PLACE-BASED LEARNING OF SCIENCE

POORNIMA ARUN & NISHANT

What is science, and what is its role in education? What kind of learning takes place when we give importance to relationships with place, people, and other beings? How do we balance immediate experience with pre-existing bookish knowledge?

"There are no unsacred places, only desecrated places" — Wendell Berry.

For the earth as a whole to matter, it is important for us to care for the place that we are in first. Our journey to reconnect with a place can be a long, ongoing process — collective and individual — of understanding, enjoying, and caring at deeper and deeper levels. This principle underlies a lot of the work at Marudam (see **Box 1**).

In terms of teaching, we don't always have ecology or earth-science as subjects, but all the class groups take time to build relationships with the natural landscape and its lifeforms. Some of these relationships are with the forests on the Arunachala hill nearby, some with the creatures in and around the school campus, with the surrounding village fields, with the plants that we eat, with the water that flows through the land and sits beneath it, and with the other people working in and around the campus (see **Fig. 1**). This process of reconnecting with nature is not an intellectual exercise, but one that emerges from experience, action, and reflection.

Relationships between people are as important as other relationships. If we acknowledge that we are all on a journey to reconnect with nature, then it becomes important for us to learn from and with each other. Teachers must also learn from those they teach because children often have keener senses and sensitivities. On the other hand, everyone, including children,

Box 1. An introduction to Marudam Farm School:

Marudam Farm School runs under the umbrella of The Forest Way — a registered non-profit charitable trust involved in education, afforestation, environmental education, organic farming, and more, near the town of Tiruvannamalai in Tamil Nadu. The journey of the school, the campus, and the land are the result of the passion and energy of several committed individuals, and the generous support of a large community of friends and donors from all over the world.

As of 2020, Marudam hosts some 130 children between the ages of 4 and 16 years; about 30 teachers and staff in different capacity; roughly 20 residents; numerous dogs, cats, cows, chickens; and a rich, diverse, and ever-growing wildlife population of all kinds. Located on an organic farm, and spread over 8 acres, land is something we constantly engage with as a rich, real-life, educational resource, integral to the learning process.

Being an immensely diverse group, originating from various cultural and social backgrounds, the richness of integration is a key element in our ethos. Working and learning closely together in such an environment, with very little formal structure, can be challenging at times. At the same time, it is endlessly enthralling, deeply rewarding, and never ever boring!

must take responsibility for their own learning. In this sense, classes can be seen as ongoing agreements that are discussed and arrived at as a group. The fact that these relationships need time together is accounted for in setting timetables and the working rhythms of the school.

Seen from this lens, what is science and what is its place in education? As teachers engaging with science, how do we bring our own understanding to these questions?

Fig. 1. Class in the Arunachala hill forest.

Credits: Marudam Farm School. Licence: CC-BY-NC.

Ground-up approach to learning science

The most positive aspects of science can begin with a child observing their surroundings, and asking about the how and why of different things around them. The child learns by engaging in open discussions about their observations, and connecting these to other things they have heard or read, including the body of knowledge that science has to offer. This process can start, for example, when a child asks how the fig tree *(Ficus mollis)* growing on a rock outcrop gets any nourishment at all. The child hears what their peers think. They discuss it together, connecting it to what they have read about roots and plant nutrition, as well as what they know about rocks, while being open to intuition. The teacher also participates in this discussion by asking questions or bringing other perspectives, but is careful about not taking over. This process can deepen each person's understanding and connection with the (amazing) fig tree, the rocks on the hill, their relationship with each other and their role in shaping the ecosystem. For this to happen, it's important that we allow some things to grow ground-up, starting from the child's experience and questions, rather than going top-down from the syllabus of a science textbook.

In fact, till middle-school, it makes sense to mostly focus on ground-up learning. To feed a child's natural curiosity, we expose them to different things around the neighbourhood and beyond. These include trips to other farms; landscapes like lakes and forests; structures like old houses, forts, temples with traditional architecture, craft centres; and other projects relating to alternate education and ecology. These are all a big part of learning in school, along with participating in the day-to-day activities of our own land. The children also spend half a day in every week of the academic year on the Arunachala hill. From middle-school onwards, there is an effort to gradually expose children to bits of the larger body of existing scientific knowledge, and connect these with their lived experiences to enrich their relationships. Learning science in this way brings together multiple perspectives — some to science, and others to the context in which it has evolved.

Bringing together multiple perspectives to science

A lot of scientific knowledge has been created with the assumption of human mastery over the earth. For example, science books often focus on the technical expertise involved in large-scale mining of ores and metals, widening of roads, harnessing of energy from rivers, the 'green' revolution, or the uses of forests. But they make no mention of the destructive impacts of these activities on the many webs of relationships in nature. In addition, some approaches to science can be very reductive. One example is of reducing a plant's complex interactions with soil to that of a mechanical pump-like uptake of water and mineral ions. This can help justify the use of chemical fertilizers without asking what they do to the countless relationships that exist between the plant and soil, or without acknowledging the experience of the soil actually being alive. These aspects of science have to be questioned as they come up. And they will definitely come up, because for children and adults who have a strong intimate understanding of plants, animals, and nature, these aspects are often jarring.

Going beyond questioning, we also have to integrate these as different perspectives. Often, it can seem as if science is the only systematic body of knowledge. This is seen, for example, in claims that modern biotechnology is an extension of, and an improvement over traditional agricultural knowledge, modern allopathy evolved from 'cruder' systems of traditional medicine, and modern civil engineering represents 'progress' beyond traditional structures. It is important to understand science, as found in textbooks, as just one form of knowledge. To recognise that emphasis on universal laws can often cause us to ignore the beautiful complexities in nature. That scientific knowledge can focus on reducing, manipulating, and extracting. But it can also increase our sense of wonder for and our connection to the earth, and can be used to have a healthy give-and-take with nature. That even though science has had a chequered history, it may still have a part to play in our onward journey to live harmoniously with the earth. Similarly, it is important to recognise that while traditional knowledge can help to hold up our intimate relationships with nature, it can sometimes lack some of the larger perspectives that we need to understand global phenomena. Also, it can get misrepresented and used in a wrong way or context. This is seen, for example, when people over-emphasise the benefits of some traditional food, or use herbal medicine as a simple substitute for allopathic practices. How can we get the best of both, or rather, all these worlds?

Building an understanding of context

Aside from bringing together multiple perspectives to science, it is also important to place science in its proper context. To do this, we often have to go into its history and sociology.

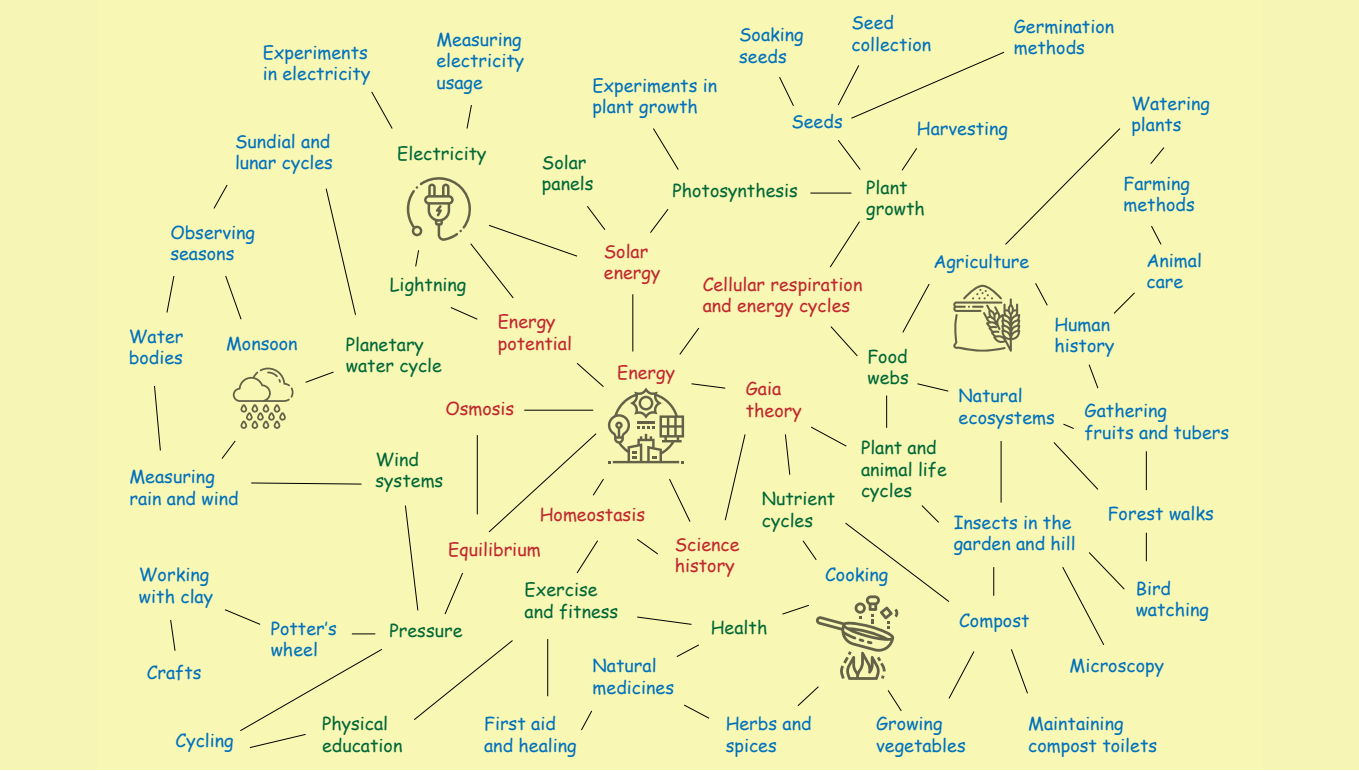

Fig. 2. Weaving a web of concepts. The concepts in red font in the center are more abstract concepts. Those in blue font, towards the edges, are activities. The ones in green build bridges between the ones in red and blue.

Learning the historical context in which various discoveries were made or technologies were developed becomes important. To talk about the motivations and intentions of scientists and other contributors to this body of knowledge. To talk about and with people who hold other forms of knowledge. When we say in science that *'we're standing on the shoulders of giants'*, we often fail to appreciate that the giants are not in science but in indigenous systems of knowledge. For example, the sheer diversity of crops, which is the foundation for modern agriculture, was built through more than ten thousand years of local expertise. Similarly, much of our current pharmacological knowledge was derived from indigenous knowledge systems and practices. Interacting with practitioners of traditional and alternate systems can help us appreciate these things. For this reason, we often invite practitioners from diverse fields to share their perspectives with the school. These include ayurvedic and homeopathic doctors, allopathic doctors who are more conscious of their practice, wildlife conservationists, queer activists, architects practicing traditional and alternate methods of building, farmers using traditional varieties, organic farmers, and many others.

It is also important to continuously engage with the sociological context of science. For example, a discussion on the use of chemical fertilizers brought in by the 'green' revolution can involve many sociological threads. One thread is of how the Haber-Bosch process, which helps in artificially fixing nitrogen, came from advances in warfare. Another thread is about how the relationship between gut health and soil microorganisms is being underplayed in spite of confirmation from recent research. A third thread is of the current need for fertilizers given the growing world population, their diet, and the state of soil around the world. Related threads are of the importance of the soil tilth that many organic farmers consider central to plant growth, or the

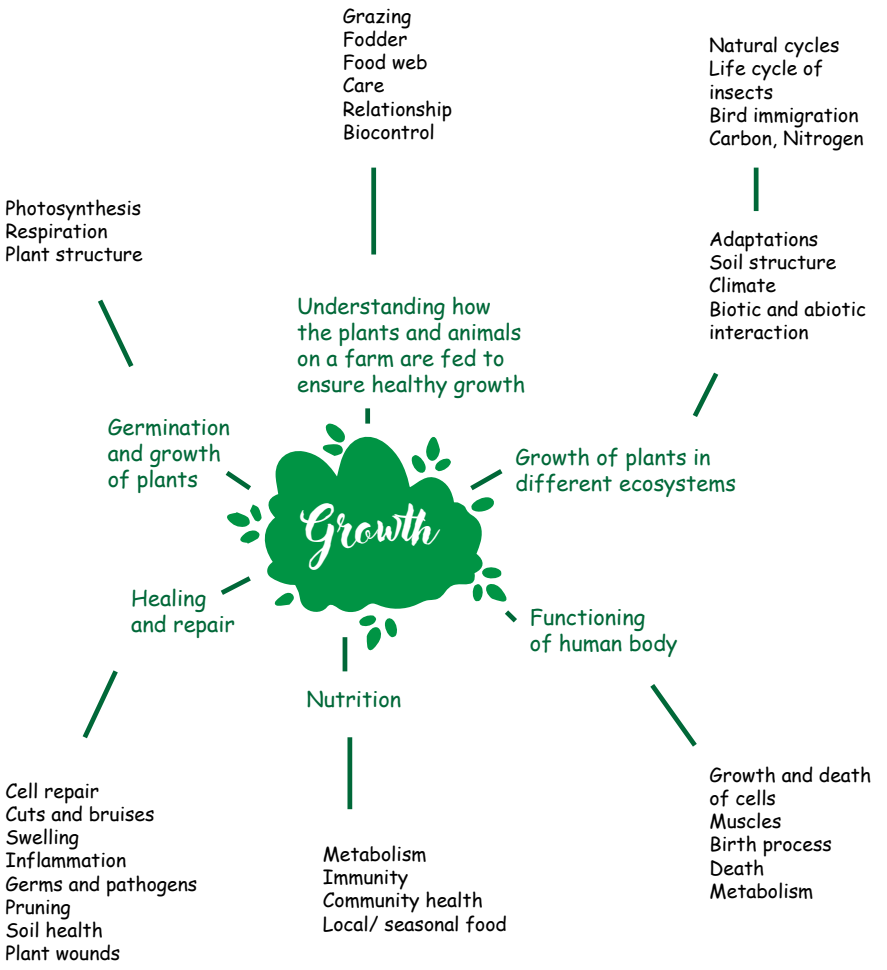

Fig. 3. This is what a concept map around growth may look like at Marudam. It is, of course, not possible to show all the interrelations between the concepts and activities, but a rough design is shown.

experimentation with and rejection of chemical fertilisers by various indigenous people (like the Warlis of Maharashtra), and farmers (like Bhaskar Save). This, in turn, could lead to a discussion on the use of fertilizers in the neighbourhood, as well as interviews of local farmers and owners of agricultural shops.

Weaving a web of concepts

Aside from these issues of perspective, the sheer volume of the science syllabus can also be overwhelming. We have to be cautious not to dump concepts before there is a foundation of experience with which children can assimilate them. Also, since all the seemingly different divisions of science are actually interconnected and rest on each other, explaining almost any concept of science often brings up ten other concepts! For example, the idea of (cellular) respiration rests on the idea of chemical reactions, which rests on the idea of moles, valency, and bonds. This, in turn, depends on the Bohr model of the atom, and to appreciate this model, one needs to be familiar with radiation. This can continue almost endlessly. Parallelly, understanding cellular respiration also rests on the idea of cells. To understand this, one has to experience and understand microscopy, which rests on ideas in optics, which is connected to the properties of glass, and so on. Again, these connections are almost endless. Because of this web of interconnections, a child might take to science and begin a journey that gathers more and more momentum, or might not connect to its perspective and find it more and more contrived.

To address the problem of inter-related concepts all hanging in the air, it often helps to reorganise the syllabus. This can be done along themes that help us to draw from the rich experiences of a child in a particular place (see **Fig. 2**). A bridge concept, like the food-web for example, allows us to move across plants, our own bodies, agriculture, nutrient and energy cycles. But what we can't see fully is that these are in turn drawing from the rich experiences of children working in the garden and forest nurseries, helping with peanut, sesame and rice harvests, watering tree saplings, helping with cows, chickens, wild birds, and dogs, taking regular walks in the nearby forest or wilderness, picking wild fruit, using lenses and microscopes, observing insects and birds in the vegetable gardens, composting and maintaining compost toilets, helping in the kitchen for school lunch especially with salads, baking, and so on (see **Fig. 3**). If this ground work is in place, then more abstract concepts like gaia theory, energy, thermodynamics, equilibrium, cellular respiration can be approached. We can again use these central concepts to **build bridges** in other directions, like connecting the theme of 'energy' to the solar panels on top of the building, to measuring electricity flow in lights and fans, to measuring wind speeds and rain, to how cycles work, to the potter's wheel. Then come the big questions. For example, is this 'energy' really the **same** in all these contexts? What are the **differences?** Similarly, other central concepts like growth, or life-cycles, or body-movement, can be used to build bridges across a greater variety of experiences.

Parting thoughts

While we have tried to share some general approaches that are practised at Marudam, there is much more to share in terms of what we actually see in specific individual and collective learning journeys. Articulating these 'experiences of integration' has been an act of self-reflection for us, and will hopefully be interesting to other practitioners.

Key takeaways

- In terms of practice, there is always a question of what is universal and what is specific to a place. Perhaps it is important to be connected with one's local landscape and place-based knowledge, and evolve teaching practices along with it. So, if monsoons, ragi, and giant lakes are part of your landscape, and palm-leaf weaving, cow husbandry, and pottery are local skills, it makes sense to design teaching around these.
- It is important to explore science-based knowledge in the correct context — in terms of its history and politics, as well as in terms of each child's innate intuition. This is so that science is in service of wholesome learning instead of acting as a dominant system of knowledge that children must submit their intuitions to.
- Finally, the more bridges we build between experience and concepts, the more coherent academic learning can be. For this, experiences have to be rich, and time must be given for bridge-building.

Poornima Arun is a founder member and Head teacher of the Marudam Farm School, which started in 2009 with 20 children and has around 120 children now. She is involved in all aspects of running the school, from curriculum development to teacher training and administration. She has also conducted the annual craft week at Marudam for eight years now, in which traditional crafts people and artisans from all over come and teach these skills to children from various schools. She has been an active member of the Alternative Education Network for the past seven years, and was instrumental in starting a Tamil Nadu chapter three years back.

Nishant has been learning to teach for a few years now, mostly in Marudam, and over the summers at Marpha Foundation in Nepal. His interest in science is balanced by an equal interest in gardening and forests. He is constantly challenged by the process of bringing these together as group learning experiences. He also has a deep interest in practices of harmonious living, especially in the context of community life, to the extent that he is able to understand them.