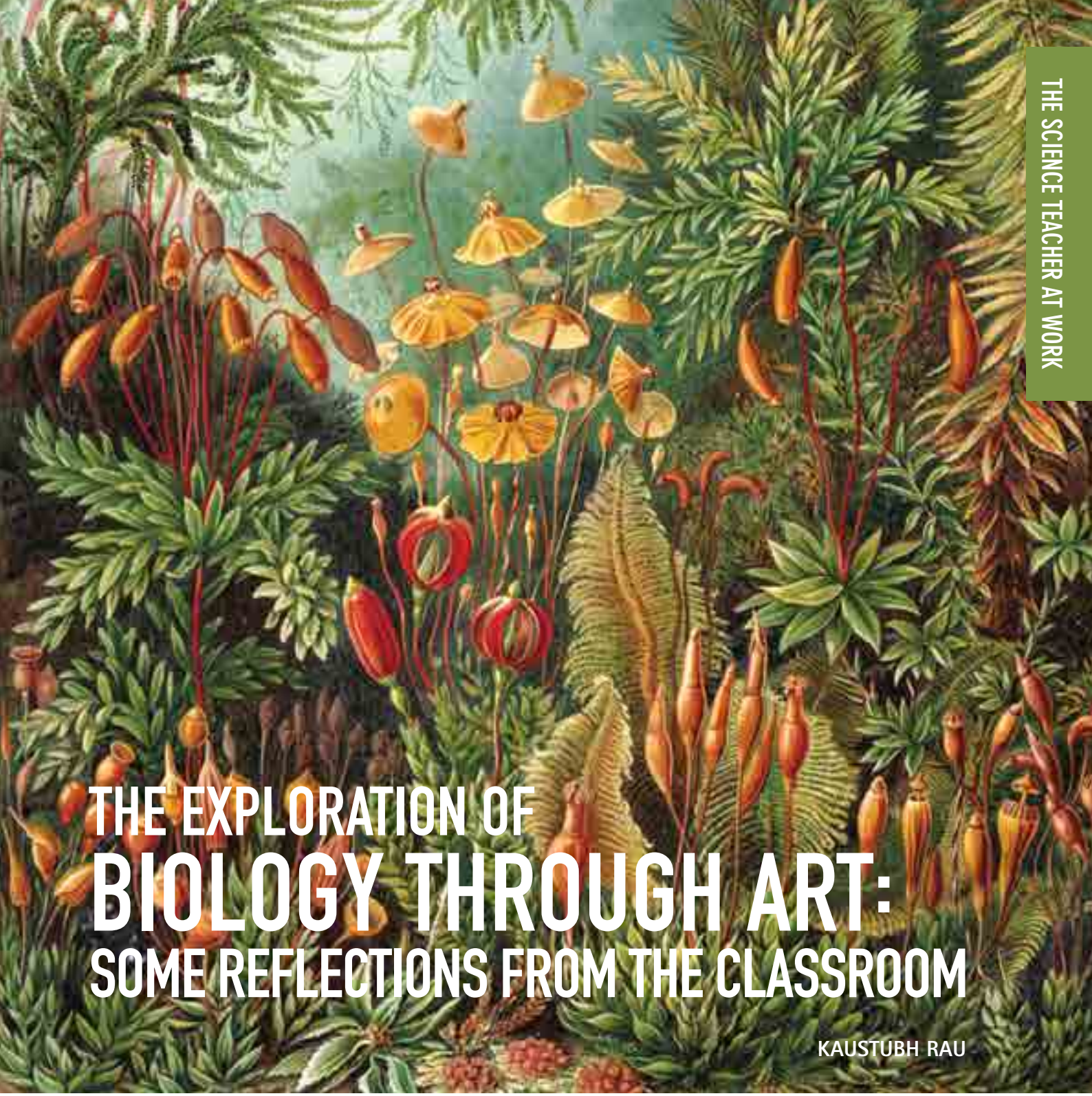

THE EXPLORATION OF BIOLOGY THROUGH ART: SOME REFLECTIONS FROM THE CLASSROOM

KAUSTUBH RAU

Are approaches to teaching Biology determined and constrained by its origins as a 'science'? Or, would an approach that incorporates 'art' into its teaching practice enhance student learning? The author attempts to answer this question through some classroom examples from his own practice.

Our modern understanding of science is of it being a rational, objective, observation-based endeavour. Conversely, art is understood as being a wholly subjective means of self-expression, with an approach completely at odds with that of science. However, this distinction has not always been as rigid. Historically, many artists have used a scientific approach to understand perspective, light and form; and, many scientists have revealed themselves as fine artists in their use of art to document natural phenomena.

Historical connections

Biology, in particular, readily lends itself to being rendered as art; and, artists have been recording natural history for hundreds of years. Court artists in the Mughal Empire, for example, were renowned for the accuracy with which they depicted flora and fauna in their paintings. The most famous of these is a painting of a Mauritian Dodo, by an artist called Ustad Mansur, based on one of two living specimens brought to Emperor Jehangir's court in 1625 (refer **Fig. 1**). This painting is believed to be the archetype on which all subsequent drawings of the Dodo were based – hence assuming an importance beyond its artistic value. The four other bird species that share this frame with the Dodo — Blue-crowned Hanging Parrot (upper left), Western Tragopan (upper right), Bar-headed Goose (lower left), and Painted Sand-grouse (lower right) — are also painted with such accuracy as to be readily identifiable.

In colonial India, many naturalists mainly of British descent travelled the length and breadth of the country, assiduously collecting (and naming) our biological heritage. The British were also excellent at documentation, leaving behind a rich legacy of books on India's natural history that are still referred to by specialist and amateur biologists. Among the most famous of these is Robert Wight's *Icones Plantarum Indiae Orientalis*, a six volume compendium of Indian plants. Wight employed many local artists, the most well-known of them being 'Rungiah and Govindoo' *[sic]*, whose proficiency in painting life-like representations of plants is evident in the lithographic colour-plates in Wight's books (refer **Fig. 2**). Perhaps the most glorious example of this kind of natural history can be seen in Ernst Haeckel's painstaking drawings of organisms (particularly small marine animals) in his book, 'Art forms in Nature'. With each drawing composed to maximise its artistic impact, this book went on to deeply influence varied fields, including engineering design and architecture.

Fig. 1. Painting by the Mughal artist Ustad Mansur from c1625.

Credits: By Ustad Mansur - Hermitage, St. Petersburg (http://julianhume.co.uk/wp-content/uploads/2010/07/History-of-the-dodo-Hume.pdf, and an earlier version: http://www.natuurinformatie.nl/nnm.dossiers/natuurdatabase.nl/i005387.html), Wikimedia Commons. URL: https://commons.wikimedia.org/w/index.php?curid=3224929. License: Public Domain.

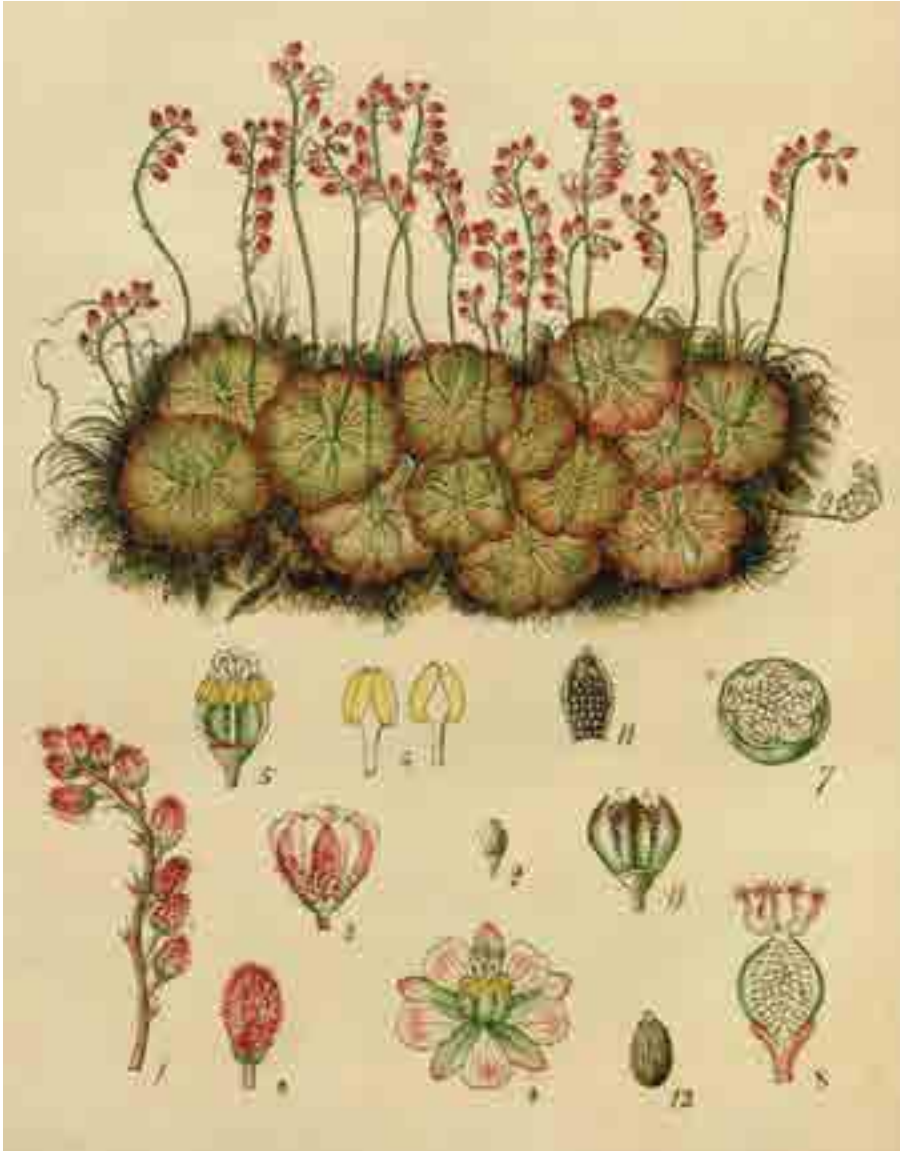

Fig. 2. ***Drosera burmanni*** **by the artist Rungiah from** ***Spicilegium Neilgherrense*****.**
Credits: Robert Wight (http://www.botanicus.org/item/31753002447933), Wikimedia Commons. URL: https://commons.wikimedia.org/w/index.php?curid=19375800. License: Public Domain.

Art in the Biology classroom

I have always found myself fascinated by these artistic depictions of Biology, the perfect amalgam of art and science. Whether it be the delicate lines and colours of Mughal paintings, or the breath-taking detail of 19th century botanical drawings, these works of art speak to us across the passage of years – bestowing a living, breathing quality to their subjects that a mere photograph couldn't. This interest has seeped into my classroom practice, and I have found myself showing students links between art and biology in many different classes.

Conventional teaching practice draws a sharp distinction between art and science. We tend to assume that very different skills are required for 'doing' art versus 'learning' science. Classroom practice, however, is not rigidly defined, and children are more flexible about applying concepts and skills learnt in one area to another (although this flexibility seems to diminish as they move up to higher grades – perhaps as a direct consequence of teachers reinforcing the compartmental approach in school). Based on my own classroom experiences, I can now see that the lines between art and biology are fluid, and learning and practices from one field can inform and enhance understanding in the other. Also, certain requirements, such as the need for acute observational skills or the ability to synthesize information from varied inputs to develop a coherent image, are common to both fields.

In this article I provide examples from classroom teaching of Grade VIII Biology (and one from Grade XI) where certain scientific concepts were rendered as works of art. I also explore the idea that in producing such art, children may develop a deeper understanding of the concepts themselves.

Representing scale

We begin Grade VIII Biology by looking at the scale of life, particularly the size ranges at which certain mechanisms operate. Students of Biology can find a ready-made version of this scale in every textbook. However, the question of whether the essence of Biology can be conveyed through one drawing depicting the various scales at which organisms exist has always seemed fascinating to me. What is even more interesting is to engage students in the exercise of creating such a drawing and discovering their individual artistic interpretations of it (refer **Fig. 3**).

While the teacher's inputs may be needed to guide the basic components of such a drawing, there is sufficient scope in this exercise for a student's unique individual conception of size to also come through. It is also likely that Grade VIII students may not grasp the deeper aspects of some of the processes (genetics, metabolism, evolution) depicted in such a drawing. However, in the process of working on it, they become familiar with these terms and the range at which their effects can be seen. Also, this exercise helps fix certain standard size markers (diameter of the double helix,

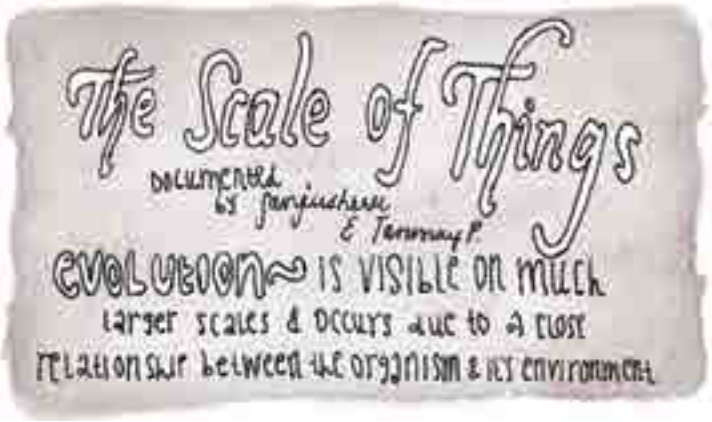

Fig. 3. Drawing of length scales of organisms.

Credits: Tanmay Pandya and S. Sanjushree (ICSE 2018), Rishi Valley School.
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the size of red blood cells, the tallest organisms on earth etc.) in their mental make-up of biology.

Depicting Biological Classification

Another concept that offers interesting possibilities to explore Biology through art is that of the classification of life. While discussing this idea with one batch of Grade VIII students, I touched upon the fact that there are many depictions of the 'Tree of Life'. This seemed to capture the students' imagination and they wanted to paint their own version of the tree.

Having an excellent art department in the school really helped on this project. While I dug out different artistic representations of the Tree of Life, the art teacher, Sreekumari J. L., helped students create their own. She chose a style for the mural, and expertly guided students in working on it, while also ensuring that they sustained the energy to complete it. The finished piece turned out to be a large 4.5m X 2.5m mural on a wall of the main school building (refer **Fig. 4**). Although our class discussion may have provided the initial spark for this project, it acquired a life of its own in the students' minds. Not only did the students volunteer to take on the project, they also devoted many weekends working on it.

As a teacher, listening to the discussions between students while they worked on the mural was quite informative. In spite of many class discussions on how all life on earth originated from a group of bacteria more than 3.5 billion years ago, it was only while drawing branches of the tree that several students truly experienced that *aha* moment. Discussions on ways of depicting extinct species or evolutionary 'dead-ends' gave students a better appreciation of the forces underlying natural selection. These were finally depicted as dried leaves that had dropped off the branches of the tree. Such discussions led to a richer understanding of evolution and primarily of the fact that it needn't always be linear and progressive with man at its pinnacle.

While it resulted in a wonderful visual, this project left me with a lot of questions. Should there be a specific learning purpose underlying such work? Is it necessary that it convey scientific information in addition to its existence as a work of art? Is the learning in such a project dependent on the teacher shaping it with scientific facts (in this case, related to evolutionary relationships)? Or, is it enough that some learning comes about in the doing of it, even if it occurs in an unstructured fashion? Is it necessary that this project ends with students having a better understanding of classification? Or, is it enough that they produce a beautiful work of art, something that is appreciated by and will, perhaps, inspire other students and teachers?

It is probably best to conclude that it is too early to tell the impact of such a project on the students' minds. One can hope, however, that it leaves students with the memory of a richer way of understanding this basic idea about life on Earth that they continue to revisit till much later in their lives.

Nature journaling

Biological art seems to crop up in many areas — big and small — even when students don't consciously set out to produce it. A drawing made with the specific intention of recording a biological concept or phenomenon can have an artistic by-product.

One such area where all students of a class have been able to show their creativity is in journaling walks in and around the school. Fairly common in many schools now, the main purpose of such walks is for students to develop observational skills and familiarise themselves with the biodiversity of the campus. Students are encouraged to maintain records of their observations on the walks and, on occasion, use drawings to indicate places they have

Fig. 4. Tree of Life mural painted by a group of students when in Grade VIII (2015-16).

explored. This is particularly delightful because students respond to this activity with much enthusiasm, pouring their energy into recording their observations. In fact, it can keep them so engrossed that a class of students may work on their journal entries quietly, for the entire duration of a one hour class! The intense observation this activity entails brings about a natural slowing down of thought processes. Students tend to become aware of details or processes (insect moults, rock patterns, signs of animal passage etc.) that may have otherwise slipped their attention or been ignored. This focus also seems to 'free their hands' and in recording what they observe, what emerges sometimes is art.

I have used journaling in a variety of ways. For example, it was part of a challenge that I had asked my students to test during their vacations. They were asked to record their observations after five minutes of looking at the same area every day for a month. At the end of this period, they had to decide for themselves if observing the same field of view daily had led them to notice more details. I believed that getting students to engage in this process of actively observing their surroundings would help them develop a sense of association or belonging, and with it a growing sense of care for their immediate environment. While student journals were written mainly to document their observations, some of their entries (refer **Fig. 5**) had the flavour of a painting, conveying some sense of their enjoyment in creating it.

Fig. 5. A journal entry.
Credits: Aman Gwjwn (ICSE 2018), Rishi Valley School. License: CC-BY-NC.

Another joy from journaling has come from using it in working outside the classroom and curriculum with students who aren't necessarily from a science background. For example, we had been working on the idea of making maps of popular walks to familiarise visitors with the biodiversity of our school campus. On being presented with this idea and a rough sketch, a student took it upon herself to produce a stunning rendition of a map. This map showed the trail on one side, and the plants, birds and insects that could be encountered on it painted in explosions of colour on the overleaf (refer **Fig. 6**). Each image reflects the artistic eye of the fine-arts student, but is also biologically accurate. Working on this map offered the student, who may not have been actively interested in biology, the opportunity to develop a connection with her natural surroundings. It is because of this connection, perhaps, that this student chose to not produce a purely subjective version of a landscape or life-form.

Some parting thoughts

In this article, I have shared a few examples of projects in which students have been able to learn while also expressing their creativity. As a teacher, it has been both interesting and inspiring to see how students incorporate a biological concept into their art-work. However, I continue to feel ambivalent about pinning down the academic outcomes arising out of these attempts. In some cases, being fully engaged in these moments of creation, students may arrive at a biological truth in the form of an insight or observation that they make — and, perhaps, this is

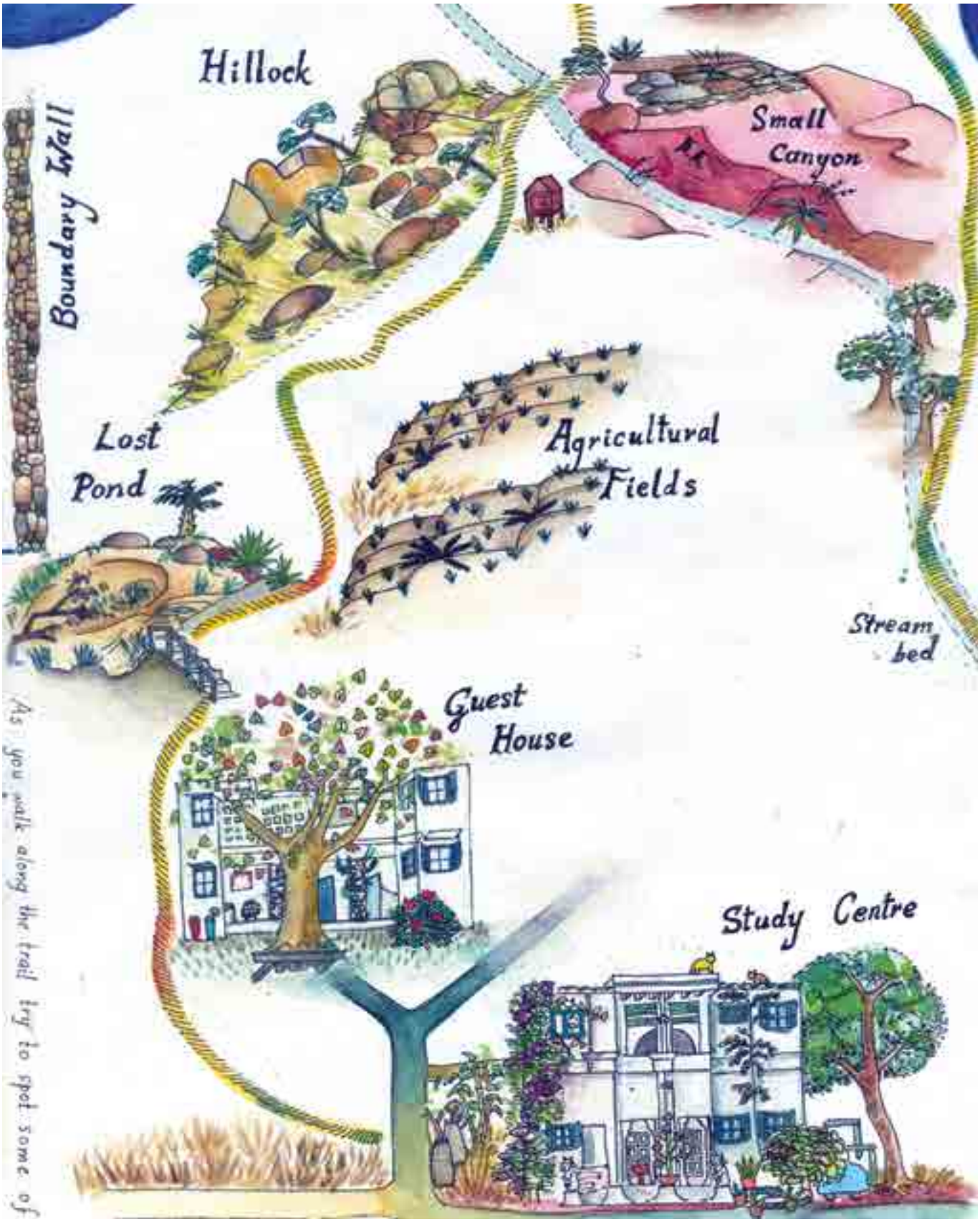
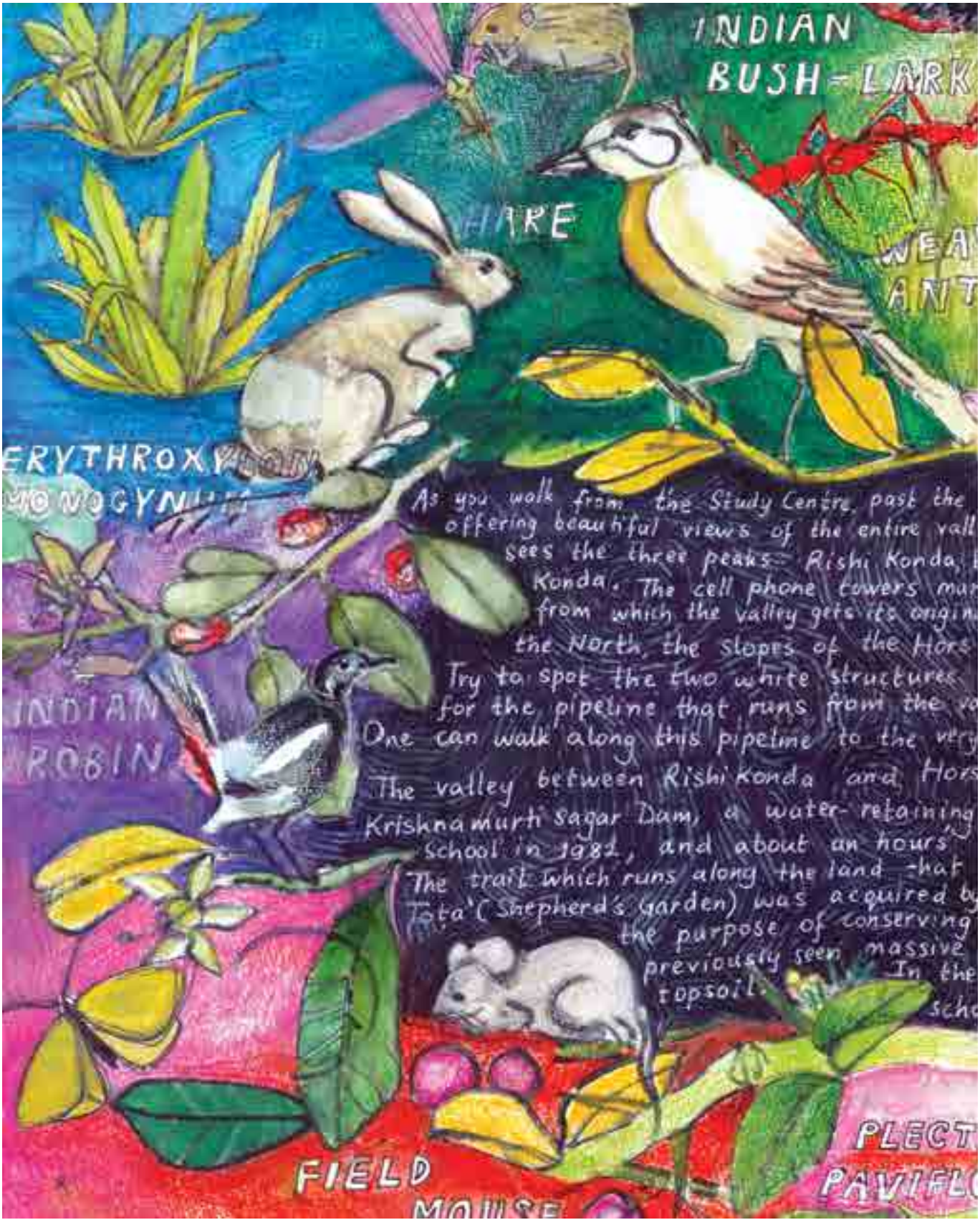


Fig. 6. Trail map with flora and fauna. The original map is two sided, with the trail directions drawn on one side and the information provided overleaf.

Credits: Painted by Rahi de Roy (ISC 2016), Rishi Valley School. License: CC-BY-NC.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for the pipeline that runs from the
One can walk along this pipeline to the very
The valley between Rishi Konda and Hors
Krishnamurti Sagar Dam, a water-retaining
school in 1982, and about an hours'
The trail which runs along the land that
Tota' (Shepherd's Garden) was acquired by
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enough. Often, the close observation required to produce these works of art leads to a better understanding of our world, a greater appreciation of the inter-relatedness of things.

New ideas emerge quite naturally in the classroom if one keeps an ear to the ground. For example, as an ever-fascinating subject for school children, a variety of art-related activities could be built around the human body that encourage them to go beyond the diagrams in textbooks. There are, after all, many ways of showing this 'home' of ours so as to bring out its beauty and connections to other organisms. In another example, students could paint the Hillis plot — a variant of the 'Tree of Life' theme in which the tree is wrapped around itself in such a way that it almost meets in a circle. Many artistic versions of this plot are now available, with some scientists even having them tattooed on their bodies. Another possibility, suggested by a friend who is a landscape architect, is to get students to create a walk depicting main events from the Earth's evolutionary timeline, starting with its origins. The length of this walk would correspond to approximately 4 billion years of the Earth's history, and important events could be shown as sculptures, drawings or writing on the stones of the walkway. The possibilities are endless.

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