8.5

Microorganisms at our doorstep

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Overview

Things that are around us often go unnoticed. During the rainy season, drainage covers and pits in the ground fill up with water, mud, leaves, etc. Can the puddles, the soil in the garden, or the playground be a context for learning biology? These micro ecosystems support different forms of life that vary from place to place and from season to season. In this Learning Unit, students will explore their immediate surroundings, i.e. their 'doorstep', to learn about the tiny life-forms (microorganisms) in their own context. From the same sampling site, some students may find life-forms and others may not. Students can report their findings to each other and also to students and teachers from other schools. This will enable everyone to learn about the diversity of microbes across different locations all over the country.

Unit-specific objectives

- To identify the sources and diversity of microorganisms in the immediate surroundings
- To draw the microorganisms as seen under the microscope
- To document through photos and notings, the details of sample, location, etc., and share the findings

Note: Identification of microorganisms is not required for this unit.

Minimum time required

Four sessions of 40 minutes each

Type of Learning Unit

Local context, field.

Links to curriculum

- NCERT Class 8 Science Textbook: Chapter 2, Microorganism: Friend and foe; Chapter 8, Cells - Structure and function
- NCERT Class 9 Science Textbook: Chapter 7, Diversity in living organisms; Chapter 13, Why do we fall Ill

Introduction

In the rainy season, puddles are formed in our surroundings. We enjoy jumping over or into such puddles. Sometimes, we have sailed paper boats in them. Often we do not pay too much attention to such places. Do you know that such puddles, the holes in the drainage covers, even the soil in the backyard, can be of immense significance for learning/understanding about tiny life-forms, and their varieties?

We shall explore our immediate surroundings, i.e., our doorstep, to learn about the tiny life-forms (microorganisms) in the local context. Let us see what we can find in these places. We can collect some soil or sample from a puddle anywhere in our surrounding and use our skills with the microscope to explore what lies around us. As they say, variety is the spice of life!

Are you familiar with these ideas?

- unicellular and multicellular organisms
- classification of living organisms

Caution

Teachers must take care about the following:

Ensure the places of sample collection are safe for the students. Places where they play everyday, outside their school or home, etc. are usually harmless places from where students can collect samples. They may keep the sample for a day and observe again, but avoid keeping the samples for longer periods.

Students must dispose off the sample back into soil and wash the glassware with detergent and their hands with soap thoroughly. If any glassware seems to be more contaminated, then it can be disinfected by keeping it in boiling water for 10 minutes.

Task 1: Collect a sample

Begin by asking a few questions to stimulate curiosity among students and encourage them to think about ways to learn about something in their immediate surroundings.

"Do you think there are life-forms in your immediate surroundings that you cannot see with your eyes?"

" Can you think of places around you where you can find these?"

Ask the students to write the answers to a few questions posed here as a preparatory step towards the investigation of places around them to learn about life-forms.

Materials

(Samples from the local environment) soil sample, water from puddles, drainage covers, wells, ponds, small container, spoon, etc.

(Lab material) test tubes, test tube stand, droppers, brush, hand lens, microscope, slide, coverslip, brush, detergent, soap.

(Stationery items) pencil, paper, graph paper, labels, (optional items: marker pen, coloured pencils, sticky notes, sticky tape).

Q1. What do puddles contain?

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Q2 When you observe these puddles carefully over a period of time, what are your experiences and what do you notice?

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Q3. Instead of a puddle, if you were to observe just dry soil, would you find organisms in it? If so, where do you think these come from – soil, water, or air?

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Q4. When the wet soil in a puddle dries up, what happens to the life-forms in it?

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Q5. Will there be life-forms in a drop of clear water? Why do you think so?

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Q6. What do we call the life-forms that are visible under the microscope but not with the naked eye?

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In your school ground/backyard, locate some puddles and/or a drainage cover with pits that are filled with soil, leaves, water, etc. These puddles or pits on the drainage covers may be dry or wet depending on the season and place. Can you collect a sample of soil or water from such places ?

Q7. How will you collect a dry soil sample and a wet soil sample?

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Explain the process of collecting/preparing a sample.

If your location is a dry place (i.e. there is no puddle), then collect the soil sample with a spoon. Place it in a clean container. Add a few drops of water, shake, and then leave it to settle. Alternatively, one drop of milk can also be added along with water. (Discuss the role of milk for growth of bacteria in the sample).

If your location is a wet place, then collect the sample with a spoon and place it in a clean container. You may need to add a little water and allow it to settle.

Label the collected samples with name/id, date, time, location, and mention whether dry sample or wet sample.

Alternatively, teachers can prepare a sample of hay infusion by collecting a sample of dry grass/hay and keeping it in water for 1-2 days in advance. This sample can also be used for observation under the microscope.

Once the introductory questions are discussed, and the students know how to collect a sample, ask the students to locate a potential spot to collect a study sample.

After the task of locating and collecting a sample, teachers can facilitate students in preparing slides and observing them under the microscope. Teachers may need to help the students in aligning the slides, focusing with the appropriate objective lens, seeing through the eyepiece, light adjustment, the total magnification at which they are observing, the visual field in which they are observing, etc.

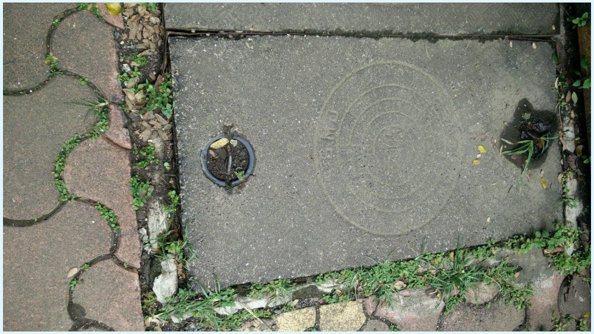

Figure 1 *Drainage Cover*

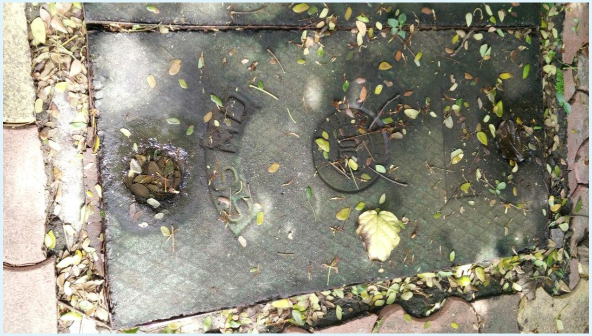

Figure 2 *Drainage Cover*

Figure 3 *Puddles*

Figure 4 *Puddles*

Task 2: Observe, describe, draw, and record

In the following task, you will prepare a slide of the sample and observe it under the microscope.

1. Prepare your slide - Place a drop of your sample on the slide and cover it with a cover-slip.
2. Pat off the excess water on the slide with a blotting paper.
3. Observe the slide under the 10X objective lens. Explore all the areas of the slide and note the variety of objects you see.
4. Once you find an object to observe, change the objective lens to the higher magnification and observe the same object. Observe the living organisms, and note the relative sizes.

Let the students know the following:

Handle the coverslips carefully, as they are very fragile and break easily. A coverslip confines the water-drop in a single plane. It also protects the objective lens from immersion into the water-drop. Use only the fine adjustment knob when focusing at higher magnification, to prevent from crashing into the slide.

Materials

(Lab material) test tubes, test tube stand, droppers, brush, hand lens, microscope, slide, coverslip, brush, detergent, soap.

(Microscope setup) ordinary compound microscope, dissection microscope, smartphone (as a digital camera), (optional items: ocular eyepiece, stage micrometre).

(Stationery items) pencil, paper, graph paper, labels, (optional items: marker pen, coloured pencils, sticky notes, sticky tape)

Calculate the total magnification (i.e. magnification of eyepiece X magnification of objective lens) while observing.

Total magnification is ____________________times.

Q1. What do you observe under the microscope (visual field)? Describe it in your own words in terms of the number of organisms, sizes, shapes, colours, location, movement, etc.

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Q2. Are the objects that you see living or non-living ? Why do you think so?

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On a plain paper or graph paper provided to you, draw what you observed. Draw a circle of your visual field and use the space inside the circle to draw the microorganisms that you observed according to their position, size, shape, colour, and so on.

Change the magnification and draw what you see, again following the same method of drawing inside the circle of visual field.

Using a smartphone or a camera, click pictures of the life-forms that you observed in the visual field. Share the photographs with the group and the teacher. Teachers can also collect students' drawings and prepare charts. These charts can be placed in the classroom or lab.

Ask the students to see each other's or other groups' slides, and compare the notes and diagrams. Encourage them to see if there is a diversity in the life-forms among the various samples. Discuss the students' observations.

Magnification: ______X

Magnification:______X

Help students to click photographs (using smartphone or camera), and share in the group. Teachers can use social media for making groups and sharing of observations. You can also join the Discussion platform on https://www.vigyanpratibha.in.

Note: Identification of microorganisms is not required for this unit.

Q3. Can you think of any other places where microorganisms may be present? Collect at least two more samples from your home or surroundings.

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Students can collect various samples from their surroundings. If the students cannot think of places to collect samples from, then the teacher can suggest exploring garden grass, hay, rotten vegetables, compost, garden soil, pond or lake water, spoiled bread slice or chapati, etc. In the next task, students can observe the various microorganisms from their collected samples.

Task 3: Explore and observe microorganisms in your surroundings

Prepare a slide for the new samples collected from your surroundings and observe it under the microscope.

Materials

(Stationery items) pencil, paper, graph paper, labels, (optional items: marker pen, coloured pencils, sticky notes, sticky tape).

If the students bring garden soil or compost soil, then ask them to observe the ants, insects, earthworms and their eggs, etc. without the microscope. Add water to the soil sample and allow the soil to settle down. Prepare the slide as explained in task 2.

If the students bring water samples from a pond or a lake, then they can put a drop of water directly on the slide.

If the students bring in rotten vegetables like beans with white cottony growth on it, bread mould, leaves with white powdery spots etc., then take a drop of water on the slide and mix a small piece of the spoiled part with the water droplet.

The teacher can extend this task by observing the following specimens: Supernatant/clear liquid from idli batter, water used to soak wheat for a day or two, sugar-cane juice rested for two to three hours after extraction etc.

Q1. What do you observe under the microscope (visual field)? Describe it in your own words stating the number of organisms, sizes, shapes, colours, location, movement, etc.

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Draw your observations on a plain paper or a graph paper.

Change the magnification and draw the same microorganisms at various magnifications. You can follow the earlier method of drawing inside the circle of visual field.

Drawing will encourage students to observe the minute details of an image. This will also enable them to compare and differentiate their observations for the earlier and this sample.

Q2. Have you observed the same kinds of organisms in two different samples? The different samples can be either from different sources or from same source but from different days. If yes, what was the difference between them, if any? State in terms of number, size, variety, etc.

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Q3. If you have observed such differences, what would you like to infer from them?

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Task 4: Estimation of the size of a microorganism

Size is an important characteristic of each microorganism. Since you have learnt how to use a microscope in Learning Unit 8.4, can you now estimate the sizes of microorganisms that you see?

Using a plastic ruler (as shown in Task 6, LU 8.4), find the diameter of the visual field.

The diameter of visual field = _ _ _ _ _ _ _ _ mm = _ _ _ _ _ _ _ _ micrometer (Note: 1 mm = 1000 micrometer)

Now consider one of the organisms your have observed and drawn above. If you want, you can make a small sketch here for reference. Mark it Organism 1.

Imagine and guess how many organisms of the same kind you can keep side by side along the diameter of the visual field. Number =_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

From these two numbers (diameter of the visual field and number of organisms than can fit along diameter), estimate the size of the organism.
Size = _ _ _ _ _ _ _ mm = _ _ _ _ _ _ _ _ micrometer.

Following the same method, estimate the size for other microorganisms as well.

Organism 2: Size = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Organism 3: Size = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Organism 4: Size = _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Materials

(Stationery items) ruler, pencil, paper, graph paper, labels, (optional items: marker pen, coloured pencils, sticky notes, sticky tape).

Points for further discussion

The teacher can lead the discussion on the variety of organisms present in our immediate surroundings. The teacher can enrich the discussion by asking questions, such as - *Are microorganisms good for humans or are they all bad?* Even if there are microbes around us we do not fall sick, because most of them are good bacteria that are useful. The microbes are essential in fermentation of several useful products that humans consume. the Teachers can discuss the role of good bacteria in antibiotics, the role of microorganisms in vaccines, the role of bacteria in maintaining ecological balance by reducing the pathogens in environment, the role of microorganisms in cleaning up, etc.

A useful context about the role of microbes for ecological services/environment can thus be discussed. You may ask - *Have you ever seen any colonies of microbes (particularly bacteria and moulds) growing on damp surfaces, or in natural environments? What do you think is happening when microbes grow on something?* (The microbes are using the substance as a food source).

Discuss the important/various roles of microorganisms, for example, as decomposers of dead organic material in ecosystems.

Introduce the use of stains while observing microscopic organisms. Discuss the difference in images when we use or do not use a stain. - *What advantages can staining bring in for observing microscopic organisms?*

Summary and reflection

After the four sessions, teachers can summarise the sessions based on:

- Objectives
- Learning outcomes
- Students' experiences of observing life-forms
- Students' drawings of microorganisms
- Difficulties/challenges that occured during the Learning Unit
- Suggestions from students about the Learning Unit

See LU 8.4 "Looking through a microscope" for suggested readings.

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