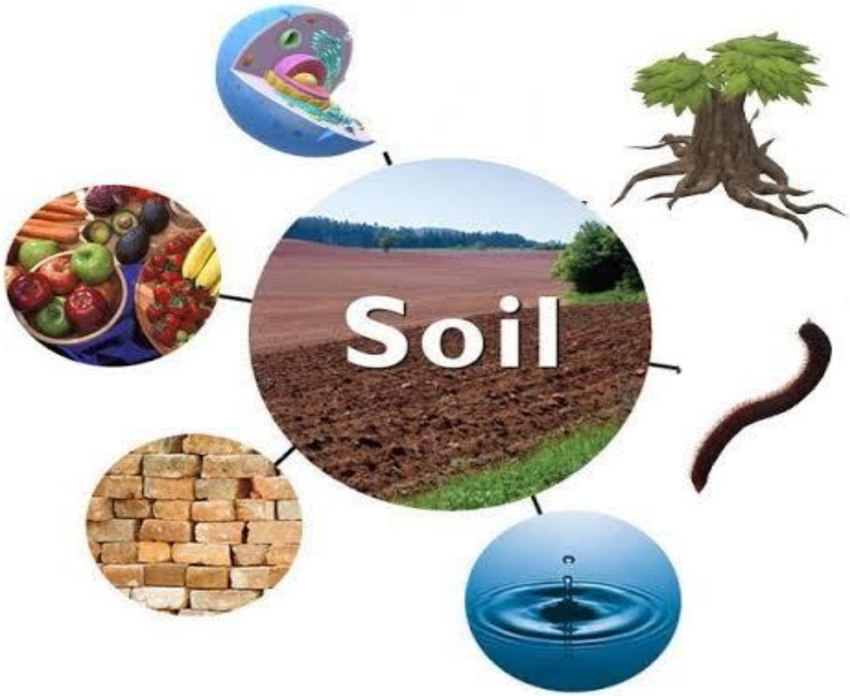
SOIL

BY TEACHER DAVIS SULPHITE 2025



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SOIL

- **Soil** is finely divided material covering the earth crust or surface. It consists of air, water, humus, living organisms, and weathered rocks

TYPES OF SOIL

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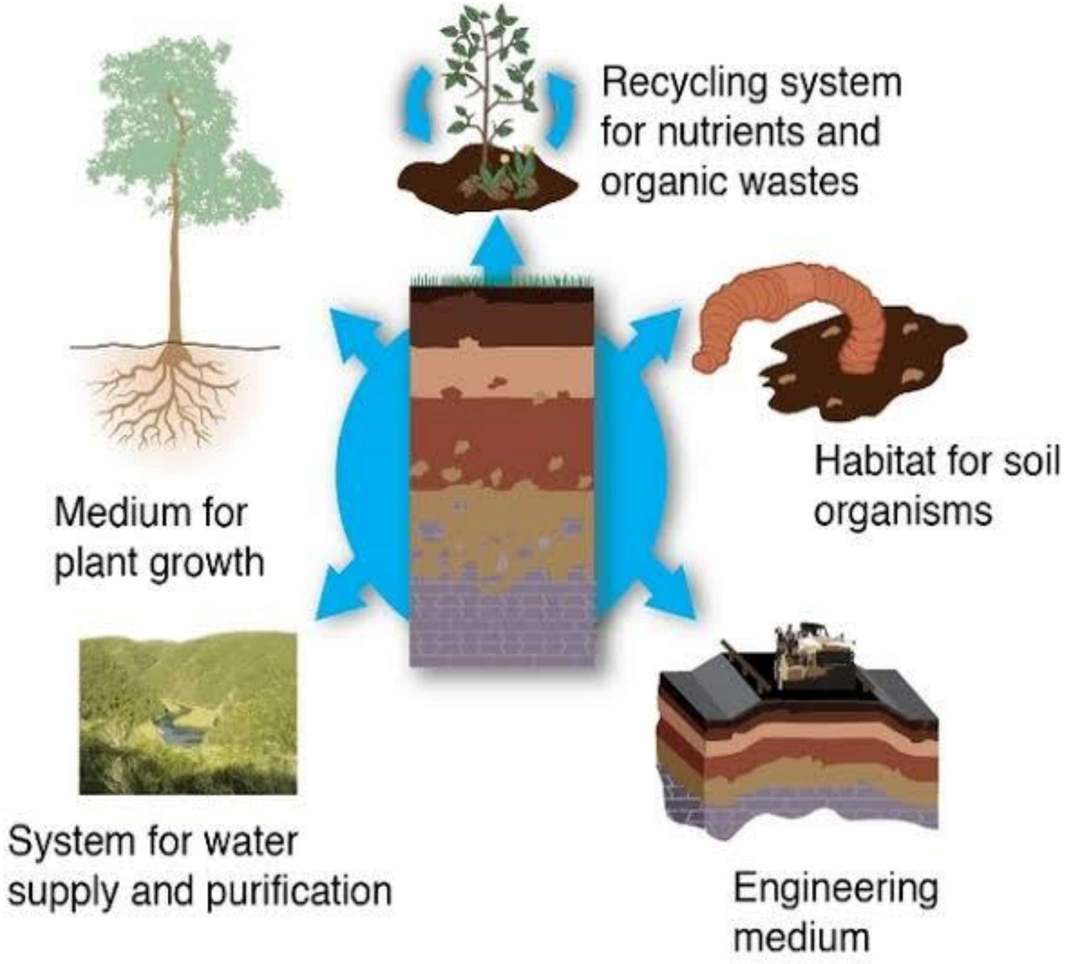
IMPORTANCE OF SOIL




Do you know that there are 3 different kinds of soil?
CLAY
LOAM
SAND

CHARACTERISTICS OF THE DIFFERENT TYPES OF SOIL

Sandy	**Clay**	**Loam**
Runs between your fingers	Feels slippery when wet	Feels crumbly
Few lumps	Dry clay is very hard	Soft and feathery
When moistened and squeezed, it will not stay together	When moistened and squeezed, it will stay together forming a tight ball	When moistened and squeezed, it will stay together forming a loose ball
Light brown	Color is determined by the minerals it contains	Dark brown or black
Mostly minerals	Mostly minerals, little humus	Balance between mineral particles and organic matter
Little food for plants	Fine texture	Lots of nutrients for plants
Dries quickly	Small pore size	Absorbs water very well

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INORGANIC PARTICLES

- soil particles can be categorized into 4 types based on their size in terms of average diameter of a particle, different types of soil are made up of different soil particles; most soils have a combination of 3 or more particles
- **Uses of soil particles**
- surface for anchoring plant roots hence providing support to the plants.
- give a rigid frame work to the soil.
- provide mineral elements to the soil which are the absorbed by plants using roots.

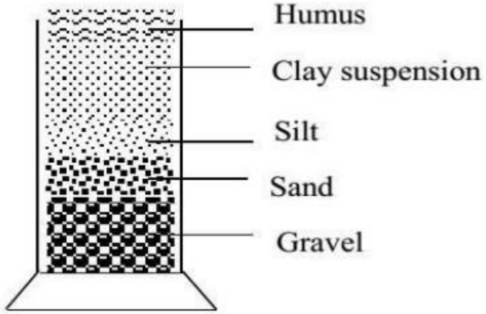

Table showing sizes of soil of particles

Soil particle	Diameter (mm)
Gravel	> 2.0
Coarse	0.2 – 2.0
Fine sand	0.02 –0.2
Silt	0.002 – 0.02
Clay	< 0.002

SOIL AIR

- EXPERIMENT TO DETERMINE THE PERCENTAGE OF AIR IN THE SOIL
- **Apparatus:** Measuring cylinders (2) Dry soil sample Water Glass rod

METHOD

Measure about 50cc of dry soil in a measuring cylinder and tap the container to level out the soil.

Measure 50 cc of water in another measuring cylinder.

Add the two together (observe carefully as you pour the water onto the soil)

Allow the mixture to stand until no more bubbles appear. Read and record the final level of water plus soil in the measuring cylinder.

Calculate the air content in terms of percentage.

Example **Volume of soil** = 50cc **Volume of water** = 50cc

Final volume of water + soil after mixing = 85cc

Volume of air in soil (100-85)=15cc

Percentage of air in soil sample= vol of air in soil×100 vol of soil used

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EXERCISE

- Alex carried out an investigation to determine the percentage of air in a given soil sample and obtained the following values:
  - Volume of soil used = 30cm3
  - Volume of water added to the soil = 50cm3
  - Final volume of water + soil after mixing = 80cm

a) determine the volume of air in the soil sample.

b) calculate the percentage of air in the soil sample

Experiment to determine the percentage of water in a soil sample

- **Apparatus**: Evaporating dish, fresh soil, weighing scale and oven or Bunsen burner.

Procedure

a) Weigh a clean evaporating dish and record its weigh. (Let the weight be X g).

b) Fill the evaporating dish with soil and record the weight of the soil plus the evaporating dish. (Let the weight be Y g).

c) Dry the soil by heating it gently over a Bunsen burner flame for about 30 minutes.

d) Heating and weighing is repeated until a constant mass is achieved. (Take care not to burn the soil to produce smoke).

e) Re-weigh the soil and the evaporating dish. (Let it be Z g).

f) Then calculate the water content in the soil sample as shown below

Results:

Weight of the evaporating dish= X

Weight of soil + evaporating dish = Y

Weight of soil + evaporating dish after heating = Z

Weight of soil sample = Y-X

Weight of water in the soil sample = Y-Z

%age of water = weight of water x 100

Weight of soil

Therefore percentage of water = (Y-Z) × 100

Y-Z

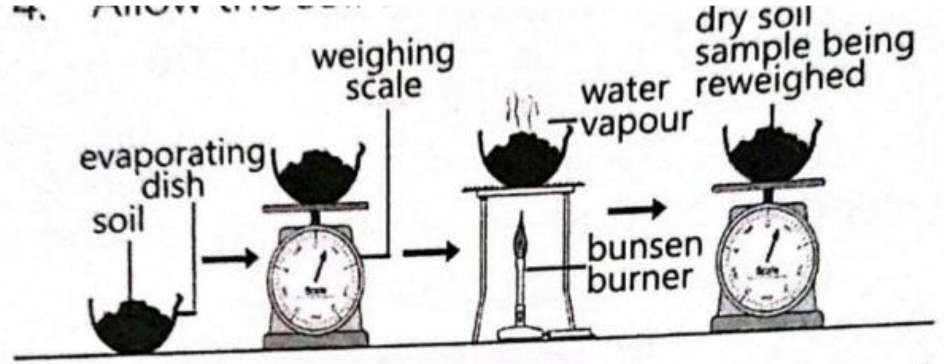


Figure 1.8: *Steps for determining the percentage of water in soil sample*

question

In an investigation 80g of fresh soil was heated in a crucible .after repeated heating and cooling. The constant mass of the soil was found to be 65 g. calculate the percentage of water in the soil sample.

HUMUS

- **Apparatus**: Crucible, soil sample, weighing scale, heat source, wire, tripod stand, pipe clay triangle

Procedure

- Weigh a clean empty crucible and record its weight (W g).
- Half fill the crucible with soil and record the exact weight of soil plus crucible on weighing scale (X g).
- Dry the soil by heating it in an oven at 1050C to constant weight (Y g) (the loss in weight of soil at this temperature is due to the water driven out by evaporation)
- Reweigh the soil and crucible and record the weight.
- Heat the dried soil on a crucible to redness in an oven.
- Weigh the soil after cooling and record its weight. g) Repeat this till a constant weight is achieved (Z g).

Results:

Weight of crucible = W g

Weight of crucible + fresh soil = X g

Constant weight of soil + crucible after heating at 105^0C =Y g Constant weight of soil + crucible after heating after heating to redness = Z g

Weight of soil = X - W

Weight of dry soil = Y-W

Weight of dry soil after burning off humus = Z - P

Weight of humus = Y - Z g

$$\text{Percentage of humus} = \frac{\text{weight of humus}}{\text{Weight of soil}} \times 100\%$$

$$\text{Percentage of humus} = \frac{(Y-Z) \times 100\%}{X - W}$$

Exercise

The following experiment was done to find out the percentage of humus in a given soil sample. The soil sample weighing 120g was heated in an oven kept at 100o C. The dry soil weighed 112g. The soil was then heated slowly to burn away humus. The weight of soil after all humus had burnt was 106g

a) Why was the soil not heated properly at first?

b) What was the weight of humus in the soil?

c) Calculate the percentage of humus in the soil.

d) How many times was water more than humus

SOIL LIVING ORGANISMS

- **Micro organisms** :bacteria and fungi **(what are their importance in soil?)**
- **b) Macro organisms:** roots of higher plants, earth worms, nematodes e.g. ascaris, hookworms, filarial worm, and soil arthropods. **State any 7 roles of earthworms in the soil**
- **Requirements**: muslin bag, soil from compost or top soil, 2 conical flasks, 2 corks, lime water/bicarbonate indicator solution

Procedure:

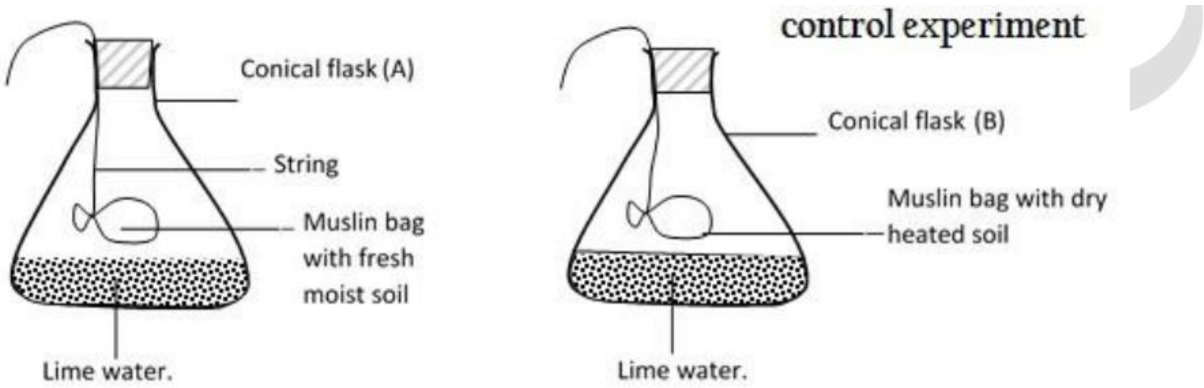
✓Collect a handful of fresh top soil and divide it into 2 equal portions ✓Sterilize one portion of the soil sample by heating strongly on a crucible for 30minutes.

Leave it to cool and place it in a muslin bag

✓Place the remaining portion of the fresh soil sample in another muslin bag

✓Add equal amounts of lime water/ bicarbonate indicator in the conical flasks and then suspend the muslin bags with soil in the conical flasks as shown in the set up

✓Allow the conical flasks to stand for about 2days and observe the appearance of lime water/ bicarbonate indicator



- **Observation :** Lime water turns milky or bicarbonate indicator solution turns yellow in the conical flask A but remains clear in test conical flask B • **CONCLUSION**
- Carbon dioxide was produced in conical flask A during respiration indicating the presence of living organisms
- Lime water remained clear in conical flask B because the living organisms in soil in conical flask B were killed by heating

Importance of humus

i) Because humus is dark-coloured, soil rich in humus absorbs more heat, and this warmth is useful for the germination of seeds and helps to speed up decomposition, making more humus.

ii) It has a high absorptive capacity for water. iii) It forma\s a sticky coat around soil particles and binds several together to form soil clumps. The clumps structure greatly improves the drainage of the soil.

iv) Humus retains moisture and minerals in the top soil and so, greatly reduces the effects of drying and leaching (washing of minerals).

v) It is a source of nutrients used by plants after it is decomposed.

vi) It improves soil aeration. vii) It improves soil structure by reducing the sticky properties of clay. viii) It stabilizes soil pH.

ix) It leads to improvement of activities of soil organisms by providing them with food and shelter.

x) It insulates soil against extreme heat and cold temperatures changes.

Importance of soil air

i) It provides oxygen for respiration of soil organisms and plant roots.

ii) Oxygen is also needed for the decay that produces humus.

iii) It also provides nitrogen for fixation by the nitrogen-fixing bacteria in the soil. The nitrogen absorbed is needed in the formation of nitrates and proteins.

iv) Carbon dioxide present in the air helps in increasing soil acidity which favors proper growth of some plants.

v) Carbon dioxide present in the air dissolves in water to form carbonic acid for weathering.

Soil water has the following functions

i) It moistens soil and keeps it humid/moist, making it favorable for survival of micro-organisms.

ii) It dissolves mineral salts making them available for plants to take.

iii) It dissolves carbon dioxide produced by living organisms to form carbonic acid which causes chemical weathering of rocks.

iv) It is a raw material for photosynthesis.

v) Water absorbed from the soil allows plant cells to be rigid (turgid), and this is very important for support of the plant, particularly herbaceous plants.

PHYSICAL PROPERTIES OF SOIL

- are qualities that can be perceived by body senses like seeing, feeling and tasting E.g. water retention, drainage, color, texture and particle size.
- **Apparatus:** 2 filter funnels, 2 measuring cylinders, 2 filter papers Equal volumes of samples of dry sand and dry clay soils, Water and Beakers

Procedure

- a) Measure an equal volume of each soil sample.
- b) Fold filter papers properly and put one in each funnel.
- c) Then place clay soil in the filter paper in one funnel and the sand in the other funnel.
- d) Place the funnels with their contents over measuring cylinders and at the same time pour an equal volume of water on each of the soil samples as shown in the diagrams.
- Observe which soil allows water to drain through quickly. Allow the set up to stand for some time till water stops draining through the soils.

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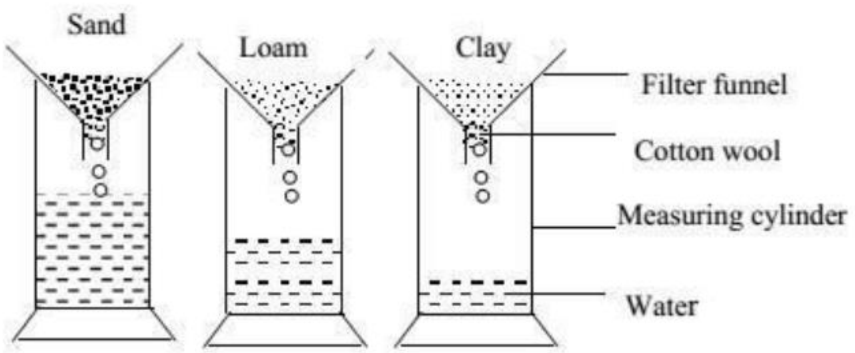


- **Observation** Water passes through sand soil faster than clay soil. So much water is collected in the cylinder with sand soil and less water is collected in the cylinder containing clay soil.
- **Conclusion** Clay soil holds more water than sand soil and sand soils drains water faster than clay.

Water capillarity

Capillarity through soil means how well water can rise up in the soil and this depends on the size of air spaces between the soil particles. Sand soil has the lowest capillarity of water while clay soil has the highest water capillarity and loam soil has medium water capillarity.

EXPERIMENT TO DEMONSTRATE AND COMPARE WATER CAPILLARITY THROUGH SAND, CLAY AND LOAM SOIL

Materials 3 long glass tubes Glass troughs Muslin bags and threads 3 retort stands and clamps 3 samples of dry sand, clay and loam soils.

Procedure

a) Tie a muslin sheath tightly at the end of the glass tubes.

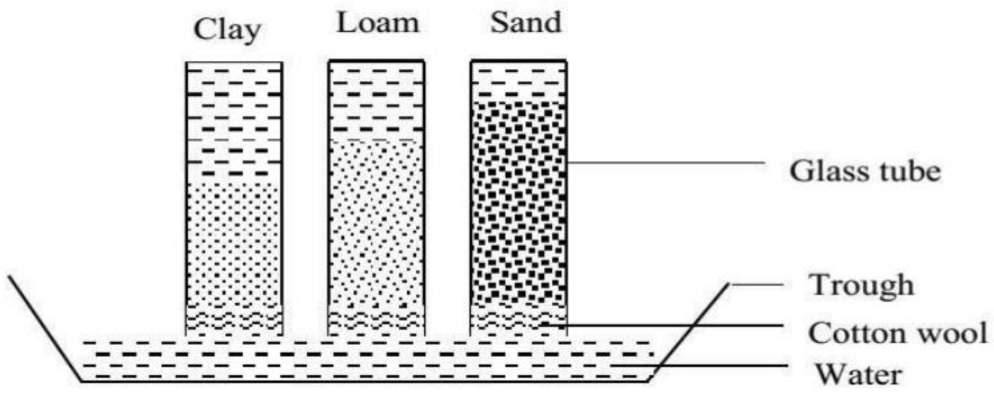
b) Fill one glass tube with dry sample of sand soil and pack it well ensuring that there are no spaces in the soil.

c) Repeat this with clay and loam soils.

d) The glass tubes are stood vertically with the ends tied with muslin sheath immersed in a glass trough containing enough water.

e) The glass tubes are supported upright with retort stands and clamps as shown in the diagram below.

SETUP



- **Observation** Water rises faster for a short distance in sand soil while in clay soil water rises slowly but to higher distances. In loam soil, water rises moderately to a moderate distance.
- **Conclusion** Clay soil has the highest capillarity of water. Sand soil has the lowest capillarity while loam has moderate water capillarity.

Applications

- Clay mixed with water, oil and honey can be used to make clay masks that ladies apply on their faces to maintain beauty.
- Basing on clay's property of being sticky when wet, it binds with germs on the surface of the skin and deep in the pores and brings the dried up germs to the surface of the skin to be washed away
- Pottery, brick making …

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CHEMICAL PROPERTIES OF SOIL

Soil colour

This determines the amount of heat that can be trapped in a soil sample. Dark soils retain heat more than light soils.

Soil PH

This is the degree of acidity or alkalinity of the soil. Most soils in the tropics are acidic but some are alkaline.

Soil pH affects the rate at which mineral salts e.g. nitrogen, phosphorous, iron are absorbed by plant roots. Most plants grow best in slightly acidic or neutral soil.

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EXPERIMENT TO DETERMINE THE SOIL PH

- **Materials** Soil Petri dish, Universal indicator,Indicator chart

Procedure

a) Place about 3g of soil on a Petri dish and soak it with universal indicator. Leave for 2-3 minutes.

b) Tilt the Petri dish so that the indicator drains out of the soil.

c) Compare the indicator color with the indicator chart.

Alternatively:

a) Soak the soil sample with distilled water.

b) Drain off/ filter off and test with universal indicator solution or universal indicator papers.

Complete the table below by filling in which crops grow well in the different types of PH Acidic PH Alkaline PH Neutral PH

ACIDIC PH	NEUTRAL PH	ALKALINE PH

END

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