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Book Review

Anil Dixit, Arvind Gupte, Bharat Pure, Kishore Pawar, Bholeswar Dubey, Sushil Joshi, Javed Siddique and Uma Sudhir, *Jeevan ki ikai - Koshika.* 72 pages. Bhopal: Eklavya. 2011. ₹ 100

Cell is a fundamental concept in biology because the understanding of cell helps understanding of biological processes (Alberts et al. 2004). Despite the explicit mention of the cell as a "structural and functional unit of life" in textbooks, children who use these textbooks still conceptualize cell as being inside the body, but not as a 'building block' (Dreyfus and Jungwirth, 1988). Children of grades 6 and 7 (11-13 years) visualize cell as two dimensional. Many students of the same age group cannot connect respiration and energy production as cellular processes. Many of them think that plant cells have a definite rectangular shape, while an animal cell has no definite shape. They think of cell and nucleus as being like jelly or butter (Kawalkar and Vijapurkar, 2009). However, these ideas about cells can be replaced and restructured through the use of appropriate teaching learning material.

Towards this, a book for teachers on Cell titled *Jeevan ki ikai – Koshika* (The unit of life – cell) published by Eklavya under the copyleft licence is a significant step. Eklavya plans to publish this material in English as well. The authors have a long experience of working with students and teachers from schools and colleges. According to the authors, the module addressed in the book has been enriched by comments from distinguished teachers and educationists as well. The book includes several appropriate and attractive photographs and illustrations by Amod Karkhanish, Karen Haydok, and Meghna Palshikar. The authors as well as the illustrators have recognized the significant role played by visuals in the teaching-learning of science (Tversky, 2005).

The National Curriculum Framework 2005 has proposed that teaching learning needs to be child centred and constructivist, building abstract concepts from children's real life experiences. But the NCF has somehow failed to fully acknowledge the instrumental role of teachers (Batra, 2005) in transacting the curriculum. Unless teachers, the principal agents of instruction, feel empowered, the philosophy enshrined in the NCF 2005 will not be realised (NCERT, 2006). Those teachers who have a rich content knowledge are more likely to handle the uncertainty arising in student-centred classrooms. Moreover, teachers' rich subject knowledge enables an understanding, among those teachers, of the nature and structure of the subject as well as its connection with other subjects. One component of teacher empowerment is to prepare materials pedagogic strategies and content knowledge (Bruner, 1977).

It is the role of subject experts to prepare materials and make it accessible to all teachers. It would be fruitful to select concepts that recur across different topics in a domain and across the years of learning. The book on Cell by the expert team of Eklavya serves this purpose. The content of the book is not prescriptive. Rather it is flexible and could serve to enrich teachers' content knowledge. In the *Introduction* (pp. 7), the authors have even encouraged teachers to develop their own way of teaching about the cell after reading this book.

Overall, the module is easy to read and comprehend. Relevant additional information and explanations have been provided separately in the boxes without compromising the lucidity and continuity of the theme. It appears that the vocabulary of the module has been carefully chosen to avoid alienation from familiar context. Most of the resources used for experiments are easily available and inexpensive. The introduction of the chapter sets the rationale, context, and philosophical underpinning of preparing such module. The authors rightly pointed out that there are biological processes like digestion that can be described without taking account of the cellular process, however, understanding of cell throws new light to our previous understanding. On the other hand biological processes like reproduction in a living being can be understood only from the understanding of cell.

Several curriculum suggests to adopt historical narrative and "explanatory stories" approach in science teaching (Millar and Osborn, 1998). The module presents a story of evolving understanding of cell from a number of observation and studies over the centuries. Thus, the module presents science as a social enterprise (King et al., 1994), not stories of individuals' success. Scientific knowledge is not the contribution of a single mind rather product of many. The knowledge is incremental and subjected to change in the light of new observations and findings. A scientist also might have misconception or incomplete idea(s); by stating "Even Charles Darwin considered that each organ has play its role in egg..." (pp. 8). The knowledge is shareable and reproducible in several instances, any one can see what Hook observed; "you too see what Hook observed" (pp. 12). The significance of an invention or discovery is valued and acknowledged by society and not determined by the inventor alone, recognition may not come instantly; "...around 55 years later in 1986 he (Ernst Ruska) was awarded Nobel Prize" (pp.24).

The module has four chapters. In the first one titled, *Koshika – Khoj ki kahaani* (Cell - Story of the discovery), tells the journey of understanding the cell and organelles as a historical narrative. There are four important clarifications made in the chapter viz.

1) Why typical textbook pictures of cell does not match with observation? (pp. 25)
2) A note on "republic of living elementary units" serves a nice introduction of "system" and its fundamental unit. Especially the distinction between the work for individual existence and the other for the community level. The property of whole is different from its constituent (pp. 28).
3) The role of evolving technologies in generating new knowledge, for example, development of electron microscope widens our understanding of cell.
4) Using 3D pictures and original photographs reduce several misconception and doubts regarding the shape and proportional size of cell or cell organelles. It links what students observed in their school laboratories.

The story of exploration of cells starts with the use of lenses during the mid seventeenth century to see the small and unobserved things. Presenting several activities (viz. observation of a slice of cork, membrane of onion and human squamous cell), an attempt has been made to introduce students with the early observation of cell and involve them in the same journey. A novel attempt is made to complement textbook photographs of cell with the actual observation carried out by students with simple microscope. The relevant informations about compound microscope, electron microscope, and centrifuge are also mentioned.

The second chapter *Koshika aaye kahan se* (where did the cells come from?) questions the origin of a cell. The chapter laid the motivation of inquiry through three steps: a) observing microscopic organisms found in pond or drain water b) investigating the theory of spontaneous generation and contribution of Francesco Redi and Louis Pasteur in refuting the possibility of spontaneous generation c) understanding cell as structural and functional unit in the context of life cycle of frog.

The division of cell is discussed in chapter three, *Koshika se koshika* (Cells from a cell). After defeat of the spontaneous regeneration theory, question remained on where actually the new cells came from? Schleiden considered that the new cell develops from the "cytoplast". Using staining technique, Strasburger and Flemming observed that nucleus consists of other components too. Some of them undergo changes and take part in cell division. The observation confirmed the theory that cell originates from another cell only. The major attraction of the chapter is the activity with onion roots to observe the phases of cell division. In the end the chapter provides a short relevant introduction on cancer cells and stem cells.

In the last chapter, *Koshika siddhant: aage badate kadam* (cell theory - ever chaning steps), the division of cell and gradual differentiation of their role is discussed. The body of a multicellular living being is not just a pile of cells, it is a coordinated system of cells. In a multicellular body of living beings cluster of cells perform differential tasks. However, there is a difference between plant and animal cell. In optimum condition a plant cell from any part of the plant has potential to grow up to a complete plant, whereas, cell from any part of a multicellular animal will not grow up to

a complete animal. It is worth appreciating that in this chapter the authors introduced cloning and biotechnology in a lucid style. Incorporating the ethical and social dimensions of cloning and genetic engineering, the authors prepared a platform for engaging students in argumentation of socio-scientific issues (Jimenez-Aleixandre and Erduran, 2007).

The evolving understanding of cell helps explain the unity as well as diversity among the living beings which leads to a better understanding of evolution of life. The same fundamental structure in all living being indicates that living diversity actually evolved from one primitive living entity. However, questions remain on how that primitive living entity appeared? Under what circumstances inorganic substances formed a living cell?

At the end of four chapters, the authors present a time line related to cell and cell theory. In appendix description of compound microscope, necessary precautions in using microscope and suggestions of further activities enrich the module's practical utility for the users. The module would be a valuable reference material for teachers as well as students of middle, high and even secondary level.

The module has shown some unique characters while building concepts of cell, through addressing possible misconceptions about cell, demystifying the microscopic observation of cells, integrating nature of science, and presenting the entire content as historical narrative. Good quality 'real' photographs of cells are indeed a treasure of the module. However, the effectiveness of the module is largely based on the primary target group, the teachers, those who are going to use the module. The underlying philosophy in writing the module needs to be in tune with that of teachers during their classroom transaction. This bridge can easily be built through a series of workshops and long term collaboration with teachers.

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