KING'S COLLEGE, BUDO

S.2 students, copy these notes in your class note books.

You will be required to present them, hand written when the term resumes

THE SOIL

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

Importance of soil

1. Soil provides nutrients e.g. water and minerals to plants which are the chief producers of food in the environment.
2. Soil is a habitat (home) for many organisms such as earth worms, termites, bacteria fungi and arthropods.

SOIL FORMATION

It is formed from parent rocks by the process of weathering. This occurs over several years. The process of weathering takes place in three ways;

1. Physical weathering:

This occurs in the following ways;

i) Alternate heating and cooling of the rocks on exposed mountain sides, causes expansion and contraction which cause the rock to crack and break up.
ii) By water: This is where rivers and streams wear away the rocks over which they flow by rolling pebbles and other hard particles on them.
iii) During sandstorm when wind blows sand against bare rocks
iv) Frosting: Frost is weather condition where temperatures fall below 0^0C, water in cracks freezes and expand, causing the rock to break up.

2. Chemical weathering

This is brought about mainly by the action of water especially rain water on the rocks. As it rains, rain dissolves carbon dioxide in the atmosphere to form weak solution of carbonic acid which when falls on soft rocks for example lime, it dissolves them, this results in the release of mineral elements like calcium, magnesium, aluminium, etc. which are components of soil.

In hot damp conditions, the constituency of rocks especially those containing iron, oxidizes very quickly. The oxidized rocks disintegrate to form soil.

3. Biological weathering

This is brought about by the action and presence of living organisms on rocks. Certain organisms such as lichens are able to grow on bare rocks while other small flowering plants are able to grow between the rock fragments. When these organisms die, they form humus which is a component of soil.

FACTORS INFLUENCING SOIL FORMATION

There are five major factors influencing soil formation:

- Climate
- Living organisms
- Nature of soil parent material
- Topography of the area
- Time that the parent rock material is subjected to soil formation.

i) Climate

The main climatic factors involved in the soil formation are rainfall, temperature and wind. Rainfall and temperature influence the chemical and physical break down of the parent rock e.g. rainfall promotes weathering of rocks into small particles by leaching of soluble constituent compound in the rock.

ii) Living organisms

These include the vegetation cover, living micro-organisms (bacteria and fungi) and invertebrates e.g. earth worms. The vegetation cover influences the characteristics of the soil formed through the litter and roots remains which add to the soil. The termites feed on dead vegetation therefore by decomposing it. The bi-products of decomposition are added into the soil.

iii) Parent rock

This influences physical properties and chemical constituents of the soil e.g. granite and sand stones which are rich in mineral content giving rise to sand soil while volcanic larva produces clay soils.

iv) Topography

It influences the movement of products of weathering which consist of soluble substances and solid soil particles. It affects soil depth and vegetation thus on a steep or rolling topography there is a tendency for soil erosion to occur with a result that relatively shallow soils develop. Therefore, it modifies the effects of soil climate and vegetation on soil formation.

v) Time

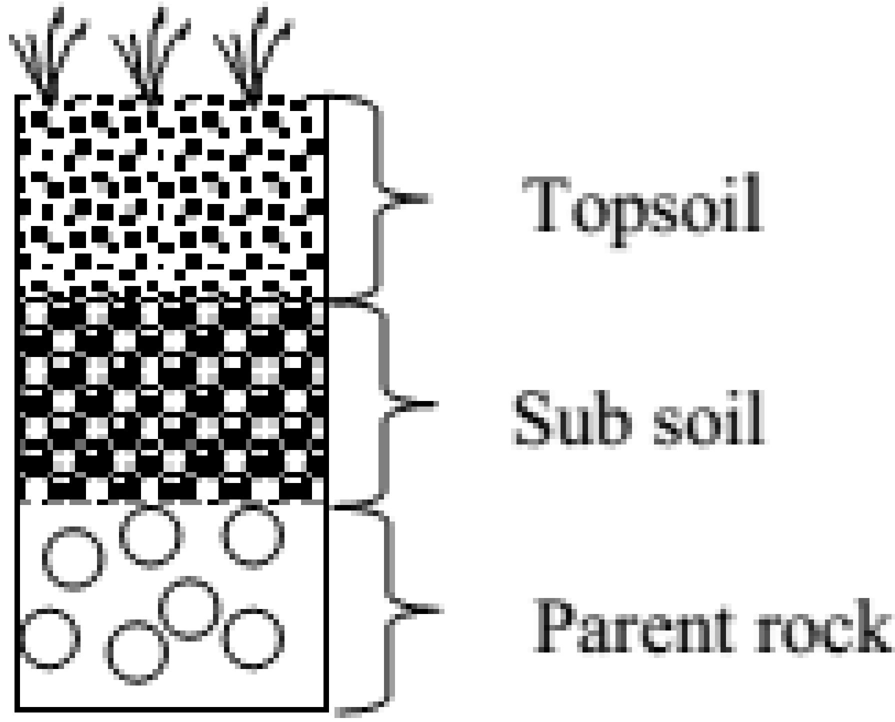
The length of time over which soil forming processes have been in action affects the age of the soil. When soils forming processes have taken place for a long time, one tends to get deep mature soils, provided other factors are constant.

SOIL PROFILE

This is the vertical arrangement of the various soil layers called horizons. It represents the different layers at various stages of soil development. A soil with distinguished soil layers is known as mature and that without clear profile is immature or young. The profile consists of the following:

i) Top soil
ii) Sub soil
iii) Parent or underlying rock

Diagram to show the soil profile



1) Horizon A – Top soil

This is the upper most soil layer. It is the most important horizon that supports the growth of plants. It has got the following characteristics:

- It's usually better aerated
- It has more active soil micro-organisms
- It contains humus so it's usually dark in colour.
- It contains more plant roots and usually litter.

2) Horizon B – Sub soil

This is a thicker light brown layer lying immediately below the top soil. It's composed of mainly rock fragments, clay and gravel. It has the following characteristics:

- It is less aerated than top soil.
- It contains only deep roots of plants and hardly any other organism.
- It contains very little or no humus
- It tends to contain a lot of mineral salts due to leaching and therefore referred to as the layer of accumulation.

3) Horizon C – Parent rock

This is a solid rock layer found below the sub soil. It represents the original parent material which is still intact and unweathered.

The common parent rocks in East Africa are granites, volcanic and sedimentary rocks. This horizon lacks humus completely. It has low air content and mineral salts.

COMPONENTS OF SOIL

There are basically six components of soil. These are:

i) Inorganic particles
ii) Humus
iii) Water
iv) Air
v) Mineral salts
vi) Soil living organisms

1. INORGANIC PARTICLES

These are produced during the process of weathering. Soil particle vary in size and their sizes are used to classify them. The different soil particles are clay, silt, fine sand, coarse sand and gravel.

Table showing sizes of soil particles

Soil particle	Diameter (mm)
Gravel	> 2.0
Coarse	1.2 – 2.0
Fine sand	1.02 – 0.2
Silt	0.002 – 0.02
Clay	< 0.002

Uses of soil particles

i) They provide a surface for anchoring plant roots hence providing support to the plants.
ii) Soil particles give a rigid frame work to the soil.

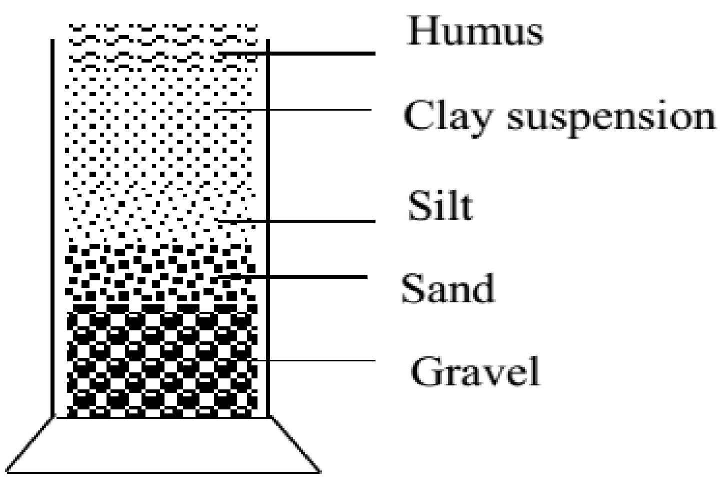
iii) They provide mineral elements to the soil which are then absorbed by plants using roots.

Experiment to show the soil texture of topsoil

Apparatus/materials:
Measuring cylinder, Top soil, Stirrer, Beaker

Procedure:
Put water in a measuring cylinder half way. Pour soil (20cm^3) in water and stir thoroughly. Leave the experiment to stand for 3 minutes and observe.

Observations
When the soil particles settle down, the particles arrange themselves according to their particle size where the heaviest settle at the bottom and the small and lightest at the top as shown below.



Conclusion
Soil is made up of different particles, which have varying sizes and densities.

2. SOIL AIR
Soil air exists between the soil particles. Airspaces in the soil are important for growth of plant roots and health of soil organisms. It is mainly oxygen and nitrogen. (Carbon dioxide

is usually in solution as carbonic acid). The depth to which the roots can grow depends on how deep the air can penetrate through the soil

Importance of soil air

- It provides oxygen for respiration of soil organisms and plant roots.
- Oxygen is also needed for the decay that produces humus.
- 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.
- Carbon dioxide present in the air helps in increasing soil acidity which favours proper growth of some plants.
- Carbon dioxide present in the air dissolves in water to form carbonic acid for weathering.

EXPERIMENT TO DETERMINE THE PERCENTAGE OF AIR IN THE SOIL

Apparatus
Measuring cylinders (2)
Dry soil sample
Water
Glass rod

Method

1. Measure about $50cm^3$ of dry soil in a measuring cylinder and tap the container to level out the soil.
2. Measure $50cm^3$ of water in another measuring cylinder.
3. Add the two together (observe carefully as you pour the water onto the soil).
4. Allow the mixture to stand until no more bubbles appear. Read and record the final level of water plus soil in the measuring cylinder.
5. 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 x100%

vol of soil used

3. WATER

Soil water comes from rain. Also, some water rise up from the ground water by capillary action to replace water lost by evaporation from the surface. It is found as a thin film surrounding the soil particles.

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.

EXPERIMENT TO DETERMINE THE PERCENTAGE OF WATER IN A SOIL SAMPLE

Apparatus:

Evaporating dish or basin, fresh soil, weighing scale and oven or Bunsen burner.

Procedure:

a) Weigh a clean evaporating dish and record its weight. (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 min.
d) Heating and weighing is repeated until a constant mass is achieved. (Take care not to burn the soil (no 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;

Note:

You should cool in a desiccator before weighing. This ensures that no fresh vapour enters the soil.

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

$$\%\text{age of water} = \frac{\text{weight of water}}{\text{weight of soil}} \times 100$$

Therefore percentage of water

$$= \frac{(Y - Z)}{(Y - X)} x\times 100$$

4. HUMUS

Humus is decaying plant and animal material i.e dead bodies of animals, fallen leaves, dead plants and animal droppings. It is a dark brown, rather sticky material that gives soil its dark colour. For the decay process that forms humus to work properly, plenty of oxygen is needed.

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 forms a sticky coat around soil particles and binds them 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.

EXPERIMENT TO DETERMINE THE PERCENTAGE OF HUMUS (ORGANIC MATTER) IN THE SOIL

Apparatus:

Crucible, soil sample, weighing scale, heat source, wire, tripod stand, pipe clay triangle

Procedure:

a) Weigh a clean empty crucible and record its weight (W g).
b) Half fill the crucible with soil and record the exact weight of soil plus crucible on weighing scale (X g).
c) Dry the soil by heating it in an oven at 105 ^{0}C to constant weight (Y g) (the loss in weight of soil at this temperature is due to the water driven out by evaporation)
d) Reweigh the soil and crucible and record the weight.
e) Heat the dried soil on a crucible to redness in an oven.
f) 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^{0}C =Y g

Constant weight of soil + crucible 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 - W

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 120 g was heated in an oven kept at 100 ^{o} C. The dry soil weighed 112 g. The soil was then heated slowly to burn away humus.

The weight of soil after all humus had burnt was 106 g.

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?

5. MINERAL SALTS

These are chemical elements inform of ions, dissolved in the film of water, surrounding the soil particle.

Some of the mineral elements in soil are; Sulphur, phosphorous, nitrogen, silicon, magnesium, iron and aluminium ions which results from weathering of rocks.

6. SOIL LIVING ORGANISMS

a) Micro organisms

They include bacteria and fungi. They play an important part in maintaining soil fertility through decomposition of plant and animal remains. Nitrifying bacteria convert nitrogen into nitrates thus making it available to plants.

b) Macro organisms.

They include roots of higher plants, earth worms, nematodes e.g. ascaris, hookworms, filarial worm, and soil arthropods.

Earth worms tunnel into the soil by force, thus improving the soil aeration and drainage.

Importance of living organisms

i) They improve fertility of the soil through fixing atmospheric nitrogen by nitrogen fixing bacteria and decomposing litter and other wastes into humus carried out by termites and bacteria.
ii) Some living organisms like earth worms burrow in the soil and this improves soil aeration and drainage.
iii) Some living organisms in soil cause diseases to man and his plants.
iv) Wastes from soil living organisms add fertility to the soil.

EXPERIMENT TO INVESTIGATE THE PRESENCE OF LIVING ORGANISMS IN SOIL

Apparatus

Two test tubes, muslin bag, top soil, two corks and lime water/ bicarbonate indicator solution

Procedure

i) Collect a hand full of fresh top soil and divide it into 2 equal portions.
ii) Sterilize one portion of the soil sample by heating it strongly on a crucible for 30 minutes. Leave it to cool and place it in a muslin bag.
iii) Place the remaining portion of the fresh soil sample in another muslin bag.
iv) Add equal amounts of lime water or bicarbonate indicator in the test tubes and then suspend the muslin bags with soil in the test tubes as shown in the set up below.
v) Allow the test tubes to stand for about 2 days

Observations

Lime water turns milky or the bicarbonate indicator solution turns yellow in test tube A but remains colourless in test tube B.

Conclusion

Carbon dioxide was produced in test tube A during respiration indicating the presence of living organisms. Lime water remained colourless in test tube B because the living organisms in soil in test tube B were killed by heating.

ALTERNATIVE EXPERIMENT

The experiment is set up as shown below;

Diagram to be drawn from school

The setup is left to stand for about 2 days and any changes in the water level in the U-tube are observed.

Observation

Water level in the u-tube increases in the left arm and decreases in the right arm. This is due to oxygen in the air inside conical flask A being absorbed by the living organisms in the soil causing reduced pressure in conical flask A hence the raised pressure of the remaining gases in conical flask B causing water to raise in the left arm of the u-tube.

TYPES OF SOIL

Soil is grouped basing on size and nature of soil particles. On this basis, there are 3 main types of soil, that is, clay soil, loam soil and sand soil.

1. Sand soils

Sand soil contains large spaces between the particles and these spaces allow water to drain out very quickly.

- They have a gritty feel when wet and felt between the thumb and finger.
- They contain only very small quantities of water and they may be deficient in calcium and magnesium
- They are described as light soils because they are relatively easy to work with.

2. Clay soil

- They have small fine particles i.e. fine texture.
- The soil particles in clay are closely packed together leaving very small spaces between them. This causes clay soils to have poor water drainage and also become water logged.
- They are difficult to work with and therefore described as heavy soils.
- They have a sticky feel when wet.

3. Loam soil

This is a mixture of sand, silt, clay and organic matter. It has stable crumb structure and is the best for crop production.

Differences between clay and sand soil

Clay soil	Sand soil
1. Very small air spaces between particles.	Large air spaces between particles.
2. Rich in dissolved salts.	Poorly dissolved salts.
3. Has high water retention capacity	Has only very low water retaining capacity

4. Poor drainage i.e. low permeability.	Very easy drainage i.e. high permeability.
5. Water can rise to high level by capillarity.	Water cannot rise to high level by capillarity.
6. More than 30% clay and less than 40% sand.	More than 70% sand and less than 20% clay.

PHYSICAL PROPERTIES OF SOIL

1. Porosity

Sandy soil possess large spaces between the soil particles and so more porous. Clay soils possess very small spaces between the soil particles thus less porous. Loam soil is moderately porous.

2. Air content

Sand contains a lot of air so it is well aerated. This is because it has large spaces existing between the particles. Clay soil contains little air so it is poorly aerated due to presence of small spaces between the particles. Loam soil has varying amounts of air.

3. Drainage of water

Sand has good water drainage so it allows water to pass through it very quickly.
Clay soil has poor drainage of water and this makes clay water logged. This can be improved by adding humus to it. Loam drains water moderately.

4. Water retention capacity

This refers to the amount of water soil can hold. Sand soil holds little water so it has a poor water retention capacity. It can be improved by adding humus to it. Humus sticks sand particles together. Clay soil tends to become water logged i.e. it holds a lot of water so has a high water retention capacity. Loam soil holds water moderately but not becoming water logged.

EXPERIMENT TO COMPARE THE DRAINAGE AND RETENTION OF WATER IN SAND AND CLAY SOILS

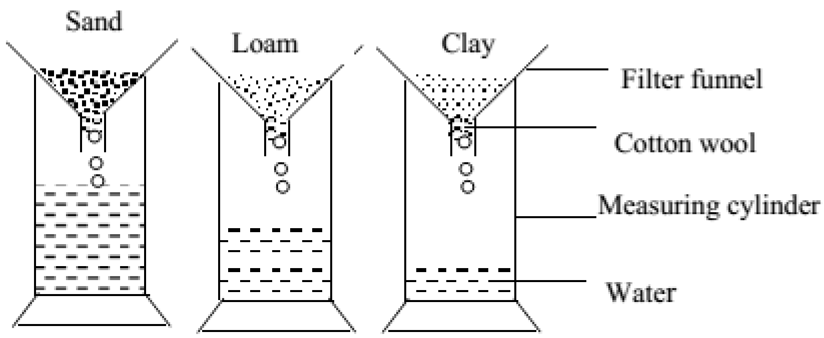
Apparatus

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.

Setup:



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.

Observations
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.

Explanation
Sand soil has larger air spaces which enable water to drain through more rapidly and on the other, clay soil retains more water than sand because it has many small particles which can hold more water.

5. Water capillarity through different soils

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.

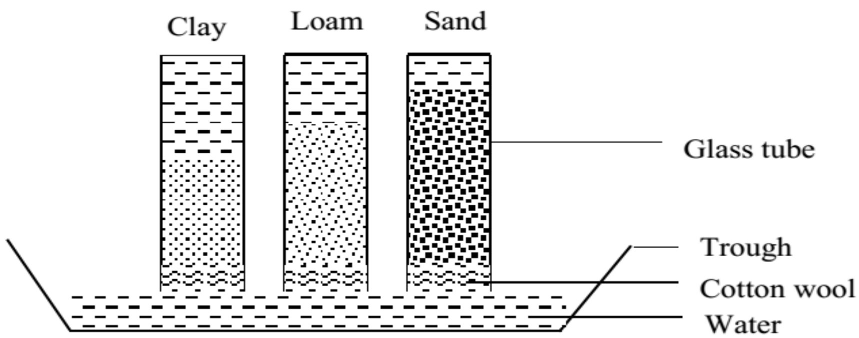
EXPERIMENT TO DEMONSTRATE AND COMPARE WATER CAPILLARITY THROUGH SAND, CLAY AND LOAM SOIL

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.

Explanation

Water rises to the greatest height at the nearest stages of the experiment in sand soil because sand has large spaces that enable water to rise more rapidly in the first hours. Clay soil shows the highest rise of water hence the highest water capillarity because it is composed of tiny soil particles which present the large surface area over which water molecules cling. Water rises at a slow rate in clay soil because clay has small air spaces between its particles.

CHEMICAL PROPERTIES OF SOIL

1. Soil colour

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

2. 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.

EXPERIMENT TO DETERMINE THE SOIL PH

Materials

Soil, petri dish, universal indicator and 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.

SOIL EROSION

This is the removal or washing a way of top soil by animals, wind or running water. The extent of soil erosion is dependent upon the intensity with which the rain falls and not the amount of water.

Types of soil erosion

Sheet erosion

This is where thin uniform layers of soil are eroded over the whole slope.

Rill erosion

This is where water cuts shallow channels called rills. The channels deepen as volume of water run off increases.

Gulley erosion

This results from rill erosion when the channels deepen and form gulleys. Here a lot of soil is carried a way over greater distances. It is facilitated by careless ploughing (up& down the slope). It may follow tracks made by vehicles and from animals.

Splash erosion or raindrop erosion

This occurs when intense raindrops displace soil.

Wind erosion

In dry conditions, herds of farm animals trample and compact the soil, causing a layer of dust on top. When wind comes, it can blow away the dust.

CAUSES OF SOIL EROSION

1) Slopes of land

The deeper the slope the greater the erosion and this is coupled with the intensity of rain.

2) Over grazing

This is caused by the keeping of many grazing animals on a small area. They finish the grass, i.e. remove the grass cover and open it to water erosion. They trample the soil and make it dusty, thus erosion can take place.

3) Deforestation

Foliage of trees reduces intensity at which raindrops reach the ground. Extensive falling of trees in an area removes this cover thus facilitating erosion on slopes.

4) Bush burning

Uncontrolled burning of bushes in dry seasons removes the grass top cover, thus leaving the soil bars for erosion.

5) Poor farming methods

Ploughing: It lessens the soil and destroys its natural structure. Failure to replace humus after successive crops reduces water holding properties, so soil dries easily and can easily be blown away. Ploughing up and down a slope accelerates water erosion. Over cropping; over use of soil depletes fertility, thus causing loss of plant cover. This leaves the soil bare and so susceptible to erosion.

Methods of reducing (preventing) soil erosion

a) Contour ploughing

Ploughing a long contours i.e. across a slope and not up and down. It allows furrows to trap water rather than to channel it a way.

b) Strip cropping

This consists of alternate bands of cultivated and uncultivated soil, following contours. Un tilled soil is covered with grass.

By alternating the grass and crops each year, the soil is allowed to rebuild its structure while under grass.

c) Terracing

This is cultivation a long contours in horizontal strips supported by stones or walls, so breaking up the step down water rush of the surface run-off. The steeper the slope, the closer the terraces must be.

d) Correct crop for soil

Steep slopes which should not be ploughed are covered with pasture crops, their roots hold the soil

e) Afforestation

This is the Planting large areas of land with trees. They act as wind brakes, hold the soil together, and prevent raindrops from hitting the soil directly

They conserve water and control flooding.

f) Mulching

covering of top soil with plant material e.g. banana leaves, maize stems after harvest, cut grass etc. it protects the top soil and conserves the water in the soil.

Effects of soil erosion (to farmers)

- Nutrients and soil organisms are carried a way in the top soil.
- The soil left behind is unproductive.
- Fields may be cut into irregular pieces by rill and gulley erosion
- Floods carry a way or submerge and suffocate crops and soil organisms.

SOIL FERTILITY AND CONSERVATION

SOIL FERTILITY

Soil fertility refers to the amount of nutrients in the soil that can support the growth of plants. Soil can lose its fertility through the following ways.

1. Soil erosion.
2. Leaching; this is the washing down of soluble minerals from topsoil layers to bottom layers where they cannot be accessed by plants.
3. Soil exhaustion; this is the depletion/reduction in soil nutrients as a result of monoculture, over cropping, etc.
4. Soil compaction; this is the hardening of soil on the surface due to action of heavy machinery, movement of animals and man on soil, etc. Soil compaction prevents water from penetrating into the soil.

SOIL CONSERVATION

This is the protection and careful management of soil to maintain its fertility. It includes methods of controlling erosion and others such as:

Intercropping

Here, plants are alternately planted in a systematic or even random manner e.g. coffee, beans, and banana can be intercropped.

Fallowing

Land is left to rest and grow back to bush.

Crop rotation

The farmer carefully rotates his crops season after season, so that the plants make different demands on the soil.

Deep rooted crops like cassava are rotated with shallow rooted ones e.g. g. nuts

Application of manure (organic manure)

1) Green manure;

These are green plants, mostly legumes which can be dug back into the soil. However, any available green plants can do.

2) Farm yard manure;

This is from wastes of farm animals like urine and faeces when left become manure. This improves the process of nitrification (addition of nitrates to the soil) e.g. poultry dropping, goats, pigs, cows etc.

3) Compost manure;

This is made by collecting all available organic materials like chicken waste, weeds, fresh leaves into a pit with alternating layers of soil, and leaving them to rot. Water is added periodically to keep it moist for bacteria and fungi in the soil speed up the process. When well decayed, the compost is spread over the garden. Organic manure adds humus to the soil and maintains the crumb

Structure

4) Artificial fertilizers;

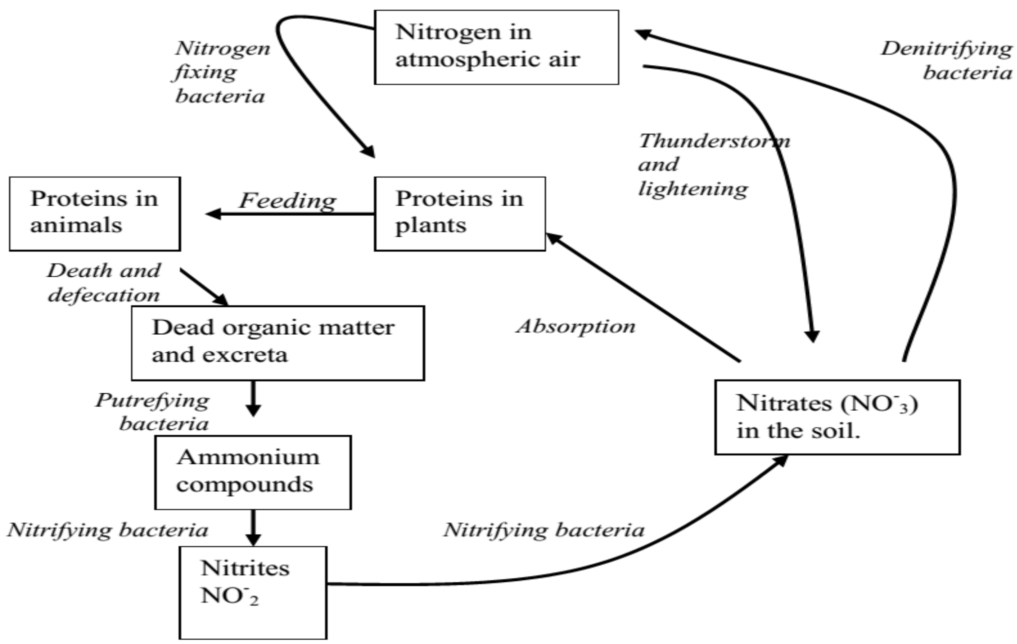
These are added directly. The most common element lacking in highly cultivated soils are nitrogen, phosphorus and potassium. They are supplied in form of potassium sulphate, ammomium sulphate and calcium phosphate which lead to high yield.

THE NITROGEN CYCLE

Nitrogen is one of the elements that make up proteins. Nitrogen makes up to 80% of air but it is un reactive so cannot be used by plants and animals in its elemental form. It becomes part of the bodies of organisms in a process called the nitrogen cycle. The changing of nitrogen into more reactive forms is called nitrogen fixation.

Nitrogen fixation takes place during lightening, in the manufacture of artificial fertilizers and in the metabolism of the nitrifying and nitrogen fixing bacteria. Plants absorb nitrogen as ammonium salts or nitrates. Animals obtain nitrogen they need by eating plants or other animals that have eater plants. At death or by leaf fall, egestion, excretion (urine), the nitrogen of plants and animals is returned to the soil. Nitrogen is in constant circulation between autotrophs, heterotrophs, and the soil in atmosphere. Plants absorb nitrogen inform of nitrates and ammonium salts, for manufacture /build up of proteins they require. At death or by leaf fall, egestion, excretion (urine), the nitrogen of plants and animals is returned to the soil.

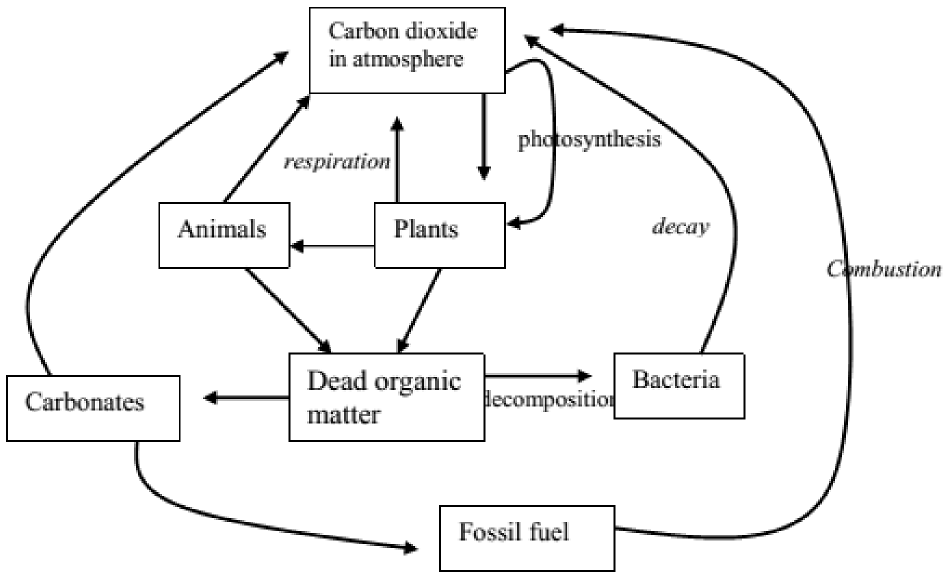
The nitrogen cycle



<u>THE CARBON CYCLE</u>

Carbon is an element which occur in all elements that make up a living organism. Carbon is therefore a major component of all organic matter. Plants get carbon from the atmosphere in the air during the process of photosynthesis. Plants use carbon to make food like starch. Starch is eaten by animals to get energy. When animals die, they decay and release the carbon and other nutrients in the soil. The circulation of carbon in nature from the atmosphere into the living organisms and back into the atmosphere forms the carbon cycle.

The carbon cycle



Removal of carbon dioxide from the atmosphere:

Green plants remove carbon dioxide from the atmosphere during the process of photosynthesis. Some of the carbon dioxide in the atmosphere dissolves in rain water to form carbonic acid. This acid reacts with soil mineral salts to form carbonates.

Addition of carbon dioxide in the atmosphere:

a) Combustion (burning)

When carbon containing fuels e.g. petroleum, coal, natural gas, fire wood are burnt, carbon dioxide is released into the atmosphere. Formation of such fuels over millions of years is referred to as fossilation.

b) Respiration in animals and plants.

c) Decomposition of organic matter by bacteria and fungi. During this process, carbon dioxide is released into the atmosphere.