4 SOIL

INTRODUCTION

Soil is the upper weathered humus containing part of earth's surface, which support terrestrial plant life. Soil is formed by weathering of rocks and process of soil formation is called **pedogenesis**.

When soils are brought from other places through gravity called **colluvial soil**, through running water called **alluvial**, through wind called **aeolian** and through glacier called **glacial soil**.

Soil has various abiotic and biotic factors.

Soil is the top most part of earth's crust, which supports :-

(a) Growth of plants by holding roots and supply water, nutrients also

(b) Growth of various organisms, like earthworms.

(c) Agriculture that provide food, shelter, clothes etc.

Thus, soil is an inseparable part of our life.

Polythene bags and plastics causes soil pollution. They also kill the soil organisms. Besides the waste products, chemicals & pesticides also pollute the soil. Thus, waste products, chemicals should be treated before being released into soil. Whereas use of pesticides should be minimised.

SOIL PROFILE

(i) A vertical section through different layers of the soil is called **soil profile.**

(ii) Each layer of soil profile differ in colour, depth, chemical composition. These layers are called **"soil horizons"**.

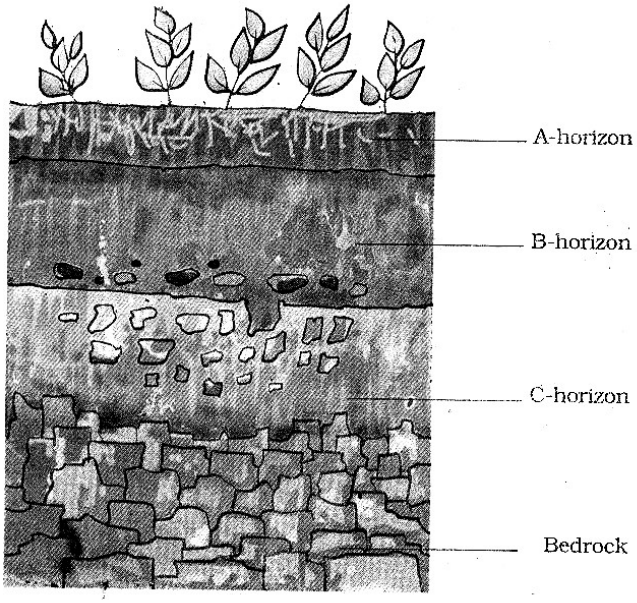


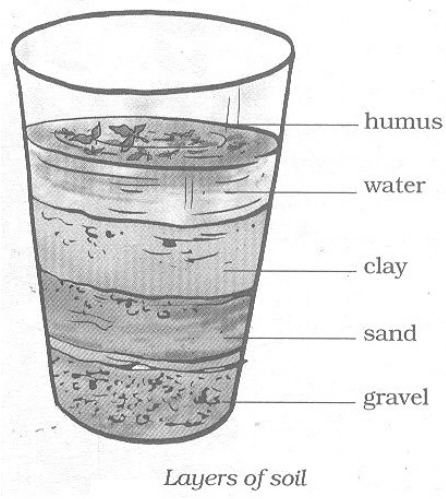
FIGURE: SOIL PROFILE

- Soil profile can be seen in recently dug ditch, during digging a well or laying the foundation of a building.
- Soil profile shows three main horizons : -

  A-Horizon: - Uppermost, dark coloured, rich in humus and supports plants and many living organisms like worms, rodents, moles and beetles. Humus makes the soil fertile & provides nutrients to the growing plants. This layer is generally soft, porous and can retain more water. It is also called top soil.

  B-Horizon: - It is also called middle layer, which is generally harder and more compact, having less amount of humus but more minerals.

  C-Horizon: -It is made up of small lumps of rocks with cracks & crevices, called third layer. Below this is bed-rock, which is hard and difficult to dig with a spade.



Layers of soil

- Soil profile can be observed by dissolving little soil in glass tumbler, three quarters filled with water. Each layer in glass shows different size of soil particles.
- The rotting dead matter in the soil is called **humus**.

SOIL TYPE

- Due to weathering of rocks different kinds of sand particles are formed like sand, clay etc., their ratio in soil depends on the kind of rock from which these particles are formed.
- **ROCK PARTICLES + HUMUS = SOIL**
- Soil contain various biotic and abiotic factors. Former includes bacteria, plant roots, earthworms, nematodes etc. Later includes water, air, minerals etc.
- Classification of soil is based on proportion of soil particles of various sizes.

  (a) Sandy Soil: Soil contains greater proportion of big size particles.

  (b) Clayey Soil: Proportion of fine particles is relatively higher

  (c) Loamy Soil: Amount of large and fine particles is almost same.
- On the basis of size, soil particles are broadly classified into following categories:

  (i) Gravel or Stones → 2 mm

  (ii) Sand → 0.05 to 2 mm

  (iii) Silt and clay → below 0.05 mm
- Properties of different soil depends on sizes of soil particles it have. In sandy soil, particles size is quite large so they can not fit closely together and have large spaces between them. These spaces are filled with air. Thus, soil is well aerated having less water holding capacity. Hence sandy soil is light, well aerated and dry.
- In clayey soil, soil particles are much smaller, tightly packed and having little air space. Thus, clayey soil, have little air, more water holding capacity and great amount of humus.
- Loamy is best soil for growing plants. Loamy soil contains equal mixture of sand, silt and clay soil particles. Size of silt particles is between sand and clay. Loamy soil have great water holding capacity, large amount of humus and is well aerated so, it is regarded as best soil for growth of plants.

PROPERTIES OF SOIL

Soil shows various characteristics like:

Percolation rate of water in different type of Soil

- Take three PVC pipes of about 5 cm diameter and 20 cm length.
- Select three different sites or places having soil of different types, say sandy, clayey and loamy.
- Now place the three PVC pipes about 2 cm deep in the ground (Fig. 8.8).
- Pour 200 mL water with the help of a graduated beaker in each pipe slowly.
- Note the time taken to pour 200 mL water till all the water in the pipe has seeped into the ground.

Calculate the rate of percolation for the three sites separately as follows :

$$\text{Percolation rate for site A} = \frac{\text{Amount of water (ml)}}{\text{Percolation time (min)}}$$

Using the formula, calculate the percolation rate for soil at sites B and C also.

Greater the spaces between soil particles greater will be percolation rate. On the basis of this, properties of soil particles can be determined.

Moisture in soil

- Soil can hold water, which makes soil moist.
- Amount of moisture in soil depends on type of soil, clayey and loamy soil have greater moisture than sandy soil.
- Due to moisture in soil, air above the land is shimmering during a hot summer day.
- Some water goes down the particles due to force of gravity is called **gravitational water**.
- Water held between the soil particles due to capillary action is called **capillary water**.

ABSORPTION OF WATER BY SOIL

(i) It depends on size of soil particles. Greater the size of soil particles lesser will be its absorption rate.

(ii) Percentage of water absorption can be calculated by experiment.

Perform this activity with two types of soil, say sandy and clayey soil.

- Take two funnels (glass or plastic).
- Place the funnels over the conical flasks or beakers. Also, place a cone of filter paper inside each funnel.
- Now put 20 gm of dry sand in one funnel and 20 gm of dry clay in another.
- Pour 200 mL of water drop by drop in the soil in each funnel. Take care to pour water all over the soil. You will observe that the water starts dropping in the conical flask or beaker.
- Leave the apparatus for some time till the water from the funnels stops dropping.

Note the amount of water collected in the conical flask or beaker.

Calculate the amount of water retained or absorbed by the soil as follows:

Weight of soil = 20 gm

Weight of water poured in each funnel = 200 ml

Amount of water collected in the flask/beaker = x mL

Amount of water retained or absorbed by 20 gm soil = (200 – x)mL

$$\text{Percentage of water retained by soil} = \frac{200 - x}{20} \times 100$$

Colours of Soil :

- **Black colour soil** contains dead organic matter and water. This soil is suited for growing cotton and sugar cane.
- **Red colour soil** gets its colour due to the presence of oxides of iron. This soil is poor in humus but becomes quite fertile when manures or fertilizers are added to it. Groundnuts, millets, rice, potato, etc. grow in this type of soil.

Growing of Crops Depends On Type of Soil :

Growing of crops in a region is determined by the type of soil present in that region.

- Sandy soil, found in deserts, does not support growth of crops. In sandy soil the soil particles are quite big, so the water percolates very quickly. It also carries away the nutrients. This is called **leaching** of nutrients. This makes the soil unfit for plant growth.
- Loamy soil is suitable for growing crops like lentils (masoor) and gram. Such soil does not show waterlogging. Water is easily drained out of it.
- Clayey soil is good for crops like wheat and paddy. Clayey soil has good water retaining capacity. Waterlogging takes place when there is heavy rainfall. Being rich in humus, clayey soil is very fertile.

SOIL AND CROPS

- In different parts of India, different types of soils are found.
- Soil profile and soil structure both are affected by some climatic factors i.e. temperature, light, humidity, wind velocity, rainfall etc.
- Climatic factors, various components of soil determine various types of vegetation and crops in particular region. Clayey and Loamy soils are suitable for cereals like wheat as soil can retain water, rich in humus and is very fertile. For paddy, clayey soil rich in organic matter is good as it can retain good amount of water for long duration. Loamy soils, which drain water easily are required for lentils or masoor. For cotton, sandy-loam or loam, which drain water easily required as it can hold plenty of air.

SOIL EROSION

- Removal of top soil by water, wind or ice is called **soil erosion**.
- Plant can check soil erosion as their roots firmly bind the soil. That's why soil erosion is more in those areas having little or no surface vegetation, like desert or bare land.
- Cutting of trees and deforestation should be prevented in order to check soil erosion.

SOIL MOISTURE

- The amount of water held by a soil is called **soil moisture**. Moisture content of soil can be calculated by formula :-

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

ALLUVIAL SOIL

- The soil which is formed by deposition of material i.e. silt, clay, sand and gravels carried by rivers called alluvial soil. For eg. soil of North Indian plains formed by rivers of North India which flows from Himalayas. Such soil is very fertile and supports half the population of India.

PREVENTION OF SOIL EROSION

Soil Conservation

The methods are as follows:

(a) **Afforestation** should be undertaken not only in the areas where green cover is already removed but additional areas should be brought under plantation.

(b) To reduce the effect of strong winds in the fields, trees should be planted along the boundaries of the fields.

(c) Crop rotation

(d) Proper drainage and irrigation arrangements should be made.

(e) Terrace cropping

CONCEPT APPLICATION LEVEL - I [NCERT Questions]

Q.1 In addition to the rock particles the soil contains.

(A) Air and water (B) Water and Plants

(C) Minerals, Organic matter, Air and water (D) Water, Air and Plants

Ans. (C)

Q.2 The water holding capacity is the highest in

(A) Sandy soil (B) clayey soil

(C) Loamy soil (D) Mixture of sand and loam

Ans. (B)

Q.3 Explain how soil is formed.

Ans. There are a number of natural processes involved in the formation of soil. Some of them are as follows:

(i) **Earthquakes or volcanic eruptions:** There is a hard layer of rocks just below the earth. Due to natural calamities like earthquake-or volcanic eruptions, these big and heavy rocks are broken into smaller pieces and come on the surface of the earth.

(ii) **Weathering of rocks:** Due to fast-blowing winds, snowfall, moving glaciers and running water from rains, fine particles from surface of rocks are carried to different place. This process is very slow and takes thousands of year. This is called physical weathering.

(iii) **Corrosion or decomposition:** The smaller particles of rock obtained due to weathering, get further decomposed when exposed to air and moisture for long. These processes range from oxidation, reduction, hydration, hydrolysis or carbonization. Lichens and other plant also help in this process. For example rocks of minerals like felspar and mica combine with water through the process of hydration and become soft and easily disintegrable. Silicate rocks on hydrolysis produce silicate clays. These are also slow processes. These are also called chemical weathering.

(iv) **Addition of humus:** Finally, the decomposed parts of dead plants and animals get mixed up with the soil formed due to the processes mentioned above. This gives the soil enough energy in the form of organic matter.

Q.4 List the differences between clayey soil and sandy soil.

Ans.

Clayey Soil	Sandy Soil
1. Proportion of fine particles is large.	1. Proportion of big particles is large.
2. Has least percolation rate of water.	2. Has largest percolation rate of water.
3. Has good water holding capacity.	3. Has poor water holding capacity.

Q.5 How is clayed soil useful for crops?

Ans. Clayey soil has following features;

(a) It has good water retaining capacity.

(b) Rich in humus.

(c) Fertile in nature.

This is the reason why this soil is useful for growing crops like wheat and rice.

Q.6 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.

Ans. It is given that,

Amount of percolated water = 200 ml

and time taken for percolation = 40 min

We know that,

$$\text{Rale of percolation (ml / min)} = \frac{\text{Amount of percolated water}}{\text{Percolation time}} = \frac{200}{40} = 5 \text{ ml/min}$$

Q.7 Explain how soil pollution and soil erosion could be prevented.

Ans. **Prevention of soil pollution:** Polythene bags that are made up of plastics, pollute the soil. Other substances which pollute the soil are a number of waste products, like chemicals and pesticide. So to prevent the soil pollution:

(i) There should be a ban on polythene bags and plastic.

(ii) Waste products and chemicals should be treated before they are released into the soil.

(iii) The use of pesticides should be minimised.

Prevention of soil erosion: Soil erosion can be prevented by:

(i) planting of trees

(ii) protecting of forests

(iii) holding suitable minerals or organic matter in proper amounts.

(iv) maintaining porous structure of soil.

(v) control and reclamation of ravines and adopting shifting cultivation.

CONCEPT APPLICATION LEVEL - II

Section – A

Q.1 What physical properties of soil are important to us?

Ans. The physical properties of oil, that are important to us are:
(i) Soil texture (ii) Colour (iii) Porosity
(iv) Presence of living organisms (v) Water holding capacity.

Q.2 What is soil profile? How many layers are found in the soil profile? Discuss.

Ans. The soil formation over a period of time results in vertical stratification of horizontal layers one over the other in the progressive state of maturity. The vertical section of soil up to unweathered rock is made up of a succession of horizontal layers (horizons) of varying thickness but is reasonably differentiated on the basis of colour, texture, structure and chemical characteristics. Such a vertical section of soil from top soil to underlying bed-rock is called a **soil profile**.

There are three horizons in the soil profile, as given below:

(a) A-horizon. This is the uppermost layer. It is generally dark in colour and rich in humus and organic matter. The organic matter is present in different stages of disintegration and decomposition. It is soft and porous. It has the highest water holding capacity.

The large content of humus makes it more fertile and helps plants to grow. The soft and porous nature and large water holding capacity provides proper living environment for many living organisms such as worms, rodents, beetles and moles.

(b) B-horizon. This is the middle layer and has lesser amount of humus but more of iron oxide and minerals. This is a little harder and more compact due to formation of aggregation of iron and aluminium compounds.

(c) C-horizon. This is the lowest layer and is made up of small lumps of rocks which have cracks and crevices. This horizon thus represents weathered parent material which has not become true soil.

Q.3 What makes soil a shelter for many living organisms?

Ans. The addition of humus to the soil with some other forms of organic matters like starch, sugars, cellulose, fats and protein etc., join together with air, water and minerals and give enough energy to living organisms to sustain themselves in the soil.

Q.4 How do plastics and polythene bags pollute the soil?

Ans. Plastic and polythene bags pollute the soil because they do not decay or decompose and remain as such indefinitely. They also kill the living organisms.

Q.5 What is humus?

Ans. The rotting dead matter in the soil is called humus.

Q.6 What is weathering?

Ans. A process in which soil is formed by the breaking down of rocks by the action of wind, water and climate is called weathering.

Q.7 Which horizon of soil is most suitable for growth of plants? Explain why.

Ana. The uppermost layer of soil profile, called A-horizon is the most suitable for growth of plants, because:
(i) it has high content of humus which provides nutrients to growing plants.
(ii) it is soft, porous and has more water retaining capacity.

Q.8 How are soil erosion and plantation of trees related?

Ans. Gradual removal of top soil by the action of wind, snow and flowing water is called soil erosion. The areas with low vegetation or deforestation suffer from more erosion of soil because the top soil in such areas gets exposed and becomes loose. So soil carried away by blowing wind and flowing water. To prevent such soil erosion, sufficient number of trees should be planted to keep the particles of soil bind with the roots of the trees.

Section – B

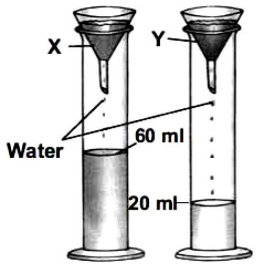
PREVEIOUS YEAR'S NSO QUESTIONS

Q.1 Which of the following statements are incorrect? **[NSO-2010]**

(i) Diurnal animals are active during the day.
(ii) Soil is the topmost layer of the Earth crust.
(iii) Humus is the top soil containing small rocks.
(iv) Alluvial and loamy soil are not suitable for growing crops.

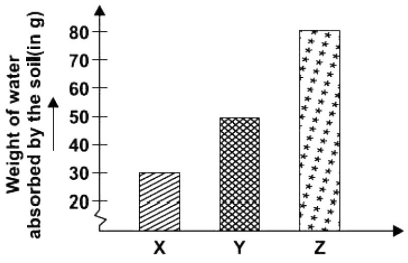
(A) (i) & (ii) (B) (ii) & (iii) (C) (iii) & (iv) (D) (i) & (iv)

Q.2 Beena pertormed an experiment on two soil samples X and Y as shown, to study the absorption of water by the soil. She poured 100 ml of water in both the samples and noted the percolated water. Identify X and Y. **[NSO-2011]**



(A) X-Laterite soil, Y-Sandy soil
(B) X-Loamy soil, Y-Desert soil
(C) X-Sandy soil, Y-Clayey soil
(D) X-Clayey soil, Y-Sandy soil

Q.3 Sandeep has three soil samples X, Y and Z, each with weight 50 g. 100 ml of water is poured drop by drop with the help of a dropper on all the soil samples. The given graph shows weight of water absorbed by each soil sample. Select the correct option regarding the soil samples. **[NSO-2012]**



(A) X is a mixture of sand, silt and a good amount of clay.
(B) Y is a mixture of sand, silt and appropriate amount of clay.
(C) Z is a sandy soil with very little clay.
(D) Z is a mixture of clay and silt with higher amount of sand.

Q.4 Read the given statements and select the correct option.

Statement 1 : Forests prevent soil erosion.

Statement 2 : Canopy formed by crown of leaves of forest trees reduces the force and speed of raindrops. **[NSO-2012]**

(A) Both statements 1 and 2 are true and statement 2 is the correct explanation of statement 1.
(B) Both statements 1 and 2 are true but statement 2 is not the correct explanation of statement 1.
(C) Statement 1 is true but statement 2 is false.
(D) Both statements 1 and 2 are false.

DIRECTION (Q.5 & 6) : Refer the given passage and answer the following questions. A farmer is growing crop regularly in his field. He uses chemical fertilizers. pesticides. organic manures as well as biofertilizers. There is a huge lake nearby to his field and a factory which emits smoke as a by product.

[NSO-2013]

Q.5 A considerable Increase in water pollution was noticed as the farming activity intensified. The most likely reason for this could be _____.

(A) Chemical fertilizers leached into the lake from the field.
(B) Living organisms used in biofertilizers polluted the lake.
(C) Organic manure leached into the lake from the field.
(D) Smoke particles from me industry got settled in moist surroundings of me lake.

Q.6 An expert agriculturist suggested the farmer to minimize the use of chemical fertilizers and instead use biofertilizers as they have many advantages over chemical fertilizers. Which of the following is not true regarding bioferlilizers?

(A) They are economical.
(B) They will least pollute lake.
(C) They are renewable.
(D) They require large set-up for their production.

Q.7 Read the given passage.

The water-bearing layer of the earth called __P__ is made up of two components __Q__ and __R__. The top level of layer __P__ is called __S__. When too many tubewells are used in an area, the level of __S__ in that area goes down.

Select the correct sequence of words to fill up the blanks in the above passage. **[NSO-2014]**

	P	**Q**	**R**	**S**
(A)	Sea	Permeable rocks	Soil	Aquifer
(B)	Water lable	Soil	Permeable rocks	Aquifer
(C)	Lok	Permeable rocks	Soil	Water lable
(D)	Aquifer	Soil	Permeable rocks	Water lable

Q.8 Kanika noticed that her potted plant was not growing healthily. She put three earthworms into the pot. After a few weeks, she noticed that her plants looked healthier. What could be the possible reason for this? **[NSO-2014]**

(A) The earthworms ate up the pests in the soil.
(B) The earthworms helped the plant to take III water.
(C) The earthworms allowed the plant to make food faster.
(D) The earthworms increased the air and nutrient content of the soil.

CONCEPT APPLICATION LEVEL - III

SECTION - A

- **Fill in the blanks with suitable words.**

1. _____ soil have maximum water holding capacity.
2. For making pots, toys and statues _____ soil is used.
3. Amount of water present in soil is called _____.
4. _____ is the process of soil formation.
5. Cotton crops can be grown in _____ soil.
6. Highest percolation rate is observed in _____ soil.
7. Soil erosion can be prevented by _____.
8. Vertical section of earth crust showing process of soil formation is called _____.
9. The rotting dead matter in the soil is called _____.
10. Removal of top soil by wind, water is called _____.
11. Mixture of sand, silt and clayey soil is called _____.
12. Bed rock is found below the _____ horizon.
13. Silt and clay particles range in size _____.
14. A-horizon is also known as _____.
15. Rate of percolation can be calculated by:
    percolation rate = amount of water / _____.

SECTION - B

- **Match the following (one to one)**

Q.1

Column I	Column II
(i) Temperature	(a) Meteorological department
(ii) Rain gauge	(b) Humidity
(iii) Hygrometer	(c) Thermometer
(iv) Weather report	(d) Rainfall

SECTION - C

- **Mark 'T' if the statment is true and 'F' if it is false:**

1. Plants roots can firmly bind the soil.
2. Soil Organism helps in increasing fertility of soil.
3. Greater the size of soil particles lesser will be percolation rate.
4. Types and properties of soil is not affected by climatic factors.
5. Earthworms helps in binding the soil particles.
6. Soil contain biotic and abiotic both factors.
7. Clayey soil is light in colour.
8. Clayey soil is good for planting rice.
9. Different layers of the soil in soil profile differs in texture.
10. Chemical used in agriculture, do not causes soil pollution.

ANSWER KEY

CONCEPT APPLICATION LEVEL - II

SECTION - B

Q.1 C Q.2 C Q.3 B Q.4 A Q.5 A Q.6 D Q.7 D
Q.8 D

CONCEPT APPLICATION LEVEL - III

SECTION - A

1. Clayey	2. Clayey	3. Soil Moisture	4. Pedogenesis
5. Sandy Loam	6. Sandy	7. Afforestation	8. Soil profile
9. Humus	10. Soil Erosion	11. Loamy Soil	12. C
13. Below 0.05 mm	14. Top soil	15. Percolation time	

SECTION - B

1. (i)-c, (ii)-d, (iii)-b, (iv)-a

SECTION - C

1. T 2. T 3. F 4. F 5. F 6. T 7. F 8. T 9. T 10. F