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			
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			**(Periods - 26)**
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.

Questions	Key Concepts	Resources	Activities/ Processes
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 ***Importance of water*** What will happen to soil, people, domestic animals, rivers, ponds and plants and animals if it does not rain this year? What will happen to soil, people, domestic animals, plants and animals living in rivers and ponds, if it rains heavily?	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. 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	Experience.	Discussion.

Questions	Key Concepts	Resources	Activities/ Processes
	upper layers of soil; but all need air to breath/to respire.		

Waste Do you throw away fruit and vegetable peels and cuttings? Can these be re-used? 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.