Highlights of the iThink Biology Textbook

Developed by Azim Premji University

Free and self-contained online resource

Capacity Development

Context-specific resource

Case studies rooted in the Indian context
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Writing a modern biology textbook for the Indian classroom: the experience with *iThink Biology*

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In 2015, Azim Premji University developed a new Bacherlor's programme in Biology with the goal of helping students become independent thinkers with an integrated view of biology. Interactions with the students made us realize that they have diverse motivations for studying biology at the undergraduate level: for their passion for the subject, to pursue higher education and research, for gainful employment, and out of sheer confusion. The Bachelor's programme would have to acknowledge these motivations and help students develop academically. However, the teaching resources we were using as instructors, such as a textbook widely used in American universities and video clips from *iBiology* and similar websites fell short in addressing these concerns. Given the socio-economic and geographic diversity of our students, they often seemed lost at the examples given, such as that of otters and killer whales for trophic levels, or the comments made by the scientists in these videos. Students also came away with the view that no science was practised in India and all biological knowledge is being developed elsewhere. We needed teaching resources that could address some of these concerns.

In 2018, a group of us came together with a view of writing an introductory college-level textbook; not a comprehensive one, but rather a supplement for teachers and students who wish to explore alternate ways of studying life sciences. From the beginning we were sure about making it a free online resource. And rather than view it just as a website to access the book, we saw it as an educational platform with which to engage with learners. After many debates and arguments about its essential attributes and doing much of the writing during the first COVID lockdown in 2020, with authors juggling viral infections, online teaching and tight deadlines, we finally inaugurated the textbook in December 2021. Taking inspiration from Darwin's famous sketch from *'The Origin of the Species'*, which places evolution as the bedrock of all biology, we called the textbook *iThink Biology.*

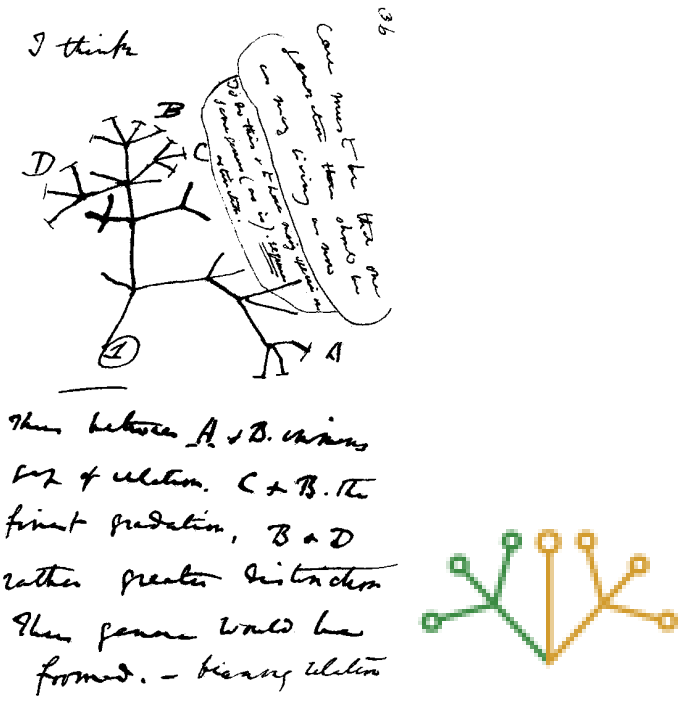

Figure 1: Darwin's sketch later used in a modified form in '*The Origin of Species*' that inspired the title and logo (shown) of our textbook.

Quoting from the About section of the iThink Biology website, *"Our goal in developing the iThink Biology textbook was to produce a* ***context specific resource*** *that is self-contained, views* ***biology as an integrated field****, and that* ***nurtures essential capacities*** *for the Indian student"*. Here is how we went about building these attributes into the textbook.

Context specific: Science typically is viewed as a context-free endeavour (e.g., the law of gravity operates on you the same way whether you are bacteria, slime mold, tree or mammal). However, teaching scientific concepts as if they were discovered in vacuum, free of all human drives and emotions, does students a disservice and detracts from their understanding. This context-free thinking permeates standard biology textbooks that focus on building content knowledge, often neglecting the importance of history, collaboration, the process of science, and the context of the readers themselves.

When writing *iThink Biology* we decided to provide context to the student by developing each chapter as a narrative. This allowed us to provide timelines for a particular concept or discovery or give its socio-cultural background. We often highlighted a scientist's personal story, allowing students to see that the biological fact they read about was developed via a process of doubt and questioning. An extract from the chapter on Malaria is shown below in which Ronald Ross' discovery that mosquitoes transmit the malaria parasite is described. In this section we also ask the reader to reflect on what they have read and understood from this discovery about the process of science.

Let us step back 170 years and follow Dr Ronald Ross's (Figure B1.5) pioneering research on how malaria was transmitted. As you read the story of Ross's remarkable work, try to identify different steps of the scientific process that ultimately led to his discoveries.

Ross was born in India in 1857, and was educated in Britain. He studied medicine, and while he was a qualified physician, he took additional courses in bacteriology and public health. Ross had a wide range of interests. He was passionate about literature, mathematics and music, and he was also a published poet.

Figure 2: Providing context about Ronald Ross' discovery of malarial transmission by mosquitoes.

Integrated Biology: We tried to view complex biological systems as a whole, rather than through the lens of separate disciplines such as molecular biology, cell and developmental biology, evolution, and more. This is why the textbook does not have chapters like genetics or biochemistry, but instead is divided into four themes: Land and waterscapes, Human health, Food and agriculture, and Interactions between organisms. Within each theme there are several chapters. For instance, in 'Interactions between Organisms', we have a chapter on figs in which we explore different aspects of this organism. These include ecology, species interactions, research design, and science communication. Figure 3 shows a mind map of the chapter and the topics explored within it. The student, upon reading this chapter, will understand the multiple levels at which figs can be understood – species, ecosystem and societal – and also learn some solid biology along the way.

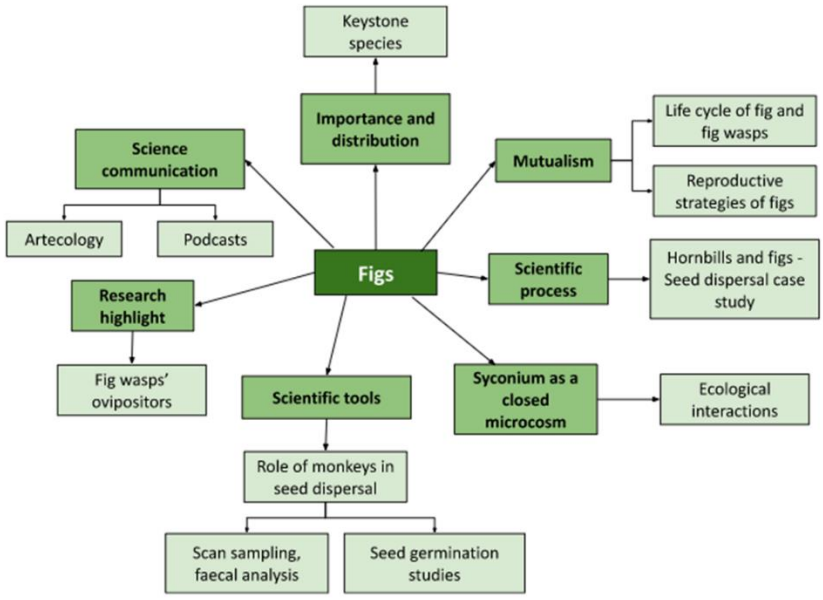

Figure 3: Sub-headings in the chapter on figs showing the different aspects of fig biology that are explored in the chapter.

Capacity development: Based on our teaching experience we saw that if students develop basic capacities or skills at the undergraduate level, they are equipped and trained to choose almost any career path. Content knowledge is of course important and relevant, however, we felt that students

can absorb content more easily when they have these basic capacities. We identified five basic capacities, and each section of the textbook attempts to develop those competencies. This approach ensures that learners are equipped with the means to critically think about any real-world problem, not specific to studies in biology. Another objective that is met with this type of content is that the reader is allowed to approach questions and biological systems independently.

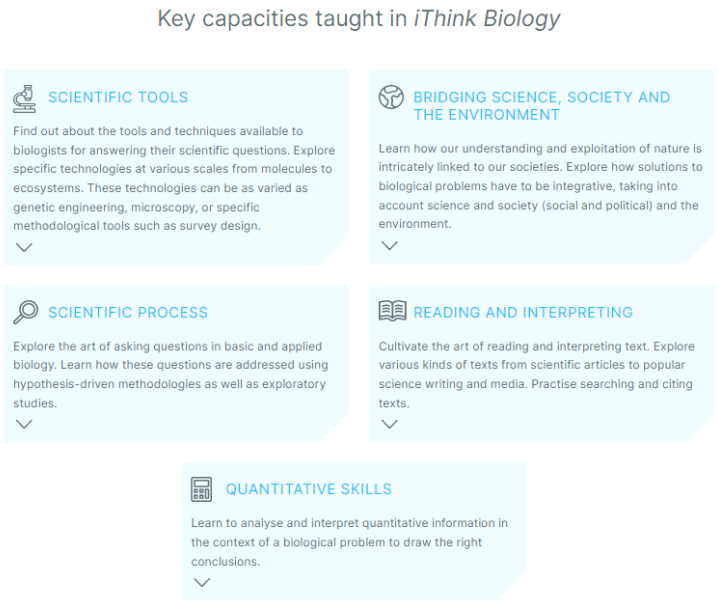

Figure 4: The five capacities that are used as a framework in each chapter of the textbook.

In addition to being context specific, having an integrative view of biology and emphasizing capacities over content, iThink Biology has other features, such as:

- *Case-study-based chapters*: Each chapter is based on one or more case studies that belong to one of the four themes mentioned above.
- *India-specific content*: All case studies use examples from India, highlighting the variety of scientific work done within the country. The Research Highlights section provides annotated scientific articles, if students and teachers wish to explore a topic in-depth.
- *Writing style*: The content is explained in a language that is easy to follow. The tone is conversational and includes many pauses to encourage the reader to think critically about what they have just read. Knowledge of biological concepts is not assumed and terms are often explained in-text, or attached to a pop-up glossary. A motivated student should be able to engage with the content even in the absence of a teacher.
- *Digital and dynamic*: *iThink Biology* is an electronic book that can be accessed through a computer, mobile or tablet. A handful of digital features makes this resource dynamic and interactive. Web links to external resources on the world wide web, demonstration videos and interview recordings within chapters, and quizzes are some such features. *(e.g., the video of Prof. Gagandeep Kang explaining different types of viruses in the Rotavirus chapter)*.
- *Production quality:* We wanted to make sure that the production quality of the book matched that of other such resources from around the world. The text, illustrations and colours are meant to make it a pleasing experience to engage with the textbook. A unique feature of the textbook is that all the chapter-opening illustrations have been done by students in the APU biology program.

The features and objectives detailed above try to help teachers and students examine not just what we teach, but why we teach it. We are currently developing teaching guides for each chapter in the textbook. The teaching guide will map the topics in that chapter to current university curricula allowing teachers to see where they could make use of it for their particular course. The teaching guide will also contain suggested activities and worksheets for teaching a particular concept and these will be made available to teachers upon request. We also have new chapters planned with more videos or other learning materials.

Our challenge now is to make teachers across the country see its relevance and encourage its use in their classrooms. To that end we are conducting seminars and workshops for teachers to demonstrate how the textbook could be used *(invite us to your institution).* We also use social media handles on Twitter and Instagram to engage with the teaching community.

iThink Biology is a small step on the long path to transforming educational resources in India to make them relevant, accessible, and encouraging of a learner's curiosities and capabilities. Looking back, it is fulfilling to realize that we have produced a learning resource of quality that can prove useful to generations of learners. We are hoping this textbook to be the start of what could turn into a lifelong journey of learning.

Postscript:

The authors of the textbook are Divya Uma, Sravanti Uppaluri, Jayanti Mukherjee, Kaustubh Rau and Sriram with support from Anjali Paranjape and Neelima Menon. The illustrations in the book are by Ipsa Jain, Kshiraja Krishnan, Aranya Broome, and Neeharika Verma. The book was produced by Electric Book Works.