

# SCIENCE

# Soil

# **Learning Objectives**

- 1. To understand concept of soil formation
- **2.** To understand soil profile and composition of soil
- **3.** To learn about different types of soil
- **4.** To study soil erosion-its causes and preventions
- **5.** To learn about soil pollution –its sources and control.

Soil is a precious gift from nature. Soil supports life on earth. Most people think soil as a layer of dirt and mud. However this layer of mud and dirt is actually filled with life. Food we eat, fibre we use to make fabric, habitat for various organism etc. is provided by soil. If you closely observe a freshly dug pit you may see various creatures like earthworm, ants, beetles etc. Soil provides nutrients to the plants and support their growth. All living organisms depend directly or indirectly on soil. Let's learn more about soil.





# SOIL

The mixture of rock particles and humus is called soil. Soil is an important natural resource. It contains water, dissolved substances, mineral salts and living organisms. Soil forms a very thin layer on the surface of the earth ranging from a few m to 3 to 4 m.

Note: Humus is a brown or black organic substance formed from decaying plant remains or animal matter. It determines the fertility of soil. It is porous in nature and increases the ability of soil to retain water.

# SOIL FORMATION

Soil is formed from parent rock material over millions of years by a process of weathering. Weathering is the process of breaking down of rock present on the surface of earth into fine particles.

## Weathering Occurs by Two Main Processes

(a) Physical weathering, which is caused by physical phenomena like atmospheric changes (heating, cooling, wetting-drying etc).

(b) Biological weathering, which involves breaking down of rocks by the action of living organisms.

Do you know?

Earthworm's burrows act as tunnels which allow water to moves quickly and provide pathways for roots to grow. They also decompose dead plants and animal matter. Their castings are valuable as fertilizer.



# SOIL PROFILES

Soil profile is a vertical section of different layers of the soil. Various layers are called horizons. Each layer diners in colour, depth, chemical composition. Generally we see the top surface of the soil, not layers below it. Soil profile can be seen while digging a we!l or laying the foundation of a building. Soil profile i.e. various layers of soil can also be observed in a deep cut through the soil. Typically, four distinct soil layers can be seen. It can also be seen at the sides of a mad on a hill or at steep river bank.

A-Horizon

The upper most horizon is dark in colour. It is rich in humus and minerals. The humus makes the soil fertile and provides nutrients to growing plants. It is generally a soft, porous layer and can retain more water. It is also called top-soil or the A-horizon.

Functions of Top-soil or A-horizon

(i) it provides shelter for many living organisms such as worms, rodents, moles and beetles

 $(\mathrm{ii})$  The roots of small plants are embedded entirely in the top-soil

B - Horizon

Middle Layer or B-horizon or subsoil is the layer next to the top-most soil or A-horizon. It contains lesser amount of humus but contains more of minerals. It is generally harder and more compact.

# C- Horizon

Third layer or C-horizon is the layer below the Blayer and is made up of small lumps of rocks with cracks and crevices. It is difficult to dig beyond this layer.

#### R- Horizon

Bed rock or R-horizon is a layer below Chorizon. It is hard and difficult to dug with a spade. It mainly consists of parents rock. It undergoes weathering.

#### **COMPOSITION OF SOIL**

Main components of soil are:

(i) Soil particles like sand, silt, clay, gravel etc.

(ii) Humus, an organic matter formed by decomposition of dead organisms.

(iii) Air, Water, Soil organisms.

The difference in the proportion of these components leads to the formation of different kinds of soil.

#### Do you know?

When rainwater sinks underground, it reaches the impervious layer R-horizon and accumulates over it. This water is called groundwater. The upper level of this layer which is saturated with water is the water table. Water table is rarely leveled and follows the general slope and land above it. The level of water table fluctuates from season to season. It rises in the rainy season and falls in the dry season.

### **TYPES OF SOIL**

On the basis of proportion of particles of various sizes soil can be classified as.

(i) Sandy soil: If soil contains greater proportion of big particles it is called sandy soil.

(ii) Clayey soil: In such a soil the proportion of fine particles is relatively higher.

(iii) Loamy Soil: In such a soil the amount of large and fine particles is about the same.

Properties of Various Types of Soil

(i) Sandy Soil: Contains sand particles of large size and they can't fit close together. Large spaces are available between them. The spaces are filled with air and thus such a soil is well aerated, water can drain through the spaces and so sandy soil is light, well aerated and dry. (ii) Clayey Soil: The smaller particles present in it can pack tightly together, leaving little space for air. These tiny gaps can hold water so clayey soil has little air. They are heavy as they hold more water as compared to sandy soil.

(iii) Loamy Soil: Best top soil for growing plants is loam. Loamy soil is a mixture of sand, clay and silt (a type of soil particles). The loamy soil also contains humus. Such a soil has the right water holding capacity for the growth of plants Note: The properties of soil are greatly influenced by the size of particles present in it.

# **TYPES OF INDIAN SOIL**

1. Red Soil: This soil is red in colour due to the presence of large amounts of iron oxide.

2. Black Soil: It is rich in the minerals, iron and magnesium. This soil is suitable for the growth of sugarcane and cotton.

3. Alluvial Soil: This soil, formed by the weathering of rocks is brought down by flowing rivers from the mountains. It is very fertile and rich in humus. It is suitable for the cultivation of wheat, rice and sugarcane.

4. Desert Soil: This sandy soil does not hold much water. Cacti, Date palm. Coconut palm etc. which do not need much water grow in this type of soil.

5. Mountain Soil: This is highly fertile soil contains the highest humus content.

6. Laterite Soil: This soil is found in regions of heavy rainfall. It is good for the growth of plantation crops like, coffee, tea, coconut and banana.

# **PROPERTIES OF SOIL**

Adsorption of Water in the Soil Plants need water to grow. If the soil does not hold water the plants would need frequent watering or they will die. The amount of water a particular type of soil can absorb is called its water absorption tendency.

Note: Silt occurs as deposit in river beds. The size of silt particles is between those of sand and clay.

#### Moisture in Soil

Soil holds water in it which is called soil moisture. The capacity of soil to hold water is important for various crops.

Percolation Rate of Water

The rate at which water exits in the soil is known as its percolation rate. Different soils have

different percolation rate of water. To calculate percolation rate we use the following formula

Percolation rate (mL/min)= Amount of water percolated (mL) Percolation time (min)

#### Do you know?

Percolation rate is highest for sandy soil and least in case of clayey soil.

#### SOIL EROSION

The removal of top soil by water and wind is known as soil erosion.

The top soil contains humus and mineral salts, which are vital for the growth of plants. So, removal of top soil by water and wind leaves the underneath subsoil and rocky base exposed.

Thus, erosion causes a significant loss of humus and nutrients and hence, decreases the fertility of soil.



Soil Erosion

#### **Causes of Soil Erosion**

There are several causes of soil erosion, which can be divided into two categories.

(i) Natural causes: It involves natural agents like wind and water.

(a) High wind velocity over lands, which have no vegetation, carries away the loose top soil.

(b) Pouring raindrops, over areas with no or very little vegetation, also carries away the top soil.

(ii) Man-made causes: Besides natural agents, there are certain man-made activities, which cause soil erosion. For example:

(a) Deforestation: Deforestation is the cutting or removal of trees or other vegetation for timber or for farming purposes. It increases soil erosion. Roots of plants hold soil particles together. In the absence of plants, the top layer of soil is easily removed by the action of high speed winds or water flow, thereby increasing the chances of soil erosion.



#### Deforestation

(b) Overgrazing: Overgrazing by flocks of cattle, buffaloes, goats and sheeps leaves a very little plant cover on the soil. The hooves of the animals make the soil dry, which reduces its porosity and percolation.

(c) Improper agricultural practices: Improper tillage and burning of stubble of weeds reduces the water-holding capacity of the soil. As a result, soil become dry and hence, can be easily blown away as dust.

(d) Heavy rainfall and strong winds: Uncovered soil is eroded quickly by heavy rain and strong winds.

(e) Slope: Run off water passing along the slope gathers speed and develops high cutting and carrying capacity.



Overgrazing

## **Effects of Soil Erosion**

1. Soil erosion reduces the fertility of soil.

2. It leads to land sliding.

3. Soil erosion exposes the lower hard and rocky layer. As a result, the fertile land gets converted into a desert. This process is known as desertification of land.

4. It leads to flash floods. Roots of plants hold soil particles together. In the absence of plants, the seeping of water is reduced and thus the ground water does not get replenished. This could then cause floods.



**Decertification of Land** 

#### **Control of Soil Erosion**

1. Deforestation should be stopped and more and more plants/trees should be planted.

2. Wind erosion is reduced if rows of trees and shrubs are planted at right angles to the prevailing direction of wind.

3. There should be a control on grazing. Grazing should be allowed only on areas meant for it and not on agricultural land.

4. Adopt terracing of field. In this, slope is divided into a number of flat fields for slowing down the flow of water.

5. Floods can be controlled by building dams. Embankment or mud walls should be constructed around hill slopes or field to stop the flow of water



**Terrace Farming** 

### SOIL POLLUTION

Soil pollution occurs either by direct wastes or indirectly by air pollution. The main source of air pollution are:

**1.** Improper dumping of garbage and sewage wastes in soil



#### **Dumping Of Garbage**

**2.** Acid water from factories and industries and acid rain



Acid Waste and Spilling

**3.** Excessive use of pesticides and fertilizers.

**4.** Spilling or leakage of chemicals

**5.** Improper dumping of plastic and metals which do not decay easily.

Do you know?

Over 80% of items in landfills can be recycled, but they're not.

Control of Soil Pollution

**1.** Use of organic fertilizers instead of chemical fertilizers and pesticides

**2.** Proper treatment of liquid waste before release into water bodies

**3.** Recycling of solid waste like plastic and metals**4.** Use of animal and domestic wastes for producing biogas.

