

9

Soil



0758CH09

Soil is one of the most important natural resources. It provides anchorage to the plants and supplies water and nutrients. It is the home for many organisms. Soil is essential for agriculture. Agriculture provides food, clothing and shelter for all. Soil is thus an inseparable part of our life. The earthy fragrance of soil after the first rain is always refreshing.



Fig. 9.1 Children playing with soil

9.1 SOIL TEEMING WITH LIFE

One day during the rainy season Paheli and Boojho observed an earthworm coming out of the soil. Paheli wondered whether there were other organisms also in the soil. Let us find out.

Activity 9.1

Collect some soil samples and observe them carefully. You can use a hand lens. Examine each sample carefully and fill in Table 9.1.

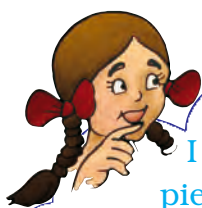
- Discuss your observations with your friends.
- Are the soil samples collected by your friends similar to the ones collected by you?

Boojho and Paheli have used soil in many ways. They enjoy playing with it. It is a great fun indeed.

Make a list of the uses of soil.

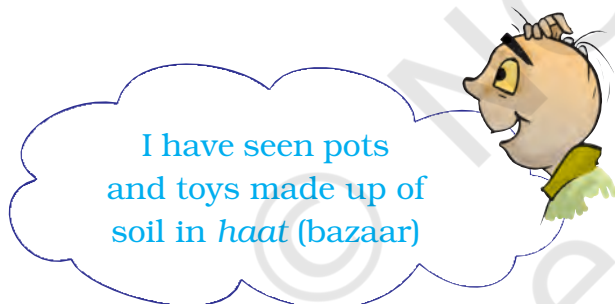
Table 9.1

S. No.	Soil source	Plants	Animals	Any other observations
1.	Garden soil	Grass,	Ant,	
2.	Soil from the roadside			
3.	Soil from the area where construction is going on			
4.				
5.				



I wonder why I found some pieces of plastic articles and polythene bags in the soil sample collected from the roadside and the garden.

Polythene bags and plastics pollute the soil. They also kill the organisms living in the soil. That is why there is a demand to ban the polythene bags and plastics. Other substances which pollute the soil are a number of waste products, chemicals and pesticides. Waste products and chemicals should be treated before they are released into the soil. The use of pesticides should be minimised.



I have seen pots and toys made up of soil in *haat* (bazaar)

9.2 SOIL PROFILE

Soil is composed of distinct layers. Perform the following activity to find out how these layers are arranged.

Activity 9.2

Take a little soil. Break the clumps with your hand to powder it. Now take a glass tumbler, three quarters filled with water,

and then add a handful of soil to it. Stir it well with a stick to dissolve the soil. Now let it stand undisturbed for some time (Fig. 9.2). Afterwards, observe it and answer the following questions:

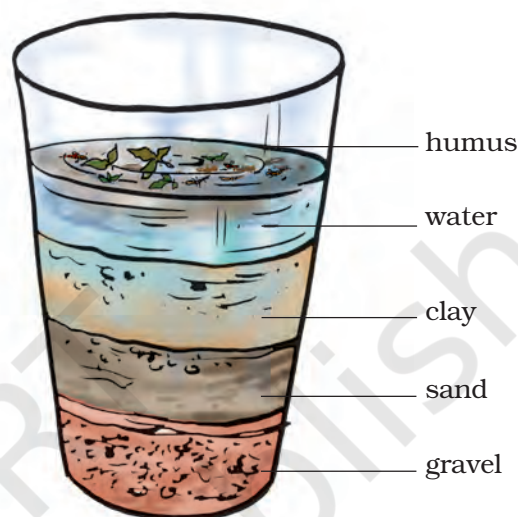


Fig. 9.2 Layers of soil

- Do you see layers of particles of different sizes in the glass tumbler?
 - Draw a diagram showing these layers.
 - Are there some dead rotting leaves or animal remains floating on water?
- The rotting dead matter in the soil is called **humus**.

You probably know that the soil is formed by the breaking down of rocks by the action of wind, water and climate. This process is called **weathering**. The nature of any soil depends upon the rocks from which it has been formed and the type of vegetation that grows in it.

A vertical section through different layers of the soil is called the **soil profile**. Each layer differs in feel (texture),

colour, depth and chemical composition. These layers are referred to as **horizons** (Fig. 9.3).

soil fertile and provides nutrients to growing plants. This layer is generally soft, porous and can retain more water. It is called the **topsoil** or the **A-horizon**.

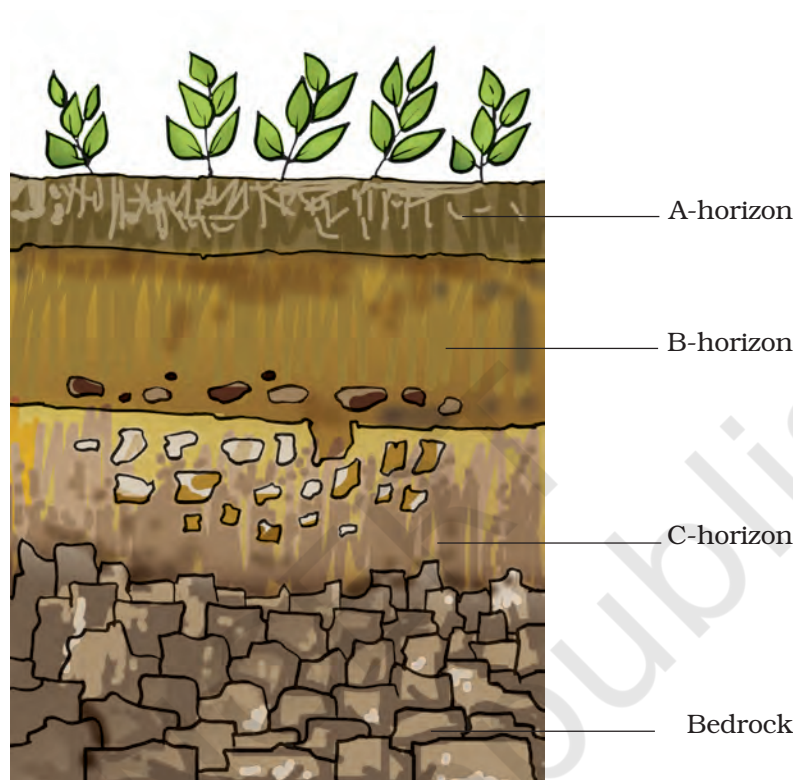


Fig. 9.3 Soil profile

We usually see the top surface of the soil, not the layers below it. If we look at the sides of a recently dug ditch, we can see the inner layers of the soil, too. Such a view enables us to observe the soil profile at that place. Soil profile can also be seen while digging a well or laying the foundation of a building. It can also be seen at the sides of a road on a hill or at a steep river bank.

The uppermost horizon is generally dark in colour as it is rich in humus and minerals. The humus makes the

This provides shelter for many living organisms such as worms, rodents, moles and beetles. The roots of small plants are embedded entirely in the topsoil.

The next layer has a lesser amount of humus but more of minerals. This layer is generally harder and more compact and is called the **B-horizon** or the middle layer.

The third layer is the **C-horizon**, which is made up of small lumps of rocks with cracks and crevices. Below

this layer is the **bedrock**, which is hard and difficult to dig with a spade.

9.3 SOIL TYPES

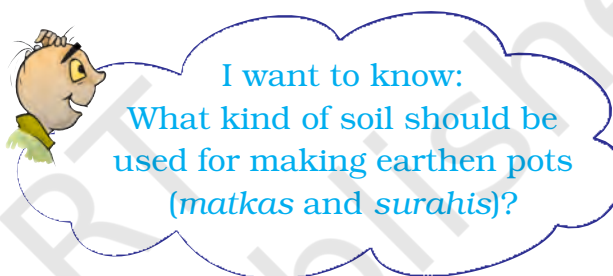
As you know, weathering of rocks produces small particles of various materials. These include sand and clay. The relative amount of sand and clay depends upon the rock from which the particles were formed, that is the parent rock. **The mixture of rock particles and humus is called the soil.** Living organisms, such as bacteria, plant roots and earthworm are also important parts of any soil.

The soil is classified on the basis of the proportion of particles of various sizes. If soil contains greater proportion of big particles it is called **sandy soil**. If the proportion of fine particles is relatively higher, then it is called **clayey soil**. If the amount of large and fine particles is about the same, then the soil is called loamy. Thus, the soil can be classified as sandy, clayey and loamy.

The size of the particles in a soil has an influence on its properties. Sand particles are quite large. They cannot fit close together, so there are large spaces between them. These spaces are filled with air. We say that the sand is well aerated. Water can drain quickly through the spaces between the sand particles. So, sandy soils tend to be light, well aerated and rather dry. Clay particles, being much smaller, pack tightly together, leaving little space for air. Unlike sandy soil, water can be held in the tiny gaps between the particles of clay. So clayey soils have less air. But

they are heavy as they hold more water than the sandy soils.

The best topsoil for growing plants is loam. **Loamy soil** is a mixture of sand, clay and another type of soil particle known as silt. Silt occurs as a deposit in riverbeds. The size of the silt particles is between those of sand and clay. The loamy soil also has humus in it. It has the right water holding capacity for the growth of plants.



Activity 9.3

Collect samples of clayey, loamy and sandy soils. Take a fistful of soil from one of the samples. Remove any pebbles, rocks or grass blades from it. Now, add water drop-by-drop and knead the soil [Fig. 9.4 (a)]. Add just enough water so that a ball [Fig. 9.4 (b)] can be made from it, but at the same time it should not be sticky. Try to make a ball [Fig. 9.4 (c)] from this soil. On a flat surface, roll this ball into a cylinder [Fig. 9.4 (d)]. Try to make a ring from this cylinder [Fig. 9.4 (e)]. Repeat this activity with other samples also. Does the extent to which a soil can be shaped indicate its type?

Can you suggest which type of soil would be the best for making pots, toys and statues?

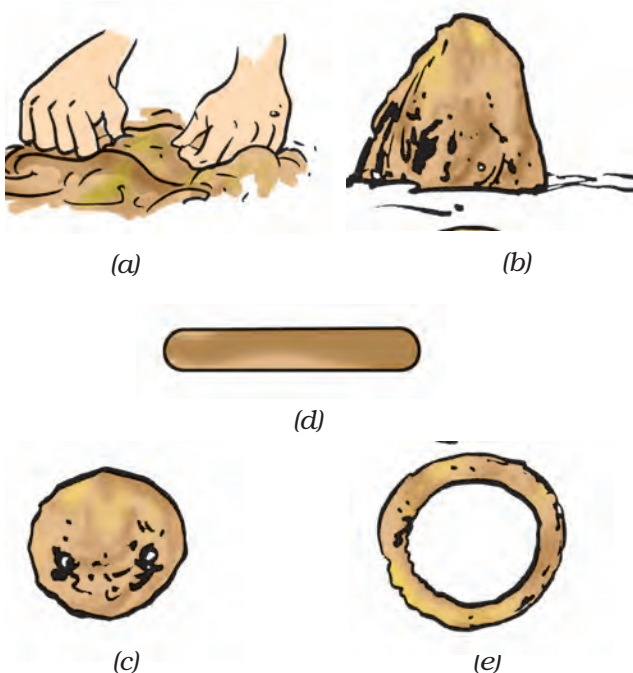


Fig. 9.4 Working with the soil

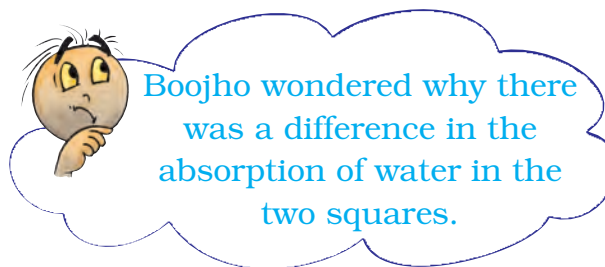
9.4 PROPERTIES OF SOIL

You have listed some uses of soil. Let us perform some activities to find the characteristics of the soil.

Percolation rate of water in soil

Boojho and Paheli marked two different squares of 50 cm × 50 cm each, one on the floor of their house and the other on the *kutchra* (unpaved) road. They filled two bottles of the same size with water. They emptied the water from the bottles, one each, at the same time in the two squares. They observed that the water on the floor flowed down and was not absorbed. On the *kutchra* road, on the other hand, the water was absorbed.

Now let us perform an activity to understand this.



Activity 9.4

For this activity divide yourself into three teams. Name the teams A, B and C. You will be finding out how fast the water passes down the soil. You will need a hollow cylinder or a pipe. Ensure that each team uses pipes of the same diameter. Some suggestions for obtaining such a pipe are given below:

1. If possible, get a small tin can and cut off its bottom.
2. If PVC pipe (approx. diameter 5 cm) is available, cut it into 20 cm long pieces and use them.

At the place where you collect the soil, place the pipe about 2 cm deep in the ground. Pour 200 mL water in the pipe slowly. For measuring 200 mL water you can use any empty 200 mL bottle. Note the time when you start pouring water. When all the water has percolated



Fig. 9.5 Measuring rate of percolation

leaving the pipe empty, note the time again. Be careful not to let the water spill over or run down on the outside of the pipe while pouring. Calculate the rate of percolation by using the following formula:

$$\text{percolation rate (mL/min)} = \frac{\text{amount of water (mL)}}{\text{percolation time (min)}}$$

For example, suppose that for a certain sample, it took 20 minutes for 200 mL to percolate. So,

$$\text{rate of percolation} = \frac{200 \text{ mL}}{20 \text{ min}} = 10 \text{ mL/min}$$

Calculate the rate of percolation in your soil sample. Compare your findings with others and arrange the soil samples in the increasing order of the rate of percolation.

9.5 MOISTURE IN SOIL

Have you ever passed through a farmland during a hot summer day? Perhaps you noticed that the air above the land is shimmering. Why is it so? Try out this activity and find the answer.

Activity 9.5

Take a boiling tube. Put two spoonfulls of a soil sample in it. Heat it on a flame (Fig. 9.6) and observe it. Let us find out what happens upon heating.

Do you see water drops anywhere? If yes, where did you find them?

On heating, water in the soil evaporates, moves up and condenses on the cooler inner walls of the upper part of the boiling tube.

On a hot summer day, the vapour coming out of the soil reflect the sunlight

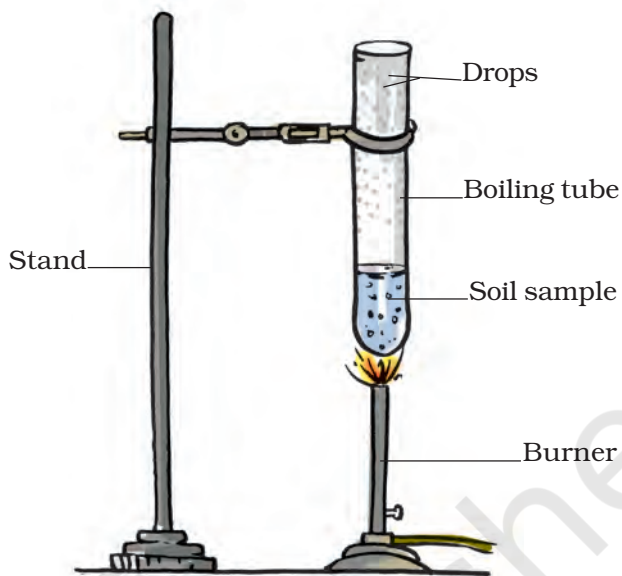


Fig. 9.6 Removing moisture from the soil

and the air above the soil seems to shimmer.

After heating the soil, take it out of the tube. Compare it with the soil which has not been heated. Note the difference between the two.

9.6 ABSORPTION OF WATER BY SOIL

Do all the soils absorb water to the same extent? Let us find out.

Activity 9.6

Take a plastic funnel. Take a filter paper (or a piece of newspaper sheet), fold and place it as shown in the figure (Fig. 9.7). Weigh 50g of dry, powdered soil and pour it into the funnel. Measure a certain amount of water in a measuring cylinder and pour it drop by drop on the soil. You can use a dropper for this purpose. Do not let all the water fall at one spot.

Pour water all over the soil. Keep pouring water till it starts dripping.

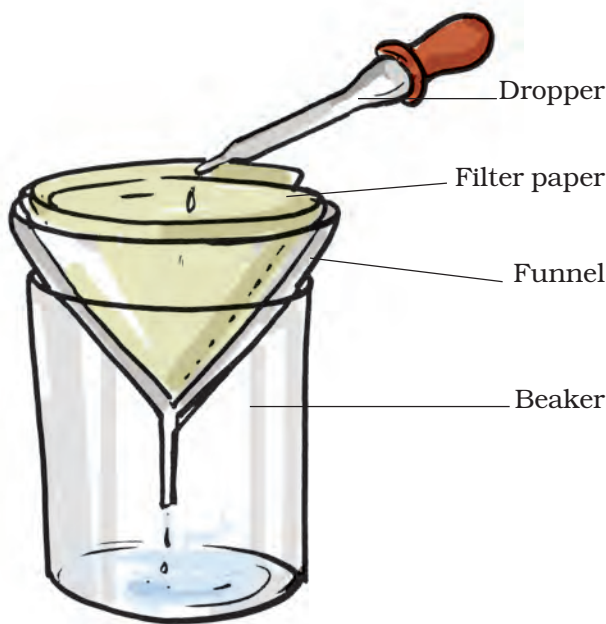


Fig. 9.7 Absorption of water in the soil

Subtract the amount of water left in the measuring cylinder from the amount you started with. This is the amount of water retained by the soil. Record your results in your notebook in the following manner:

Weight of soil = 50g

Initial volume of water in the measuring cylinder = U mL

Final volume of water in the measuring cylinder = V mL

Volume of water absorbed by the soil = (U – V) mL

Weight of water absorbed by the soil = (U – V) g

(1 mL of water has weight equal to 1 g)

percentage of water absorbed

$$= \frac{(U - V)}{50} \times 100$$

Repeat this activity with different soil samples. Would you get the same results for all the samples? Discuss the results with your friends and answer the following question:

- Which soil would have the highest percolation rate?
- Which soil would have the lowest percolation rate?
- Boojho heard from his neighbour that 8–10 days after the rain, the level of water in a pond or well rises. Which type of soil will allow water to reach a well faster and in greater amount?
- Which type of soil retains the highest amount of water and which retains the least?
- Can you suggest any method to let more rain water percolate and reach the water underground?

9.7 SOIL AND CROPS

Different types of soils are found in different parts of India. In some parts there is clayey soil, in some parts there is loamy soil while in some other parts there is sandy soil.

Soil is affected by wind, rainfall, temperature, light and humidity. These are some important climatic factors which affect the soil profile and bring changes in the soil structure. The

Gram (g) and kilogram (kg) are actually units of mass. A mass of 1 gram weighs 1 gram weight, and a mass of 1 kilogram weighs 1 kilogram weight. However, in daily life, and in commerce and industry, the distinction between gram and gram weight is generally omitted.

climatic factors, as well as the components of soil, determine the various types of vegetation and crops that might grow in any region.

Clayey and loamy soils are both suitable for growing cereals like wheat, and gram. Such soils are good at

retaining water. For paddy, soils rich in clay and organic matter and having a good capacity to retain water are ideal. For lentils (*masoor*) and other pulses, loamy soils, which drain water easily, are required. For cotton, sandy-loam or loam, which drain water easily

A case study

John, Rashida and Radha went to Leeladhar Dada and Sontosh Malviya of Sohagpur in Madhya Pradesh. Leeladhar Dada was preparing the soil to make items like *surahi*, *matki*, *kalla* (earthen frying pan) etc. The following is the conversation they all had with Leeladhar Dada:

– Where was the soil obtained from?

Dada–We brought the black soil from a piece of barren land.

– How is the soil prepared?

Dada–Dry soil will be placed in a large tank and would be cleaned of pebbles etc. After removing these things the soil will be soaked for around 8 hours. This soil would be kneaded after mixing horse dung. The kneaded soil would be placed on the wheel and given appropriate shape. The final shape is given with hands. The items are coloured after three days of drying. All the items are baked at high temperature after drying in the air.

– Why is the horse dung mixed in soil?

Dada–Burnt horse dung helps open up the pores in the soil. So that water could percolate out of the *matkas* and *surahis*, evaporate and cools the water inside. You know Sohagpuri *surahis* and *matkas* are famous in far off places like Jabalpur, Nagpur, Prayagaraj (erstwhile Allahabad) etc.



Fig. 9.8 Making pots

and can hold plenty of air, are more suitable.

Crops such as wheat are grown in the fine clayey soils, because they are rich in humus and are very fertile. Find from your teachers, parents and farmers the type of soils and crops grown in your area. Enter the data in the following Table 9.2:

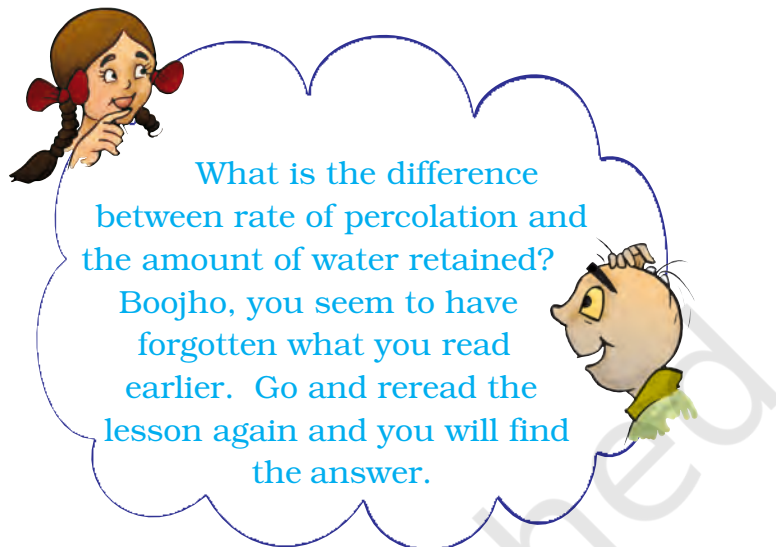
Which kind of soil would be most suitable for planting rice? Soil with a higher or lower rate of percolation?

Table 9.2

S. No.	Type of soil	Crop grown
1.	Clayey	Wheat
2.		
3.		

Keywords

Clayey	Moisture
Humus	Sandy
Loamy	Water retention
Percolation	



Soil erosion

The removal of land surface by water, wind or ice is known as erosion. Plant roots firmly bind the soil. In the absence of plants, soil becomes loose. So it can be moved by wind and flowing water. Erosion of soil is more severe in areas of little or no surface vegetation, such as desert or bare lands. So, cutting of trees and deforestation should be prevented and effort should be made to increase the green areas.

What you have learnt

- Soil is important for life on the earth.
- Soil profile is a section through different layers of the soil, Various layers are called horizons.
- Soil is of different types: clayey, loamy and sandy.
- Percolation rate of water is different in different types of soil. It is highest in the sandy soil and least in the clayey soil.
- Different types of soils are used to cultivate different types of crops. Clay and loam are suitable for growing wheat, gram and paddy. Cotton is grown in sandy loam soil.

- Soil holds water in it, which is called soil moisture. The capacity of a soil to hold water is important for various crops.
- Clayey soil is used to make pots, toys and statues.

Exercises

Tick the most suitable answer in questions 1 and 2.

- In addition to the rock particles, the soil contains
 - air and water
 - water and plants
 - minerals, organic matter, air and water
 - water, air and plants
- The water holding capacity is the highest in
 - sandy soil
 - clayey soil
 - loamy soil
 - mixture of sand and loam

- Match the items in Column I with those in Column II:

Column I

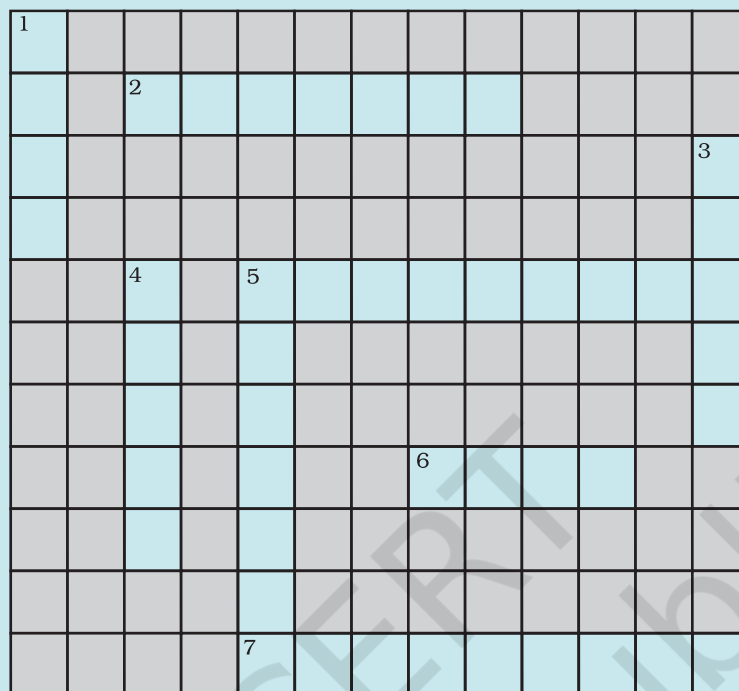
- A home for living organisms
- Upper layer of the soil
- Sandy soil
- Middle layer of the soil
- Clayey soil

Column II

- Large particles
- All kinds of soil
- Dark in colour
- Small particles and packed tight
- Lesser amount of humus

- Explain how soil is formed.
- How is clayey soil useful for crops?
- List the differences between clayey soil and sandy soil.
- Sketch the cross section of soil and label the various layers.
- Razia conducted an experiment in the field related to the rate of percolation. She observed that it took 40 min for 200 mL of water to percolate through the soil sample. Calculate the rate of percolation.

9. Explain how soil pollution and soil erosion could be prevented.
10. Solve the following crossword puzzle with the clues given:



Across

2. Plantation prevents it.
5. Use should be banned to avoid soil pollution.
6. Type of soil used for making pottery.
7. Living organism in the soil.

Down

1. In desert soil erosion occurs through.
3. Clay and loam are suitable for cereals like.
4. This type of soil can hold very little water.
5. Collective name for layers of soil.

Extended Learning — Activities and Projects

1. Boojho would like to know the difference between raw and baked soil? Investigate how the soil from which *matkas* are made is different from the soil used to make statues.

2. Paheli is worried. She could see a brick kiln from her house. Bricks were being made there. There was so much smoke coming out of the kiln. She was told that the best quality of clay is required for making pottery, statues and bricks. She has seen truck loads of bricks being taken away for construction of buildings. At this rate, she fears, no soil will be left. Are her fears justified? Discuss this problem with your parents, teachers and other experts of your area and prepare a report.
3. Try to find out the moisture content of a soil sample. One method is given here.

Activity: Take 100g soil. (Take help from any shopkeepers to weigh the soil.) Place it on a newspaper in the sun and allow it to dry for two hours. This activity is best done in the afternoon. Take care that the soil does not spill outside the newspaper. After drying it, weigh the soil again. The difference in the weight of the soil before and after drying gives you the amount of moisture contained in 100 g of soil. This is called the percentage moisture content.

Suppose your sample of soil loses 10 g on drying. Then

$$\text{Per cent of moisture in soil} = \frac{\text{wt. of moisture (g)}}{\text{Original wt. of soil sample (g)}} \times 100$$

In this example

$$\text{Per cent of moisture in soil} = \frac{10 \times 100}{100} = 10\%$$

Did you know?

Rivers of north India, which flow from Himalayas, bring a variety of materials including silt, clay, sand and gravel. They deposit their materials called alluvial soil, in the planes of north India. This soil is very fertile and supports nearly half the population of India.