Part 1

Work with Life Forms

‘Life forms’ include all living things on earth. They include human beings, mammals, birds, fish, plants, insects, reptiles and even bacteria and viruses. Projects on “Work with Life Forms” will help you work with living things in different ways. You can take up projects related to growing plants in various ways, recording the biodiversity around you, surveying medicinal plants, learning to care for domestic and farm animals, and maintaining a nature journal. It is up to you to imagine all that you can do in the activities with your peers.

Two examples of projects are given in this section, which are Hydroponics: Growing Plants without Soil and Feeding and Caring for Farm Animals. You can either choose one of these projects or you can design a project of your own choice with the help of your teacher.

Project 1

Hydroponics: Growing Plants without Soil

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Experts work towards finding agricultural solutions that will meet the demand for healthy food grown in an environmentally friendly manner. Hydroponics is one of the solutions that allows plants to be grown without soil or using a small amount of soil. This project is about developing a hydroponic unit in school.

As part of the project you will be able to:

Figure 1.1: *Do-It-Yourself Hydroponics*

Farmers put a lot of effort into growing healthy food in the shortest period. But as the world population grows, the demand for food also increases. More and more land is needed to meet this demand — this land is taken from forests, leading to deforestation. Deforestation leads to the loss of biodiversity and contributes to climate change.

Another challenge is that, as the same land is used over the years to grow plants, it loses its nutrients, which is known as soil degradation. Heavy use of fertilisers to compensate for the loss of nutrients further degrades the soil quality due to the chemical component of most fertilisers. Besides loss of nutrients, erosion caused by wind and rain, water pollution due to industrial drainage, land degradation due to mining activities and even excessive water for irrigation, all contribute to the reduction of the land available for farming and the quality of produce.

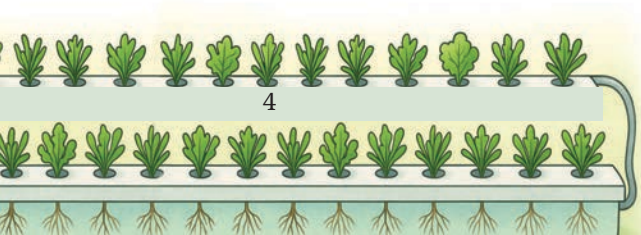
The Government of India is encouraging farmers to use hydroponics through the Mission for Integrated Development of Horticulture, Ministry of Agriculture and Farmers Welfare. Technologies like hydroponics, and aeroponics in which plants are not in direct contact with soil, are being promoted under this mission.

In India, nearly 33% of the Total Geographical Area (TGA) is affected by soil degradation. This means we are losing our fertile farming land. Nearly 109 million hectares of land is facing declining soil quality.

The focus of agricultural scientists, nutritionists, engineers and environmental experts has been to help farmers adopt sustainable farming practices. Sustainable farming aims to produce food that is healthy for humans with minimum negative impact on the environment.

The term hydroponics is derived from the Greek words ‘hydro’, that is, water, and ‘ponos’, that is, labour or toil.

Hydroponics is a method of growing plants in a nutrient-rich water solution instead of soil (Figures 1.1 and 1.2). Plants in a hydroponic unit receive nutrients directly from the water



solution, allowing the farmer to ensure that they receive the precise amount. Therefore, it is also referred to as a 'precision farming technique'.

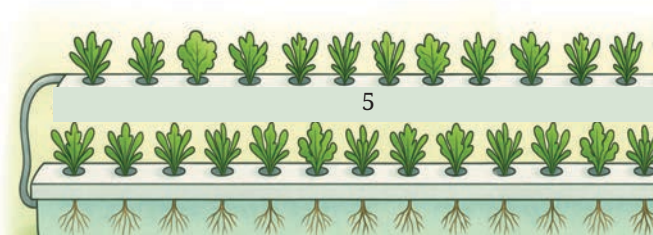
Figure 1.2: *Hydroponic setup in a polyhouse*

You can have multistorey (vertical) farming in hydroponics to utilise vertical space and produce more food in less space. Similarly, recirculating (reusing) water and fertilisers, controlling climatic parameters like temperature, humidity and light for photosynthesis and maximising plant growth is possible in hydroponics (for example, the hydroponic unit could be placed in a polyhouse). Hydroponics is also used for growing crops in cities, which is known as "urban farming".

What will I be able to do?

At the end of the project, you will be able to:

1. Grow healthy microgreens using a basic hydroponics system.
2. Establish hydroponic unit using wick-based, Deep Water Culture (DWC), and Nutrient Film Technique (NFT).
3. Prepare organic liquid manure for hydroponics.
4. Improve the quality of water by varying pH.



What will I need?

You will need different equipment and materials for various methods of hydroponics, as listed in Figure 1.3 given below.

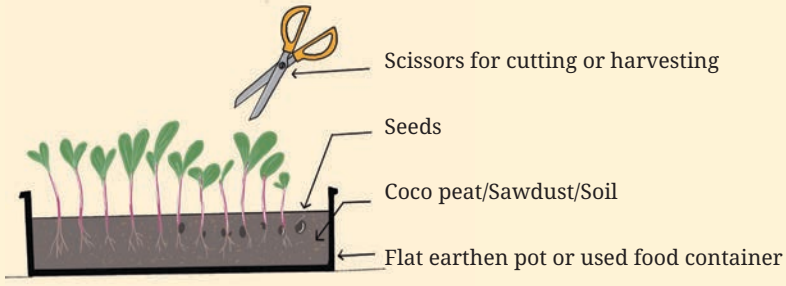


Figure 1.3 (a): *Microgreens setup*

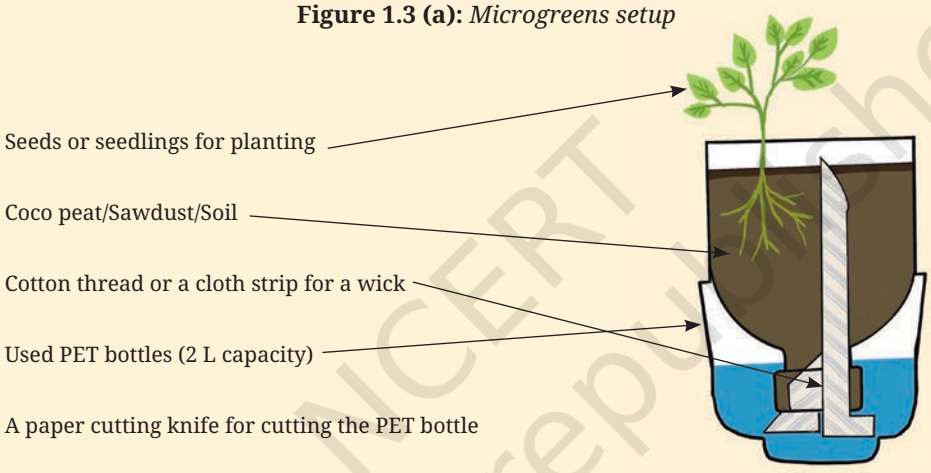


Figure 1.3 (b): *Wick hydroponic setup*

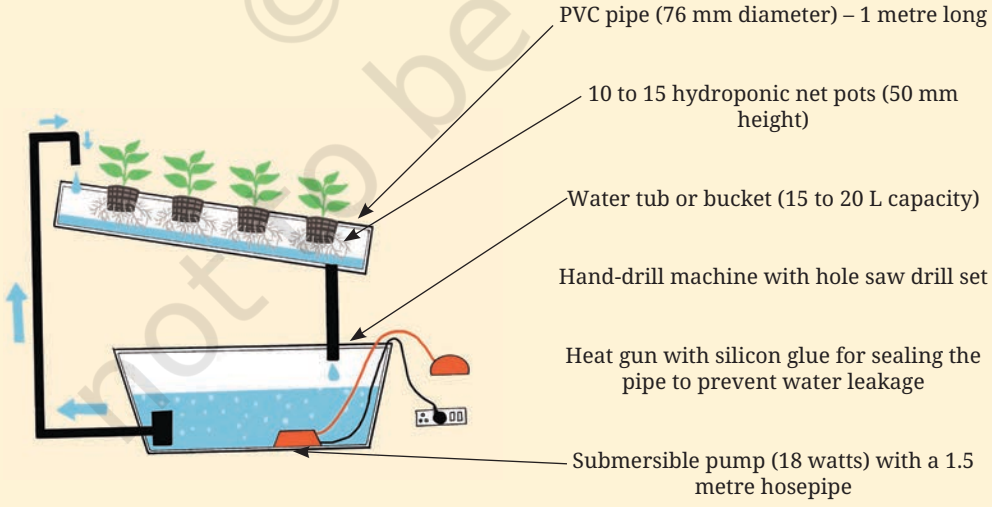
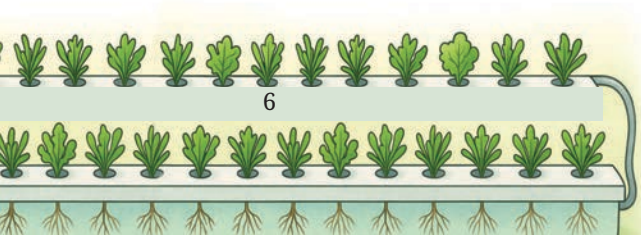


Figure 1.3 (c): *NFT hydroponic setup*



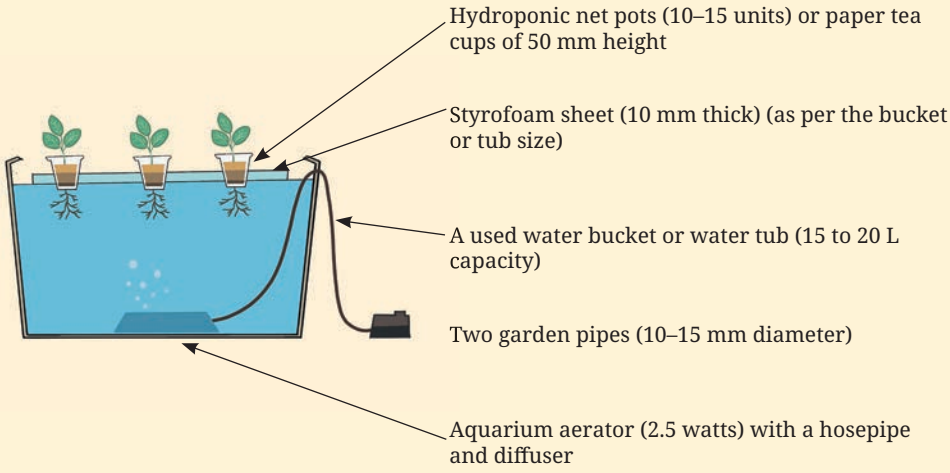


Figure 1.3 (d): *DWC hydroponic setup*

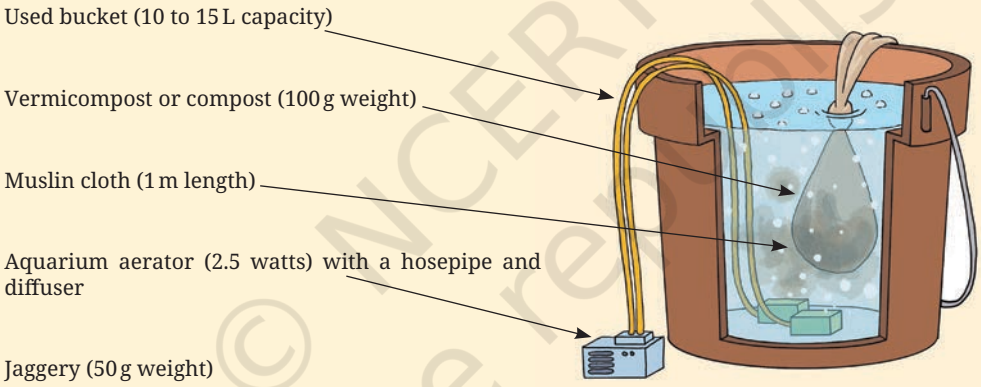


Figure 1.3 (e): *Compost Tea setup*

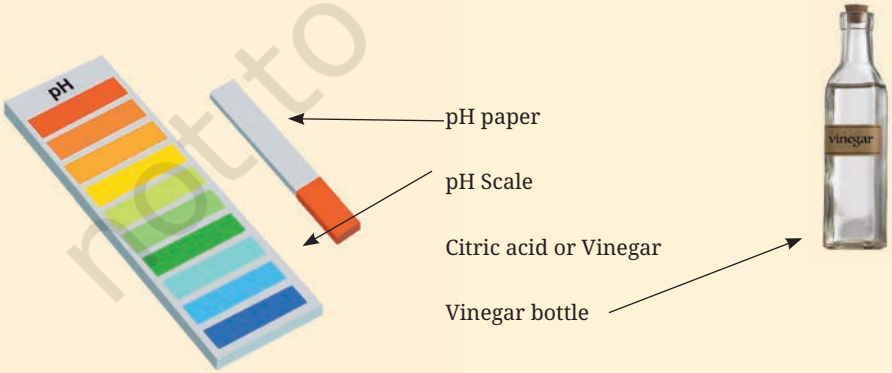
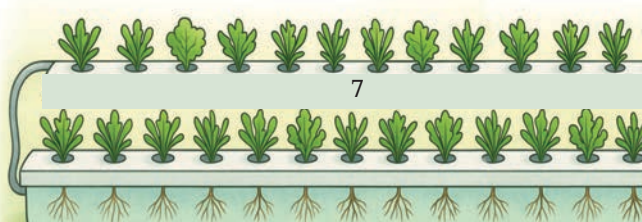


Figure 1.3 (f): *Materials required for adjusting the pH*



How do I keep myself and others safe?

Some key precautions to be followed while working in hydroponic farming are as follows:

1. **Safety while using tools and materials:** Wear gloves when handling tools, and pay attention during demonstrations to understand the correct techniques for using tools. Take special care when using sharp tools and power-driven machines like a drill machine and a submersible pump.
2. **Safety while using electrical gadgets:** Be careful while working with gadgets like aerators and submersible pumps. Work only under the supervision of the teacher or expert.

Internet safety: Ask your teacher for help while using the Internet. Be careful not to upload or download anything without checking. Do not share personal information with anyone.

What do I need to know before I start?

You have learnt in Science as well as in Vocational Education that plants require certain essential conditions to grow. Air, temperature, humidity, carbon dioxide, nutrients, soil and water are necessary for the growth of plants.

Try to use waste materials for your project. So, use scrapped plastic bottles and cups, Styrofoam sheets, and pipes to build hydroponic systems.

Now, reflect on whether these needs can be fulfilled even without soil. Record the details in Table 1.1.

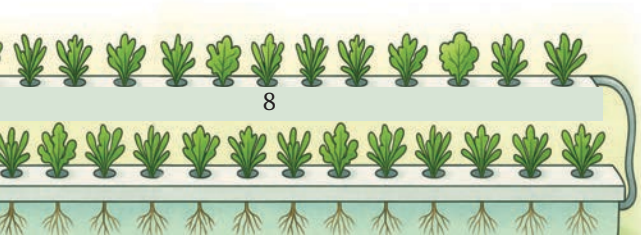
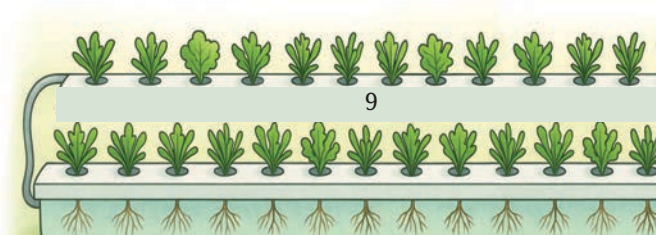


Table 1.1: Conditions for plant growth and how they can be fulfilled

Conditions for plant growth	How are they fulfilled when planted in soil?	Can we replace soil and ensure conditions are fulfilled?
Germination of seeds	Seeds absorb water and start the germination process.	Yes. Seeds can be soaked in water to germinate just like we make sprouts.
Physical support for plants	Roots hold soil to provide support to plants.	In hydroponics, plants are placed on floating sheets or net pots to hold them above water, thus providing the required support.
Sunlight for growth	Plants absorb sunlight to make their food through photosynthesis.	Sunlight and artificial light are both used in hydroponics.
Nutrients for plant growth	Plant roots absorb minerals in the soil.	In hydroponics, minerals (nutrients) are added to water in the required quantity and absorbed by plant roots.
Any other specific need	Plants or crops are sown directly in the soil with the addition of compost or fertilisers.	Growth media are used instead of soil. Some common growth media are coco coir, coco peat, gravel, sand, red-brick or clay, pebbles, rockwool, and vermicompost.

In addition to the above, plants also need help from microbes. You are probably aware that microbes are organisms that cannot be seen without a microscope. Microbes do multiple things useful for plants, like breaking down complex organic matter into simpler compounds so that plant roots can absorb them easily, suppress diseases and help in communication with neighbouring plants. However, care needs to be taken to ensure that only microbes that help plants grow are added to the water.



Therefore, any hydroponic unit must fulfil all these needs for the healthy growth of plants.

Did you know?

Indian Space Research Organisation (ISRO) has successfully sprouted cowpea seeds in its PSLV-C60 POEM-4 mission. The experiment for creating 'space gardens' is a crucial step towards the establishment of space stations and permanent human colonies in space.

Activity 1: Field visit to a farm

Before you start, it would be best to visit a place with a hydroponic unit—it could be a large unit or a small one run in a home.

You can try to find a hydroponic farmer or home gardener nearly. You can also contact the *Krishi Vigyan Kendra* (KVK) in your region, an agricultural university, college or a research centre.

Record your observations in Table 1.2.

Table 1.2: Record of observations during field visit

i. Date of visit: .....

ii. Name of the agri-clinic /KVK/farm:

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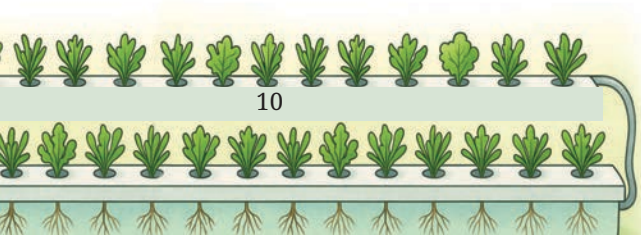
New technologies related to liquid nutrients, use of artificial lights instead of sunlight, simulating moisture in a dry area, protection from light and wind, control of water supply, etc.	**Observations**



You can watch hydroponic videos on the Internet. Such videos can be searched using the following keywords:

- Basics of hydroponics + school student
- (DIY) hydroponics + instructions + home
- Hydroponic system + beginner

Try to find videos created by the Indian Council of Agricultural Research (ICAR) or Agricultural Universities.

Your questions to experts may include the following:

1. What are the advantages and disadvantages of the hydroponics system?

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2. Is there any difference in the method or tools used for harvesting, transport, and storage?

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What do I have to do?

You will grow microgreens, vegetables and flowering plants using the hydroponic technique.

Plants need time to grow. Hence, you need to plan activities so that you will be able to harvest plants on time. Table 1.3 will help you to prepare a plan. You will also learn to record plant growth like vegetative growth (of stems and leaves), root growth, and the effect of changing water pH.

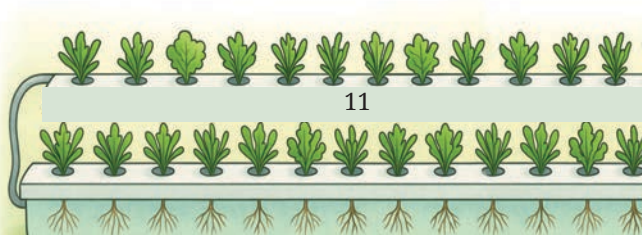


Table 1.3: Schedule for growing plants using different methods

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Build a microgreen system.	Observe microgreen growth.	Harvest microgreens Record the yield.	Record the growth of plants in the wick system.	Observe the growth of plants in the DWC system.	Experiment with compost tea applications.	Record the effect of compost tea and water pH on plant growth.
	Build a wick method hydroponic system.	Observe the growth of plants in the wick method.	Start making compost tea.	Build NFT hydroponic system.	Observe the growth of plants in the DWC and NFT systems.	Maintain DWC and NFT systems.
		Build DWC hydroponic system.	Observe the growth of plants in DWC.	Compost tea is ready for use.	Experiment with water pH change.	Harvest and record the yield.

Did you know?

Dal lake in Srinagar, Jammu and Kashmir with its floating farms (Figure 1.4), *'Phumdis'* made in Loktak lake of Manipur, and the floating garden of coastal Odisha are some of the other ancient farming methods that can be linked with hydroponic farming.

Figure 1.4: *Dal Lake in Srinagar with floating farm*

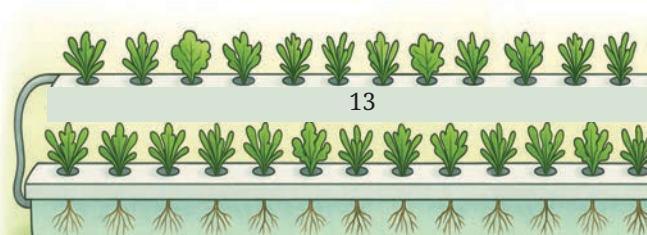
Activity 2: Growing microgreens for preparing a healthy salad.

Microgreens are young seedlings of vegetables and herbs. They are harvested just after the emergence of the initial 2–4 leaves (size 1–3 inches). Producing microgreens is an easy and quick way of producing healthy sprouts in a compact space. People find microgreens tasty and consume them raw. They use them for garnishing salads, soups and sandwiches. Microgreens are a rich source of vitamins C, E, K, and A, and carotenoids. They can be produced from various vegetables like cabbage, beetroot, fenugreek, mustard, spinach, coriander, and wheat.

You can use the Internet to find out different methods of growing microgreens. You can search using the following keywords:

- Do-It-Yourself (DIY) + methods of growing microgreens
- DIY + beginners + growing microgreen,
- Instructions + self-watering microgreens
- Instructions + beginners + microgreens with artificial light

Figure 1.5 shows the process of creating a microgreen producing system.



Step 1: Use a plastic tray or a flat earthen pot (ideally, dimensions should be 10 cm × 30 cm). You can also use old plastic-food-packaging containers, office trays, and flat planters to grow microgreens.
Make holes at the bottom of the tray to drain extra water.

Step 2: Fill the container with soil or cocopeat—about 2 inches deep.

Step 3: Uniformly moisten the soil by adding water.

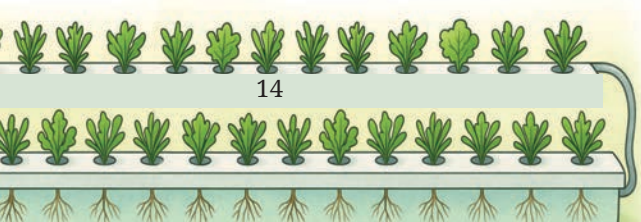
Step 4: Spread the seeds in the container and cover them with a thin layer of soil or cocopeat.

Step 5: Usually, seeds will start germinating within 2–3 days. Keep trays in a moist and humid place. Observe plant growth daily.
You can place the trays near a window for sunlight or in racks with artificial light, like a white tubelight or a Light Emitting Diode (LED) bulb.

Step 6: Harvest microgreens when you see a set of first true leaves (about 5 to 7 cm height). True leaves emerge after the initial seed leaves appear. For most microgreens, this is approximately 10 days after planting.

Cut the microgreens with scissors just above the soil surface. Gently rinse with water. You can eat them raw, use them for garnishing salads, or make sandwiches and pizza.

Figure 1.5: *Steps for growing microgreens*



Did you know?

Sprouts are generally grown without light and provide extra nutrients. They are consumed raw along with roots in 2–5 days.

Microgreens are grown with light, and extra nutrients can be added. They are consumed raw or as a garnish without roots in 10–15 days.

Record the details of the activity in Table 1.4.

The first leaves that appear when a seed germinates are called "seed leaves". Seed leaves are part of the seed that contains stored food, which the developing plant uses for nourishment until it can start making its food through photosynthesis. The leaves that appear after the seed leaves are called "true leaves".

Table 1.4: Recording details of growing microgreens

Date of start of the activity	
Materials used (tray size, types of seeds, quantity of soil used in grams)	
Number of trays prepared	
Number of days required for sprouting	
Number of days required for the emergence of the initial pair of leaves	
Date of harvest	
Quantity harvested per tray in grams	
Significant challenges or difficulties you faced during the activity	

Reflect on your learnings

1. What are the advantages and disadvantages of growing microgreens using hydroponics?

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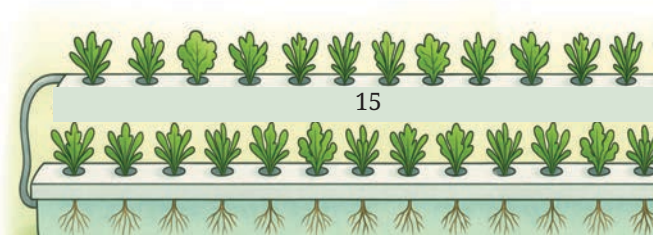

2. Have you used the microgreens? How did you use them (raw salad or as a garnish)?

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3. Can this method be applied to all crops? What are the probable limitations of microgreen production?

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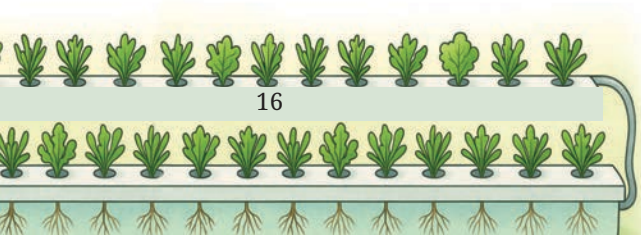
Activity 3: Building a hydroponic system using "Wick Method"

Plants are grown in microgreen systems for 1–2 weeks only. However, hydroponic systems are designed for the full growth of plants. A simple hydroponic system can be made from used (polyethylene terephthalate) PET bottles. It is a useful way to recycle waste into useful hydroponic planters.

You can watch hydroponic videos on the Internet. Such videos can be searched using the following keywords:

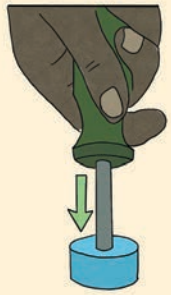
- Do-It-Yourself (DIY) + methods of wick hydroponics
- DIY + beginners + wick hydroponics
- Instructions + wick hydroponics
- Wick hydroponics + school learning activity

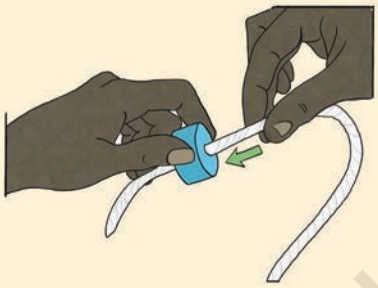
Figure 1.6 shows the process of growing plants using wick method.



Step 1: You can use any PET bottle. Take a used PET bottle of 2 L capacity. Cut the top (10–15 cm) with a cutter or knife under the teacher's supervision.

Step 2: Flip the top upside down to rest on the larger bottom part. The top part will be used as a planter while the bottom will be used as a water reservoir. Using a screwdriver or scissors, make a hole in the bottle cap.





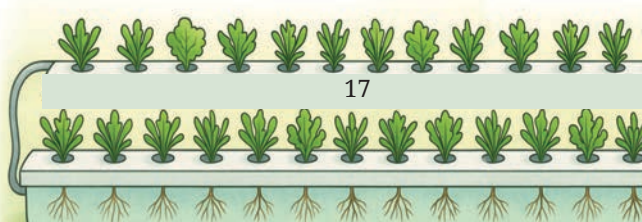
Step 3: Attach a wick of any waste cotton cloth or thread through the hole.

Step 4: Fill the bottom reservoir with water. Place the cap on the bottle and fill the latter with growth medium.

Step 5: Once the soil gets soaked, plant seeds or seedlings.

You can paint your hydroponic planters. Place a thread for hanging on wall or windows. You can also use PET bottles of different shapes and sizes to decorate a wall or window in school.

Figure 1.6: *Growing plants using wick method*



System maintenance: Wick method does not require much maintenance as it does not have a water pump, or electrical equipment, like an aerator. You need to add water in the reservoir, check wick functioning, and remove dead or older plants on a regular basis.

Record the details of the activity in Table 1.5.

Table 1.5: Details of growing plants using wick method

Number of wick bottles prepared by your class	
The quantity of soil used in grams	
Number of seeds/seedlings planted	
Number of plants survived	
Plant growth record (average height increased by 15 days)	

On the basis of the activity, respond to the following questions:

1. Which seeds, seedlings or plant cuttings did you use for the system?

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2. Were you able to observe the soil getting wet in the upper pot?

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   .....

The action is similar to getting pumped up by the wick. This is called 'capillary action'. Capillary action is the process by which liquid moves through a narrow space, like the fibres of a wick without the help of external forces like gravity.

3. List three key difficulties you experienced while building the system. What did you do to overcome them?

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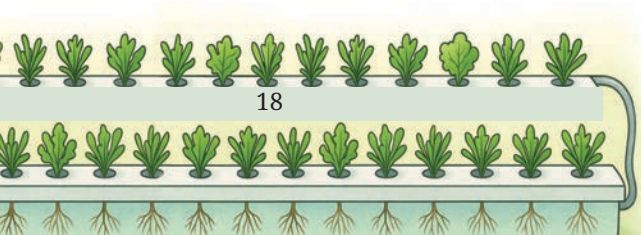
Now, move on to the following method of growing plants using hydroponics.



Activity 4: Building a hydroponic system using Deep Water Culture (DWC) or Bucket method

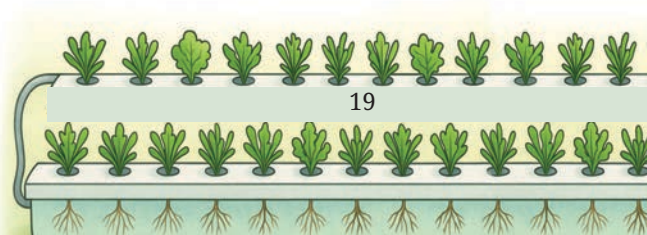
The Deep Water Culture (DWC) is one of the easiest and commonly used hydroponic methods. In this method, plant roots are suspended in water containing essential nutrients. Expanded Polystyrene (EPS), thermocol, or styrofoam sheets are used as a float for plants (Figure 1.7). Plants can be placed in plant cups, net pots, or on top of a bucket if styrofoam is unavailable. Net pots are used for planting seeds or seedlings. A bucket or water tube can be used as a water reservoir for small systems with plant nutrients.

Figure 1.7: *DWC hydroponics*

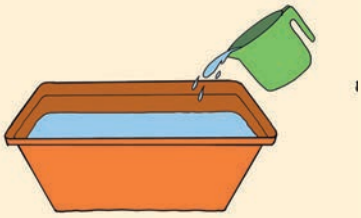
You can use the Internet to find different methods for building a hydroponic system using the DWC method. You can search using the following key search words:

- Do-It-Yourself (DIY) + methods of DWC hydroponics
- DIY + beginners + DWC hydroponics
- Instructions + DWC hydroponics
- DWC hydroponics + school learning activity

Oxygen is required for healthy root growth. When you aerate water, oxygen present in air get dissolved in water. This dissolved oxygen is used for plant growth and by other living organisms.



Now, build a DWC hydroponic system for cultivating spinach or any other leafy vegetable (Figure 1.8).

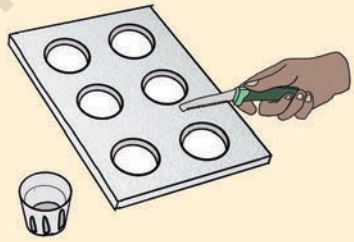


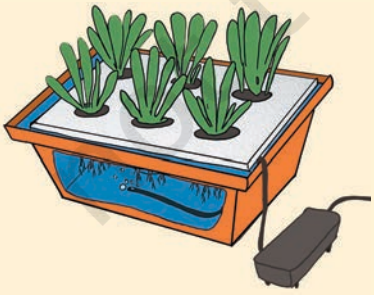
Step 1: Get a bucket or water tub (10–15 L capacity). You can use any recycled bucket or water tub. Just ensure that it does not leak.

Step 2: Make a lid for the bucket or tub using a plastic sheet (a wooden or styrofoam sheet can also be used).

Step 3: Now, make holes in the lid to place the plant cups (net pots). You can use tea or coffee cups as net pots by making holes or vertical slits.

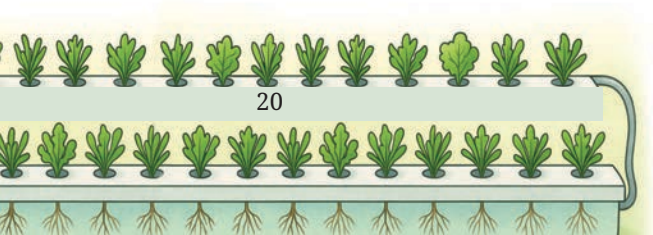
Step 4: Fill growth medium like cocopeat, coco-coir, or sand in the plant cup along with 2–3 seeds or seedlings of spinach.
A net cup needs to fit the hole firmly. You can keep a space of 5–10 cm between the cups.





Step 5: Add water in the reservoir such that it just touches the base of the net pot.
Place an aerator in the water tub and observe plant growth regularly.

Figure 1.8: *Growing plants using DWC hydroponic system*



System maintenance: Ensuring the working of the aerator is important for healthy root growth. Healthy roots should be white. If roots are brown, they may be starving due to lack of dissolved oxygen (DO). Similarly, water should be free from green algae. Covering the water surface with a styrofoam sheet prevents the entry of sunlight in to the water, preventing algae growth that may otherwise hinder plant growth.

Harvest vegetables regularly and replace old plants with new seedlings.

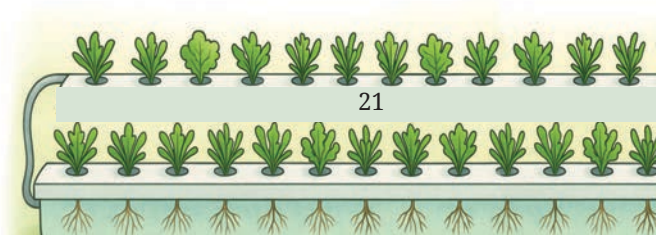
Complete Tables 1.6 and 1.7 based on your work.

Table 1.6: Details related to setting up the DWC hydroponic system

System component	Approximate cost (₹)
Water reservoir	
Planting cups	
Plant cup holder	
Air blower or aerator	
Growth media	
Plants	
Total cost	

Table 1.7: Observing growth of plants in DWC hydroponic system

Name of the crops (plants) used	
Date of planting	
Number of plants planted in the system	
Increase in height of plants per week	
Increase in root length per week	
Date of harvesting	
Quantity of harvest	



List three key challenges you faced during the construction and maintenance of the system. What will you do differently next time?

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.....

Activity 5: Building a hydroponic system using Nutrient Film Technique (NFT)

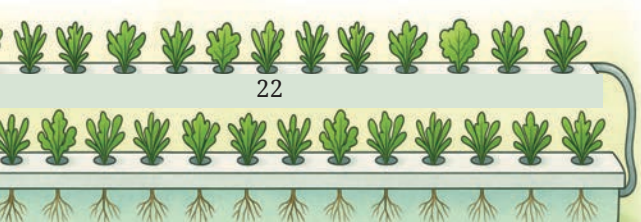
In the DWC hydroponic method, plant roots are suspended in standing water. The DWC system uses horizontal space. Vertical stacking of water tubs is complex due to the heavy load of the water reservoir. So, what if we take water near the root zone instead of placing the roots in standing water? This allow you to increase the number of plants while using lesser amount of water and utilise the vertical space. In this method, plants stand in a shallow stream of water. Water flows in the form of a thin film containing plant nutrients. As water continuously flows in a stream, NFT does not require an air pump to increase dissolved oxygen.

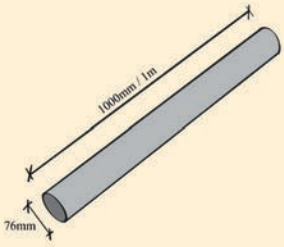
You can build an NFT system in different shapes and sizes, like horizontal or vertical stacking of pipes, a-frame or pyramid stacking, etc. You can select the shape based on space, material and convenience.

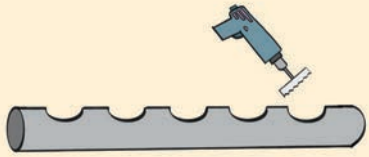
You can use the Internet to find different methods for building a hydroponic system using the NFT method. You can search using the following key search words:

- Do-It-Yourself (DIY) + methods of NFT hydroponics
- DIY + beginners + NFT hydroponics
- Instructions + NFT hydroponics
- NFT hydroponics + school learning activity

Follow the steps in Figure 1.9 to build the NFT system using Polyvinyl Chloride (PVC) pipes.

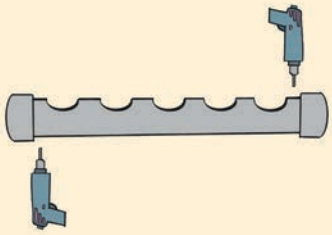




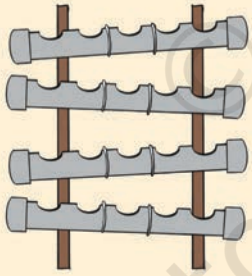


Step 1: Use a PVC pipe of 3 inch (76 mm) diameter and 1 metre length. You can plant 6 to 7 plants in a metre-long pipe. You can make stacks of 4–5 pieces.

Step 2: You will also need two end caps to close both ends of the pipe. Make holes at equal intervals in the PVC pipe using a saw drill. You must be careful to ensure that the size and distance of the holes accommodate the net pot and keep equal space between the plants.



Step 3: You can get the help of an expert (metal fabricator or carpenter) to drill a hole in the PVC pipe. Place the end caps at both ends of the pipe. Drill water inlet and outlet holes at the side of the end caps. You will need to seal these holes with a silicone glue gun after placing the water pipe.



Step 4: Make a structure using wooden or bamboo sticks or a metal rack to place the PVC pipe vertically.

Step 5: You can use a water bucket or a tub as a water reservoir. Add a water pump to the water inlet while connecting all the outlets to the NFT beds. You can attach a simple on–off timer for controlling water flow. An on–off timer is a device that automatically turns on or off an electrical appliance at pre-determined times.

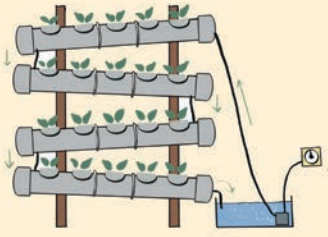
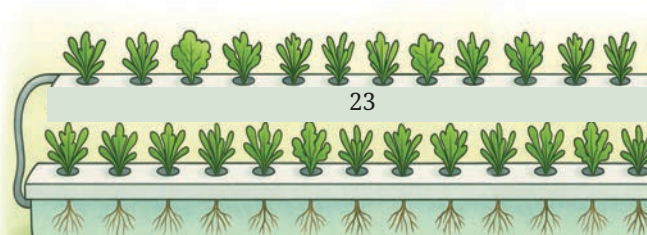


Figure 1.9: *Growing plants using NFT hydroponic system*



Complete Table 1.8 and 1.9 based on your work.

Table 1.8: Details relating to setting up the NFT hydroponic system

System component	Approximate cost (₹)
Total Cost	

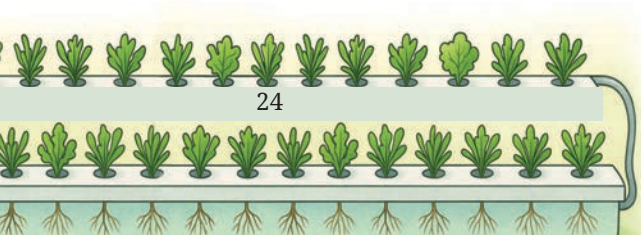
Table 1.9: Record of observations related to growth of plants using the NFT system

Name of the crops (plants) used	
Date of planting	
Number of plants planted in the system	
Observe the plant leaves for any colour change—this could be the symptom of disease, pest infestation or nutrient deficiency.	

System maintenance: You may need to adjust the water level in the pipes. Water level in the pipes should be around half of pipe diameter. Water level should not be too low (e.g., plant root not reaching water) or high (e.g., overflowing from pipes). To ensure there is no overflow from the pipes, adjust the slope of the pipes.

1. Why did you use an aerator in the DWC system but not in the NFT system?
   .....
2. Make a comparative chart for DWC vs NFT systems—you can compare aspects such as ease of construction, plant growth, etc.

You can use the Indian Council of Agriculture Research (ICAR) AI-DISC mobile application to identify plant diseases, pests, and nutrient deficiencies.



Activity 6: Making compost tea

You might have probably used compost or vermicompost while working with plants. Compost is made of decaying plants, food waste or manure. You will need liquid compost for a hydroponic system.

To make liquid compost, also known as compost tea, you will need a good quality compost from kitchen/garden waste. You can also use animal manure to make liquid manure. A good compost is dark brown to black with a pleasant earthy smell and crumbly (like tea leaves) texture.

You can make compost tea by following the steps as shown in Figure 1.10.

Step 1: Get 100 to 150 g of ready to use compost. Compost has essential plant nutrients, like nitrogen, phosphorus, potash, magnesium, sulphur, etc.

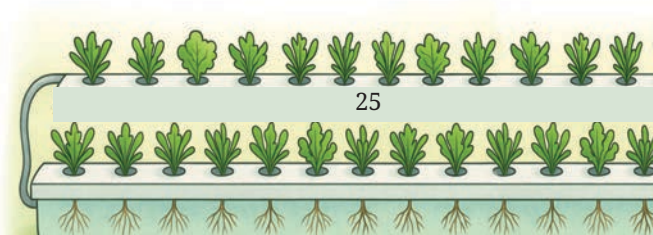
Step 2: Add compost to a muslin cloth and place it in a bucket of 15 L capacity. Add around 10 L water in bucket.

Step 3: Add 50 g jaggery or sugar, stir with wooden stick to mix it. Jaggery or sugar will act as food for microbes in compost. Microbes help plant roots to absopt plant nutrient faster.

Step 4: Put a aerator to brew it for 2–3 days. Aerator provides oxygen, essential for microbial growth.

After 2–3 days you will get a brown liquid ready to use for hydroponics. You can add 1 L liquid compost to 10 L hydroponic water.

Figure 1.10: *Process of making compost tea*



Write your observations in Table 1.10.

Table 1.10: Record of observations during process of making compost tea

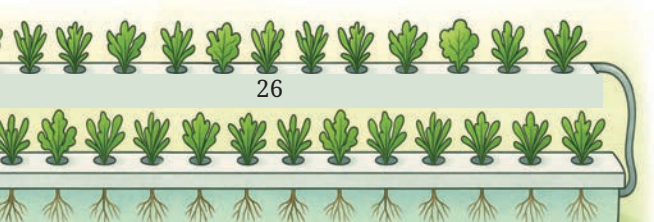
Parameter	Your observation	Usual observation	Remark/ Probable reason
Colour of compost tea		Compost tea is usually dark brown.	If it is very dark, dilute it by adding water in a 1:3 proportion.
Smell of compost tea		Compost tea should smell earthy.	If it smells bad, it may be due to poor aeration, too much compost, poor microbial balance, lower water use, or water evaporation.
Any other observations or difficulties faced		Foam formation on the surface, growth of maggots, mosquito larvae, and fungal growth on the water surface.	Sometimes, during aeration, foam forms on the surface of compost tea. It can occur due to microbial growth.

Did you know?

Apart from water pH, Dissolved Oxygen (DO), i.e., amount of oxygen dissolved in water, Total Dissolved Solids (TDS), i.e., concentration of all kinds of mineral, salts, metals and other impurities, water hardness, i.e., dissolved calcium and magnesium in water, Electrical Conductivity, i.e., ability of water to conduct electricity, which depends on dissolved ions, are some critical water quality paraments.

Activity 7: Maintaining water pH

Maintaining water quality parameters in hydroponics is very important for healthy plant growth. One of the critical water quality parameters for plant growth is pH. You have learnt about pH in your Science textbook in Grade 7; pH is the acidity or basicity of water.



Nutrient mobility (transport of nutrients from water to the plant body) is best when water pH is in the range of 6.0 to 7.0. If the pH is 7, then water is neutral. But if pH is more than 7, this means the water is alkaline. You need to add acid to reduce the pH so the value is between 6.5 and 7.0.

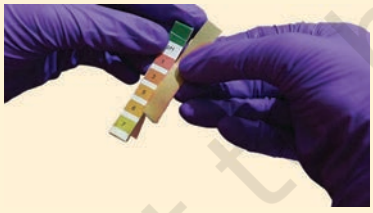
Let us check the pH of your hydroponic system. For this, you will need a strip of pH paper. Check the pH of your hydroponic system using the pH paper.

Generally, if the pH is more than 7, then you need to reduce the pH of hydroponic water by adding a weak acid like Acetic acid (Vinegar) or Citric acid (lime juice).

Check the pH of water by following the steps given below in Figure 1.11. Note your observations after the experiment with the hydroponics system in Table 1.11.

Step 1: Take 1 L of tap water. Check its pH with a pH paper strip. It will be neutral.

Step 2: Add a cup (20–30 mL) of a weak acid. Adjust its pH to 4 (acidic) using weak acids like vinegar or citric acid.

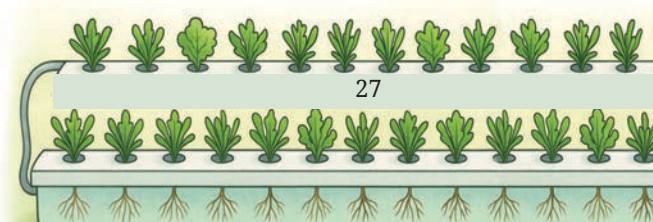


Step 3: Add this water to your hydroponic system (DWC or NFT). Check the change in the pH value of water.

Step 4: Check its effect on the growth of plant roots and leaves in 2–3 days, and note your observations.

If the pH of a hydroponic system is more acidic, you need to add a base to adjust the pH between 6.5 and 7.0.

Figure 1.11: *Maintaining water pH in hydroponic system*



Did you know?

Difference between Strong and Weak Acids: Hydroponic farmers/ gardeners can use strong or weak acids to reduce the pH of water. Strong acids (for example, phosphoric acid, sulfuric acid, nitric acid) are required in lower quantities but are challenging to handle. Weak acids (citric acid, acetic acid, monoammonium phosphate) are easier and safer to handle.

Record your observations in Table 1.11.

Table 1.11: Results of pH test of water before and after adding acid

Date	Activity	Observation
	What is the pH of your water?	
	Which acid did you use?	
	What is the water pH of the system after adding the acid?	
	After 4 days of adding acid, what is the effect of the change in pH of water in the hydroponic system?	

What did I learn from others?

1. Have you come across any other advanced farming technology in your locality? If yes, describe the technology.

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2. Name any three things that you learnt while setting up the hydroponic system.

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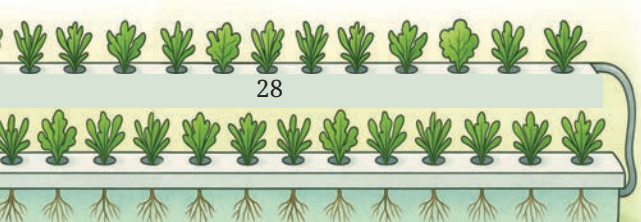


What did I do and how long did it take?

It is important to understand how much time is required for an activity to be completed.

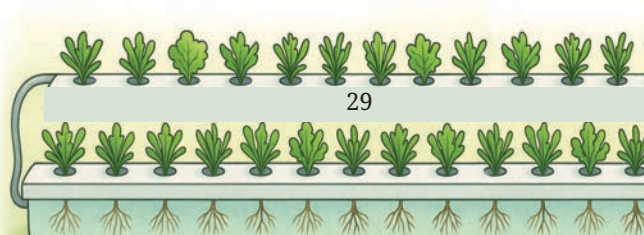
Calculate the approximate number of hours you spent on each activity. Mark them on the timeline below. If you did more than the activities suggested in the book, please add the number and time taken.

Activity	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Time taken (Periods)	---	---	---	---	---	---	---

What else can I do?

The following are some of the things you can try to expand your learning:

1. You can use the camera of a mobile phone to take photos or videos of the steps followed for the microgreen and hydroponic system production. You can make a photo-story using time-lapse photography or a short video of your systems.
2. You can paint wick-hydroponic bottles with attractive colours and gift them to school visitors and guests.
3. Try growth media you have not used for the different systems, for example, soil, sand, cocopeat, a mixture of all these, or anything else the experts recommend.
4. Find out the difference in temperature, humidity and light intensity, inside and outside a nursery. You can use a mobile-based application like 'MAUSAM' for the live weather report. You can also check the intensity of sunlight by using a lux meter application on a mobile phone.
5. Display hydroponic-farming models and posters of what you learned during the *Kaushal Mela*.



Think and Answer

1. What did you enjoy doing the most?
2. What were the challenges you faced?
3. What will you do differently next time?
4. Do you think it is economical and practically feasible to grow all crops using hydroponics? Give reasons for your response.
5. Identify a few examples of jobs related to the work you just did, for example, a gardener, botanist, forest officer, farmer, or agricultural scientist. Look around, speak to people and write your answer.