HYDROPONIC FARMING
WITH TRIBAL STUDENTS OF ASHRAM SHALA

PRASHANT WAHULE

Children bring experience and observations from their real-world contexts into the classroom. Do these experiences and observations have any connections with classroom learning? Can children lead this process of science learning? What is the role of the teacher in this process?

In an oft-quoted approach to education, children are seen as empty pots that need to be filled, or shapeless clay that needs to be molded by the teacher. This approach is based on the assumption that scientific knowledge is absolute, and must be transmitted as is by the teacher to the students. It either ignores the knowledge that children bring into the classroom through their lived experiences or dismisses it as being scientifically incorrect. Consequently, children are rarely offered the opportunity to explore connections between these experiences and the concepts they are expected to learn in school. But what if we were to offer children this opportunity?

I explored this possibility with middle school children from Teesgaon Ashram Shala school, located 45 km from Aurangabad in Maharashtra. The children in this residential school come from remote areas and diverse tribal communities within a 90 km radius. Since their lives and culture are embedded in the forests where their homes are located, these children often have a deep relationship with the natural world. This contributes in significant ways to their knowledge about plants, seasonal cycles and rhythms, and traditionally diverse ways of growing food. Having seen glimpses of their food- and farming-related knowledge during brief monthly interactions with them, I designed an activity around a topic in their school curriculum — the role of soil in plant growth.

It is commonly believed that all seeds need soil to germinate and grow into plants. But the technique of hydroponics allows us to grow plants without soil (see **Box 1**). What if we were to introduce this method of farming to middle school children? How would it connect to their understanding of plant growth and their prior experiences with farming?

Box 1. What is Hydroponics?

Hydroponic farming is a technique of soil-less farming, in which water acts as a medium for germination and growth of seeds into plants in the same way as the soil usually does. Its key advantage is that it requires much less water and space than other farming methods. This means that farmers can use it to grow green fodder. Similarly, families with limited space in their homes can use this technique to grow enough organic vegetables for themselves. In addition, this technique can help protect plants against diseases caused by soil-borne pathogens.

Preparing the ground

I introduced this activity through a discussion with children from Grades VII & VIII. Their teachers were also invited to join the discussion.

I began the conversation with the question: *"Do you have a farm?"*

"Yes, we do!" declared the children.

I asked, *"Which animals help in farming?"*

The children listed cows, bulls, buffaloes, dogs, goats, hens, cats, etc.

I asked, *"Which of these produce milk and what do they eat?"*

"We get milk from cows, buffaloes, and goats. They eat green grass and dry fodder. The dry fodder is called kadba or kutti in Marathi."

I asked, *"Can we feed green grass to the animals throughout the year?"*

The children said, *"No...We get green grass only during the rainy and cold seasons. It is not possible to feed these animals grass all through the year. "*

I asked, *"What do you feed them during summer?"*

The answer was, *"We give them finely cut dry fodder mixed with a little salt."*

I asked, *"What will happen if we feed green grass to these animals, especially to the milk-producing animals?"* For a while, the whole class was silent. I thought I had asked this question rather too early.

After a while, the student sitting on the third bench excitedly said, *"Their milk yield will increase!"*

I said, *"Why? Could you explain this in a little more detail?"*

He said, *"If we give green grass to the milk-producing animals then they will produce more milk, and the milk will be slightly thicker also. I have seen this happen in my village!"* Some children laughed on hearing this. They may not have been aware of this connection, or this may have been the first time that the child had narrated his experience in such a manner.

I asked another question, *"What happens during summer when there is a dry spell and drought?"*

Children responded differently, *"Famine is a very bad situation... We have to walk huge distances to get drinking water! Animals do not get water to drink! Ponds dry up, farming stops, crops sown before summer are removed, animals do not get fodder, etc."*

I asked, *"What if green grass could be made available to farm animals even during summer?"*

Children started talking to each other. At this point, a voice was heard from the backbench, *"Milk-producing animals will become stronger, give more milk, and our income will also increase!"*

"Can we make green grass available to our animals for all the twelve months of the year?" I asked.

The children said, *"That does not seem possible at all! Crops need water. How can we find enough water in summer to grow fodder?"*

I asked, *"And can plants be grown without soil?"*

The children started laughing. But, after a few minutes, they started discussing this possibility with each other with puzzled expressions on their faces. Some of them looked at me expecting some clue. Then one girl said, *"No, we cannot grow anything without soil!"* Some of the other children nodded approvingly.

I said, *"Well, we can't grow anything without soil, but can we grow something only in water?"*

Again, the children said, *"No...!"*

I asked, *"When we sow a seed in the soil, it grows. Why? What does the soil contain to help seeds grow?"*

"The soil contains manure...there is water. There are micro-organisms in the soil. There are earthworms that live in the soil and eat wood and leaves found in the soil. Their excreta provide nutrients to the plants."

"But what if we could grow plants without soil? Would you like to try it out?"

While all the children said, *"Yes!"* in unison, they did not look as if they believed that this was possible.

Small beginnings

We started the activity with one kilogram of wheat grain (wheat was the only grain available in the school storeroom). I asked the children to soak these grains in a bowl of water to moisten them (see **Activity Sheet I**).

Noticing that the children removed the grains that floated up to the surface, I asked them, *"Why did you remove those grains?"*

After a brief discussion amongst themselves, one child said, *"These will not grow after sowing."*

I asked, *"Why?"*

The child said, *"Because they are spoiled."*

Another child said, *"They are infested with worms so we have removed them."*

We spread the soaked wheat grains on four trays (with breather holes), forming a 1-centimeter-thick layer. I explained that this was done to allow uniform exposure of all seeds to air, water, and sunlight. If the layers are thicker than this, the seeds at the bottom may spoil from microbial growth caused by lack

Fig. 1. Using trays and/or perforated bowls with breather holes allows the roots of seedlings space to grow.

Credits: Prashanth Wahule. License: CC-BY-NC.

of sunlight. Later, when the seeds had germinated, these holes would also allow the roots of the seedlings space to grow (see **Fig. 1**). I asked the children to look around for a cloth to cover the tray. A girl brought her old white scarf and covered them well.

I asked, *"Why do you think we have covered the trays with the cloth?"*

The children offered many reasons — to prevent air or sunlight from getting in, prevent water present in the wet wheat from evaporating, prevent rats from being able to get inside, or to maintain humidity (see **Box 2**).

I asked, *"Now that we have soaked these grains, what do you think is likely to happen to them?"*

"The grains will sprout by morning due to the humidity in the cloth-covered tray."

I asked, *"How do you know all this even though this is your first experience of hydroponic farming?"*

One of them said, *"We eat matki usal (sprouts). And it is kept in a wet cloth before making the usal."*

Box 2. Why do we cover grains with a cloth?

The response offered by the students is only partly correct. A cloth is used to cover the grains to allow air to move in and out. This air circulation would be blocked if the grains were covered with a plastic or carboard sheet. While covering trays with cloth may not prevent rats from getting to the grains, it may help retain humidity for longer.

The rest of the children agreed, and it seemed like half my job was done. The children prepared four more trays using wheat grains. I asked them to keep these trays in a dark place to prevent the grains from drying on exposure to sunlight.

The children then set up a similar activity using fenugreek and coriander seeds. But, this time, we spread and moistened the seeds in some perforated bowls (with the perforations acting like breather holes and improving aeration) lined with paper to prevent the seeds from falling through the perforations. Some of the children accepted the responsibility of watering the bowls twice a day, for 20 days, with a small spray pump. A pump is the cheapest way to disperse small air bubbles containing dissolved oxygen. Using these to water the growing plants helps ensure that their roots remain well-aerated.

Now was the time for patience and regular observation. Since the children stay at the Ashram Shala, they keenly watched these trays and bowls before, in between, and after the classes. They would report their activities and observations, on a daily basis, to their science teacher. Whenever it was possible, they would call and share their observations with me on phone. In 3-4 days, the seeds had sprouted, and the seedlings had started growing. Although I was unable to visit the school, the children kept me updated, and consulted me whenever they had any problems. On the ninth day, the children called to inform me that there was some fungal growth in the trays.

Rather than offering a solution, I asked the children, *"What could have led to this fungal growth?"*

One boy said, *"Sir, it has been very cloudy here for the last two days. Since it is quite hot inside the tray, the wheat must have become moldy."*

Some of the children were upset. They felt that all their hard work had gone in vain. But, a day later, one of their teachers sent me photos showing that the children had kept all the trays in the sun (see **Fig. 2**). This reduced fungal

Fig. 2. The children kept their trays of hydroponically grown wheat in the sun to reduce fungal growth.

Credits: Prashanth Wahule. License: CC-BY-NC.

growth. Neither I nor the other teachers of the school had asked them to do this; they did it on their own. I did not get an opportunity to follow up with the students to understand why they kept the trays in the sun. Where did this knowledge come from? Perhaps from having observed their parents working at home and in the fields.

When one of my colleagues, Sheetal, visited Ashram Shala, the children shared their experience with her, and expressed their wish to talk to me on the phone. Sheetal shared pictures of the trays and bowls showing the growth of the wheat, fenugreek, and coriander plants. On seeing the pictures, I felt that there were enough fenugreek leaves to prepare curry for two people. Since we had planted a limited quantity of wheat, its yield was too little for us to find out whether there would be any increase in the milk-producing capacity of dairy animals.

Through this activity, children developed an understanding of moisture, mold, planning of space, water administration, regularity of time, observation, etc. They were also able to get pesticide-free plants. This effort was not limited to just a feeling of 'children were able to practice farming'. It also provoked many questions that children shared with their teachers. For instance, *"what other crops can we grow with this method? How do we control fungal infections? Fertilizers are also necessary for plant growth. How do we give that to plants grown through hydroponic farming?"*

I tried to answer these questions through telephonic discussions with the teachers (see **Box 3**). During one of these discussions, one of the teachers expressed the belief that this activity would make it easier for the children to understand curricular concepts related to seeds, leaves, and roots. The students expressed the wish to share their experience with hydroponics farming

Fig. 3. Two of the tribal children presented their learning and experience of hydroponics at a science exhibition.

Credits: Prashanth Wahule. License: CC-BY-NC.

in a science exhibition. Two students were chosen for this presentation. While slightly intimidated by the newness of this experience, the two students showed remarkable confidence — both in speaking about this group effort, and answering questions raised by the judges and other participants (see **Fig. 3**). I believe that this confidence, a rare sight, came from their keen sense of observation, interest, and the effort they had invested in this experience.

Box 3. Nutrients in hydroponic farming:

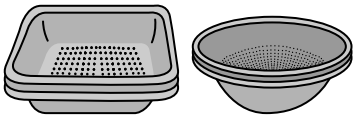
While unfiltered tap water is often sufficient for growing fodder, the filtered water used to grow crops for human cultivation may need to be re-mineralized with supplementary nutrient solutions (mainly nitrogen, phosphorous, and potassium). These nutrients can come from natural sources such as farm manure, chemical fertilizers, or synthetic nutrient solutions. To learn more about nutrient management in hydroponics, watch this: https://www.youtube.com/watch?v=6S6n3E3F4z0.

Parting thoughts

This brief experience of hydroponic farming in Ashram Shala has inspired me to teach and design activities that offer students the opportunity to express and apply their understanding from real-world experiences to the concepts and activities shared in the classroom. For example, hydroponic farming was helpful both as an example and as a medium for students to develop connections with concepts such as seed germination, the role of soil, roots, and water in plant growth, etc. It also offered them the opportunity to actively collaborate and learn from each other's food- and farming-related contexts and experiences.

ACTIVITY SHEET I: GROWING PLANTS WITHOUT SOIL

You will need:



Plastic trays or perforated plastic bowls (light-weight and portable ones, with many holes that help aerate seeds and allow space for its emerging roots to grow)

Bucket

Mugs

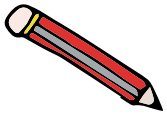
Plastic spray pump

Piece of cloth (preferably cotton)

Some seeds of readily available grains, like wheat, coriander, fenugreek etc.

Water

Notebook



Pen/ pencil

What to do:

1. Soak seeds of grains in water for 2 h or overnight.
2. Spread the soaked seeds in a 1 cm-high layer on a tray/bowl.
3. Cover the tray/bowl with the cloth and place it in the shade.
4. Moisten the seeds with water from the spray pump, twice a day, for 20 days.
5. Observe changes in the seeds.
6. Record your observations in the table on the next page.

Discuss:

- How long does it take for the seeds to germinate?
- Are there differences in the appearance and growth rate of different seeds?
- How long does it take for roots to make an appearance?
- How long do these plants survive?
- How does the growth of hydroponically grown plants differ from those grown in soil?

i wonder... Rediscovering school science

Contributed by:
Prashant Wahule, who works as a research associate with Eklavya Foundation, Aurangabad (MH). His research interests lie in primary and middle school education. He is also deeply interested in agriculture, and sharing his experiences through articles and poems on social topics.

Azim Premji University

Days:	Wheat grains:	Coriander seeds:	Fenugreek seeds:
Day 1			
Day 2			
Day 3			
Day 4			
Day 5			
Day 6			
Day 7			
Day 8			
Day 9			
Day 10			
Day 11			
Day 12			
Day 13			
Day 14			
Day 15			
Day 16			
Day 17			
Day 18			
Day 19			
Day 20			

Key takeaways

- Children bring knowledge from their context and life experiences into the classroom.
- Designing activities that value children's prior understanding can help build stronger connections between their real-world experiences and the concepts they learn in the science classroom.
- Encouraging student-led inquiry, discussion, and collaborative work can help children to develop into confident learners.

Acknowledgements: The author thanks Nitika Meena and Pooja Mule for editorial inputs to the English version of this article that helped convey his ideas with clarity.

Note: Source of the image used in the background of the article title: Green fodder from wheat, grown by children using hydroponics. Credits: Prashanth Wahule. License: CC-BY-NC.

Prashant Wahule works as a research associate with Eklavya Foundation, Aurangabad (MH). His research interests lie in primary and middle school education. He is also deeply interested in agriculture, and writing pieces that share his experiences and poems on social topics.