INTRODUCTION

The task of building an enlightened, knowledgeable and prosperous nation rests on the shoulders of its children, the future citizens, who are to be cherished, nurtured and taken care with tenderness. Education, particularly school education has always played this important role. It has emerged as an important segment of the total educational system expected to contribute significantly to the individual, social as well as the national developmental processes. In order to effectively fulfill this role, its progress and processes including curriculum need to be continuously reviewed, restructured and updated. The present National Curriculum Framework–2005 (NCF–2005), has identified five guiding principles for curriculum planning, development and transaction —

- Connecting knowledge to life outside the school.
- Ensuring that learning shifts away from rote methods.
- Enriching the curriculum so that it goes beyond textbooks.
- Making examinations more flexible and integrating them with classroom life.
- Nurturing an overriding identity informed by caring concerns within the democratic polity of the country.

Most pertinent of these guiding principles is perhaps the one pertaining to evaluation system which expects to make examination processes more flexible and to integrate them with everyday life. It can be implemented effectively only if evaluation is designed in such a manner that it can be used as a powerful means of influencing the quality of classroom instructional transactions so as to help the learners internalise the subject matter rather than make them a store house of information. But the evaluation system, as it exists today, is such that it focuses only on cognitive learning outcomes and completely ignores the non-cognitive aspects, which are equally vital components of human personality.

CHILD AS A CONSTRUCTOR OF KNOWLEDGE

Traditionally, it is believed that students learn from teachers and it is their responsibility to ensure that students learn. A teacher is classified as effective or otherwise depending on the achievements of his/her students in examinations. Actually the examination system in India occupies a central place in the entire

education system that it tends to thwart any attempt to innovate teaching-learning process. In order to improve the quality of school education, it is imperative that examination system ought to be debated in detail at the highest policy levels and transformed radically throughout the country. Examinations in their present form are not the real measure of student's potential because these are limited to test only one aspect i.e., content knowledge of the course that the students strive to learn over a period of one year.

NCF–2005 suggests that teaching should be learner centred where learner is placed at the centre of teaching processes. It envisages the primacy of children's experiences, their voices and their active involvement in the process of learning. Learning experiences at school should pave the way for construction of knowledge and fostering creativity so that it becomes a source of joy and not a stress. The syllabi and textbooks developed on the basis of NCF–2005 signify an attempt to implement this basic idea. The syllabus designers have tried to address the problem of curriculum burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology. The textbooks, particularly in science, attempts to enhance this endeavour by giving higher priority and space for contemplation and wonder in the texts, and suggesting discussions in small groups and activities requiring hands on experiences, through exercises and practical work.

In the present Science Textbook for Class IX the science concepts are framed not along disciplinary lines, but rather organised around themes that are potentially cross disciplinary in nature. The themes are— Food, Materials, The World of the Living, Moving Things, People and Ideas and Natural Resources. There are fifteen chapters in Class IX Science Textbook and these cover the above mentioned themes.

Chapter-1 " Matter in Our Surrounding" deals with three states of matter that is solid, liquid and gas. These states of matter are inter-convertible and can be changed by changing temperature or pressure. This chapter also deals with the process of sublimation, evaporation, latent heat of evaporation and latent heat of fusion.

Chapter-2 " Is Matter Around Us Pure" deals with elements, compounds and mixtures. Mixtures can be separated into pure substances using appropriate separation techniques. This chapter also highlights about homogenous mixtures, heterogenous mixtures, colloids, physical and chemical changes.

Chapter-3 " Atoms and Molecules" explains about law of conservation of mass and law of definite proportions. It introduces the idea of an atom as the smallest particle of an element that can exist independently and retain all its chemical properties. It also explains about writing of chemical formulae of simple compounds, formula unit mass and mole concept.

Chapter-4 " Structure of the Atom" presents a brief historical account of development of the model of an atom from Thomson, Rutherford and Bohr, including distribution of electrons in different orbits. The concepts of valency, atomic number, mass number, isotopes and isobars have also been introduced.

Chapter-5 " The Fundamental Unit of Life" deals with the building blocks in cell, tissue, organ and various systems in multicellular organisms. The chapter describes structure of various types of cells viz, eukaryotic, prokaryotic, animal or plant cell. The text provides ample knowledge about the various orgenelles present inside the cell and their functions which are characteristic of all living forms.

Chapter-6 "Tissue" highlights the various types of plant and animal tissues, their structure and function. An attempt has been made to help learners ponder over as to how different organs and organ systems in plant and animal bodies are made up of different types of tissues, function together in a coordinated manner in a system to perform specific functions of the living body.

Chapter-7 "Diversity in Living Organisms" deals with classification and evolution of various living organisms. The five kingdom classification of Whittaker is discussed in detail. The text highlights the salient features of different classes under plant and animal kingdom.

Chapter-8 "Motion" introduces physical quantities like distance, displacement, speed, velocity and acceleration that are essential to describe motion of an object which could be uniform or non-uniform. The motion of an object moving with uniform acceleration has been described algebraically with the help of three equations. Graphical method for investigating motion has also been discussed.

Chapter-9 "Force and Laws of Motion" describes the three laws of motion. The concepts of inertia and mass, momentum and conservation of momentum have been introduced.

Chapter-10 "Gravitation" explains that law of gravitation is universal as it applies to all objects anywhere. The weight of a body is the force with which the earth attracts it. It is equal to the product of mass and acceleration due to gravity. An object experiences an upward force called buoyancy when it is immersed in a fluid. If the density of the fluid (or liquid) is less than that of the object, it sinks, while it floats in the liquid if the density is more.

Chapter-11 "Work and Energy" introduces work done on an object as the product of force and displacement. The concepts of potential energy and kinetic energy have been introduced together with the law of conservation of energy. The idea that energy can neither be created nor destroyed but can only be transformed from one form to another have been discussed. Power is defined as rate of doing work.

Chapter-12 "Sound" explains that sound is a form of mechanical wave that is produced by vibrating objects. The distinction between two types of waves — longitudinal and transverse have been explained. Sound can be described by frequency, amplitude and speed. It is characterised by loudness, amplitudes, pitch. Speed of sound depends on medium and it obeys Laws of reflection. Echo is reflection of sound. Audible range of human ear is 20 Hz to 20,000 Hz. Ultrasound has many medical and industrial applications. This chapter discusses about SONAR which is used to determine the depth of the sea.

Chapter-13 "Why do We Fall Ill" deals with the human health and some common diseases. The chapter highlights various types of diseases, their causal organisms, their mode of infection and transmission of infectious diseases in humans. It also provides information about prevention of diseases and importance of immunisation for various diseases in human beings.

Chapter-14 "Natural Resources"discusses about various types of resources, pollution, biogeochemical cycle, ozone layer and green house effect. In this chapter various causes and effects of pollution, effects of depletion of natural resources and cycling of materials and its conservation has been discussed.

Chapter-15 "Improvement in Food Resources" deals with the various techniques used in improving the crops and other food resources. The chapter deals with crop variety improvement, agricultural practices and management techniques. This also discusses the different cropping patterns and protective

strategies. Some aspects of animal husbandry, poultry, fisheries and bee-keeping have been discussed as an integrated management of food resources along with agriculture.

ASSESSMENT IN SCHOOL

National Focus Group Position Paper on 'Examination Reforms' strongly recommends a System of Continuous and Comprehensive Evaluation (CCE) in order to reduce stress on children, make evaluation comprehensive and regular, provide space for the teachers for developing creative thinking, provide a tool for diagnosis and for equipping learners with greater skill. The CCE scheme is simple, flexible and implementable in any type of school from the elite one to a school located in rural or tribal areas.

SUGGESTED TYPES OF QUESTIONS

National Focus Group Position Paper on 'Teaching of Science' asserts that the major deficiency in current examination system in science is that it does not really assess genuine understanding of the subject. It is mostly confined to elicit information through theoretical questions, which can often be handled by rote learning without proper understanding of the concepts. The tests rarely include questions that require students to apply their understanding of concepts to new situations or that compel them to correlate or even to interpret phenomenon that they experience in daily life or the ones that are based on experimental data. Usually, it is seen that language of questions framed is vague, ambiguous and misleading. Most questions seek a direct answer.

In the present book an attempt has been made to include a few **Multiple Choice Questions** in each chapter which can be used to test real understanding of the concepts. These questions are likely to help learners to develop proper discriminating power and thereby reduce guess work factor to a minimum. Efforts have been made that each one of the options given in MCQ's appear equally probable. Further, sentence structure and language used often gives sufficient clue for the correct answer defeating the very purpose for which it has been framed. Therefore, utmost care needs to be taken while framing multiple-choice questions, so that, these may be used to test real understanding of concepts, which in-turn would also help reduce student anxiety.

Some open ended questions are given in each chapter to test the expression and the ability to formulate an argument using relevant facts. A method has to be developed in marking these questions as multiple answers, all equally

appropriate, are possible. Further direct answers to such questions may not be available in textbooks.

The activity based questions i.e., 'learning by doing' not only increase the sense of observations among children but also help in better understanding of the concepts.

Some challenging questions are also framed for the children with higher mental ability. Good question setting needs drastic reforms. Good questions can be canvassed from experts in their discipline, school teachers, educators and even from students. These questions can be pooled together and can be used in the examination after careful vetting by evaluation experts. Certain conditions must be met in order to frame a good question. Unambiguous language, clarity about expected task, provision of proper data and values of constants are some of the pre-requisites for framing a good question.

Design of the two sample question papers of Science Class IX theory are given in **Appendix-I.** Definition of the SI base units is given in **Appendix–II.** Elements, their symbols, atomic number and atomic mass are given in **Appendix–III.**

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