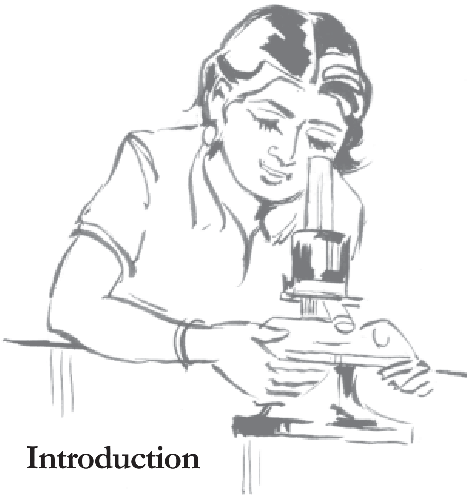

SCIENCE

CLASS VII

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 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 - 38)**
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?	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.	Collection of different samples of woollen and silk cloth. Activities to differentiate natural silk and wool from artificial fibres. Discussion.
What kinds of clothes help us to keep warm? What is heat? What is the meaning of 'cool'/'cold' and 'warm' 'hot'?	Heat flow; temperature.	Potassium permanganate, metal strip or rod, wax, common pins, spirit lamp, matches, tumblers, Thermometer etc.	Experiment to show that 'hot' and 'cold' are relative. Experiments to show conduction, convection and radiation.

Questions	Key Concepts	Resources	Activities/ Processes
How does heat flow from/to our body to/ from the surroundings?			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, $CuSO_4$, etc.	Experiments involving chemical reactions like rusting of iron, neutralisation (vinegar and baking soda), displacement of Cu from $CuSO_4$ 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.

Questions	Key Concepts	Resources	Activities/ Processes
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 there blood in all parts of the	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

Questions	Key Concepts	Resources	Activities/ Processes
body? Why is blood red? Do all animals have blood? What is there in urine?			on dialysis using egg membrane.
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?	Vegetative, asexual and sexual reproduction in plants, pollination - cross, self pollination; pollinators, fertilisation, fruit, seed.	*Bryophyllum* leaves, potato, onion etc.; yeast powder, sugar.	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)**
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?	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.	Daily-life experience; metre scale, wrist watch/ stop watch, string etc.	Observing and analysing 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.

Questions	Key Concepts	Resources	Activities/ Processes
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.	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, aluminium 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 electro-magnet. 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			**(Periods - 24)**
Rain, thunder and lightning			
What causes storms? What are the effects of storms? Why are roofs blown off?	High-speed winds and heavy rainfall have disastrous consequences for human and other life.	Experience; newspaper reports. Narratives/stories.	Making wind speed and wind direction indicators. Activity to show "lift" due to moving air. Discussion on effects of storms and possible safety measures.
Light			
Can we see a source of light through a bent tube?	Rectilinear propagation of light.	Rubber/plastic tube/ straw, any source of light.	Observation of the source of light through a straight tube, a bent tube.

Questions	Key Concepts	Resources	Activities/ Processes
How can we throw sunlight on a wall?	Reflection, certain surfaces reflect light.	Glass/metal sheet/metal 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 plants when there is not enough water for plants? Where does a plant go when it dies?	Water exists in various forms in nature. Scarcity of water and its effect on life.	Experience; media reports; case material.	Discussions. Case study of people living in conditions of extreme scarcity of water, how they use water in a judicious way. Projects exploring various kinds of water resources that exist in nature in different regions in India; variations of water availability in different regions.

Questions	Key Concepts	Resources	Activities/ Processes
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.	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.	Observation and experience; photographs.	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.