Learning Science the NCF Way

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The National Curriculum Framework (NCF) 2005 states that "one important human response to the wonder and awe of nature from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world. This human endeavor has led to modern science."

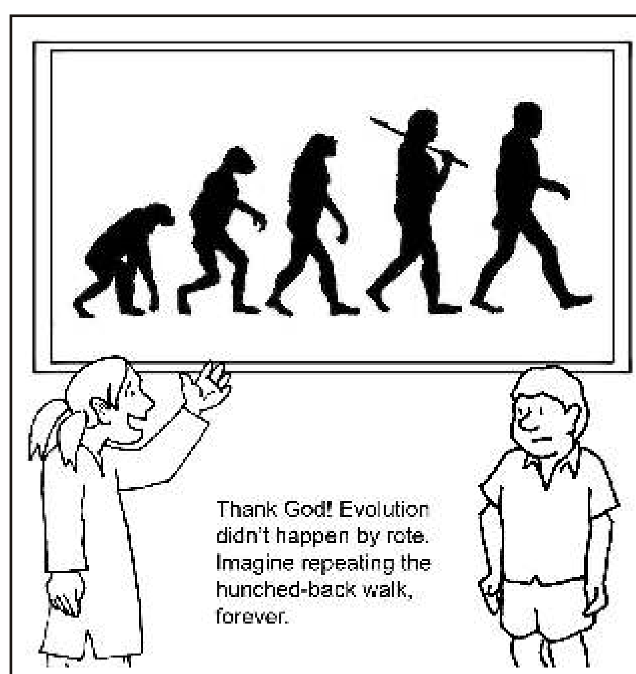
The conviction that the learning *of* science needs to be accompanied by learning *about* science is basic to a liberal approach in learning of science. Teachers of science need to know something of the history and nature of the discipline that they are teaching. Science taught from such a perspective, informed by the history and philosophy of the subject, can engender an understanding of nature, the appreciation of beauty in both nature and science, and the awareness of ethical issues unveiled by scientific knowledge and created by scientific practice.

The NCF identifies three critical issues that stand out in the complex scenario of science education in India:

- Science education is still far from achieving the goal of equity enshrined in our Constitution
- Science education, even at its best, develops competence but does not encourage inventiveness and creativity
- The overpowering examination system is basic to most, if not all, fundamental problems of science education

According to the NCF, science education should enable the learner to:

- Know the facts and principles of science and it's applications, consistent with the stage of cognitive development
- Acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge
- Develop a historical and developmental perspective of science and view science as a social enterprise
- Relate to the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society
- Acquire the requisite theoretical knowledge and practical technological skills to enter the world of work
- Nurture the natural curiosity, aesthetic sense and creativity in science and technology
- Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment
- Cultivate 'scientific temper' - objectivity, critical thinking and freedom from fear and prejudice



The scientific method, as described in the NCF 2005, involves several inter-connected steps: observation, Asking questions

"Air is everywhere" is a statement that every schoolchild learns. Students may know that the earth's atmosphere consists of several gases, or that there is no air on the moon. We might be happy that they know some science. But consider this exchange in a Class IV classroom.

Teacher: Is there air in this glass?

Students (in chorus): Yes!

The teacher was not satisfied with the usual general statement, "Air is everywhere." She asked the students to apply the idea in a simple situation, and found, unexpectedly, that they had formed some "alternative conceptions".

Teacher: Now I turn the glass upside down. Is there still air in it?

Some students said "yes", others said "no", still others were undecided.

Student 1: The air came out of the glass!

Student 2: There was no air in the glass.

In Class II, the teacher put an empty glass over a burning candle and the candle went out! The students had performed an activity whose memory had remained vivid even two years later, but some of them at least had taken away an incorrect conclusion from it.

After some explanation, the teacher questioned the students further. Is there air in this closed cupboard? Is there air in the soil? In water? Inside our body? Inside our bones? Each of these questions brought up new ideas and presented an opportunity to clear some misunderstandings. This lesson was also a message to the class: do not accept statements uncritically. Ask questions. You may not find all the answers but you will learn more.

(From NCF 2005)

looking for regularities and patterns, making hypotheses, devising qualitative or mathematical models, deducing their consequences, verification or falsification of theories through observations and controlled experiments, and thus arriving at the principles, theories and laws governing the natural world. The laws of science are not supposed to be viewed as fixed eternal truths. Even the most established and universal laws of science are always to be regarded as provisional, subject to modification in the light of new observations, experiments and analyses.

Curriculum design in the NCF is in accordance with stages of learning. The focus at the primary stage is on nurturing the curiosity of the child about the world (natural environment, artifacts and people) and to develop basic cognitive skills like observation, classification and inference along with psychomotor skills through hands-on activity. It is also important for children to learn the “language” of science. The NCF recommends that science and social science continue to be integrated as 'environmental studies' with health as an important component.

At the upper primary stage, the child should be engaged in learning the principles of science through familiar experiences, working with hands to design simple technological units and modules (e.g. designing and making a working model of a windmill to lift weights), and continuing to learn more about the environment and health, including reproductive and sexual health, through activities and surveys. Scientific concepts are to be arrived at, mainly from activities and experiments. Science content, at this stage, is not to be regarded as a diluted version of secondary school science. Group activities, discussions with peers and teachers, surveys, organization of data and their display through exhibitions, etc. in schools and the neighbourhood, should be important components of pedagogy.

At the secondary stage, students should be engaged in learning science as a composite discipline, in working with hands and tools to design more advanced

What Biology do Students Know?

"These students don't understand science. They come from a deprived background!" We frequently hear such opinions expressed about children from rural or tribal backgrounds. Yet, consider what these children know from everyday experience.

Janabai lives in a small hamlet in the Sahyadri hills. She helps her parents in their seasonal work of rice and *tuvar* farming. She sometimes accompanies her brother in taking the goats to graze in the bush. She has helped in bringing up her younger sister.

Nowadays, she walks 8 km every day to attend the nearest secondary school. Janabai maintains intimate links with her natural environment. She has used different plants as sources of food, medicine, fuelwood, dyes and building materials; she has observed parts of different plants used for household purposes - in religious rituals and in celebrating festivals. She recognises minute differences between trees, and notices seasonal changes based on shape, size, distribution of leaves and flowers, smells and textures. She can identify about a hundred different types of plants around her many times more than her Biology teacher can, the same teacher who believes Janabai is a poor student.

Can we help Janabai translate her rich understanding into formal concepts of Biology? Can we convince her that school Biology is not about some abstract world coded in long texts and difficult language? Rather, it is about the farm she works on, the animals she knows and takes care of, the woods that she walks through every day. Only then will she truly learn science.

(From NCF 2005)

technological modules than at the upper primary stage, and in activities on (and analyses of) issues concerning the environment and health, including reproductive and sexual health. Systematic experimentation as a tool to discover/verify theoretical principles, and working on locally significant projects involving science and technology, are important.

The NCF recommends that the curriculum load should be rationalized and the tendency to cover a large number of topics of the discipline superficially should be avoided. Both teacher empowerment and examination reform are seen by the NCF as pivotal enablers of change in the teaching and learning of science. In this regard, the document also speaks of a national testing service which could replace the current system of multiple entrance examinations.

One very interesting recommendation of the NCF is that there should be a massive expansion of activities along the lines of the Children's Science Congress, along with large-scale science and technology fairs at the national level with feeder fairs at cluster, district and state levels.

The NCF is cognizant of the fact that though all children do not become scientists or technologists when they grow up, they need to become 'scientifically literate' to better understand social, political and ethical issues, posed by contemporary society. The document also recognizes the importance of developing awareness among learners about the interface of science, technology and society, sensitizing them, especially to the issues of environment and health, and enabling them to acquire practical knowledge and skills to enter the world of work.

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