**BIOLOGY NOTE (SS 1)**

**SECOND TERM 2024/2025 SESSION**

**SCHEME OF WORK**

Lesson One: Basic Ecological Concept

Lesson Two: Ecological factors

Lesson Three: Relationship between soil types and water holding capacity of the soil

Lesson Four: Population studies by sampling method functioning Ecosystem

Lesson Five: Functioning Ecosystem

Lesson Six: Nutrient cycling in nature

Lesson Seven: Ecological management

Lesson Eight: Adaptation

Lesson Nine: Pollution

Lesson Ten: Conservation of Natural Resources

**BASIC ECOLOGICAL CONCEPTS**

**WHAT IS ECOLOGY?**

Ecology is the study of the interrelationship between living organisms and their environment. The basic unit of ecology is the ecosystem.

Ecology is divided into two main branches. They are;

1. Autecology.
2. Synecology.
3. **Autecology**: This is the study of an individual organism or a single specie of organism and their relationship with its environment. E.g. the study of a single lizard and its environment.
4. **Synecology**: it is the study of the interrelationship between groups of organisms living together in an area. E.g. the study of different organisms in a stream in relation to their aquatic habitat.

**BASIC CONCEPTS IN ECOLOGY (ECOLOGICAL CONCEPTS)**

1. **Ecosystem**: Is a basic functional unit in nature in which, their s an interaction between all living organisms (biotic factors) and non-living organisms (abiotic factors) within an environment or habitat. Such interaction includes feeding energy flow, material cycling e.t.c.
2. **Environment**: Is everything or sum total of biotic and abiotic factors affecting living organisms and their surroundings.
3. **Biosphere or Ecosphere**: It includes the part of the earth and atmosphere occupied by living organisms. It is a layer of life which exists on the earth surface.
4. **Lithosphere**: It is the solid portion of the earth i.e. land. It is the outermost layer of the earth crust. It is made up of rocks and mineral materials. Lithosphere forms the basis of all human settlements.
5. **Hydrosphere**: It is the part of the earth occupied by water e.g. ocean, sea, river, stream e.t.c. It holds water in various forms i.e. solids (ice), liquids (water) and gases (water vapour).
6. **Atmosphere**: it is the gaseous portion of the earth. It contains 78% of Nitrogen, 21% of Oxygen, 0.03% of Carbondioxide (CO2) and inert gases.
7. **Habitat**: Is a place or an area occupied by a biotic community or organisms. In other words, habitat is an environment in which organisms live naturally. We have two types of habitat.
8. **Terrestrial habitat**: This covers life on land and it includes;
9. **Aboreal habitat** i.e. either or, in or among trees e.g. monkeys
10. **On ground** e.g. man
11. **Underground** i.e. below soil level e.g. earthworm, termite
12. Tropical rain forest, savanna, desert e.t.c.
13. **Aquatic habitat**: This refers to water (i.e. organisms living inside water). They include;
14. **Marine water habitat** (salt water) e.g. sea and ocean.
15. **Brackish water or estuarine water habitat** all water bodies with a mixture of salt and fresh water e.g. lagoon, delta, bay
16. **Fresh water habitat** (i.e. salt free water bodies e.g. stream, ponds, rivers e.t.c.)
17. **Ecological niche**: it is the functional role an organism plays in a community and its habitat.

**OR**

Ecological niche is the specific portion of a habitat which is occupied by particular specie or organism and its functional role in that habitat. E.g. Some organism serves as food for others, it obtains nutrients from its habitat and returns nutrient to its habitat. Some of these organisms may be a producer or a consumer. The sum total of all these roles for any given for any given organism is referred to as its ecological niche.

For instance, a caterpillar and an aphid which lives on the same plant occupy different position and feed on different source of food.

**Roles of Mango tree in the ecological niche**

1. Mango tree absorb sunlight for photosynthesis.
2. It absorbs water and mineral salts from the soil
3. It provides shelter for animals and other plants
4. It produces foods or fruits for animals.
5. They serve as sources of fuel for animal
6. It covers the soil/ground with dead leaves that enrich the soil.
7. **Population**: Is the total number of organisms of the **same species** living together in the same habitat or environment at any given time. E.g. mango trees in a school compound, Tilapia fish in a stream e.t.c.
8. **Community or biome**: Is a large group of natural population of plants and animals that occur in a given area or habitat and are adapted to the conditions of their surroundings and directly or indirectly dependant on each other for their survival.

**Effects of overpopulation on a community**

1. Competition for limited resources.
2. Predation or cannibalism.
3. Spread of diseases
4. Food shortage
5. Limited space for an individual to live
6. High death rate
7. Increase in social vices or behaviour.
8. Build up of toxic waste in the environment.

**COMPONENTS OF AN ECOSYSTEM**

The ecosystem is made up of two main components. These are;

1. Biotic (living) components
2. Abiotic (non-living) components.

**Biotic component**

This is the living part of an ecosystem. It is composed of all the living organisms in the environment. In an ecosystem, the biotic community includes;

1. Producers
2. Consumers
3. Decomposers
4. **Producers**: they are green plants or autotrophs which traps the energy from sunlight and converts it to chemical energy (food) i.e. photosynthesis, using CO2 and water as raw materials. It forms the starting point of every food chain. We have aquatic producers (e.g. phytoplankton, algae, diatom) and terrestrial producers e.g. green plants.
5. **Consumers**: These are organisms that depend on plants directly or indirectly for food, energy or nutrients. All consumers are heterotrophs i.e. they cannot manufacture their own food because they lack chlorophyll.

Consumers are subdivided into;

1. **Primary consumers**: They are also called herbivores i.e. they derive their food by eating plants directly. E.g. cow, sheep, goat, mosquito larvae, copepod, tadpole e.t.c.
2. **Secondary consumers**: They are also called carnivores i.e. they eat herbivores thus derive their food/energy from the producers. E.g. cats, lion, leopard e.t.c.
3. **Tertiary consumers**: They feed on secondary consumers.
4. **Decomposers**: they are fungus or bacterium which lives saprophitically or feed on dead remains of plant and animals leading to the recycling of nutrients for organisms by breaking down organic matters to produce soluble nutrients which are absorbed by plants.

**Abiotic components**

This is the non-living part of an ecosystem. It consists of abiotic resources and conditions. This includes:

1. **Climatic factors** temperature, wind, humidity, sunlight, rainfall
2. **Inorganic materials and nutrients or chemical factors** like CO2, Oxygen, Hydrogen, Calcium, Phosphorus e.t.c.
3. **Edaphic factors** like soil, rocks and topography
4. Other factors like dust, storm, fire and water.

**INTERACTION AMONG THE COMPONENTS OF AN ECOSYSTEM**

1. Green plants reacts with CO2, H2O and chlorophyll in the presence of sunlight to produce carbohydrate or starch during photosynthesis.
2. Animals feed on green plants.
3. Plants releases oxygen for animals to breathe during respiration.
4. Animals take in oxygen for respiration and in turn release CO2 for plants to use for photosynthesis.
5. Plants absorb water and mineral salts (non-living factors) for their growth.
6. Micro-organisms and other decomposers break down dead plants and other organisms to release nutrients into the soil which are absorbed by plants.

**LOCAL BIOTIC COMMUNITY OR BIOMES IN NIGERIA**

**BIOME** is a larger region or area on the earth where vegetation grows and is characterised by a distinct climate, soil, plants and animals.

The local biome community in Nigeria are;

1. Mangrove/brackish water/estuarine swamp forest.
2. Tropical rain forest.
3. Montane forest.
4. Guinea savanna (northern and southern guinea savanna)
5. Sudan savanna.
6. Sahel savanna.

**NOTE:** No. 1 and 2 are grouped as forest zone while No. 4, 5 and 6 are grouped in the savanna zone.

**MAJOR BIOMES OF THE WORLD**

They include;

1. **Tropical rain forest**: They are found in the amazon basin of South America, Zaire basin of central Africa, the coast of West Africa and interior Malaysia.
2. **Savanna or grass lands**: It is a translational biome between the forest and the desert grasslands are grouped into;
3. **Tropical grass land**- South America, Brazil.
4. **Temperate grass land**- North America, Argentina, South Africa and Australia.
5. **Desert**: We have the hot and cold desert shrubs
6. **Shrubs.**
7. **Afro-alpine.**
8. **Swamp**
9. **Deciduous forest.**
10. **Tundra**
11. **Coniferous forest.**

***Diagram of map of Nigeria showing rainfall and nature of vegetation***

***Diagram showing the major Biomas of Africa***

**LOCAL BIOTIC COMMUNITIES (BIOMES)**

1. **Tropical rainforest**

They are mostly found in the southern Lagos, Edo, Delta, Imo, Abia, Ogun, Anambra.

**Characteristics**

1. Presence of broad leaves and dark ever green leaves. This enables the plant to receive abundant light and enhance transpiration.
2. Presence of buttress root for support.
3. Trees are predominantly woody, very tall (some are called emergents and attain a height of over 60 metres).
4. The trees in the rainforest are shaped in such a way as to form canopies.
5. Trees exist in layers or storeys.
6. Presence of leaf litters on the forest floors.
7. The trees have thin bark to enhance gaseous exchange and transpiration.
8. Abundant rainfall, moderate temperature and high relative humidity.
9. Presence of epiphytes and climbers.

Plants found here are African walnut, Mahogamy, Opepe, Obeche, Iroko, Oil palm, Ferns, Orchids, Mosses, Mistletoes, Lichens e.t.c.

Animals found here are monkeys, snakes, birds, lizards, squirrels, chameleons, tree frogs, snail, ants, earthworm e.t.c.

1. **Mangrove swamp forest**

It is found in areas along the coast especially in states like Delta, Cross River, Rivers, Akwa-Ibom, Bayelsa, Ogun and Lagos.

**Characteristics**

1. It has tall woody trees.
2. Ever green leaves with broad leaves.
3. Plants with breathing roots and stilt/prop roots.
4. High rainfall, high humidity and high salinity.
5. The soil is always waterlogged.

Common plants species found here are white mangrove, red mangrove, raffia palm, coconut tree e.t.c.

Animals found here are tilapia fish, oysters, crabs, snakes birds, king fishes e.t.c.

1. **Montane forest**

i.e. the biome of the biotic community of montane (Plateau).

**Characteristics**

1. High rainfall, high relative humidity and low temperature.
2. Few trees that are scattered.
3. Grasses form the most predominant biotic community.
4. Abundant grazing animals.
5. **Guinea savanna**

We have the southern guinea savanna and the northern guinea savanna.

1. **NORTHERN GUINEA SAVANNA (NGS)**: This is found in states like Plateau, Kaduna, Niger, Bauchi, Taraba and Kano.
2. **SOUTHERN GUINEA SAVANNA (SGS)**: This is found in states like Kwara (Ilorin), Oyo, Ebonyi, Enugu, Kogi, Benue and Ekiti.

**Characteristics**

1. High temperature and low relative humidity.
2. Grasses are predominant.
3. Grasses grow tall during the rainy season
4. Few trees.
5. Annual bush fires are common.
6. Trees are fire resistant with thick corky bark.
7. Extensive tap root system.

Plants found here are locust bean tree, shea butter, isoberlina, date palm, silk cotton, Baobab.

Animals found here are lions, leopard, antelopes, zebra, snakes e.t.c.

1. **Sudan savanna**

**Characteristics**

1. Very high temperature, low humidity and rainfall is scarce.
2. Trees are few and scattered.
3. Annual bush fires are common.
4. Thorny/spiny leaves/reduced leaves.
5. Fire resistant trees present.
6. Extensive tap root system.

Examples of state in sudan savanna are Kano, Sokoto, Gongola, Bauuchi, Bornu.

1. **Sahel savanna**

They are found in the extreme northern parts of Nigeria such as Bornu, Kastina, Sokoto, Yobe, Kebbi, Zmafara, Jigawa and kano (Maiduguri)

**Characteristics**

1. Very high temperature with scanty rainfall.
2. Short and scanty grasses which grows in clusters.
3. Short and tough shrubs or trees.
4. Extensive tap root system.

Plants found here are acacia, gum arabic, euphobia, cactus and date palm e.t.c.

Animals are antelopes, zebra, horses, camel, lizard, bird, insects e.t.c.

**ECOLOGICAL CONCEPTS**

These factors which can influence living organisms or cause changes in any habitat be it aquatic or terrestrial is called an ecological factor.

Ecological factors are of two categories;

1. Biotic factors.
2. Abiotic factors.
3. Biotic factors are made p of the effects of other plants and animals on a given organism. They are parasitism, commensalism, predation, pathogens, mortality, migration, competition, dispersal, natality, food, diseases and pests.
4. Abiotic factors comprises of;
5. **Climatic factors** e.g. temperature, rainfall, pressure, sunlight, humidity.
6. **Chemical factors** e.g. O2, CO2 , mineral saltsH2O and nitrogen.
7. **Physiological factors.**

(i)**Edaphic factors** e.g. soil, soil nutrients, soil profile, texture, structure and pH.

(ii)**Topographic factors** i.e. the shape of the earth surface e.g. effect of rivers, hills, mountains, and valleys.

**ECOLOGICAL FACTORS COMMON TO ALL HABITATS**

Factors common to all habitats (i.e. both terrestrial and aquatic habitats) are;

1. Temperature
2. Rainfall
3. Sunlight
4. Wind
5. Pressure
6. pH
7. **Temperature**:
   1. High temperature leads to high transpiration rate in plants.
   2. High temperature leads to high rate of metabolism in organisms.
   3. High temperature leads to high rate of decaying of organic matter.
   4. High temperature makes plant to wilt
   5. High temperature makes poikilothermic animals to hibernate or look for shade from heat.
   6. High temperature leads to high incidence of bushfire.
   7. At very low temperature, plants root absorbs water at a slower rate and reduction in transpiration and metabolism of organisms
8. **Rainfall**:
9. Makes water available to organisms.
10. Quantity of rainfall determines the type of vegetation in a habitat.
11. Vegetation in turn influences the type of animal that will live there.
12. It helps to dissolve nutrients in the soil but when in excess causes erosion or may waterlog the soil.
13. May form puddles or pond thereby creating habitats or breeding grounds.
14. It is necessary for seed germination
15. Plants use water for photosynthesis
16. **Light**:
17. It is necessary for photosynthesis.
18. Affects the rate of transpiration or stomata opening.
19. Adequate sunlight promotes growth of many plants species.
20. Light affects the vision or movement of animals.
21. Light is the ultimate source of energy for every living organism.
22. **Pressure/altitudes**:
23. Atmospheric pressure decreases as one goes up from the sea level and increases as one moves down the water.
24. At high altitude, temperature decreases while wind action increases which affects the distribution of organisms.
25. Altitude may affect speciation.
26. Pressure is responsible for the movement of winds
27. **pH- Hydrogen ion concentration**:
28. Increase in salinity or alkalinity or acidity of the soil which affects plants and animals.
29. Affects the distribution of plants.
30. Delays germination in some seeds.
31. Enhance germination in some seeds.
32. Affects turgidity of some plants.

**ECOLOGICAL FACTORS AFFECTING AQUATIC HABITAT**

1. **Turbidity**: turbidity is caused as a result of suspended materials in water. Clear water has low turbidity. Turbidity reduces light penetration into the water, reducing the ability of aquatic green to carry out photosynthesis and it causes pollution.
2. **Salinity or salt content**: Salinity can be defined as the degree of saltiness or concentration of salt in water. The concentration of salt in water determines the type of organisms that can live there. Salinity is low in clear water, high in marine water and moderate in brackish water.
3. **Dissolved gases**: i.e. oxygen and carbondioxide. The O2 concentrate of water decreases with depth. O2 is required by most aquatic organisms for respiration and also for decaying of organic substance. CO2 is required as raw material for photosynthesis.
4. **Density**: Density of water varies with the type of aquatic habitat. For pure fresh water -1.00, sea water -1.028. The organisms living in water must have certain density which gives them that ability to float in water e.g. fish has streamlined body.
5. **Water currents**: Water current increase aeration of the water. It also affects the distribution of aquatic organism. The type of organisms found in each aquatic habitat is affected by the speed of water current. E.g. animals in a fats flowing water must develop some features which will enable them to withstand H2O current.

Other factors are temperature, rainfall, light, pH. These factors have been explained above.

**ECOLOGICAL FACTORS AFFECTING TERRESTRIAL HABITAT**

Factors common that affects terrestrial habitats are:

1. Temperature
2. Wind
3. Rainfall
4. Light
5. Pressure
6. pH
7. Edaphic factors
8. Topographic factors or land surface.

Some of these factors have been discussed before. Other factors not discussed are:

1. **Edaphic factors**: These include the nature of the soil, soil type, soil texture, soil structure, moisture content, pH of soil, nutrient content e.t.c. All these affects terrestrial habitat in one way or the other.
2. **Topographic factors**: The structure of the earth surface, the effects of rivers, mountains, hills and valleys are vital.

**SIMPLE MEASUREMENT OF ECOLOGICAL FACTORS**

1. **Temperature**: A maximum and minimum thermometer is used in the measurement of atmospheric temperature while soil thermometer measures soil temperature. To measure temperature of a medium , the bulb of the thermometer is suspended in the medium (whose temperature is to be measured) for about one to five minutes. The level of the mercury or liquid in the stem of the thermometer is read off or recorded. About three readings are recorded and the average found.

***Diagram of some Ecological instruments***

1. **Relative humidity**: Is measured with a hygrometer. We have the pocket hygrometer and the wet and dry bulb hygrometer.
2. **Rainfall**: A rain gauge is used in measuring the amount of rainfall.

***DIAGRAM OF THE RAINGAUGE***

**How to use the raingauge**

1. Mount instrument on a raised platform while an elevated funnel is fixed to it.he site (platform) is devoid of any shade like trees or houses. The bottle must be clean and empty and a measuring cylinder should be used in the exercise.
2. After the rainfall, the reading of the volume of rain water in the bottle shows the amount of rainfall.

After each rainfall, the amount of water collected in the measuring cylinder is noted and recorded over of period of time.

Amount of rainfall is calculated using the formular which is

i.e X h

D2 = Diameter of cylinder

d2 = mouth of funnel

H = height of rain water

1. **Turbidity**: The turbidity of the water can be measured used secchi disc.

The surface of the disc is painted white with black stripes and it is tied with a graduated string or rope.

**How to use secchi disc**

* Lower the graduated string with secchi disc into the water.
* Note the depth of the string when the disc is no longer visible.
* Pull the string out gently until the disc becomes just visible.
* Repeat the procedure above again.
* Take the average of the reading.
* The depth at which the disc just cannot be seen measures the turbidity or transparency of the water.

1. **Light intensity**: Light meter or photometer is used in measuring the amount of light intensity in a given habitat.  
   **DIAGRAM OF A LIGHT METER**
2. **Wind speed**: Anemometer is used for measuring the velocity or speed of the wind.

**DIAGRAM OF ANEMOMETER**

1. **Air or atmospheric pressure**: Barometer is used for measuring this and special pressure gauge for below water surface. Pressure is measured in units of force known as millibars.

Another instrument used for measuring pressure is known as aneroid barometer. A modified barometer known as altimeter is used in aeroplanes.

1. **The pH or acidity/alkalinity of the soil or water**: This is measured using an instrument called pH indicator or pH meter/paper or calorimeter.
2. For measuring distance or length of an object, we use the metre rule or tape measure.
3. For measuring the slope of land, we use the slope gauge or plumb line.
4. To compare the numbers and types of animals in different soil sample, we use an instrument called the **Tullgren funnel.**

It is also used for catching small animals from the soil and putting dead samples into a preservative liquid (formalin). The soil material is heated under a light source. As the animals move away from the light, they pass through a sieve and then into a container into which formalin has been prepared.

1. To measure light intensity in water we use **hydrophotometer**.
2. To collect tiny organisms living in the soil water, we use **Baermann funnel.**
3. For the population of plants and other slow moving animals we use the **Quadrat.**

Example of animal measure with Quadrat are ant, millipede, beetle, Garden snail

Example of plant measure with Quadrat are tridax, water leave, spear grass

1. For catching insects on the surface of the water, we use **Sweep or insect net**
2. For catching fish we use **Fish traps.**
3. **Pooter** is used to collect small insects and invertebrates that are fast moving from leaf litters, tree trunks and crevices of rocks and walls.

***DIAGRAM OF POOTER***

**RELATIONSHIP BETWEEN SOIL TYPES AND WATER HOLDING CAPACITY OF THE SOIL.**

**SOIL.**

Soil is defined as the uppermost layer of the earth crust which provides support and nutrients for plant growth and a habitat for some animals. Soil is formed by the gradual breaking down of rocks into small pieces.

**CONSTITUENT/COMPONENT OF THE SOIL.**

Soil consists of the following;

1. Soil particles.
2. Organic matter or humus.
3. Soil water.
4. Soil air.
5. Soil mineral salts.
6. Soil organisms.
7. **Soil particles**: These are products of weathering. They form a basic skeletal structure with uneven pore spaces. The sizes and chemical nature largely determines the properties of the soil.

|  |  |
| --- | --- |
| **Types of soil particles** | **Size (mm)** |
| Stone and gravel. | 2.00 and above |
| Coarse sand | * 1. - 0.20 |
| Fine sand | 0.20 - 0.02 |
| Silk | 0.02 - 0.002 |
| Clay | * 1. and below |

1. **Humus/organic matter**: Humus is defined as the part of the soil that is made up of decomposed organic matter or remains of dead plants and animals and it is done or formed by the action of micro-organisms (fungi and bacteria).

**Characteristic features of humus**.

* Black or dark brown in nature.
* Porous in nature
* Colloidal in nature.
* It absorbs cations or it contains mineral salts or it is rich in plant nutrient.
* It is completely decomposed into carbon(iv)oxide, water and mineral salts are released.

**Importance/role of humus in the soil.**

* It improves soil fertility.
* It maintains acid-base balance in the soil.
* It contains bacteria and fungi (decomposers).
* It binds lose particles of soil together hence improving the soil structure and reducing soil erosion.
* It provides plants nutrients especially nitrogen, phosphorus and sulphur.
* Decomposition of humus release carbon(IV)oxide and ammonia gas to the atmosphere.
* It reduces evaporation by formation of surface mulch.
* It allows burrowing of earthworm, ants, rodents into te soil for better air and water infiltration.
* It lowers soil acidity or pH.

1. **Soil water**: Soil water contains mineral salts dissolved in it. Some soil have higher water retaining capacity than the others. When soil contains too much of water, that soil is said to be waterlogged.
2. **Soil air**: Soil usually contains air in the pore spaces which plant plant roots and soil organisms use to carry out gaseous exchange or cellular respiration.
3. **Mineral salts:** They are salts of potassium, iron, magnesium, phosphorus, sulphate, nitrate e.t.c. They always occur in solution in soil water and are absorbed by the plant roots. The plants use it to build up call materials.
4. **Soil organisms**: They are termites, earthworms e.t.c. Which improve the circulation of air in the soil through their tunnelling activities. Decomposers like fungi and bacteria breakdown the dead organic matter/humus thereby improving the soil fertility.

**SOIL PROFILE**

Soil profile is any vertical section of the ground that can be seen at the side of a deep well or earth cutting along our highways.

Profile shows that soil occurs naturally in fairly distinct horizontal layers (strata) called **HORIZONS.** Soil horizons includes the surface downward i.e. litter (surface layer), top soil, sub soil, weathered materials and parent rocks.

**Diagram of the Soil profile**

**TYPES OF SOIL**

There are three major type of soil. They are;

1. Sandy soil.
2. Clay soil.
3. Loamy soil.

**Sandy soil**: A soil is said to be sandy if the proportion of the sand particles in a sample of soil is very high (0.02mm to 2.0mm).

**Characteristics of sandy soil**

1. Low plant nutrient or humus content hence it supports scanty vegetation or grasses.
2. Well aerated or large air spaces or pores.
3. Large particles of coarse texture/gritty.
4. Highly porous/percolation/well drained or it does not retain water.
5. Low capillarity.
6. Particles are loose and do not stick together.
7. Very low base exchange capacity.

**Clay soil**: A soil is said to be clayey if the proportion of clay soil in a soil sample is very high i.e. less than 0.002mm.

**Characteristics of clay soil**

1. It has little nutrients and so can only support little vegetation.
2. They are fine and smooth particles.
3. Poorly aerated i.e. small air spaces because the particles are tiny and closely packed together.
4. High water retention.
5. High capillarity.
6. Sticky when wet.
7. High base exchange capacity.

**Loamy soil**: Loamy soil is a mixture of sand and clay particles with high proportion of organic matter. Loamy soil is more fertile than either clay or sandy soil. If a soil is described as sandy loam, it means that the proportion of sand is high and if it is clay loam, it shows that the proportion of clay is high while that of the sand is low.

Loamy soil is fertile as it contains plant nutrients and it is the best soil for planting.

**Reasons why clay soil and sandy soil are not suitable for plant production**

Clay soil

It contains small soil particles, which leads to less air space, and high water retention, thereby making the soil easily water waterlogged.

It contains nitrifying bacteria, it is low in nitrate.

It contains little humus, which makes it low in soil nutrients.

It is heavy and sticky when wet, which makes it difficult to cultivate.

It is very hard when dry, which makes it difficult for plant roots to penetrate.

Sandy Soil

1. It has large soil particles, with more spaces thereby making it difficult to cultivate.
2. It has low water retention, and has high water drainage which makes mineral to be easily washed, also known as leeching.
3. It retains small amount of water, which makes soil dry, hence making it difficult for plants to get water.
4. The soil is light and easily blown away.

**Importance of soil to plants.**

1. Soil provides medium for microbial activities.
2. It provides anchorage for plants.
3. Soil improves soil fertility hence, providing nutrients for plants.
4. It is useful for better plant growth.
5. It contains soil water, dissolved inorganic material for healthy growth of plants.
6. It provides raw material for photosynthesis.

**Advantages of vegetation to the soil**

1. Prevents the loss of humidity.
2. Protects the soil from leaching and erosion especially the cover crops.
3. The roots, underground stem and stolons help in binding the soil particles together.
4. The leaves protect the soil from getting direct heat from the sun and adds nutrients to the soil.

**The summary of the relationship between soil types and water holding effect on vegetation**

|  |  |  |  |
| --- | --- | --- | --- |
| **Soil type** | **Sandy soil** | **Loamy soil** | **Clayey soil** |
| **Texture** | Particles are coarse, loosely packed (light soil) | Intermediate (particles are not to packed and not too loose) | Particles are strongly stick together. |
| **Composition** | Mainly silica | Mixture of sand, silt, clay and humus in equal proportion | Silicate, sulphate, phosphate, Ca, Mg, Al and Iron. |
| **Air content** | High, because of large pore spaces among the particles. | Intermediate | Low because of closed packed particles. |
| **Water content** | About 25%, nearly all the water can be absorbed by roots of plants. | About 50%, most of the water can be absorbed by the root of the plant | Greater than 70%, only small amount of water can be absorbed by the roots of plants. |
| **Porosity** | High | Intermediate or moderate | Waterlogged soil |
| **Capillary action** | Low | Intermediate | High |
| **Humus content** | Very little | High | Variable or little |
| **Vegetation** | Poor i.e. scanty vegetation | Supports heavy vegetation | Support mainly plants that cannot stand upright. |

**WATER HOLDING CAPACITY OF THE SOIL**

Water holding capacity of soil is the ability of the soil types like sandy, clay and loamy soil to retain water.

**FACTORS AFFECTING THE WATER HOLDING CAPACITY.**

1. Organic matter content.
2. Size of the particles
3. Soil texture
4. Clay content
5. Mineral/pH

**EXPERIMENT ONE**

**Aim**: Experiment to compare the porosity and water holding capacity of the three types of soil; Loamy soil, clayey soil and sandy soil.

**Materials required**: Three measuring cylinders of 100cm3, cotton wool, three funnels, water, dry sand, dry clay, dry loam, stop watch or clock.

**Method:**

1. Obtain the samples of sandy, loamy and clayey soil
2. Grind loamy and clayey soil into fine particles after proper drying in the sun. Sandy soil must also be dried.
3. Equal masses of the dry sand, clay and loam are placed separately into three different funnels which are blocked by the neck with dry cotton wool.
4. The three funnels containing different soil types are then placed on top of the three measuring cylinders as shown below.
5. Pour equal amount of water into the funnel containing each soil type
6. The set-up is allowed to remain for one hour.
7. For each soil find the difference between the volume of water in the cylinder to obtain the amount of water retained by each soil.

**Observation**: It is observed that water drains out from sandy soil faster followed by loamy soil and lastly by clayey soil.

**Conclusion**: From the observation, it shows sandy soil is porous because of its large particles and retains water less. Clay soil is the least porous because of its fine particles and retains more water. Loamy soil is second most porous because of its moderate air spaces and slightly bigger particles.

**CALCULATION**

If 60cm3 of water is poured equally into three different funnels containing sand, loam and clay soil. 50cm3 of water drains out of sandy soil, 40cm3 drains out of the loamy soil while 30cm3 drains out of the clay soil. Find the;

1. Water holding capacity in each of the samples of soil.
2. Percentage of water retained in each of the soil samples.

**EXPERIMENT TWO**

**Aim**: Experiment to find the relative amount of different soil particles in a soil or soil sedimentation.

**Apparatus**: Measuring cylinder with 200cm3, water, soil sample.

**Method**:

1. In a measuring cylinder (200cm3) fill two-third of it with a given soil sample..
2. Add sufficient amount of water to cover the soil surface or until it is above the soil sample.
3. As you are pouring the water into the soil, air or oxygen bubbles will be released.

**Functions of air bubbles**

* + 1. Provides oxygen or aerates the soil.
    2. It provides aerobic respiration for soil micro-organisms.
    3. It makes soil porous.
    4. It contributes to soil fertility.

1. Cover the cylinder with your palm and shake the whole content very well.
2. Allow it to stand on a smooth table for 30 minutes.

**Observations**: After 20 minutes, it will be observed that the soil sample settle in different layers starting from the top, we have humus, water with clay in suspension, clay, silt, fine sand, coarse sand and gravel.

**EXPERIMENT THREE**

**Aim**: Experiment to determine the percentage of humus in a soil sample.

**Apparatus**: Crucible, fresh soil, oven, dessicator, weighing machine.

**Method**:

1. Empty crucible/weighing dish, weigh and weight recorded (m1g).
2. Fill crucible with soil sample (m2g).
3. Weigh and record to get weight of soil (m2g-m1g)
4. Put crucible with soil in the oven and dry to constant weight (m3g)
5. Cool in a dessicator and dry.
6. This dry sample is then heated to redness or red hot until no smoke is evolved.
7. Cool and weigh.
8. Repeating burning and cooling until constant weight is achieved (m4g)
9. Calculate the difference between the weight of the oven dry soil and the weight of burnt soil in the crucible (m3g-m4g).
10. This weight gives the weight of the humus in the soil and it can be used to calculate the percentage of humus content of the soil i.e.

Weight of humus × 100 = (m3-m4)g × 100

Weight of soil (m2-m1)g

**FORMULAR**

Mass of crucible = m1g

Mass of crucible + mass of fresh soil=m2g

Mass of fresh soil = (m2-m1)g

Mass of crucible + dry soil before strong heating = (m3g)

Mass of crucible +dry soil after strong heating = (m4g)

Mass of humus = (m3-m4)g

% of humus = (m3-m4)g × 100

(m2-m1)g

1. 28g of soil sample was heated to a constant weight of 24g, when further heated, it weighed 18g. what is the percentage of humus in the soil sample.

**EXPERIMENT FOUR**

**Aim**: To show the presence of living micro-organisms in the soil sample.

**Materials**: Muslim bag, lime water, flask, fresh soil sample

**Method**:

1. Put a fresh soil sample in a muslin bag and then the whole set-up is put into a conical flask containing lime water.
2. Allow it to stand for 1-2 hours.

**Observation**: it will be observed that the lime water turns milky showing the presence of carbon(IV)oxide. This shows that living organisms in that soil sample carry out respiration.

**Conclusion**: This shows that the soil sample contains living organisms.

**EXPERIMENT FIVE**

**Aim:** Demonstration of differences in capillarity of sandy, loamy and clayey soil.

**Materials**: Three long capillaries glass tubes, sandy, loamy and clayey soil, cotton wool, trough of water, clamps and stand.

**Methods**:

1. Three wide and long glass tubes are packed with equal amount of sandy, clayey and loamy soil.
2. The lower end of the three glass tubes plugged with cotton wool.
3. The tubes are placed vertically In a trough containing water (the end containing the cotton wool is the area to be immersed into water).
4. The set-up is allowed to stand for one to three days.

**Observations**: After a few hours, water is observed to have risen in the sandy soil. After 2 days, it will be observed that water rises in the clay soil followed by loamy soil and the least sandy soil.

**Conclusion**: Sandy soil has poor capillary action due to large pore spaces and particles, while clay and loamy soil have greater capillary action but greatest in clay than loamy.

**EXPERIMENT SIX**

**Aim**: To demonstrate amount of water in a soil sample.

**Method**:

1. An evaporating dish is weighed (W1g).
2. A soil sample is placed in the dish and the soil and dish are weighed (W2g).
3. The weight of the soil sample is obtained by subtracting W2g from W1g i.e. (W2-W1)g and it is recorded as W3g
4. The soil in the dish is heated in a steam oven to evaporate the moisture content in the soil and it is recorded as W4g.
5. Then to obtain the amount of water in the soil, the weight of the heated soil is subtracted from the weight of the original soil sample i.e. (W3-W4)g.

**CALCULATION**

Weight of the dish = 3g

Weight of dish + soil before heating= 11g

Weight of soil dish + soil after heating = 9g.

Find the percentage of water in the soil.

**ASSIGNMENT**

Three samples of soil were collected from three different locations K, L, M. the soil samples were analysed separately for water content, humus content and water permeability. The water obtained are given in the table below.

**SOIL SAMPLE**

|  |  |  |  |
| --- | --- | --- | --- |
| **Soil analysis** | **K** | **L** | **M** |
| **Water content (%)** | 15 | 25 | 5 |
| **Humus content (%)** | 10 | 3 | 2 |
| **Permeability of water (cm per min)** | 4 | 4 | 23 |

1. From the result, identify the soil type of each of the samples K, L, M.
2. Give one reason for your answer in a above.
3. Which of the soil sample is most suitable for the cultivation of crop.
4. Give two reasons for your answer in c above.

An experiment was performed with one of the soil sample as follows. 20cm3 of the soil sample was put into a measuring cylinder and 30cm3 of water was put in it. The content of the measuring cylinder were mixed thoroughly and allowed to stand for 10 minutes. The final volume of the mixture was found to be 46cm3. Calculate the percentage of air in the soil sample.

**SOLUTION**

**EXPERIMENT SEVEN**

**Aim:** To demonstrate the amount of air in a soil sample.

**Apparatus**: Graduated cylinder, soil sample, water.

**Method**:

1. A sample of soil is put in a graduated cylinder of up to one quarter level.
2. The cylinder is topped in order to compact the soil, this will ensure the absence of air spaces.
3. The volume of the soil is noted (Vs).
4. An equal cylinder is half-filled with water and the volume of the cylinder is also noted (Vw).
5. The water is completely poured into the soil and shake carefully. Bubbles of air are noticed as the water is poured into the soil.
6. The final volume of the soil and water put together is noted (Vw +Vs).
7. The amount of air in the soil sample can now be calculated using the following method.

Volume of soil = 10cm3.

Volume of water = 20cm3

Volume of soil and water after water has been poured into the soil = 28cm3.

1. Calculate the volume of air escaped from the soil.
2. Calculate its percentage.

2. in an experiment to determine the percentage of air in a soil sample, the following reading are taking.

(i) volume of water in measuring cylinder = 500cm3

(ii) volume of soil added to water = 300cm3

(iii)volume of water after stirring = 750cm3

What is the percentage of the air in the sample.

**POPULATION STUDIES BY SAMPLING METHOD.**

**POPULATION**

Population is the sum total or number of organisms of the same species living together in a particular area or habitat.

In population studies of a habitat; we investigate the following.

* The type of organisms (species) that are present in a particular area or habitat.
* The dominant species i.e. highest occurrence.
* The characteristic features of each population. These characteristic features are;

1. Population size.
2. Population density.
3. Population frequency.
4. Percentage cover.
5. Distribution of organisms
6. Population dynamics.
7. Population cycle.

Reasons why ecologists use sampling techniques in population studies

1. Counting individuals could be impossible and difficult for fast-moving organisms.
2. Counting individuals could be tedious.
3. Counting could be time-consuming use of sampling techniques saves time.
4. Terrain/habitat could be difficult to reach.

**POPULATION SIZE OR NUMBER**

It refers to the total number of individuals of the same species in a defined area. A large population stands a better chance of dangerous and unfavourable conditions such as fire, diseases e.t.c. While a small population can easily be wiped out.

Population size = population density × Area of habitat.

**POPULATION DENSITY (D).**

It is defined as the number of individual per unit area or volume in a population of a given habitat.

Expressing mathematically;

Population density = Total population size/number

Area of habitat

The population density of an organisms can be measured using a quadrat.

**FREQUENCY**

It is the number of times an organisms occurs within a given area of a habitat i.e. the frequency of a specie can be determined by the total number of times the specie appeared in the number of plants covered by the quadrat.

The frequency percentage of the species is determined by dividing the number of plots in which the species occurs by the total number of throws of the quadrat and multiplying by hundred. For example:

Number of plants in which Andropogen species occurred is 25.

Total number of tosses made = 75.

A group of college students undertook an ecological study to determine the frequency of two plants species, Tridax procumbens (A) and Andropogen spp (B) using the quadrat sampling method. The result obtained are as follows;

Number of throws = 100.

Total frequency of species for A = 59

Total frequency of species for B = 31.

Find the % the frequency of spps A and B in the study area.

**POPULATION DYNAMICS**

This is the branch of biology that studies the size and age composition over many time intervals.

**POPULATION CYCLE**

Population cycle in animal is a phenomenon where population rises and falls over a predictable period of time.

**DOMINANCE**

In a community, if the population is greater in number than the other members of the community, that population is said to be a dominant species.

**DISTRIBUTION**

It means the way in which individuals of a particular population are arranged in a given habitat. The distribution may be in clumps, evenly spaced or randomly spaced.

**FACTORS AFFECTING POPULATION SIZE**

1. Availability of resources such as water, space, food, resting sited, nesting sites e.t.c in a given habitat tends to increase the population of that habitat.
2. Natality (birth rate).
3. Mortality (death rate).
4. Emigration and immigration/dispersal will affect population size.
5. Predator organisms feed on the members of the population will affect the population size.
6. Overcrowding leading to competition.
7. Abiotic factors such as climatic (rainfall, sunlight, humidity), topography and soil will affect population size.
8. Natural disasters like fire, drought, floods, earthquakes may lead to a decrease in population.

**DETERMINATION OF POPULATION SIZE**

The technique used to determine the population size depends on the species and its habitat. They are;

1. Complete census
2. Sampling method.

**COMPLETE CENSUS**: When the area covered by the species is small and the individuals are few in number and large in size, a complete census may be used i.e. all the individuals in that area will be counted per head. E.g. palm trees in a palm plantation, all the students of E.H.J.M.C Ilorin.

**SAMPLING METHOD**: This method can be used when the individuals in the population are small in size, many in numbers or covers a large area which makes it difficult to count them one by one. In such a case, only part of the population is taken and counted. Each part chosen or studied is called a sample.

There are four major methods of sampling which are:

1. Quadrat method
2. Volume sample method
3. Transect sampling method
4. Capture-mark-release-recapture method.

Other methods are as follows:

1. Pitfall-trap method
2. Sweep net method
3. Tullgren funnel method
4. Light trap method
5. Random sampling method
6. Systematic sampling method
7. Convenient sampling method
8. Certified method
9. Clutter method

**QUADRAT METHOD**

Quadrat is a square, rectangular or circular frame usually made from wood or metal.

The population size and population density of a particular specie in a terrestrial habitat can be estimated by the following procedures;

1. The area to be studied is located and demonstrated.
2. Identify the species in the demarcated plot/area.
3. Measure the area with a measuring tape to know the area of the habitat.
4. Use a quadrat of known size.
5. Throw or toss the quadrat randomly at intervals for up to 10 or above
6. After each throw, the number of species within the area of the quadrat is recorded.
7. The average number of species is then calculated by dividing the total number of the species under study by the number of throws.
8. The density of the species is calculated by dividing the average number of the species within the quadrat or the average frequency of the species by the area of the quadrat.

The calculation can be worked at the way;

Frequency of tridax = 53.

No. of tosses = 100.

Area of quadrat = 1m2

Calculate the density of tridax.

1. Estimate the population density of tridax Androgen in a given area of the population of tridax is 50 and that of Andropogen is 18 and the area of quadrat is 10cm2

**Solution**

1. Estimate the;
2. Population density
3. Population size of elephant grasses using the information below;

Area of the habitat = 15m2

Frequency of elephant grasses = 400

Number of tosses = 50

Area of quadrat = 1.6m2

**Solution**

**TRANSECT SAMPLE METHOD**

It is used to find out what percentage of the total number of organisms in an area belonging to a particular specie. It is a line that runs through a plot.

**HOW TO USE THE LINE TRANSECT IN POPULATION STUDY.**

1. A chain or string or rope is marked or knotted a regular intervals and ties to the pegs at each end of thr area under investigation
2. Intervals should be between 50cm-100cm.
3. Members of a particular plant species (tridax plant) touching the chain at knotted points are counted as X
4. All plants which do not touch the chain at the knotted or marked points are counted as Y.
5. Lay out several transect and repeat the counting of the particular specie as well the total number of plants as done above.
6. The percentage of the particular plant species is calculated as x/y × 100.

**CAPTURE-MARK-RELEASE-RECAPTURE METHOD**

This technique is used for very fast moving organisms. It is commonly used for animals.

**METHOD/PROCEDURE**

1. Mark out a particular area.
2. Instruments like handpicking, sweep nets or traps are coated with materials to capture the animal.
3. Capture the animals e.g. insects, lizards, count and mark with paint. Release marked insects or lizards.
4. After a period of time, (that is to allow the marked ones mix with the unmarked ones) second sample is taken i.e. recapture insects/lizards, cont the number of insects/lizards and count the number of insects/lizards recaptured.
5. Determine the population of the following by the formular;

Population size =

**i.er population size =**

|  |  |  |
| --- | --- | --- |
|  | | |
|  |

Where; M1 = number of individuals marked and released

M2 = total number of individual recaptured

M3 = total number of individual marked

**PRECAUTION:**

1. The area under investigation should be controlled.
2. Markings should be unwashable.
3. Markings should not attract predators.
4. Markings must not impend the movement of marked animals.
5. Handle captured organisms with care.

**QUESTION**

In a capture-mark-release-recapture exercise to estimate the number of dragon flies on a stretch of string, 250 individuals were captured, marked and released. A second sample of 250 individuals were captured two days later, out of which 50 had the mark. Estimate the size of the population.

**Solution.**

**USE OF A PITFALL TRAP IN SAMPLING ORGANISMS**

It consists of:

1. A large jar with straight sides buries in a hole in the soil with the mouth upwards.
2. Food as bait is put into the trap/large jar.
3. The baits are placed randomly within the demarcated habitat.
4. Examined regularly or at intervals
5. Organisms lured by the bait fall into trap.
6. The organisms captured are collected identified, counted and released.

**FUNCTIONING ECOSYSTEM**

An ecosystem is a basic functioning unit of nature which comprises of both living and non-living things.

When living things die, the energy in them is converted to other forms. Energy is thus converted to other forms. Each organism is an important link in the system and cannot be replaced by another at all.

Living organisms in an ecosystem may be classified into producers (autotrophs), consumers and decomposers (heterotrophs).

**FOOD CHAINS**

Food chain is defined as a linear feeding relationship in which energy is transformed from producer through a series of organisms or trophic levels in which each organisms feeds on the preceding one and provides food for the succeeding one in the habitat. i.e.

Producers → Primary Consumers → Secondary consumers

Examples of food chain in a terrestrial habitat are:

1. Guinea grass → Grasshopper → Toad → Snake → Hawk

Producer Primary Secondary Tertiary Quatiary

consumer consumer consumer consumers consumers

1st trophic 2nd trophic 3rd trophic 4th trophic 5th trophic

Level level level level level

1. Grass → Antelope → Lion

*Producer primary consumer secondary consumer*

*1st trophic level 2nd trophic level 3rd trophic level*

Examples of food chain in aquatic habitat are:

1. Diatoms → Mosquito larva → Tilapia → Whale

Producer Primary Secondary Tertiary

consumer consumer consumers consumers

1st trophic 2nd trophic 3rd trophic 4th trophic

Level level level level

1. Spirogyra → Copepod → Tilapia → Shark

**The arrow(→)**: The arrows in food chain represents the direction in which the food is being transferred.

**Trophic level**: Is defines as a feeding level or energy level in an ecosystem involving several organisms with energy transfer usually from smallest (numerous) to larger (few) organism with decrease in energy at every level. At each trophic level, energy is utilised or lost (through respiration/sweating in some cases).

**NOTE**: Every food chain usually begins with a producer (green plants) that are feed on by a herbivore (Primary consumer) which is in turn feed on by a carnivore.

Even though most food chain begins with producers, there are few exemptions that start with decomposers e.g.

1. Humus → Earthworm → Domestic fowl → Man
2. Dead wood → Termites → Chicken → kites

Roles of producers in food chain

1. They are the photosynthetic plants that serve as food for primary producers.
2. They are the most abundant in the food chain
3. They mark the beginning of the food chain.
4. They are able to capture energy from the sunlight
5. The producers also known as green plants can produce carbohydrates or sample sugars during photosynthesis.

Roles of Herbivores in food chain

1. They are plant eaters or primary consumers
2. They serve as food for primary consumers
3. They occupy 2nd trophic level in a food chain

The role of secondary consumer in food chain

1. They feed on primary consumers/they are flesh eaters.
2. They are the secondary consumers and serve as food for tertiary consumers.
3. They are fewer in number.

Roles of decomposers in a food chain

1. They are saprophytic organisms that feed on dead or decaying organic matter
2. They help in recycling of nutrients.

**ENERGY FLOW IN A FOOD CHAIN**

The energy flow in a food chain is uni-direction or non-cyclic. It is either utilized or stored. Light energy from the sun is absorbed by chlorophyll in green plants and used in photosynthesis to produce food (carbohydrate). The chemical energy in food is passed down the food chain. When the primary consumers feed on the producer, the chemical energy is passed along the food chain to the secondary consumer and then to the tertiary consumer or decomposer.

**THE ENERGY LOSS IN A FOOD**

Energy is lost at each tropic level. When a herbivore/primary consumer feeds on a plant or producer; not all parts of the plant is eaten, as a result, not all energy in the plants is consumed. Plants lose energy through respiration, excretion and transpiration. Successive animal members of the chain do not utilize all the energy present in preceding members. Energy is also lost in respiration, excretion, movement and other metabolic process. This follows the second law of thermodynamics.

**FOOD WEB**

Food web is a complex interconnecting food relationship among plants and animals in an ecosystem.

**FOOD WEB IN A TERRESTRIAL HABITAT**

**FOOD WEB IN AN AQUATIC HABITAT**

**DIFFERENCE BETWEEN FOOD CHAIN AND FOOD WEB**

|  |  |
| --- | --- |
| **FOOD CHAIN** | **FOOD WEB** |
| 1. It is a linear feeding relationship | It is a complex feeding relationship |
| 1. It involves one food chain | it involves two or more food chain |
| 1. It involves fewer organisms | It involves many organisms |
| 1. Organisms have lesser chance of survival | Organisms have greater chance of survival. |

**ECOLOGICAL PYRAMIDS**

Ecological pyramids are diagrammatical representation or graphical representation of food chain in an ecosystem, in which the producer form the base and the consumers form the apex.

The ecological pyramids;

**Pyramids of number**

This is a diagrammatical representation of the progressive decrease in number of individuals along the food chain in a community. In any natural community, the number of individuals at the lower part of a chain or web is greater than those above.

Producers therefore are greater in number than the primary consumers and the secondary consumers and so on. This number reduces until the terminal group of organism is reached which have no predator depending on them for food.

**PYRAMID OF ENERGY**

This is the diagrammatical representation of energy flow in a food chain among living organisms in which there is a progressive decrease in energy from the first trophic level to another. In other words, the pyramid of energy represents a progressive decrease in energy from the first tropic level to the last tropic level in a food chain or web. Here, energy is lost as food is transferred from the first tropic level to the next hence pyramid of energy is always upright.

**PYRAMID OF BIOMASS**

This is the total wet or dry mass of the organism. To construct the pyramid of biomass, the organism in a given area is first counted and weighed. Then the total biomass of the organism in each tropic level is obtained from the data. The dry weight biomass can be estimated from the wet biomass. Each horizontal represents the total biomass of organisms at that tropic level.

The pyramid of biomass takes account of both the size and number of individual organisms

Most pyramid of biomass takes an upright shape but a few may have odd shape.

**ENERGY TRANSFORMATION IN NATURE**

Energy exist in various forms. These forms of energy are inter-convertible i.e. one form of energy can be transformed into another form. Each energy transformation are governed by the laws of thermodynamics.

In nature, energy transformation is brought about by the activities of living organisms which causes energy to flow in an ecosystem. Sun is the ultimate source of energy in an ecosystem.

**ENERGY LOSS IN THE ECOSYSTEM**

The energy from the sun passes through food chains. However, only a small portion of the sun’s energy gets into the bodies of the final consumers. The rest of the energy is lost as heat along the food chain. This progressive loss of energy at each level of food chain puts a natural limit on the weight f the living matter that can exist at each level. Energy can also be lost through vegetation, soil, air, evaporation of water and wind.

**NOTE**: the rate at which primary producers manufacture food per unit area per unit time is called Gross Primary Productivity of the ecosystem

After manufacturing of food by the producers, 30% of the food is used up by producers, then the remaining stored is called the Net Primary Productivity or NPP of the ecosystem.

**NUTRIENT CYCLING IN NATURE**

This refers to the movement of certain nutrients such as carbon, nitrogen, water and other elements from the environment into various organisms and back into the environment. The path through which the element passes is called the **CYCLE**.

1. Nitrogen cycle.
2. Carbon cycle.
3. Water cycle.
4. Decomposition in nature.

**CARBON CYCLE**

Carbon is an essential element in the life of organisms and soil. Carbon enters the biological community as carbondioxide.

**PROCESS OF CARBON CYCLING**

These are:

1. CO2 is removed from the air during photosynthesis to manufacture food.
2. Carbon is lost in form of carbonates of calcium and magnesium through leaching and drainage.

The atmosphere gains CO2 through:

1. Burning of fuel like coal and wood.
2. The action of volcanoes which release CO2.
3. The respiration by plants and animals.
4. The death, decay and putrefaction of plants and animals.
5. Diffusion of CO2 from seas and other water bodies acting as reservoir of CO2.

**IMPORTANCE OF CARBON IN NATURE.**

1. Carbon is used by plants in form of CO2 during photosynthesis to manufacture food.
2. It provides carbon which is the major building block of all organic matter.
3. Organic matter which is made from carbon helps to replenish soil nutrients.
4. It occurs in diamond, graphite and lamp and these are precious to man.

**CARBON-OXYGEN**

Oxygen is one of the gases found in the atmosphere and its composition is 21%.

The process which removes oxygen from the atmosphere are respiration, decay and combustion while the only process which returns oxygen into the atmosphere is photosynthesis.

Human activities which can upset the carbon-oxygen balance in nature are:

1. Pollution of aquatic bodies with high decomposers can lead to decrease in oxygen content of the water and increase in carbondioxide concentration of the water. It can affect the life of aquatic organisms.
2. **Deforestation:** This will lead to the release of less oxygen into the atmosphere and at the same time less carbondioxide will be removed from the atmosphere.
3. Increase in the combustion of fuel, respiration and decaying of organic matter will lead to decrease in oxygen concentration in the atmosphere and increase in carbondioxide concentration.

As a result of the above activities, oxygen level in the atmosphere decreases while carbondioxide level increases. A decrease in the atmospheric oxygn level by 2-8% does not cause any significance effect but a slight increase in the atmospheric carbondioxide may cause a green house effect (i.e. increae in the retention of the sun’s radiant heat/energy); this may result to global warming of the earth’s surface.

Therefore, to prevent this, there is the need to always balance the carbon-oxygen level in the atmosphere.

**WATER CYCLE**

The circulation of water in nature is referred to as water cycle.

Water cycle can be defined as the continuous movement of plants from the atmosphere to the earth and from the earth to the atmosphere.

**Features of water cycle**

Sun, clouds, animals, ground/earth/soil, river or water bodies/sea/steam and plants.

**Processes with corresponding arrows**

1. Precipitation or condensation in clouds.
2. Evaporation of water from water body.
3. Evaporation of water from soil or ground.
4. Excretion by animals.
5. Drinking of water by animals.
6. Respiration in plants.
7. Respiration in animals.
8. Absorption of water by plants roots.
9. Transpiration by plants.
10. Erosion/run-off water from soil.
11. Decay in plants and animals.

***Annotated diagram of water cycle***

**Explanation of water cycle**

Water vapour in the atmosphere condenses, falls as rain. Some of these rain sinks into the ground, run-off or evaporates back into the atmosphere. Plant absorbs water from the ground to make food and release water during transpiration into the atmosphere.

Animals feed on plants or drink water directly. Animals releases water vapour into the atmosphere during respiration or sweating and adds water to the soil in form of liquid waste product such as urine. All these activities add and remove water to or from the soil. In this way, the cycle continues.

**Role of plants and animals during water cycle**

1. Plants and animals produce water has a by-product of respiration
2. Plants give-off water through transpiration
3. Animals give off water by excretion. i.e. sweating and urinating.
4. Plants absorb water with root hairs.
5. Animals drink water for body metabolism

**Importance of water in living organisms**

1. Life arose or started in water
2. It serves as a habitat for some organisms.
3. It is an essential raw material for photosynthesis.
4. **As a solvent**: It removes excretory products, component of secretion, digestive juice, tears and venom in snakes.
5. Temperature control through sweating in animals and transpiration in plants.
6. Water is necessary for seed germination.
7. Water constitutes about 90% of the protoplasm.
8. It act as a medium of transportation for plants nutrient.
9. Lubricate i.e. mucus for external movement in snails and earthworm.
10. **Support**: Amniotic fluid in mammals, virtreous and aqueous humour in mammalian eye, tugor pressure in herbaceous plants.

**DECOMPOSITION IN NATURE**

Decomposers are those organisms such as bacteria and fungi which are responsible for breaking down of dead plants and animals materials, hence bringing about their decay and at the same time add nutrient into the soil in order to increase the soil fertility.

**Decay**

Decay: It is the breaking down of complex organic matter, into small compounds, so that their nutrients can be absorbed.

**Factors that cause decay of organic matter**

1. Warmed temperature or heat
2. Osmotic pressure
3. Amount of water
4. Amount of oxygen

**TYPES OF DECOMPOSERS**

1. **Micro-decomposers**: They are microscopic and small organisms that brings about decaying of organic matters. E.g. fungi and bacteria.
2. **Macro-decomposers:** These are bigger organisms that bring about decaying of dead organic matter. E.g. earthworm, termites, snails, mushroom, toad stools e.t.c.

**PROCESS OF DECOMPOSITION**

The decomposers e.g. bacteria or fungi secretes enzymes onto their food (i.e. decaying plant or animals). The enzymes breakdown complex organic compounds (food) like carbohydrate and protein into simple soluble inorganic compounds. In doing so, a lot of chemical energy in the organic compound is lost as heat energy.

The decomposers only absorb a small amount of nutrients and enrgy for their use. The rest is released into the soil, air and water.

When the decomposers die, other decomposers feed on them. The nutrients released are used by the plants to manufacture their food.

The products released during decomposition are:

1. Gases e.g. hydrogen sulphide, ammonia and water vapour.
2. Heat energy.
3. Nutrients such as nitrates, sulphates, phosphate ions e.t.c.

**Roles of decomposers in ecosystem**

1. They enrich the soil with nutrients required for plant growth.
2. They are useful in making cheese and yoghurt.
3. They contribute to environmental pollution.
4. They also prevent an unsightly accumulation of remains and waste of living organisms on the earth surface.
5. They allow the ecosystem to function by enabling the recycling of nutrients.

**EXPERIMENT ONE**

**Aim**: To show that CO2 is released during decomposition.

**Materials required**: Two test tubes, delivery tubes, decaying humus and lime water.

**Method**: Test tubes labelled A and B are used. A contains humus and B contains lime water. The two test tubes are connected together with the help of a delivery tube. The whole set-up is allowed to stand for 3 to 4 hours. A control experiment is also set-up with no humus in the test tube.

**Observation**: It is observed that the lime water in test tube B turns milky while in control experiment the lime water remains unchanged.

**Conclusion**: It shows that CO2 is released during decomposition.

**EXPERIMENT TWO**

**Aim**: To show that heat is released during decomposition.

**Materials required**: Two vacuum flasks, moist humus and two thermometers.

**Methods**: Two vacuum flasks labelled X and Y. In vacuum flasks X, moist humus is placed in it. The mouth of the flask is covered with cotton wool with thermometer inserted inside the flask. Also cover the mouth of the vacuum flask Y with cotton wool and insert the thermometer (this serves as control experiment). Allow the two flasks to stay for about 3 to 4 hours.

**Observation**: The thermometers inside the two flasks are observed and the readings are taken. The reading taken from flasks K is higher while that of Y is very low.

**Conclusion**: This shows that heat was released during decomposition of humus.

**ECOLOGICAL MANAGEMENT**

**BIOLOGICAL ASSOCIATION**

Association are different kinds of close relationship between organisms of different species in a community. Some of these associations are beneficial, some are natural while others are harmful.

**TYPES OF ASSOCIATION**

1. Symbiosis/mutualism.
2. Parasitism
3. Commensalism
4. Saprophytism
5. Epiphytism

We may also have predation and competition as parts/types of biological association.

**COMMENSIALISM**

This is an association between two organisms of different species living together, in which one or a commensal gains or benefits but the host is not affected I.e. neither gains or losses.

**Examples of commensalism**

1. **Man and intestinal bacteria**: These bacteria live in the large intestine of man and feeds on undigested food there. The bacteria receive food and protection from the man whereas the man neither gains nor suffer any disadvantage from the presence of bacteria.
2. **Remora fish and shark**: In this, the remora fish attached itself to the body of a shark which carriers it about. The remora fish feed on the left over food by the shark; and also obtain protection and shelter from the shark whereas the shark neither gains nor loss.
3. **oysters and crabs:** The crab is found inside the oysters shell. Hence, the crab is protected yet no harm is done to the oyster.

**NOTE:** The association between an epiphyte and a tree may be regarded as commensalism. Here, the epiphyte gets a site where it can get enough sunlight to carry out photosynthesis. The advantage here is positional. Example of epiphyte is Platycerum fern found on large trees.

**PARASITISM**

Parasitism is an association between two organisms of different species in which one called the parasite lives in or on and feeds on the expense of the host. The parasite benefits from the association while the host usually suffers harm or may die.

**Examples of parasitism**

1. Man and tapeworm that lives inside small intestine of man.
2. Mistletoe and flowering plants.
3. Ticks and dogs
4. Man and ascaris.

**MUTUALISM/SYMBIOSIS**

This is an association between two organisms of different species called symbiont in which both of them benefits from each other.

**Examples of mutualism**

1. Algae and fungus in lichen.
2. Nitrogen fixing bacteria in the root noodles of legumes.
3. Bacteria in the rumen of ruminant animals

The ruminant animal provides the bacteria with protection and feeds on leftover food, while the bacteria helps the animal to digest cellulose, which digests cellulose.

1. Protozoa in the intestine of termites.

The protozoa in the intestine of terminates, provides cellulose which helps to digest cellulose. The terminate provides the protozoa with protection and food. The name of this protozoa is Trychonympha.

1. Flower and insect pollinators: The flower provides food for the insect(nectar) while the insect pollinates the flower.
2. Mycorrhizae and roots of vascular plants/fungi.

Mycorrhizae are symbiotic association between the roots of vascular plants and fungi. The mycorrhizae helps to transfer phosphorus and other nutrients from the soil to the roots of the plants. In return, the plant provides carbohydrate to the symbiont fungus.

**Two types of mycorrhizae**

1. Endomycorrhizae (penetrates the cell of the root)
2. Ectomycorrhizae (does not penetrate the cells of the host).
3. Egret birds and cattle.

The birds eat the insects of the cow’s body and them the cow protects the bird.

1. Sea anemone and hermite crap:

The sea anemone attaching itself to the hermite crab, it feeds on leftover food found on the shell of the hermite crab. The hermite crab in turn enjoys protection against the predators.

Note: Sea anemone stings, this sting protects the hermite crab from it’s predators.

**Diagram of lichen showing algal cells arranged in fungal hyphae**

**PREDATION**

This is a type of association between two organisms in which the predator (usually bigger in size) kills the other called the **PREY** (small in size)and directly feeds on it. The predator is always stronger than the prey hence, it benefits by deriving its food from the prey. Here, the prey is completely eliminated.

**Examples of predation**

1. The hawk and chicks of domestic fowls.
2. Lion and goat.
3. Cat and rat

**SAPROPHYTISM**

This type of association involves two different species of organisms in which one is called the saprophyte obtains it’s food from dead plants and animals hence, bringing about their decomposition. In this, the dead organisms is not losing or gaining. E.g.

1. Fungi and dead rat.
2. Bacteria and dead plants.

**TOLERANCE**

Tolerance is defined as the ability of an organism to live/withstand/survive/cope with all or some of the unfavourable environmental conditions (i.e. biotic and abiotic) which affects their survival in its habitat within certain minimum and maximum limit in that habitat.

Abiotic factors play an important role in the distribution of living organisms in the various habitats. Some organisms can tolerate slight changes in this factors e.g. a slight increase in the salinity of an aquatic habitat while others can tolerate more severe changes and some cannot tolerate any changes at all. Some organisms when faced with unfavourable conditions die or leave the habitat.

**MINIMUM AND MAXIMUM RANGE OF TOLERANCE**

**Tolerance range**: Is defined as the range between the minimum and maximum limits to which organisms can tolerate certain changes in their environment so as to survive.

Most living organisms have a range of tolerance to different environmental factors. The organism will be able to survive, grow, reproduce and carry out other vital activities within such range.

Hence, each organism has minimum and maximum limit of each factors which it can tolerate.

1. **Minimum limit range of tolerance**: This is the lowest possible limit at which organisms can have tolerance over changes in environmental factors.
2. **Maximum limit range of tolerance**: this is the upper limit beyond which the organism will not be able to survive.
3. **Optimum range of tolerance**: This is that limit or range in which the organisms growth and reproduction are its peak.

**GEOGRAPHICAL RANGE**

This is a given location within which most organisms can live successfully because they have a combination of features that are adapted to the prevailing environmental factors there.

**ADAPTATION**

Adaptation is defined as the possession of special features such as modification of structures, physiology and behaviours which improves the chances of an organism to survive and reproduce in its environment. In other words, adaptation is the ability of an organism to live successfully in a particular habitat as a result of its structure, appearance and behaviour.

It is expected that every organism **MUST** adapt to its environment in order to survive. Plants and animals possess certain features which enable them to adapt to either aquatic or terrestrial habitat.

**Types of adaptation**

They are;

1. Structural adaptation.
2. Adaptive colouration.
3. Behavioural adaptation.

**STRUCTURAL ADAPTATION**

These are special modification of structures which enables organisms to survive better in their various habitats.

**Examples of structural adaptation**

1. Obtaining food.
2. Escape and defence.
3. Securing mates.
4. Regulation of body temperature.
5. Conservation of water.

**STRUCTURAL ADAPATION OF BIRDS FOR OBTAINING FOOD AND ESCAPING FROM PREDATORS.**

Birds have beak and feet to catch and grip food.

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | **Bird** | **Type of food** | **Adaptation to its mood of feeding** |
| **1.** | Hawk, Owl and Eagle | Feeds on flesh  (i.e. carnivorous birds) | **Beak**: Powerful, sharp and carved beaks for killing and tearing flesh of their prey.  **Feet**: Sharp, strong and curved claws for catching, gripping and killing the prey. |
| **2.** | Domestic fowl | Grains, seeds, worms, insects | **Beak**: strong, short, horny beaks for pecking/picking grains and worms.  **Feet**: Short, blunt and strong claws on digits for scratching the soil in search of seeds and worms.  Presence of scales on feet to prevent dessication or drying up. |
| **3.** | Duck | Filter feeding i.e. organisms found in ponds, rivers e.t.c. | **Beak:** flat and rigid or serated edges for sieving out food from under water into the mouth.  **Feet**: Webbed digits for swimming and paddling in water, it also increases the surface area for walking on mud.  Presence of scales on feet to prevent dessication and injury. |
| **4.** | Woodpecker | Insects | **Beak**: Long, strong, narrow and pointed beaks for picking insects from cracks and hole in the bark of trees. |
| **5.** | Sun bird, Humming bird e.t.c. | Nectar  (sucking birds) | **Beak**: Long, slender, pointed and slightly curved beak with tubular tongues for sucking nectar from flowers. |
| **6.** | Parrot | Seeds | **Beak**: Short, strong and hooked beaks for cracking hard seeds. |
| **7.** | Heron, King fisher | Fish eaters | **Beak**: Long pointed beaks for killing and picking fish in water.  **Feet**: Long feet for waddling in water in search of food. |

**Structural adaptation of birds to flight**

1. Light skeleton with hallow bones to make room for lightness in order to ease flight.
2. Possession of streamlined body for easy flight.
3. Forewings are modified into wings for easy flight.
4. Strong rigid hind limbs to withstand shock on landing and also for movement on land.
5. Possession of oil gland which serves as water proof against wetness of feathers.
6. Tail feathers for steering and balancing.
7. Feathers for insulation of the body hence keeping the body warm.

**Structural adaptation of Toad/frog for obtaining food, protection and movement.**

1. **For obtaining food:**
2. The presence of long sticky tongue for capturing its prey.
3. It posses special olfactory organ on the head for perceiving the oder of the food.
4. Possession of bulgy eyes to detect their prey.
5. The tongue is attached at the front of the mouth which can be rapidly extended to capture its prey.
6. **For protection**:
7. Slimy skin with mucus gland which makes the animal difficult to catch by predators.
8. Presence of poisonous glands on the skin which is poisonous and distasteful to the predators.
9. Cryptic colouration helps to blend with the colour of the environment hence, prevents enemies or predators from noticing them.
10. **For movement**:
11. Long muscular hind limbs for hopping or jumping.
12. Webbed hind limbs for swimming in water.
13. Absence of tail facilitates fast hopping and jumping movement.
14. Short powerful nature of forelimbs used for withstanding shock on landing.
15. It posses streamlined body for easy movement and swimming.

**Structural adaptation for obtaining food in insects**

**­**

1. **Biting and chewing mouthparts**: E.g. grasshoppers, cockroaches, termites e.t.c. They posses sharp, strong heavy toothed mandible and maxillae mouth parts for biting and chewing of plant materials.
2. **Piercing and sucking mouthparts**: E.g. mosquito, aphids, cotton stainers e.t.c. They have long proboscis and sharp stylets for piercing and sucking blood or cell sap from plants.
3. **Sucking mouthparts**: E.g. butterflies, bees e.t.c. They have long coiled proboscis for sucking nectar from flowers of plants.

Housefly is also under here but it has spongy mouthparts for sucking liquid food.

1. **Boring mouthpart**: E.g. weevils and their larvae. They have long rostrum for boring holes in the grains.

**Structural adaptation for climbing animals**

1. Presence of prehensible tails for holding unto trees or for climbing e.g. monkeys.
2. Presence of opposable digits for climbing e.g. monkey, geckos, chameleon.
3. Possession of sticky adhesive discs on fingers e.g. geckos.
4. Snakes posses grasping scales for climbing.
5. Tree frogs have grasping pads to hold on to the tree when climbing.
6. Some animals have long, sharp claws for climbing e.g. squirrels.

**Adaptation of predators to capture their prey**

1. Well developed muscular limbs structured for speed to overtake their prey in a chase. E.g. tiger, cats e.t.c.
2. Sharp claws for grasping and tearing of the prey. E.g. hawks, leopard e.t.c.
3. Sharp teeth for tearing the flesh of the prey from the bones. E.g. dogs (carnassials teeth)
4. Sharp beaks for tearing the flesh of prey e.g. kites.

**Adaptation of prey to escape from predators.**

1. Presence of hard outer covering or shell to protect against attack by predators. E.g. snail, tortoise, oyster e.t.c.
2. Chemical protection in form of poisonous secretions of skin gland. E.g. toad, squids
3. Rolling the body into a ball e.g. millipedes, porcupine e.t.c.
4. **Mimicry**: This si the act of harmless animals resembling a dangerous one and hence avoid being killed by the predators.
5. Fast movement to escape from enemies. E.g. rat, cockroach e.t.c.
6. Secretion of offensive smell to scare off predators e.g. skunk.
7. Bees and wasps have stings for attacking their enemies or any intruder.
8. Movement in groups to frighten predators. E.g. monkeys
9. Detachment of parts of the body to escape predators. E.g. lizards.
10. **Fearsome appearance**: Soma animals protect themselves from their predators by having fearsome colour or appearance. E.g. beetles, variegated grasshopper
11. **Protective colouration**: Some animals can change their colour to match with that of their surrounding so as to escape detection. E.g. chameleon e.t.c.
12. **Counter-shading**: This can be found in animals that posses two different colours on the dorsal (upper side) and ventral (lower side) which agrees with the respective background of the dorsal and ventral sides. E.g. a fish in water is seen from the dorsal side and this agrees with the colour of the water which forms the background. When the fish is seen from above, the silvery white ventral surface blends with the sky colour. This protects them from predators looking at them from below.

**Structural adaptation for regulation of body temperature**

1. Mammals skin covering with hairs or furs.
2. Bird’s body is covered with feathers.
3. Some animals produce layers of fat under the skin and the skin has a large surface area for heat loss during radiation.
4. The sweat gland in the skin helps in the production of sweat hence reducing the body temperature.

**Structural adaptation of animals for water conservation**

1. Possession of dry horny scale on the skin to reduce water loss from the body e.g. lizard, snakes e.t.c.
2. Possession of shell which helps them to reduce evaporation of water e.g. land snail.
3. Exoskeleton which is made up of chitin which helps to reduce water loss from the body e.g. locusts, termites,
4. Presence of feathers on the skin to reduce water evaporation from the skin. E.g. birds.

**ADAPTATION OF PLANTS TO WATER AVAILABILITY**

Water is essential for the life of all living organism including plants. The different ways in which plants adapt to availability of water are:

**HYDROPHYTES**: They are plants that can survive in water or in a very moist/swampy environment. Examples are water lily, water hyacinth, water lettuce, water weeds.

**Structure which adapts the water lettuce to its habitat**

**Natural habitat**: On the surface of ponds, lakes, streams.

The adaptations are as follows;

1. Broad aerial leaves or rosette arrangement of leaves which makes it buoyant and also to receive maximum sunlight for photosynthesis.
2. Numerous adventitious root for absorption of water and mineral salts and to also aid floatation.
3. Green leaves for photosynthesis.
4. Slender stems and stolon that offers maximum resistance to water current.
5. Hairs on the surface of the leaves prevent water from blocking stomata which can affect photosynthesis.
6. Buds on stems or stolon for vegetative propagation.
7. Spongy leaves aid buoyancy.
8. Waxy cuticles on leaves prevents wetting.

**Adaptation in other hydrophytes**

1. Possession of long flexible stem and flower stalk to expose the leaves and flowers for pollination and photosynthesis. E.g. water lily.
2. Possession of air floats in the leaves and stems for buoyancy. E.g. water hyacinth.
3. Possession of breathing roots for gaseous exchange. E.g. white mangrove and red mangrove.
4. Possession of air spaces where oxygen is stored for buoyancy or floating.
5. Well developed stomata for gaseous exchange and also to increase the rate of transpiration.

**DIAGRAM OF THE WATER LETTUCE**

**DIAGRAM OF THE WATER LILY**

**MESOPHYTES**: They are plants which grow in places that are neither too wet nor too dry. They are land plants. E.g. water leaf, hibiscus, Cassava plants e.t.c.

**Adaptation of water leaf to its habitat**

1. Well developed roots (tap root system) for anchorage and absorption of water and mineral salts.
2. Numerous green leaves for photosynthesis.
3. Erect stem to hold the leaves in a good position to receive maximum sunlight for photosynthesis and also to expose the flowers for pollination.
4. Swollen tap roots for storage of food.

**DIAGRAM OF WATER LEAF**

**Observable differences between water leaf and water lettuce**

|  |  |
| --- | --- |
| **Water lettuce (hydrophytes)** | **Water leaf (mesophytes)** |
| 1. Adventitious root system. 2. Horizontal stem/stolon. 3. Hairs on the leaves. 4. Leaves arranged in rosette pattern. 5. Absence of branches. 6. Flowers absent. | Tap root system.  Erect stem.  Hairless leaves/ smooth surface.  Leaves arranged singly on the stem.  Branches present.  Flowers present. |

**XEROPHYTES**: They are plants that can survive in a dry environment such as savanna, desert where water is scarce. E.g. Cactus, Acacia, Eucalyptus.

**Adaptive features of cactus**

1. Leaves are modified into spines to reduce water loss through transpiration.
2. Succulent stems for water storage.
3. Thick waxy cuticle on stem which reduces water loss by transpiration.
4. Greenish stem for photosynthesis.
5. Sunken/hidden stomata to reduce the rate of transpiration.

**General adaptive features of xerophytes**

1. They have swollen/succulent stems or leaves to enable them store excess water. E.g. cactus, Aloe spp.
2. They have extensive root system for anchorage and water absorption. E.g. acacia
3. They have protoplasm in their cells which can tolerate a high degree of water loss without being damaged e.g. Aloe spp
4. Presence of hairy leaves (eucalyptus) or crown thorns (Euphobia) to reduce water loss.
5. Thick bark stem to protect the internal tissue and to reduce rate of transpiration.
6. Thick or waxy cuticle to reduce rate of transpiration.

**HALOPHYTES**: This are plants that grows in water of high salinity, coming into contact with saline water through its root or by salt spray such as in saline semi-desert, mangrove swamp, marshes and sea shores. Examples of halophytes are salt marsh grass (Spartina alterniflora).

**Adaptation of aquatic animals**

1. Possession of streamlined body for easy movement e.g. tilapia fish and toad).
2. Possession of fins and tail fins for movement.
3. Possession of gills for gaseous exchange in fishes and tadpole.
4. Possession of swim bladder for buoyancy in water e.g. tilapia fish.
5. Presence of lateral lines to detect vibration in water.
6. Scales for protection and osmoregulation e.g. tilapia fish.
7. Possession of sticky substance under surface for attachment to object e.g. snails, flatworms.
8. Possession of suckers or hairs for attachment to vegetation so as to avoid being swept away by water current e.g. leeches.

**Structural adaptation to attract mates**

1. Display of brightly coloured head of Agama lizard to attract the female lizard.
2. Presence of nuptial pads on the male toad thumbs which helps to hold the females firmly during mating.
3. Male domestic fowls and peacocks have brightly coloured feathers which they display to attract mating partners.
4. In flowering plants, the bright coloured petals attract insects which pollinates the flowers.

**BEHAVIOURAL ADAPTATION**

Behaviour is everything an organism does geared mainly towards promoting the organism survival in its environment.

**Behavioural adaptation to protect prey from predators**

1. **Hiding**: Some animals when being chased can suddenly stop running and hide where it is difficult to cover them. E.g. rats.
2. **Swaying in air**: Bats hold on to branches of trees with the head upside down and sway in air like leaves to escape being detected by predators.
3. **Remaining motionless**: Soma animals when touched retract into their shells and remain motionless. E.g. land snail.
4. **Secretion of irritating liquid**: Some animals secrete offensive odour to scare predators away. E.g. wasp.
5. **Feigning death**: Some animals feign death when attached, so that the predators will leave e.g. millipede.
6. **Swelling up**: Some animals swell up or puff off so that predators will find it difficult to swallow them e.g. toad.
7. Some animals like antelopes, rats depend on speed to escape from their predators while birds, mosquito simply fly away.

**Behavioural adaptation for avoiding adverse weather conditions**

1. Aestivation.
2. Hibernation.
3. Migration.
4. **Aestivation**: This is a condition whereby some animlas spend the hot dry season in a sleep-like state or manner, where metabolism is reduced to the barest minimum. E.g. lung fish, crocodiles.
5. **Hibernation**: This is a condition whereby some animals spend the cold season or winter in a sleep-like inactive state in which their metabolic activities and body temperature are kept very low. Such animlas store a large amount of fat in their bodies which they slowly burn during this period. E.g. insect-eating bats.
6. **Migration**: This is the movement of animals from one place to another due to scarcity of food, seasonal changes, breeding e.t.c.

Organisms can also migrate to avoid overcrowding, establish new habitat and for the aim of reproduction e.g. the movement of cattle egrets between the north and south of Nigeria during the dry and raining season.

**Behavioural adaptation in plants**

1. Shedding of leaves to reduce water loss e.g. silk cotton tree.
2. Death of vegetative parts so as to survive long dry seasons e.g. stubborn grass.
3. **Dormancy**: This is a period of minimal metabolic activities of an organism to survive adverse environmental conditions e.g. seeds.
4. Phototropic movement of plants shoot which is needed for photosynthesis.
5. Coiling response of leaf tendrils of some plants when they touch a support e.g. Glorissa lily, mimosa leaf.
6. Carnivorous plants having traps to capture insects e.g. venus fly trap, pitcher plants.

**GREGARIOUS BEHAVIOUR IN ANIMALS**

When animals of the same species move together in a group, they are said to be gregarious. These co-operative behaviour of gregarious animals gives them survival advantage.

Examples of organisms which exhibit gregarious behaviour are elephant, gazelles, zebra, some flocks of birds, shoals of fish, social animals (i.e. termites, bees, wolves, baboons and foxes).

**ADAPTIVE COLOURATION**

1. **Concealing or cryptic colouration or camouflage:**

**(NOTE**: colouration that helps an animal to escape predators is known as **protective colouration**).

Examples are:

1. Green cuticle of the grasshopper helps it to blend with the grasses to escape predators.
2. Green snakes have green pigment which makes them blend easily with the grasses.
3. Counter-shedding in fish is a dark dorsal side with silvery ventral side which protects them from predators looking at the from above and below the water.
4. Ability of some animals to change the colour to look like that of their environment e.g. chameleon.

**MECHANISM OF COLOUR CHANGE**

Animals that change colours have special pigment cells called chromatophores on their body surface.

They bring about colour change in two ways

**(a)Morphological colour change**: I.e. the animal increases or decreases by;

1. The number of chromatophores in its body surface or
2. The concentration of the pigment in the chromatophores.
3. **Physiological colour change**: The animal:
4. Forms one colour by spreading the pigments throughout such chromatophores and
5. Another colour by concentrating the pigments in a small area of each chromatophore e.g. in chameleon.

**WARNING COLOURATION:** This scares away the animal’s enemies. Examples:

1. Black and yellow colour of variegated grasshopper.
2. Yellow and black stripes of yellow jackets and other wasps which have painful stings e.t.c.

**MIMICRY**: This is the resemblance of an animal called a mimic to another different object. E.g. the stick insect resembles dead twigs.

We have two types of mimicry

1. **Batesian mimics**: Unprotected species that resembles others that have unpleasant structures. E.g. pleasant tasting swallow tail butterflies mimics various fowl tasting butterflies.
2. **Mullerian mimics**: Unrelated animals with unpleasant features look similar and are avoided by potential predators. E.g. the striped pole cat and the striped weasel, owl.

**DISRUPTIVE COLOURATION**: Some animals have patterns on their body surface. These pattern breaks up the familiar shapes of the body, enabling them to go undetected. E.g. spots and stripes of the tigers, leopard, giraffe, zebra e.t.c.

**POLLUTION**

Pollution is the release of toxic substance into the environment through human activities, natural form and other animals in an amount that is harmful to man, crops, other animals and the environment.

Any substance/material/energy that causes pollution or can contaminate the environment is known as **POLLUTANTS**. Pollutants are divided into three:

1. Biodegradable pollutant
2. Non-biodegradable pollutant
3. Poisons.
4. **Biodegradable pollutants**: They are those pollutant such as dead animals, plants, excreta that can be broken down by natural process (i.e. bacteria and fungi) into simpler substances.
5. **Non-biodegradable pollutant**: They are those pollutants that cannot be broken down into simpler substances by natural process. E.g. glass, plastics, tins, nylon, scraps or metals e.t.c.
6. **Poisons**: They are heavy metals and their salts. E.g. lead, mercury and certain insecticides (e.g. DDT) which are harmful to man and his crops. Although those pollutants are released in low concentration into the environment, they tend to accumulate in living organisms and eventually reach the toxic level.

**TYPES OF POLLUTION**

1. Air pollution.
2. Water pollution.
3. Land pollution.
4. Noise pollution.

**AIR POLLUTION**

Air pollution is mainly caused by air borne particles. The pollutants of air are smoke, dust, carbon(iv)oxide, sulphur(iv)oxide, hydrogen sulphide, oxides of nitrogen, carbonmonoxide, radioactive particles, chlorofluro carbon, spores from bacteria and fungi and pollen grains.

**Effects of air pollution**

1. Impaired health causing asthma, bronchitis, cancer of the lungs
2. Damage plants e.g. some gases such as ozone cause yellow spots on leaves.
3. Reduces the visibility of the atmosphere.
4. Destroys the ozone layer leading to global warming.
5. Causes metals to corrode.

**Control of air pollution**

1. Industries should be sited away from residential areas.
2. Tall factory chimneys should be built.
3. Passing of waste through filters and absorbers.
4. Creating conditions for complete combustion of fuels in internal combustion engines.
5. The use of lead free fuels should be encouraged. Leda is very poisonous; it can cause anaemia and brain damage in children and injury to the nervous system in adults.
6. Avoid driving cars that are not well maintained.
7. Legislation should be made against indiscriminate burning which brings about smoke.

Smog**:** it is a combination of chemical pollutants and water droplets. Photochemical smog is formed when sunlight causes the oxides of nitrogen and unburnt hydrocarbons to react chemically. It leads to reduced visibility and it can also irritate the eyes, nose, air passages and lings and also damage the vegetation.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Pollutants** | **Sources** | **Effects** | **Control** |
| **1.** | Carbon(IV) oxide; CO2 | - Cigarette smoking.  - Fumes from motor vehicle exhaust.  - Burning of fossil fuels.  - Respiration.  - Bush fires and refuse burning. | - Causes global warming or green house effect.  - Respiratory problems.  - Melting of ice cap of polar region which leads to flooding. | \* Planting of trees.  \* Avoid smoking of cigarette.  \* Building of tall chimneys  \* Siting industries away from residential areas |
| **2.** | Chlorofluorocarbon (CFC) | * Gases that are used as coolants in refrigerators, air conditioners and plastic forms. | \* Accumulates in the upper atmosphere and reacts with ozone in the presence of light, converting it to oxygen thereby depleting the ozone layer.  \* Increased ultra violet radiation may cause cataracts in human and skin cancer. | \* Internal combustion of engines. |
| **3.** | Carbon  monoxide (CO) | \* Fumes from exhaust pipes of vehicles and industries | \* Poisonous to man and other animals because it combines with haemoglobin in the blood, thus reducing the power of the blood to carry oxygen which can also lead to death. | \* Complete combustion of fuels before using.  \* Cars should be well maintained to avoid releasing of smoke. |
| **4.** | Radioactive rays | - Industrial process such as electric plant which uses radioactive substance | \* It impairs health as it is known to destroy genes i.e. gene mutation. | Industry should be sited away from residential areas. |

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| **No.** | **Pollutant** | **Sources** | **Effects** |
| **1.** | Smokes and soot (mass of impure carbon particles resulting from incomplete combustion of hydrocarbon e.g. wood, coal) | \* Burning of coal and other fuels in industries, fire wood e.t.c. | \* Causes breathing difficulty.  \* Causes injury to the lining of respiratory tracks/lungs.  \* Reduces visibility thereby reducing photosynthesis and hence leading to low crop yield.  \* Causes discomfort to the eyes.  \* Contains carbonmonoxide which is dangerous to man. |
| **2.** | Dust particles | \* Mechanised filing of soil, reconstruction of road  \* Sweeping of road, rooms and open spaces | \* Irritation of lungs/respiratory passage.  \* Settles on vegetation hence reduces light reception and lowers the rate of photosynthesis.  \*It reduces visibility. |
| **3.** | Nitrogen(iv)oxide | \* Burning of coal and organic matter.  \* Industrial process  \* Exhaust fumes from vehicles.  \* Fumes from industries. | \* Poisonous to plants and animals  \* Irritates the skin and respiratory system.  \* It forms acid rain which corrodes with metallic objects.  \* They undergo changes in the atmosphere to form photochemical smog. |
| **4.** | Sulphur(iv)oxide | \* Fumes from factories  \* Smokes from industries  \* Fumes from electricity generating stations  \*Mining activities | \* Smoke from industries damage plant cells and affect photosynthesis.  \* Stops plants from growing  \* Causes acid rain which speeds up corrosion of metals.  \* Damages building  \* Increase acidity of aquatic animals which kills aquatic organisms.  \* In humans, it causes lung disease, cancer of lungs, respiratory disease, bronchitis.  \* Depletion of ozone layer  \*Skin and eye irritation |

**WATER POLLUTION**

Pollutants may be released into lakes, stream, rivers and seas.

The major water pollutants are;

1. Untreated sewage and domestic waste (refuse) and other household waste.
2. Industrial waste such as dyes, detergent, mercury, hot water from industries.
3. Agricultural waste like pesticides, fertilizers, insecticides e.t.c.
4. Oil spillage.

The balance of live in the ecosystem is upset by these pollutants thus, making the water unsuitable for domestic and recreational activities.

**Activities of man that pollute water bodies.**

1. Dumping of household refuse into the water bodies.
2. Oil spilage from drilling of tankers.
3. Thermal pollution of hot water from industrial plants or atomic reactor into water bodies.
4. Dumping of agro-chemicals like pesticides, fertilizers, paraffin and fungicides.
5. Dumping of dyes from textile factories into water.
6. Dumping detergent from homes or factories into water.
7. Untreated sewage dumped into water bodies.
8. Radioactive fallout from nuclear plants washed into water.
9. Use of chemicals or Gammalin 20 or DDT in fishing.

**EFFECTS OF WATER POLLUTION**

1. It makes water unfit for drinking.
2. Destruction of valuable aquatic species such as fish and sea birds.
3. Food chain is affected.
4. Foul smelling water makes it unfit for recreational activities.
5. Pollutants encourage bacteria growth.
6. Bacteria growth leads to reduction of dissolved oxygen in water and this will make

the aquatic organism to die.

1. Epidermis diseases like cholera and diarrhoea can be spread.
2. Leads to algae growth/boom/eutrophication.
3. Leads to migration of some aquatic animals.

**PREVENTION OF WATER POLLUTION.**

1. Treat raw sewage before discharging into water bodies.
2. Avoid dumping of refuse or photochemicals or treat industrial waste before

discharging.

1. Recycle industrial waste before discharging.
2. Limit the use of pesticides, insecticides, detergents e.t.c.
3. Avoid the use of explosive chemicals in fishing.
4. Cool hot water from industrial plants before discharging into water.
5. There should be strict control by the government or local authority monitoring of

industrial waste by enacting laws.

1. The use of efficient technique to prevent oil spillage.
2. Prevention of radioactive fallout.

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| **No.** | **Water pollutants** | **Sources** | **Effects** |
| **1.** | Domestic waste | Untreated sewage and refuse | * Bacterial break down of sewage reduces the dissolved oxygen in water causing aquatic organisms to suffocate and die. * It leads to offensive odour making the water unfit for drinking. * Contaminated sewage spreads disease causing organisms which cause disease like cholera, typhoid * Rapid growth of aquatic plants due to mineral rich sewage (eutrophication). * It reduces light penetration which affects photosynthesis. |
| **2a.** | Industrial wastes e.g. dyes. | From textile factories. | * Poisonous to aquatic organisms. * Reduces light penetration for photosynthesis. |
| **b.** | Heavy metals like lead and mercury. | Industries like oil refineries, steel industries, mills power plants. | * Heavy metals that are not biodegradable accumulate in the food chain leading to poisoning. * It kills living organisms. |
| **c.** | Hot water | Water from cooling industrial plants. | * It increases the temperature of the water hence, reducing the oxygen content of the water. * It leads to death of aquatic organisms. * It leads to migration of organisms from their habitat. |
| **d.** | Detergents | Detergents from manufacturing industries and those that use them to wash bottles. | * Foams on water surface reduces light penetration/photosynthesis. * Phosphate in the detergent may cause rapid algae growth or eutrophication. * It is toxic to some fishes and other animals in water. |
| **3.** | Agricultural waste | Fertilizers, pesticides, insecticides | * May accumulate to a toxic level thereby poisonous to aquatic organisms. * Fertilizer residues stimulate the growth of Aaquatic plants. * Making water unfit for drinking. * It can lead to death of aquatic animals. |
| **4.** | Crude oil spillage | Explosion of oil rigs, breaking of oil pipeline or tankers | * Oil reduces the surface tension of water causing floating animals to sink. * Animals die from lack of oxygen. * Makes water unfit for drinking and domestic purposes. * Soaks the feathers and furs of animals making them unable to fly. * Coats gills of aquatic organisms thereby killing them. * Reduces light penetration and hence reduces photosynthesis. * Sources of income for fishermen are destroyed. |

**Prevention of oil spillage.**

1. Tankers of oil should not be illegally washed at the sea or river or water bodies.
2. Spraying of affected area with detergents to dissolve the oil.
3. Proper loading of tankers and offloading them to prevent oil spillage.
4. Avoid dumping oil at the sea.
5. Proper maintenance of pipelines.
6. Legislation should be made against pipeline vandalization.

**NOTE**

**Eutrophication**: This is the process by which some nitrates and phosphate are washed into the water bodies resulting to the growth of algae or algae boom. This leads to excess producers in the water without enough primary consumers to feed on them. When the producers die, the decaying of these producers causes the oxygen concentration of the water to decrease and this will affect the aquatic organism, making them to suffocate and die.

**Causes of Eutrophication**

1. Overuse of fertilizers which drain off into the water bodies.
2. Untreated sewage discharged into the water bodies.

**METHODS OF PURIFYING WATER.**

1. Boiling of water.
2. Filtration.
3. Distillation.
4. Sedimentation and boiling.
5. Addition of chemicals e.g. alum, chlorine
6. Sterilization by using light.

**LAND POLLUTION**

They are soil pollutant and vegetation pollutants.

The soil pollutants include refuse, sewage, metal scraps, glass, plastics, chemicals, crude oil e.t.c.

The vegetation pollutants are pesticides, waste product from exhaust fumes of vehicle and effluents from chemical industries.

**EFFECTS OF LAND POLLUTION.**

1. Metallic objects slowly rust occupying valuable land. It decays slowly and affects plants and animals life.
2. Plastics and glass do not decompose.
3. Poor crop yield.
4. A whole community can be poisoned.
5. Refuse dumping can encourage breeding of pests and diseases.
6. Incessant dumping of refuse is an eye sore.

**CONTROL OF LAND POLLUTION.**

1. Apply pesticides/fertilizers in the correct amount and manner.
2. Burn plastics in proper incinerators to control their fumes.
3. Metal scraps or tins/cans/bottles have to be recycled.
4. Avoid indiscriminate dumping of refuse or use disposal van or cans or bins.
5. Refuse should be buried or burnt in incinerators.
6. Proper disposal of radioactive wastes.
7. Tanker drivers and oil companies should take adequate measures to prevent oil spillage.

**NOISE POLLUTION**

Noise pollution is an unwanted sound dumped into the atmosphere without regards to adverse effects it may have. It is unpleasant and irritating. It is common in big towns, cities and industrial areas.

**SOURCES OF NOISE POLLUTION**

1. Factory or industrial noise.
2. Noise from aeroplane when taking off or landing.
3. Railway and locomotive engine noise.
4. Vehicles horns or sirens.
5. Loudspeakers or high pitch musical sound noise.
6. Drumming.
7. Noise from thunder or explosion.

**EFFECTS OF NOISE POLLUTION IN HUMANS**

1. It may damage eardrums or tympanum and can cause total or partial deafness.
2. Emotional disturbance e.g. anxiety.
3. Causes headache.
4. Restlessness or irritation.
5. High blood pressure.
6. Lack of concentration.

**CONTROL OF NOISE POLLUTION.**

Airport should be sited at the outskirts of towns.

1. Increased attention to the technology on noise.
2. Highway should be built some distance away from residential areas
3. Use of sound proof or silent generators.
4. Legislation i.e. noise control laws should be enacted.
5. Education and public enlightenment on effect of noise pollution.

**CONSERVATION OF NATURAL RESOURCES**

Conservation of natural resources is defined as the wise or judicial or rational use of the natural resources so as to ensure their availability and preserve the quality of the environment.

**OR**

It is the planning and management of natural resources in order to ensure their wise use and continuity of supply while maintaining and enhancing their quality, value and diversity.

**Natural resources** are those resources that exist naturally which man derives benefit.

Natural resources can be classified into two:

1. Renewable natural resources
2. Non-renewable natural resources
3. **Renewable natural resources**: They are those resources that are recovered or recoverable e.g. water, animal, plant, air, soil.
4. **Non-renewable natural resources**: They are those resources which when exhausted cannot be replaced or recovered. E.g. mineral resources like coal, tin, petroleum, gold, copper, zinc e.t.c.

**NEEDS OR REASONS FOR CONSERVATION**

1. To prevent the destruction of the natural ecosystem.
2. For medical purposes.
3. To protect natural beautiful sceneries for aesthetic values.
4. For research purposes e.g. forest, wildlife e.t.c.
5. To promote recycling of some scarce mineral resources or water.
6. To prevent the destruction of the natural ecosystem.
7. To allow for continuous use of natural resources for man’s benefit.
8. For preservation of rare and valuable species of plants and animals for future generation or to save them from extinction.

Natural resources that need to be conserved are:

1. Soil or land.
2. Water.
3. Forest or plant.
4. Wildlife/animal.
5. Air.
6. Mineral resources.
   * + - 1. **METHOD OF CONSERVING FOREST**
7. Establishment of forest reserve. Some of these forest reserve in Nigeria are:
8. Shasha river forest reserve in Ogun state.
9. Ijero forest reserve in Ekiti state.
10. Omo forest reserve in Ogun state.
11. Olomu forest reserve in Kwara state.
12. Zamfara forest reserve in Sokoto state.
13. Awaba forest reserve in Oyo state.
14. Sakpoba forest reserve in Edo state.

These forest reserves are protected by laws that prohibit tree falling, hunting and other human activities that may harm the forest in an ecosystem.

1. Through reforestation or tree planting should be encouraged.
2. Discouraging bush burning.
3. Pest and diseases of plants should be controlled.
4. Ensure cutting of trees without damaging undergrowth.
5. Educating the public on the value of forest and the importance of conservation.

**USEFULNESS OR IMPORTANCE OF CONSERVING FOREST**

1. It serves as wind breakers and also helps to bring about rainfall.
2. Forest provides timbers for making furniture, medical requirement for material, fibre e.t.c.
3. Check desertification or desert encroachment.
4. It provides home for wild animals and natural species.
5. Forests are sources of fuel or firewood which are used for cooking.
6. It serves as food supply e.g. fruits, vegetables e.t.c.
7. Forest provides employment for some people.
8. It also serves for tourism.
   * + - 1. **METHOD OF CONSERVING WILDIFE**
9. Establishment of game reserves. Examples of game reserves in Nigeria are:
10. Yankari game reserve in Bauchi state.
11. Borgu game reserve in Niger state.
12. Sambisa game reserve in Borno state
13. Mamu game reserve in Anabra state
14. Jos wildlife park in plateau state
15. Falgore game reserve in kano state.
16. Establishment of ecological garden.
17. Prohibiting bush burning.
18. By educating the public on the importance of wildlife conservation.
19. By placing a ban on hunting of animals going into extinction and their products e.g. leopard skin and elephant tusk for trophies and for sports.
20. Discouraging deforestation and encouraging afforestation.

**USEFULNESS OR IMPORTANCE OF CONSERVING WILDLIFE.**

1. It provides education and scientific research.
2. They provide food for human consumption e.g. meat, fish and egg.
3. It can serve as tourist centres for pleasure and relaxation hence generate revenue for government.
4. It provides employment for some people.

**WHAT IS A THREATHENED SPECIES AND AN ENDANGERED SPECIES?**

**Threatened** **species** are the organisms that have not disappeared but are faced with extinction e.g. elephant.

**Endangered species** are organisms that are seriously threatened and have become depleted due to human activities or natural disasters and such have become so disturbed that the species may be lost forever or become extinct hence require human protection to survive e.g. gorilla.

Reason why it’s not necessary to remove a wild animal from its habitat

1. The animal maybe one of the endangered species.
2. It could lead to the death of the animal having the chance to reproduce is defeated which to leads extinction.
3. Animal can physically attack other animals and humans causing injuries.
4. Animals can transmit diseases
5. Food chain can be disrupted

Factors responsible for declining abundancy and variety of wildlife

1. Indiscriminate killing of animals by commercial hunters.
2. Industrialization which involves clearing of forest for various purposes e.g. construction.
3. Destruction of wildlife by human activities i.e. bush burning which can lead to death of wildlife.
4. Environmental pollution, which releases dangerous materials into environment making it unbearable for wildlife.
5. Excessive tree felling to make charcoal.
6. Lack of awareness or inadequate educate on the need for conservation.
7. Lack of adequate funding/money to enforce conservation policy.

Ways by which government can improve the situation above

1. Establishment of forest department
2. Establishment of environmental protection agency to improve situation
3. Creation of parks and game reserves centre
4. Establishment of zoological garden to protect endangered species
5. Educating people to carryout tree planting, campaign to prevent bush burning.

Reasons why animals are pouched

1. For their unique body parts (tusks and skin)
2. For sports and games
3. For money/business
4. For food
5. For trado-medicinal purposes

Examples of animals that are commonly pouched

Elephant, crocodile, snake, Hippopotamus, deer, Tiger, lion, shark, zebra, ape, leopard, rhinosaurus, porcupine

* + - * 1. **METHOD OF CONSERVING SOIL**

The soil becomes polluted when it loses its fertility. This leads to poor vegetation of the soil.

**Conservation practices include all measures aimed at:**

1. Protecting the soil from erosion.
2. Improving and maintaining soil fertility.

**Practices which protect the soil from erosion are:**

1. Afforestation.
2. Avoidance of bush burning.
3. Avoidance of overgrazing.
4. Terracing.
5. Mulching.
6. Contour ploughing.

Practices which increases or maintains soil fertility are:

1. Cover cropping or planting of leguminous crop.
2. Shifting cultivation/bush burning.
3. Practicing of crop rotation.
4. Application of manure and chemical fertilizer.

**USEFULNESS OR IMPORTANCE OF CONSERVING SOIL**

1. Soil support agricultural practices.
2. It supports forest and its resources.
3. It supports wildlife resources.
4. It serves as home for some organisms.
5. Buildings are erected on the soil.
6. Mineral resources are obtained from the soil.

**How cover-cropping helps in soil conservation**

Note: Cover crops are crops that prevent sunlight from penetrating the soil.

1. Growing of certain crops such as sweet potato, legumes, groundnut helps in soil conservation, because their roots help to bind the soil particles together thereby reducing soil erosion.
2. The leaves prevent rainfall from directly heating toe soil surface and directly loosening it
3. Their leaves shade the soil from direct heat from sunlight, thereby reducing the evaporation of soil water.
4. Leguminous plants increase soil for fertility by adding Nitrogen to the soil and also reduces leeching.

**Soil Terracing as a method of soil conservation**

This is a method of controlling erosion on a steep slope of hills, in this, flat horizontal areas are constructed on which crops are cultivated, following the contour steeps or walls are built along the contours, ploughing is also done along the contours, hence reducing the speed of water running down the slopes . In this way, soil erosion can be prevented, hence conserving the soil.

* + - * 1. **METHOD OF CONSERVING WATER**

1. Trapping rain water in wells, tanks and impoundment.
2. Construction of dams and reservoirs to obstruct flood, use available water for irrigation and generation of hydroelectricity.
3. Saving of water by prompt repairs of burst pipes and turning off taps immediately after use.
4. Tree planting which provides vegetation and hence reduces evaporation and promotes water retention on the surface of the soil.
5. Treatment and recycling of used water.
6. Reduces water pollution.

**USEFULNESS OR IMPORTANCE OF CONSERVING WATER.**

1. Aquatic animals are preserved to serve as food for man.
2. It is used for hydroelectric power generation which provides electricity.
3. It provides means of transportation.
4. Water can be used for domestic and industrial use.
5. Water can be used for recreational and tourist attraction.
6. It provides employment for people. E.g. fisherman.
   * + - 1. **METHOD OF CONSERVING AIR.**

Air is plentiful and freely available on earth. The problem of air resources is pollution. The air can only be conserved if the amount of these pollutant are reduced. These are:

1. Prevention of fumes from automobiles or thermal plants which may render air unfit for organisms.
2. Prevention of affluent from factory or factory chimneys which may pollute the air.
3. Proper treatment and disposal of sewage.
4. Proper burning of waste so as to prevent smoke from polluting the air.
5. Proper disposal of dust from construction sites which causes air pollution.

**USEFULNESS OR IMPORTANCE OF CONSERVING AIR**

1. To provide oxygen for respiration by plants and animals.
2. To provide CO2 used by plants for photosynthesis.
3. To provide gaseous nitrogen used by plants to manufacture protein.
4. Air is the habitat of some organisms e.g. insects, birds.
   * + - 1. **METHOD OF CONSERVING MINERAL RESOURCES.**

Minerals such as gold, gas, crude oil and deposits e.t.c. are among the non-renewable resources, once removed they usually cannot be replaced. They should therefore be exploited with care in order to prolong their period of usefulness.

**CONSERVING MINERAL RESOURCES.**

1. There should be legislation against indiscriminate mining up of mineral resources.
2. Effective and efficient extraction method of mining should be used to prevent wastage.
3. Acceptable alternative should be used e.g. solar energy for fuel instead of petroleum.
4. Mineral resources should be recycled when possible e.g. mineral scraps, tins e.t.c.
5. Over dependence on a particular mineral resource should be discouraged as this leads to the depletion of such mineral resources.

**IMPORTANCE OR BENEFIT OF CONSERVING MINERAL RESOURCES.**

1. Minerals are source of foreign exchange.
2. Some are ornaments e.g. gold, diamond e.t.c.
3. To prevent exhaustation.
4. Some are used for industrial development e.g. iron, diamond e.t.c.
5. They also provide employment e.g. miners, driller e.t.c.

**AGENCIES RESPONSIBLE FOR CONSERVATION**

1. International union for conservation of nature and natural resources (IUC).
2. Nigerian conservation foundation (NCF)
3. State environmental protection agency (SEPA)
4. Federal environmental protection agency (FEPA)
5. World Wildlife Fund (W.W.F)
6. Federal ministry of agricultural water resources and rural development.
7. River Basin Development Authority (RBDA).

**WAYS IN WHICH GOVERNNMENT CAN HELP IN CONERVING OF NATURAL RESOURCES**

1. Establishment of conservation agencies.
2. Establishment of forest and game reserves.
3. Making of conservation laws.
4. Educating the public on the importance of conservation of natural resources.
5. Prohibiting the use of chemicals in fishing.
6. Setting standard for pollution control.
7. Reforestation programmes by the government through the planting campaign.

**FACTORS AFFECTING CONSERVATION OF NATURAL RESOURCES**

1. Soil erosion caused by wind or rainfall.
2. Land, air and water pollution.
3. Occurrence of natural disasters like earthquakes, floods e.t.c.
4. Problem of oil spillage which leads to loss of aquatic and terrestrial life.
5. Indiscriminate hunting leading to eradication of wildlife.
6. Adaptation of poor farming method like continuous cultivation.
7. Use of firewood and charcoal for fuel.
8. Lack of afforestation or tree planting.
9. Bush burning.

**BENEFITS OR IMPORTANCE OF CONSERVATION**

1. It provides fuel like coal, petrol, gas for man’s use.
2. They are used for industrial development e.g. diamond, gold, silver, copper e.t.c.
3. It is used as a source of foreign exchange.
4. It is used in construction of metals like zinc, aluminium e.t.c.
5. It also provides employment.

**CONSERVATION LAW**

What is conservation law?

These are set down rules with sanctions or punishment, for offenders which regulate the usage or protection of natural resources or endangered species.

Examples of conservation laws

1. No unauthorised exploration of minerals or coal, gold by individuals without permit.
2. No killing of endangered species
3. The use of poisonous chemicals/ Gammalin 20 for fishing.
4. Observing closed season for hunting and fishing .
5. No selling of body parts of endangered species.