SCIENCE IN PUVIDHAM: LEARNING BY LIVING

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Puvidham means 'love for earth' in Tamil. At the Puvidham Learning Centre, children learn intuitively by observing, exploring, and working in their natural environment. How does this approach influence the learning of science? What role do adults, like teachers, play in this process?

Science developed as a process of logical deduction of unknown facts from observed phenomena. Today, however, it is often taught within the closed environment of classrooms. Often, children are not offered time for observation, or the opportunity to connect textbook concepts with their own real-world experiences. What if children were to learn science through everyday explorations of their natural environment?

Connecting head and hands

At Puvidham, we explore scientific concepts through the work we do in and around the school (see **Box 1**). For example, all the maintenance work at Puvidham is done by the teachers with the help of the children. We also grow our own vegetables, cook our own meals, and make our own snacks. This involvement with the many activities of everyday life provides both children and adults with many opportunities to observe natural phenomena. For example, tending to our garden involves the use of a crowbar for digging, pruning shears for harvesting, and pulleys and pedal pumps for lifting water (see **Fig. 1**). Having used these implements, children are able to engage with a lesson on simple machines in practical ways, making the concept and related formulae easy to remember. Similarly, any malfunction in the pedal pump, which each child operates for 10 minutes every day to lift enough water to fill our overhead tank, provides the opportunity to find out what has gone wrong with it. Through their struggle to identify the problem, children develop a practical understanding of how pumps work in general. Activities like

Box 1. The philosophical core of Puvidham Learning Centre:

There is no learning without the desire to learn. Learning is an instinct. A child learns by observing the environment, and the events, processes, and individual players therein. Children do not learn what we teach, they learn what we live. A teacher inspires by their way of life. Thus, all adults in Puvidham adhere to the philosophy of respecting the child, the earth, and the living world. Their way of life conforms to their love for earth. This includes their commitment to ensuring minimal consumption of material goods, ensuring recycling of waste, and valuing the dignity in labour. This means, for example, that they do not shy away from menial work like cleaning the classroom or picking up garbage.

We have clubbed children in the age groups of 3, 4 & 5 years into one level, 6 & 7 years in a second level, 8 & 9 years in a third level, and 10 & 11 years in a fourth one. This helps peer learning among children of different age groups, and makes it easier for the teacher to have some support from the older kids. Since children are introduced to the study of 'subjects' only after they reach the age of 12 years, we have developed an integrated learning curriculum for children below this age. This curriculum is based on five elements — Sun, Water, Earth, Air and Space. We also write stories and songs to help children observe natural phenomena, question and deduce answers to their questions, and understand concepts related to each of these elements.

Rather than use a fixed pedagogical approach, our focus is on listening to the child, and engaging in intuitive explorations of the natural world. I think that this the only way to be with a child. The essence of this kind of engagement is that the child leads and the adult follows. Any guidance that the adult offers is from personal wisdom, gained through their own life experience.

cooking or making soaps and organic colours (from flowers, plants, and seeds) offer the opportunity to explore many interesting chemical transformations. This includes the transformation of batter into a cake in an oven, the puffing up of a *puri* or *chappathi* in hot oil due to exposure to heat, or transformations in the taste of food when different ingredients are added. Similarly, the whole world of dyes opens up to children once they understand how colour is made from plants.

Learning through inquiry

We also perform many small experiments every day, going through the stages of hypothesis, experimentation, observation, and inference. For example, one such experiment emerged from a discussion about the role of sunlight in plant growth with children in the first and second levels. Two groups emerged — one believed that plants needed the sun, and the other didn't. To help them test their beliefs, we asked both groups of children to bring two things from home — plastic wrappers used for packaging (of biscuits or snacks), and some seeds (like ragi, wheat, green gram, *methi*, mustard, *jeera* etc. that are normally available in their kitchen). The plastic wrappers were cut and fashioned into bags that were filled with a mixture of equal parts of soil, sand, and compost. The seeds were put into these pot-like bags and watered. The children were asked to put their bags in places where they thought their plants were most likely to grow well. The children who believed that plants needed the sun, put their bags in a sunny place. In contrast, those who felt that plants could grow in the absence of sunlight, kept their bags in their classroom, under a shelf, in shaded dark places. Some kids were indecisive and did what their friends did. Both groups watered their plants and observed their growth. After a week's observation, the children who had placed their bags away from sunlight began moving them to sunny places. By our next discussion, all the children were convinced that plants needed sunshine, without having to mug it up as a fact from their textbook. This is when we introduced the concept of photosynthesis to explain that plants

Fig. 1. Children at Puvidham use simple tools in the garden. This gives them an opportunity to understand the mechanics of these tools in practical ways.

also need minerals (which they absorb from the soil) and carbon dioxide (which they absorb from the air) to make food and grow.

Observing the growth of seeds into plants led to other observations and questions (see **Fig. 2**). Some of the children had noticed that some seedlings looked like a blade of grass, while others had come out with two thick leaves. At this point, we introduced them to concepts like monocotyledons and dicotyledons, and explained how this type of classification makes it easier to study the plants around us. We shared the fact that plants from these categories also differed in their root systems. Pulling a plant from each of these categories out of its pot by its roots, we introduced them to concepts like tap roots and fibrous roots. The children were then asked to observe these plants and draw all their parts, including their roots (see **Box 2**). This spurred the children to walk around school, trying to identify if the trees they saw were monocots or dicots.

On their walk the next morning, one of the children wanted to know if their teacher would classify Palmyra trees under monocots or dicots. The teacher was stumped, and asked the child for time to find out. When, after some research, the teacher shared the correct answer with the child, she was again stumped by his exclamation: *"I already know it is a monocot"!* To her question, *"How did you find out?"*, the child responded, *"Because it's roots grow like that of a grass".* It is through this process of learning (the observation of events or properties, and deducing unknown facts) that children are introduced to the process of science.

Fig. 2. Children sowing seeds in the school garden.
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Box 2. Art and Science:

Art is a vital part of the process of development of scientific thinking. The art of drawing offers a powerful way of understanding the visual world. Engaging in the process of drawing not only ensures the need to observe more closely, it increases a child's perseverance and patience. It can lead to immense improvements in their understanding of mechanics and structures. Also, since a drawing is both an expression of understanding and a visualization of possibilities, it enhances a child's concentration, imagination, creativity, and aesthetics. When we draw, our heart is silent and our mind is focused. We look through our eyes, understand the object with our brain, observe from the heart, and draw with our hands. In this action, our head, heart and hand work in coordination with each other.

The earliest drawings that children create are scribbles. We can learn a lot about a child's ability, interest, and imagination by talking to them about their scribbles. I have been repeatedly amazed by how much children can observe and learn without being taught. For example, a three-year-old scribbled a patch of lines. I asked her what she had drawn. She said it was a cow. It is likely that this was just a random response. I said, *"Wow! That is a beautiful cow. But I can't see its horns. Did you draw them?"* She replied: *"No, I didn't draw".* She then proceeded to draw horn-like scribbles. When I asked her where the tail was, I was amazed to note that she drew one at the other end of the scribble. I asked about the cow's legs, and she drew four legs in spite of not knowing numbers. And she drew them in the middle of the scribble. It seemed obvious that the child had a sense of what is where, and can make a correlation of quantity too! Isn't this scientific thinking? Doesn't it involve scientific thought, and improve scientific temper?

One of the problems with connecting art with science is that art is often judged solely for its beauty. This is why many older children, and even teachers, may be reluctant to draw. They have formed the opinion that they cannot draw. Not drawing impedes their ability to learn through observation. When art is used to learn science, the ability to observe and draw key features is much more important than the beauty of the drawing. Not only children, but teachers too need to be encouraged to engage in drawing. Only then will they be able to appreciate the power of drawing in learning.

Box 3. The teacher as a facilitator:

The most important aspect of this kind of learning environment is that the teacher acts as a facilitator. When a child asks a question, the facilitator engages with the question in a way that helps further the logical thinking and deductive abilities of the child.

Here is an example:

Child: *"How does the water go to the sky and become rain?"*

I: *"Wow! What a wonderful question? How come I never thought about it? I too would like to know how the water got there. How do **you** think it got there?"*

Child: *"It must have been there already."*

I: *"Hmm! That is possible! Actually, I have always wondered where the water in my washed clothes went. It must be going into the air."*

This is how I slowly led her to the concept of evaporation. We then did an experiment on condensation that allowed her to frame a response to her question without having to be told about it.

When the teacher shares answers to all their questions, children become dependent on the teacher and believe more in the teacher than in themselves. It is instead important for a teacher to nurture the humility required to surrender to the child's questions. The teacher is not there to show the child how much they know, but to help the child to discover answers for themselves.

Parting thoughts

Our focus at Puvidham is on nurturing people who care about the earth. People who will live more responsibly, raise their voice for, and take action to protect and maintain life on our planet. Towards this goal, we don't teach science; we try to make space for the development of the natural curiosity of the child (see **Box 3**). Children learn science naturally through the process of observation, deduction, expression, and correction. We don't just teach science as an intellectual exercise; we try to get children to care. Children become acutely aware of their surroundings, and their contribution to the havoc on the planet. We don't just view science; we try to ensure that children know that science cannot be segregated from everyday life. That life is an integration of experiences. And that each experience is an opportunity to learn to engage with life in a wiser way, and for the wellbeing of all living creatures.

Key takeaways

- Involving children and adults with the many activities of everyday life in and around school offers many opportunities to observe, question, and investigate natural phenomena.
- Encouraging inquiry and experimentation in the process of learning — observation of events, processes, or properties and deducing unknown facts — offers students a practical introduction to the process of science.
- Encouraging children and adults to use art to record their observations can improve their scientific thinking as well as their understanding of mechanics and structures.
- When a teacher helps a child find their own answers to questions, they help further the logical thinking and deductive abilities of the child.

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Meenakshi Umesh was born and brought up in Mumbai. She has always had a lot of questions about the disparities in human societies. By the age of 18, she had reached the conclusion that these disparities were perpetuated through mainstream education. This led her to purchase some land in Dharmapuri in 1992, and start the Puvidham Learning Centre in 2000. Her aim is to contribute to the creation of an anarchic and egalitarian society of people who recognise nature as their only god, and our planet as their only home.