THIRD TERM: E-LEARNING NOTES

SUBJECT: BIOLOGY

CLASS: SS 1

SCHEME OF WORK

WEEKSTOPICS

1. **Revision of work done in second term**
2. **Relevance of Biology to Agriculture**
3. **Micro-organism in action:**(a)Growth of micro –organisms: ways of measuring the growth of microorganism(b)Beneficial effects e.g. in nature, medicine and industries (c)Harmful effects of some microbes (i)Types of disease-causing microorganism (ii)Diseases caused by microorganisms (iii)Ways in which disease causing microorganisms spread and are transmitted.
4. **Towards better health:**(a)Control of harmful microorganisms (b) Vectors (i)definition (ii)ways of controlling vectors (c) Students' health: Maintenance of good health.
5. **Aquatic Habitat- Marine Habitat:** (a)Characteristics of a marine habitat (b) The major zones (i) Splash zone (ii) Inter-tidal zone (iii) Sub-tidal zone(c) Distribution of the organisms in the habitat (d) Adaptive features of marine organisms
6. **Aquatic Habitat- Estuarine Habitat**:(a)Characteristics of estuarine habitat (b)Types of estuary (c)Distribution of the plants and animals in estuarine habitat (d)Adaptive features of plants and animal in estuarine habitat.
7. Mid-Term break.
8. **Aquatic-Freshwater Habitat and Terrestrial Mash:**(a)Characteristics of freshwater habitat(b) Types of freshwater (i)Stagnant ones (ii)Running water(c) Fresh –water organisms (d) Terrestrial Mash
9. **Terrestrial Habitat-Marsh and Forest:**(a)Forest (i) Characteristics of a forest (ii)Strata in the forest (iii)Distribution of plants and animals that inhabit a forest (iv) Adaptive features of the plants and animals (b) Grassland(i)Characteristics of grassland (ii)Types of grassland (iii) Distribution of plants and animals in a grassland (iv)Some adaptations of grassland communities (c)Arid land (i)Characteristics of arid lands (ii)Types of arid lands (iii)Distribution of the organisms in the habitat(iv)Some adaptation of organisms to arid lands.

THEME:CONTINUITY OF LIFE

10. **Reproduction in unicellular organisms and invertebrates**: (a) Reproduction in Amoeba by asexual reproduction (i)Binary fission (ii) Multiple fission (b) Reproduction in Paramecium by:(i)Asexual reproduction (ii)Sexual reproduction (c)Reproduction in Spirogyra by (i)Asexual or vegetative reproduction (ii)Sexual reproduction or conjugation (d)Reproduction in the Earthworm (i)sexual reproduction only.
11. **Reproduction in invertebrates**:(a)Reproduction in cockroach (b)Reproduction in housefly (c)Reproduction in the snail .
12. **Revision.**
13. **Examination.**

TOPIC: RELEVANCE OF BIOLOGY TO AGRICULTURE
CONTENT:

1. **Classification of Plants**
- **Botanical classification**
- **Agricultural classification**
- **Classification based of life cycle**
2. **Effects of Agricultural Activities on Ecological system**
3. **Pests and Diseases of Agricultural importance**

SUB-TOPIC 1: CLASSIFICATION OF PLANTS
Classification of plants is based on botanical techniques and agricultural techniques. The botanical techniques where all plants are grouped into plant kingdom based mainly on structure, function and evolutionary trends is not very useful to a farmer. The agricultural techniques involve nature of the products and life cycle. Hence plant can be classified based on the following:

i. Botanical classification
ii. Nature and uses of products
iii. Life cycle

I. BOTANICAL CLASSIFICATION

This is the classification system of flora and fauna that uses the binomial system of nomenclature in which every plant is given two names (generic and specific names). The generic names are always written first starting with capital letter while the Last which is the specific names are written in small letters. The names are either italised or underlined separately. E.g. Rhizopus nigricans or Marchantia Palmata.
Based on what is present or absent on the plants, Botanist grouped plants by considering the plants structure, presence of flower and mode of reproduction.
Plants are classified into two groups

(i) Non flowering plant
(ii) Flowering plants

(i) Non-flowering plants

These are plants that do not have or produce flower. They are lower plants lacking vascular bundles, they lack true roots stems and leaves. The non-flowering or seeedless plants are classified into three groups:

a. **Thallophyta:** these are plants that have bodies called thalli. They lack organs like roots, stems, leaves, flowers and vascular tissues. Examples: Algae, fungi, bacteria and Lichens.
b. **Bryophyta:** the plants are multicellular and non vascular. They have stem-like and leaf-like structures but lack roots. Bryophytes live in moist place and reproduce by spores. They have rhizoids through which the plant absorbs nutrients from the soil.
c. **Pteridophyta:** they are multicellular plants with true roots, stems and leaves but lack flowers. The vascular system os primitive as well as chlorophyll. They reproduce by spores. Some of them are aquatic while some are terrestrial e.g. ferns (*Dryopteris, Nephrolepsis*).

(ii) Flowering plants:

These are the higher plants called spermatophytes or seed plants. They produce flowers and are vascular plants. Spermatophytes are further grouped and classified into angiosperms and gymnosperms.

a. **Angiosperms:** these are plants produce seed which are enclosed. Seed is produced and protected by seed coat. Angiosperms are further grouped into dicotyledons and monocotyledons.
   - **Dicotyledons** are plants with two seed leaves or cotyledons. The leaves are net-veined or reticulate e.g. beans, melon, mango and tomato.
   - **Monocotyledons** are plants with one seedleaf or one cotyledon. They have parallel-veined leaves. They possess fibrous root systems.

b. **Gymnosperms**: this group also produce see but the seeds are naked. The seeds are not enclosed in the plant e.g. pines and cones.

II. AGRICULTURAL CLASSIFICATION

In agriculture, cultivated plants or crops are grouped according to the products for which they are grown as given below:

i. **Cereals**: these plants belong to the grass family. The grains have a high starch content and varying amounts of proteins e.g. maize, rice, millet, wheat and guinea corn.
ii. **Legumes:** these plants are important source of dietary protein. They also supply protein-rich fodder for livestock in tropical countries. Legumes replenish soil nitrogen-fixing bacteria are present in their root nodules. Examples include beans, cowpea, soya-bean, groundnut, oil bean, lina bean and yam-bean.
iii. **Root crops:** they are grown mainly for starch and form the staple food of the people in many tropical countries; e.g. cassava, yam and sweet potato.
iv. **Vegetables**: they are grown to supply dietary vitamins and certain minerals like calcium. Examples include tomato, okra, onion, pepper and spinach.
v. **Fruits:** fruits are rich sources of vitamins especially vitamins A and C, minerals and sugars. Most fruits are eaten raw. Examples include orange, banana, pineapple, plantain, mango and pawpaw.
vi. **Beverages and drugs**: the crops which yield these product include cocoa, coffee, tobacco and guinea.
vii. **Spices:** pepper, ginger, cinnamon and cloves belong to this group. They are used mainly for flavouring food.
viii. **Oils**: oils producing plants include coconut, oil palm, shea-butter and groundnut.
ix. **Latex:** when a cut is made on the trunks of certain trees, a milky fluid called latex flows out. The rubber tree produces white latex which is coagulated into exported rubber.
x. **Fibres:** Plants such as jute, hemp and button are grown for their fibres which are used for making ropes and cloth.
xi. **Forage crops**: these are grasses and legumes that are grown for animal feed.

III. CLASSIFICATION BASED ON LIFE CYCLES

Plants are grouped on how long or short they live to complete their life cycle i.e. duration of their life cycles. It is a practical way of classifying crop plants as it helps a farmer to plan how to use his land to meet his goals. Plants are classified into animals, biennials and perennials.

i. **Ephemerals:** These are plants that complete their life cycles within three to four monthes and can undergo two to three life cycles within a growing season. Examles include waterleaf (eg *Talinum triangularare,*) goat weed (*Ageratum conyziodes*).
ii. **Annuals**: these are plants that complete their entire life cycle and die within one growing season which may be from a few months to a year. Examples include rice, wheat, maize, beans, flax, jute and sunflower.
iii. **Biennials**: these are plants which complete their life cycled in two years. The plant grow and store food during the first growing season to produce and use it in the second growing season to produce flowers fruits and seed before they die. Examples include cabbage, turnip and radish.
iv. **Perennials**: these plants complete their life cycles in many years or have many growing seasons for life cycles to be completed e.g. mango, orange, oil palm, and ginger.

EVALUATION

1. State two differences between angiosperms and gymnosperms.
2. State two differences between monocotyledonous and dicotyledonous plants.
3. Give two examples of each of the following groups of plants. (a) cereals (b) fibres (c) legumes (d) beverages (e) oils.
4. Classify plants on the bases of life cycle.

SUB TOPIC 2: EFFECTS OF AGRICULTURAL ACTIVITIES ON ECOLOGICAL SYSTEMS.

Agricultural activities involve both growing of crops as well as rearing of farm animals. Ecological system refers to the interrelationship between living organisms and their environments. The natural dynamic balance between plant and animal communities in the ecosystem is often disturbed by agricultural activities such as burning and tillage. Bush burning

In many places, some areas used for cropping is always set on fire before the cropping season. The ash produced by the burnt rubbish increases the alkaline content of the soil. This replaces the acidity of the soil in most tropical African soil. In contrast, burning exposes the soil surface to erosion by wind and rain, reduces the humus content of soil, destroys micro-organisms of the soil, kills small animals such as insects and earthworms, and destroys other important plants and animals. As a result, the balance of the ecosystem is disturbed by bush burning.

Pesticides

The use of pesticides in some cases disturbs the dynamic balance of the ecosystem in some unexpected ways. Insecticides affect both beneficial and harmful insects. DDT is a very stable compound; instead of being excreted by animals, it is stored in their body fats when such fat is oxidized during respiration in some animals, harmful quantities of DDT may be librated into the blood.
Effects of different types of farming have effects both desirable and undesirable on ecological systems.

Different kinds of farming have effects both desirable and undesirable on ecological systems. These effects are explained below.

(a) **Shifting cultivation:** the method is possible where population is small and where land is abundant. Ecologically, large population with small land results in overuse which inturn leads to total loss of soil fertility.
(b) **Crop rotation:** crops grown are rotated in successive seasons. The method gives better yield for respective crops because different crop make different demand of mineral elements of the soil.
(c) **Mixed farming:** this involves keeping livestock and growing plants side by side. As the product of crops is being used as food to feed livestock, the remains (faeces) of the livestock can also be used as manure for the farm crops.

ASSIGNMENT

State three advantages and disadvantages each of the following:

i. **Shifting cultivation**
ii. **Crop rotation**
iii. **Mixed farming**
iv. **Mixed cropping**
v. **Pastoral farming**
vi. **Mono cropping**
vii. **Bush fallowing**

SUB-TOPIC 3: PESTS AND DISEASES OF AGRICULTURAL IMPORTANCE

Pests are insects or animals which cause damage to farm, animals, plants, food and crop. Some pests attack crops and animals in the farm. A disease is a departure from normal state of health, expressing remarkable symptoms or outward visible signs. Both pests and diseases reduce the quality and quantity of crop and animal yield or even kill them.

PLANT AND PESTS

The most devastating pests of crops are insects e.g. grasshoppers, locusts and caterpillars. Other plant, pest includes nematodes, rodents and birds. Insects and rodents always destroy stored crops like cocoa, coffee, groundnuts and yam. Pests cause plant diseases. Specific plant pests include the following:

i. **Caspid bugs of cocoa:** they feed on leaves, stems and pods. The pest is more prevalent in dry season. Caspids are controlled by spraying with Aldrex 40, BHC, Dieldrin and Gamalin 20.
ii. **Cotton stainer bugs** are commom in cotton growing areas. They are tiny, red-coloured insects which pierce the young bolls and seeds in the open bolls and suck the sap. These insects transmit viral, fungal and bacterial diseases from one plant to another. The fungus causes the boll to rot internally and stain the ling.
iii. **Yam beetles** can destroy a whole yam crop plantain within a year. The pests are controlled in Nigeria by treating yam setts and seeds with Aldrin just before planting. Other pests of yam are eel-worm which feed on tuber rodents and wild animals which destroy the tubers.
iv. **Pests of cassava are grasshoppers** that feed on the leaves and young shoots, some rodents that feed on cassava tubers and stems and untethered goats and sheep can eat up all the leaves and stems of cassava.

Control of plant pests

Pest control is aimed at protecting crops from damage and getting rid of the pest population. Control measure of plant pest can b applied through the following methods:

- **Physical method** e.g. handpicking of pests and deterrents such as bird scares on small farm area with low infestation.
- **Cultural method**: modifying farm practices to discourage pest multiplication.
- **Chemical method** i.e. use of pesticides.
- **Biological method** e.g. introduction of predators.
- **Sterilising male technique.**

Natural Pest Control

Ladybird beetles, or ladybugs, have had their name since the Middle Ages, when people looked upon them as a gift from the Virgin Mary because of their miraculous eating habits. As both larvae and adults, ladybugs feed on aphids and other agricultural pests. Many gardeners buy ladybugs at garden stores and release them in their gardens to stave off aphids

PESTS OF ANIMALS

Animals or livestock pests are often parasitic on their victims. Livestock pests are either ectoparasites or endoparasites.

i. **Ectoparasites:** some of them are vectors of diseases e.g. ticks vectors of tick fever and heart water disease of cattle, sheep and goats. Other ectparasites of livestock are lice, nites, fleas and flies.
ii. **Endoparasites**: these include flat worm (e.g. tapeworm and liver fluke) or round worm (e.g. Ascaris, Hookworms) or protozoa e.g. Trypanosome and coccidian which cause coccidiosis. Endoparasites injure the tissue or organs in which they live. They cause wasting, stunting and death of livestock when they occur in large numbers.

Control of Endoparasites

Two main effective ways of controlling endoparasites are:

i. The use of appropriate drugs as directed by the veterinary department.

ii. Proper management to ensure that domestic livestock does not come in contact with the parasitic eggs or larvae.

SOME DISEASES OF PLANTS

Diseases of plants are commonly caused by fungi, bacteria and virus. The table below

Table: Summary of the causes, symptoms and control.

DISEASE	CAUSATIVE ORGANISM	HOST	MAJOR SYMPTOMS	CONTROL MEASURES
Anthracnose	Fungi	Cocoa, coffee, cotton and oil palm	Brown, water soaked patches on leaves and pods	Use of fungicides
Black pod	Fungi	Cocoa	Dark brown, or black rot on pod, damage to fruit and seed walls	Spraying with fungicides, farm sanitation
Brown spot	Fungi	Maize	Purplish-brown spots on leaves. Entire plant may break up.	Avoid planting on infected spots
Bacterial wilt	Bacteria	Banana, plantain, cassava, tobacco and groundnut	Leaf wild and defoliating. Wilt of entire plant	Use of clean planting material, good sanitation
Mosaic	Virus	Cassava and tobacco	Leaf-mottling with dark green and greenish yellow patterns	Use of resistant varieties

SOME DISEASES OF ANIMAL

The common diseases which affect domestic animals could be grouped as follows:

i. Bacterial diseases e.g. black quarter, anthrax, foot rot, fowl pox, tuberculosis and contagious abortion.

ii. Fungi disease e.g. ringworm

iii. Nutritional disease e.g. rickets, milk fever, ketosis, bloat and osteoporosis.

iv. Protozoan diseases e.g. coccidiosis, tick fever and trypanosomiasis (sleeping sickness)

v. Viral diseases e.g. foot and mouth diseases, foul cholera, Newcastle disease, pleuropheumonia, rinderpest and typhoid fever.

Table: Selected Domestic Animal disease

DISEASE	CAUSATIVE ORGANISM	HOST	MAJOR SYMPTOMS	CONTROL MEASURES
Coccidiosis	Protozoan	Cattle, foul, sheep, and goat	Bloody diarrhea, weakness, emaciation and death	Good sanitation. Avoid overcrowding. Disinfected sulphamethazine.
Anthrax	Bacteria	Cattle, goat, pig and sheep	Premature birth, still-birth, retention of afterbirth and sterility	Vaccination of young animals before age of breeding. Good sanitation.
Newcastle	Virus	Poultry	Yellowish droppings,	No effective cure. Kill off

			comb turns purple. Coughing, gasping and death	infected bird. Disinfected pens. Consult a veterinary officer
Ringworm	Fungus	Cattle and horses	Lesions at the base of hairs. Hairs fall off and itching	Use fungicides to wash lesions. Use antibiotics as oral treatment
Rabies	Virus	Cats, cattle , dogs, horses, sheep and pigs	Excitement, tendency to attack, paralysis in coordination and death	No effective treatment. Control by vaccination and avoiding exposure to infection.

RELEVANCE OF BIOLOGY TO AGRICULTURE

SUB-TOPIC 1: FOOD PRODUCTION AND STORAGE

The primary aim of agriculture is to provide adequate food for an ever increasing human population. The issue of food production, preservation, storage and wastage has been challenging to both the agriculturist and the government.

Adequate food production makes food available for teaming population to be well fed. It also earns the country foreign exchange through exportation of food crops. One the other hand, food shortage will increase death rate and cause migration of people to where food is available. There will be competition among organism which in turn leads to starvation and cannibalism. Natality or birth rate will be affected through avoidance of marriage.

(a) WAYS OF IMPROVING CROP YIELD

Crop yield can be improved through the following ways:

(i) Breeding high yielding crops that are resistant to plant and animal disease.

(ii) Using fertilizers and organic manure to maintain soil structure and fertility and ensure high crop yield.

(iii) Using effective method of farming such as irrigation, tillage and draining systems.

(iv) Combating weeds by using herbicides instead of cutlasses and hoes.

(v) Plant protection from pests and disease to improve yield.

(vi) Putting more land under use by motivating and formulation policies that will get more people to be involved in farming.

(vii) Practicing mechanised farming to obtain high yield. Tractors and modern farm implement to be adopted instead of manual farming.

(viii) Conservation of land to keep and maintain soil fertility. Soil erosion should be prevented, bush burning should be avoided while mulching and crop rotation should be encouraged.

(ix) Use of correct agricultural practices such as removing weeds regularly, giving adequate spacing and planting at the right time will improve crop yield.

(b) CAUSES OF WASTAGE

Reasons why crops are wasted annually on farms include the following:

i. **Late harvesting of crops**: some crops are over ripe, rot and fall off due to lateness in harvesting.

ii. **Bad harvesting techniques and incomplete harvesting**. Harvest should be invested on and used. Man may skip maize harvest and such maize may be wasted.

iii. **Delay in transporting crops** which make some drops to rot.

iv. **Lack of good storage facilities**; good barns and storage facilities should be made available. If harvested crops are not properly stored wastage will occur.

v. **Infections of farm produce** by fungi, insects and vermin due to inefficient storage method.

vi. **The decay of some stored crops caused moisture**, especially when they are not properly stored e.g. groundnut, maize and rice.

vii. **Lack of good roads and good means of transportation** for carrying farm to the market or urban centres.

viii. **Poor method of preservation** of some farm produce like tomatoes, carrots, vegetable and other perishable crops.

METHODS OF PRESERVING AND STORING FOOD

The methods commonly used in preservation and storage of foods include the following:

i. **Drying**: food items such as meat and fish can be dried to preserve food and prevent damage. Drying remove water from food and prevent growth of organism that can cause decay.

ii. **Salting**: common salt is added to fish and meat. Salt kills the bacteria by high osmosis pressure.

iii. **Refrigerating/ freezing**: keeping food at low temperature prevents bacteria growth. Meat, fish and vegetables are preserves in this way.

iv. **Smoking:** this removes water from food and prevents growth of microbes on food. Microbes are killed by poisonous substances such as phenols, present in the smoke.

v. **Canning:** if the food is sealed and air excluded, growth of micro organisms will be impossible. High temperature kills the microbes and kills the microbes and keeps the food.
vi. **Chemicals:** the application of preservatives and protective chemicals on the food keep pests away and also prevents bacteria and fungi from growing on the food, thereby preventing decay.
vii. **Pasteurisation**: it is special method of preserving milk. Milk is pasteurised by heating to 72% for 15 seconds and then cooled rapidly. This destroys micro organisms, thereby preventing the milk from becoming sour very quickly.

Other methods of food preservation are **fermentation** and **radiation.**

SUB-TOPIC 2: POPULATION GROWTH AND FOOD SUPPLY

Population can be defined as the total number of organism of the same species living in a habitat over a period of time. Food supply affects population growth both positively and negatively, based on availability or unavailability of food in a habitat.

If food is adequately available organism will be well fed, give birth to new ones; death rate reduces and population rises. When there is inadequate supply of food, the organism is malnourished, there is competition for the limited food, birth rate reduces, death rate increases and there is a decline in population of the organism. The number of organism migrating out of the habitat increases and cannibalism may set in.

Factors affecting population growth include the following:

i. Reproduction (birth rate)
ii. Migration (movement of organism)
iii. Death (death rate)
iv. Availability of food
v. Availability of space
vi. Availability of water
vii. Natural disaster
viii. Famine
ix. War

SUB-TOPIC 3: RELATIONSHIP BETWEEN AVALABLE FOOD AND HUMAN POPULATION

Malthusian hypothesis that human population increases by geometric progression while food increases in arithmetic progression, is an indication that relationship exists between population and food supply. At a point therefore, population will outgrow the supply of food and population growth will stop at one point. Malnutrition, hunger and possibly death will follow to reduce the population to the level the food can cater for.

EFFECTS OF FOOD STORAGE

Naturally, some crops are meant to grow in wet season while some few are grown in the dry season. If there is no good storage facilities, distribution of food across the season will be difficult; as there would be a period of plenty of food and another period of food shortage. To strike a balance, storage facilities will make equitable distribution of food and food will be available in required quantities at all seasons. Advantages of food storage include the following:

i. Provision of employment opportunities i.e. to workers in processing industries.
ii. Provision of adequate food supply during period of war and natural disaster.
iii. Stabilisation of food prices at all season. Equitable distribution of food will prevent unnecessary high demand for food at any time which may lead to like in prices of food.
iv. It ensures economic use of food by preventing spoilage at time of plenty and adequate supply of food at off-harvest period.
v. Provision of foreign exchange to improve the economy of the nation. Food can be used as aids to countries in need as love and donations.

SUB-TOPIC 4: GOVERNMENT EFFORTS TO INCREASE FOOD PRODUCTION

Many African countries has embarked on gigantic agricultural development programmes that failed
Because of undefined government policies, absence of planning, lack of skilled and experienced personnel and inadequate provision of funds by the government.
In Nigeria, huge finance invested in various governments' agricultural programmes (such as Operation Feed the Nation and Green Revolution) was grossly mismanaged. Gross financial management has also crippled many of the River Basin Authorities established by the Federal Government to boost agricultural production.

Factors that adversely affect food production include:

i. Unfavourable climatic conditions e.g. drought;
ii. Lack of improved varieties of plant and livestock.
iii. Conservative attitude of local farmers
iv. Inability of many farmers to use modern farming techniques and;
v. Outbreaks of insect pest and diseases.

Government should do the following to aid crop production

i. Provision of irrigation system to supply water for planting at all season.
ii. Provision of modern farming equipment to replace manual clearing equipment used by farmer.
iii. Provision of good roads and other infrastructure that can aid food production, movement and storage.
iv. Fertilizer should be made available at reasonable cost to farmers to improve soil fertility and boost crop production.
v. Training of local farmers in modern day farming to improve their skills.

TOPIC: MICRO ORGANISM AROUND US

SUB-TOPIC 1: MICRO ORGANISMS IN AIR AND WATER.

Introduction: Micro-organisms are very tiny living organisms are also known as microbes.

MICROBES

Anthony Van Leeuwenhoek (1632 – 1733) was the first scientist to discover microbes with his newly invented microscope.
Micro-organisms are dreaded as disease causing agents (germs). However, many microbes are of great benefits to man e.g. saprophytic microbes that bring about decay of organic matter. Those microbes that affect man negatively are mainly the parasitic ones which are called **pathogen.**
Micro-organism are found everywhere- in the air, water, soil, in our own food, on our food on surfaces of object, and on inside living organisms, on our bodies, inside of our bodies and on our clothes in shut, anywhere everywhere.

1. **Groups of micro-organisms:**
   Microbes are very many and are grouped as follows:

I. Bacteria
II. Viruses
III. Some algae
IV. Protozoa
V. Some fungi

Most microbes are unicellular but some fungi and algae are multi-cellular. Several microbes survive adverse conditions of temperature or humidity by forming spaces the within the cell. On the return of favourable condition of the spores are released carried in the air and on landing on suitable substrate grow and produce more spores.

I. <u>BACTERIA</u>

Bacteria can be seeing with the use of light microscope. It has a simple structure. It is unicellular. It is a prokaryotic cell i.e it does not have a true nucleus. Heredity materials are contained in a strand of DNA (Deoxyribose nucleic acid) inside the cell.

Bacteria can be described based on the following:

i. Oxygen requirement
ii. Shapes
iii. Gram's staining technique

i. <u>Based on oxygen requirement</u>.

(a) **Aerobic Bacteria:** This group of Bacteria uses oxygen in respiration e.g. *vibrio cholerae.*
(b) **Obligate anaerobes:** This group of bacteria do not utilize oxygen in respiration e.g. putrifying bacteria.
(c) **Facultative anaerobes**: These are bacteria that can exist in two states i.e. they can use oxygen and they can also do without oxygen.

ii. <u>Based on shape</u>.

(a) **Cocci**:- This group are round in shape.
(b) **Bacilli**:- They have rod-like shape.
(c) **Spirillae**:- These are spiral in shape.
(d) **Vibrios**:- They are comma shaped.
(e) **Flagellated Spirochaetes**:- A number of bacteria have whip-like structure called flagella that effect their movement.

Drawings Modern Biology Pg 170

iii. <u>Based on Gram's staining technique</u>.

(a) **Gram positive bacteria:** retains the purple/violet stain in its peptidoglycan (a large structural molecule found in the bacteria cell wall)

(b) **Gram negative bacteria:** loses or do not retain the purple stain in the cells

Bacteria can be the cause of a number of plant and animal diseases.

a) **Plant diseases caused by bacteria** e.g. web blight in cowpeas, black arm in cotton etc.
b) **Animal diseases caused by bacteria**- leprosy, lockjaw, cholera etc.

II. VIRUSES

They are unicellular in nature, without nucleus, cytoplasm and cell membrane. Smaller than bacteria and can only be seen under electron microscope. Virus lack life. Thus it cannot respire nor carry out metabolism. They can only survive inside living cells.

Types of viruses

Viruses can be grouped based on:

(a) Type of nucleic acid (DNA/RNA)
(b) Nature of Protein coat

(a) Based on type nucleic acid

i. Adenovirus, Herpesvirus (DNA)
ii. Picornavirus, Togavirus, Orthomyxovirus, Paramyxovirus, Coronavirus (RNA)

(b) Based on nature of Protein coat

i. Adenovirus, Herpesvirus, Picornavirus, Togavirus (**Icosahedral** in nature – i.e a polygon with 20 faces and 12 corners)
ii. Orthomyxovirus, Paramyxovirus, Coronavirus (**helical** in nature)

III. ALGAE

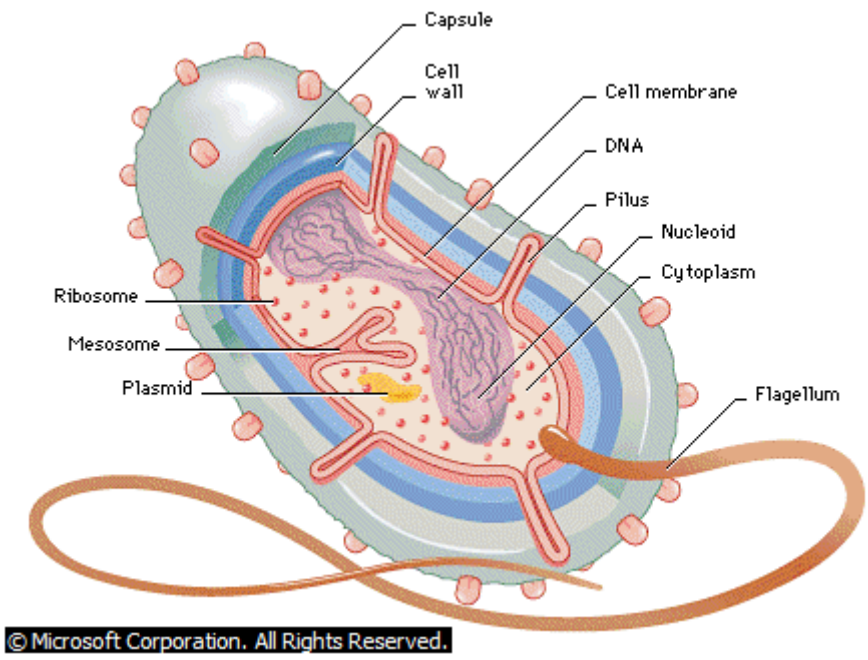
They are mainly free-living microscopic plants. They survive in a wide range of habits such as wet soil, fresh water, sea etc. they have chlorophyll to a number of other pigments giving rise to green algae, brown algae, blue/green algae etc. examples of algae are: Sprirogyra, volvox, chlamy domonas,nostoc, Diatoms etc.

IV. PROTOZOA

These are unicellular microscopic animals. They are found in damp soil and water. Some of them are parasitic while others live freely in their habit. Examples of parasitic protozoa are: Trypanosome, plasmodium etc. examples of free-living Protozoa are: Amoeba, Paramecium etc. parasitic protozoans are pathogens that cause disease like Malaria, sleeping sickness, Bilharziasis etc.

V. FUNGI:

These are non-green simple plants. They feed Saprophytically or parasitically. Saprophytic fungi such as mucor, yeast, penicilium are useful to man. Parasitic fungi do cause diseases which are unpleasant to man. Example of animal diseases caused by fungi is: Ringworm, Athelet's foot, mouth thrush, candidioses etc. plant diseases caused by parasitic fungi are: mildews, spots, wild, blights and Rots.



CONCEPT OF CULTURING

Culturing is a technique of growing micro-organisms in the laboratory for the studying the microbes.
The process has to do with:

i. Preparing a sterile medium
ii. Inoculating
iii. Incubating
iv. Examining micro-organism in the medium.

While bacteria, fungi and algae can be grown in test tubes and Petri dishes in culture media, viruses cannot be grown. They can only grow and multiple inside living cells of an organism.
Through Tissue culture, living tissues and cells of multi-cellular organism are cultured in appropriate media and studied. To carry out studies involving viruses, are cultured in the laboratory by injecting the virus into the fertilized Bird egg e.g. egg of duck.

On the culture medium, micro-organisms occur as colonies. Colonies of micro-organism do clump together in large number of organism of the same kind. Colour, appearance other characteristics of the colonies enable the investigator to identify and differentiate microbes in a culture medium.

SUB-TOPIC 2: IDENTIFICATION OF MICRO-ORGANISMS IN AIR, POND WATER, RIVER, STREAM

MICRO-ORGANISMS IN THE AIR

Micro-organisms commonly found in the air are: Bacteria, Virus and Fungi. These microbes do not grow in the air but are present as spores in dust and water droplets in the air. These spores are light and easily dispersed by air movement. When these spores land on suitable substrate, they germinate, multiply and produce more spores. Micro-organisms found in the air and examples:

a. **Bacteria**: Examples – Pneumococci, Staphylococci, Streptococci, *Bacillus anthracis*, which causes anthrax in herbivores.
b. **Virus:** examples – Influenza, Polio virus, common cold virus, measles virus.
c. **Fungi**: Examples – Sacromyces (yeast), *Rhizopus nigricans* (bread mould), Penicillium (blue-green mould) Aspergillus etc.

MICRO ORGANISMS IN WATER

Micro organisms found in water are commonly known as plankton. Aquatic environment, unlike atmosphere are rich in organic and inorganic nutrients. They can be found in all types of water habitat viz: wells, ponds, lakes, streams, rivers and seas.

All microbes found in water can be grouped into three as follows:

i. Natural water micro-organisms: these are microbes that are naturally found in aquatic habitats.
ii. Soil micro organism (washed into the surrounding water bodies during heavy rains)
iii. Sewage micro-organisms

MICRO ORGANISMS IN WATER AND THEIR EXAMPLES:

1. **Bacteria**: examples – aquatic species of coccus, Baccillus, Pseudomonas, Azobacter, Thiobacillus, Sarcinina, spirillum, Micrococcus, Vibro and Spirochaeta. These bacteria are either heterotrophic, autotrophic and chemotrophic.
2. **Blue – green algae:** examples; oscillatoria, nostoc, anabaena,
3. **Protists**: these are autotrophic diatoms e.g. chlamydomonas, cholera and some species of euglena as well as heterotrophic amoeba and paramecium.
4. **Algae**: these are located close to the shore of where they form thick green floating mesh e.g. spirogyra, volvox etc. Algae arte major part of primary producers in the aquatic habitat since they contain chlorophyll and can photosynthesis.

MICRO-ORGANISMS IN OUR BODIES

Various parts of human body such as the skin, hair, mouths, nose, ears, under the nails, our teeth etc to different micro-organisms as well as serve as entrance for these micro-organisms into our bodies.

Millions of micro-organisms living inside and outside the human body. These microbes are non-pathogenic. They are regarded as the normal micro flora which plays importance role in the body.

This normal micro flora prevents pathogen from invading the body as well as secretes certain substances that inhibits or kills some other pathogens. Weakened immune systems , indiscriminate use of antibiotics, unhygienic practices like smoking and intake of alcohol malnutrition, stress etc could make non-pathogen to become pathogenic harmful to the body as the normal micro flora become disturbed.

Pathogens harm the body by using up the hosts' nutrients thereby starving the tissue of the host.

Through their actions they damage tissues of the affected part of the host as well as produce toxins that negatively affect the functioning of particular organs or body systems of the individual.

ENTRY OF MICRO ORGANISMS INTO OUR BODY

Micro-organisms enter the human body through;

i. **Buccal cavity:** the food we eat and the water we drink. Such pathogen cause air borne infection like tuberculosis cause by **mycobacterium tuberculosis**
ii. **The nose**: Air we breathe in, into the respiratory system such virus normally cause cold.
iii. **Damages skin:** cuts or bruises on the skin into the blood stream Telamus. fungi infection, leading to ringworm on the head, foot etc.
iv. **Oesophagus:** contaminated food or drinking water.
v. **Direct contact:** skin surface e.g. fungal infections which result in ringworm of the head and foot.

MICRO ORGANISMS IN FOOD

The physical and chemical properties of any food determine the type of micro-organisms that will grow and reproduce. When micro-organisms or their spores get in contact with food, such food gets contaminated and when consumed man can have adverse effect on the individual.

CAREER OF MICRO-ORGANISM

Apart from the various means through which microbes get into our body already discussed, there are certain organisms that carry micro-organisms that can affect man negatively about. These organisms are called **Careers** are usually insects and mammals. The hairy nature of the insect body traps the microbes and gets carried from place to place. The natural habitats of these insects include latrines, food stores, dung hills and other similar places where microbes abound. The careers pick up the pathogens and bring them to exposed human food. As they land on these exposed food to feed on them, the microbes are transferred to the food which could be eaten by man and consequently bring about infection and diseases. These careers are called **Vectors**. The pathogen neither grow nor affect them adversely hence, they are called Vectors. Vectors are primary to the pathogen while man is the secondary Host.

LOCATION OF MICRO-ORGANISMS IN CAREERS

Organisms that carry micro-organisms are called Vectors. Diseases caused by career do not affect the vector that carries them.

The micro-organism found in vector lives in them temporarily for the purpose of developing to the stage where they can effectively infect man. Thus the pathogens have two hosts. This phenomenon is killed alternation of hosts. The vector is the primary host while man is the secondary host of the pathogen. Mosquitoes, Tsetse fly are examples of vectors of microorganism do not develop inside the housefly. Instead

the body of the housefly's body "collects" micro-organisms as it parches on exposed human food to feed on it, the microbes (bacteria) falls off its body onto the food which causes disease unto man when contaminated food is eaten.
Though biting and sucking man's blood, Anopheles Mosquito transmits a protozoan – plasmodium into mans blood causing disease – malaria. The pathogen is in the gut of the insect and as it feeds on the blood of man, it deposits it into man.

THEME: THE ORGANISM AND ITS ENVIRONMENT
TOPIC: MICRO-ORGANISMS IN ACTION
CONTENT:
Sub – Topic 1:MICRO-ORGANISMS IN ACTION
Micro-organisms are very small living things which are normally not visible to the naked eye but can be seen with the help of a microscope.
TYPES OF MICRO-ORGANISMS
Micro-organisms include;
(i) **All Viruses** e.g. Polio virus, Smallpox virus, etc.
(ii) **All bacteria** e.g. Salmonella, Clostridium, Treponema, Escherichia coli, etc.
(iii**) All protozoans** e.g. Plasmodium, Trypanosoma, etc.
(iv) **Some fungi** e.g. Rhizopus (mould) and Yeast (e.g. Saccharomycetes).
(v) **Some algae**.g. diatoms, dinoflagelletes, etc..
(vi**)Blue - green algae** e.g. Nostoc

Micro-organisms live everywhere, in water, air, soil, inside and outside of plants and animals including human beings. There are many more microorganisms than visible plants and animals in the world. They may have beneficial or harmful effects. Micro-organisms that cause disease are referred to as pathogens and are usually parasitic.
Growth of Microorganisms
Culturing is the growing of micro-organisms in prepared media in the laboratory. The prepared medium is called the 'culture medium'. Bacteria, fungi and algae grow easily in test-tubes, flasks or Petri dishes of culture media. Virus on the other hand, can only grow and multiply inside living cells, so they cannot be grown in a culture medium.

Micro-organisms are able to increase in size and multiply in number of cells. The growth of micro-organisms is measured based on increase in population size rather than increase in cell size. **Under favourable conditions (food, adequate temperature and humidity**) micro-organisms **reproduce asexually by binary fission**. Generation time varies from species to species e.g. **rapidly growing specie like *Escherichiacoli* can divide every 30minutes.**

Two methods are used to measure the growth of micro-organisms;
(i) First Method: This involves inoculating a bacterial sample into a nutrient broth. As the bacterial population increases, the clear liquid medium becomes cloudy / turbid. Increase in turbidity indicates an increase in number of bacterial cells. Turbidity can be measured using a spectrophotometer. Thus by measuring the turbidity of a bacterial culture in nutrient broth at regular intervals, the growth of a bacterial population can be measured.

(ii) Second Method: This involves taking small samples of bacteria from a nutrient broth at regular intervals of time and diluting the samples several times. Each diluted sample is then inoculated onto a nutrient agar medium in a petri dish and incubated. The number of colonies formed in each petri dish is counted and this indicates the number of living bacterial cells in the diluted sample. From this, the actual number of bacteria in the original sample can be calculated.

EVALUATION
1. Mention five microorganisms
2. How is the growth of microorganisms measured?
3. Describe two ways of growing microbes in the laboratory.

Sub – Topic 2: BENEFICIAL EFFECTS
(i) Bacteria in the large intestine of man synthesize the vitamin K that is needed.
(ii) Yeasts are used in baking and preparation of alcoholic drinks. Yeasts are an important source of vitamin B.
(iii) Some bacteria are used in curdling of milk, brewing of wine and in butter and cheese making.
(iv) It is used in the production of antibiotics e.g. penicillin from the mould called penicillium.
(v) Saprophytic micro-organisms decompose sewage into harmless inorganic compounds.
(vi) Most decomposers are micro-organisms and they help to maintain soil fertility.
(vii) Some bacteria living in the rumen of ruminants like sheep, goat, cattle help to digest cellulose in their food (grasses / vegetation).
(viii) Micro-organisms help in maintaining some cycles in nature e.g. the nitrogen cycle and carbon cycle. They also help in recycling phosphates and sulphate.

Sub-Topic 3: HARMFUL EFFECTS OF MICRO-ORGANISMS
(1) Most diseases in animals and plants are caused by micro-organisms especially bacteria, viruses and protozoans.
(2) Huge amounts of food are spoiled annually by saprophytic fungi and bacteria.
(3) They also cause deterioration / damage to materials such as paper, wood, cotton, leather, etc.
(4) Micro-organisms can also cause the death of plants and animals.
Disease-Causing Micro-Organisms
Micro-organisms are spread through the following;

(i) **Air**: Dust and water droplets in our air contain micro-organisms such as polio virus, measles virus, pox virus, common cold virus, *Pneumococci*
(a bacteria), *Pencillium* (a fungus), etc.
(ii) **Water**: Bacteria found in water include *Bacillus*, *Pseudomonas*, Vibrio, *Azotobacter*, Coliform micro-organisms (e.g. *Escherichia coli*, *Vibrocholerae*, *Salmonellatyphi*), etc. Blue-green algae found in water include Nostoc,Anabaena and *Oscillatoria.*Protists in water include *Chlamydomonas*, *Euglena,Amoeba*, etc. Algae include *Spirogyra*, *Volvox*. Fungi include moulds and mildews.
(iii) **Food**: Most micro-organisms in food get in through faeces, dirty utensils and equipment, unhygienic habits and vectors like flies and cockroaches. Examples are *Shigella*sp, *Salmonellaenteriditis*, *Aspergillus*f*lavus*, etc.
(iv) **Animal vectors** or carriers.
(v) **Personal or direct skin contact with a sufferer**.

Disease-causing micro-organisms can enter the body through body openings like the mouth, nose or reproductive opening, through wounds, through bites of other animals and through blood transfusions.
Some important diseases, their causative micro-organisms, mode of transmission, host and symptoms are outlined in the following tables.

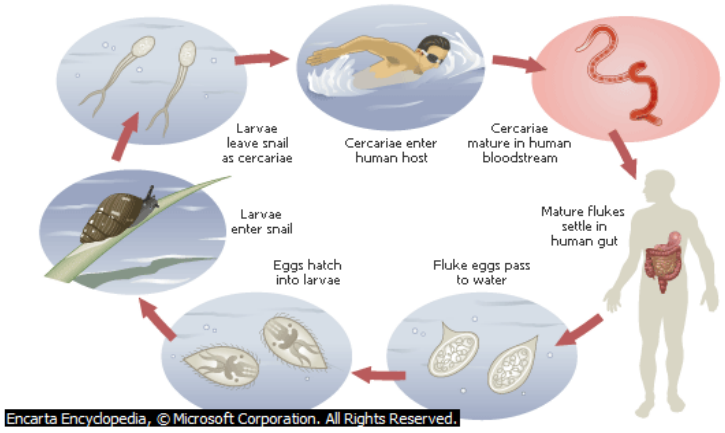
WEEK 3
TOPIC: TOWARDS BETTER HEALTH
CONTENT: 1. **Control of harmful microorganisms**
2. Vectors (i) definition (ii) ways of controlling vectors
3. Student's health: maintenance of good health

Sub – Topic 1: TOWARDS BETTER HEALTH: CONTROL OF HARMFUL MICRO-ORGANISMS
Better health can be achieved basically by controlling disease-causing micro-organisms and their animal vectors and also by improving health facilities.
Harmful microorganisms can be controlled by;
(1**) Use of high temperature** e.g. sterilization by boiling, autoclaving or heating of food, water and other products to kill micro-organisms.
(2) **Use of drugs / antibiotics** e.g. chloroquine kills plasmodium parasites.
(3**) Use of antiseptics** which kill or inhibit the growth of pathogenic micro-organisms.
(4) **By immunization or vaccination** against diseases such as measles, tuberculosis, polio, etc.
(5) **Covering of food and water** always to prevent contact with vectors.
(6) **Destruction of vectors** such as mosquitoes, flies, rats, etc.
(7) **Use of disinfectants** e.g. Lysol, carbonic acid, etc.
(8) **Use of salt**; this inhibits the growth of microbial cells and prevents their multiplication. Salt can be used to preserve food and wash cuts and wounds to prevent infection.
(9) **Dehydration** inhibits the growth of microbes; food can be preserved by drying. Drying in the sun can be used to kill micro-organisms in bedding blankets and clothes.
(10) **Promoting health education**.
(11) **Quarantine services**.
(12) **Personal hygiene** such as regular bathing, brushing of teeth, washing of hands before meal and after defecating, etc.
(13) **Maintaining good health:** This helps us to resist most pathogenic micro-organisms.
(14) **Use of ultra-violet radiation** to kill bacteria

Sub –Topic 2: VECTORS
Non-living agents that carry micro-organisms from one place to another include air, water and food.
Living agents that carry micro-organisms from place to place are animals. These animals that carry pathogenic (disease causing) micro-organisms are known as **vectors.**
Examples of vectors are cockroaches, fleas, mosquitoes, tsetse-flies, black flies, house flies, bed-bugs, ticks, rats, dogs, cats, etc. Vectors may transmit micro-organisms from place to place or person to person either mechanically or biologically.
(a) Mechanical Method: The vectors carry pathogens on various parts of their bodies e.g. legs, wings, mouthparts, hairs, etc. The pathogens do not grow or multiply on the body of the vectors. Pathogens carried in this way include *Salmonellatyphi*, *Vibrocholerae* and *Entamoebahistolytica*.

(b) Biological Method: The vector in this case becomes infected with the pathogen when it feeds on the body fluid of an infected person or animal. The pathogen develops and multiplies in the body of the vector which then infects a healthy person when it goes to feed. Thus part of the pathogen's life cycle takes place in the body of the vector. Examples of such vectors and the pathogen they carry are;
(i) Anopheles mosquito (female) carries plasmodium (protozoan) that causes malaria.
(ii) Tsetse fly carries Trypanosome (protozoan) which causes sleeping sickness (Trypanosomiasis).
(iii) Aedes mosquito carries a virus that causes yellow fever / dengue fever.

Tick; an ectoparasite



endoparasite
Life cycle of human blood fluke

Control of Vectors
Vectors can be controlled by;
(i) **Killing the vectors** e.g. by spraying with insecticides, use of traps and poisons for rats, etc.
(ii) **Use of larvicides** to kill larval stages.
(iii) **Clearing bushes** around houses.
(iv) **Destruction of breeding spots** e.g. stagnant water should be drained to prevent mosquitoes from breeding.
(v) **Use of drugs** to kill the micro-organism in the host.
(vi)**Keeping the environment clean** etc.

SUB-TOPIC 3: STUDENT'S HEALTH: MAINTENANCE OF GOOD HEALTH

Maintaining the health of students and the people in a community is the responsibility of the individuals, the community, the government and health organization. Ways of maintaining good public health include;

1. Proper observance of personal hygiene. Keep yourself and your environment clean.
2. Proper refuse disposal e.g. burning in incinerators, burying in sanitary landfills, etc.
3. Proper sewage disposal e.g. use of pit toilets and water-closet toilets.
4. Protection of water supply by boiling, filtration, addition of chlorine, storage in clean containers, etc.
5. Protection of food by keeping them in clean containers, boiling or cooking properly before eating, washing of fruits, vegetables and hands before eating, etc.
6. Health organizations such as United Nations Children's Education Fund (UNCICEF), World Health Organization (WHO), International Red Cross Society, etc. help to maintain the health of people in a country through their corporate activities.

ASSIGNMENT

1. Malaria is one of the most common diseases in the tropics. Explain clearly, how a bite from a mosquito can cause malaria.
2. Describe the functions of the following health organizations
(a) World Health Organization.
(b) United Nation Children's Fund (UNICEF)
(c) International Red Cross
3. Read on marine habitat.

TOPIC: AQUATIC HABITAT; Marine Habitat

CONTENT: 1. Characteristics of a marine habitat
2. The major zones
3. Distribution of the organisms in the habitat and their adaptive features.

Sub-Topic 1: MARINE HABITAT

An aquatic habitat is a body of water in which organisms live. Such organisms are called aquatic organisms e.g. fish, algae, crabs, etc.

There are three types of aquatic habitat namely,

1. the marine/salt water habitat;
2. the estuarine/brackish water habitat and
3. The freshwater habitat.

The marine habitat is a body of salty water.It is made up of the shore and open sea. Examples are the oceans and seas.

Characteristics of Marine Habitat

a. **High salinity**; about35.2 parts of salt per 1000 parts of water.
b. **High density** of about 1.028; this enables organisms float in it.
c. **Pressure increases with depth**.
d. It is the **largest of all habitats**. It occupies over 70% of Earth's total area.
e. There is **action of waves.**
f. **There is tide action** i.e. alternate rise and fall in level of sea water twice a day.
g. The **water is alkaline** with pH of 8.0 – 9.0 near the surface
h. Oxygen concentration decreases with depth.
i. Light penetration decreases with depth.
j. **Currents are always produced by winds** at the surface of the ocean.

Sub – Topic 2: MAJOR ZONES OF A MARINE HABITAT

It has two major zones
(i) Littoral zone
(ii) Bentic zone

I. LITTORAL ZONE (Continental shelf)

This zone is sub divided into:

a. splash zone
b. intertidal zone
c. sub-tidal zone

A. Splash zone: this zone is just above the high tide mark, and is wetted by the spray from breaking wave. It has occasional moisture since it is the area where water splashes when the waves break at the shore.

B. Intertidal Zone: This covers the shoreline between the high and low tides. The zone is covered with water during high tide and exposed to air during low tide. This happens twice daily. The zone is exposed to wave action and has high photosynthetic activities because of abundant sunlight.

C. **The Sub-tidal zone**: This is the zone that extends over the continental shelf to a depth of about 200metres. The zone experiences more variations in temperature, water turbulence, salinity and lightning more than any other zone. It is the main site of commercial fish harvest.Its high productivity is attributed to its richness in nutrients, a large part of it being in the lighted (photic) part of the ocean.

II. BENTHIC ZONE (Continental slope)

This zone is characterized by:

A. Benthic zone: This consists of the deep water that extends beyond the continental shelf, from about 500m to the very depths of the ocean. It has very low light penetration and low nutrients.
B. Pelagic or abyssal zone: this zone is about 3000m, and has low light penetration, high pressure, low photosynthetic activities and the primary production of food is by chemosynthesis.
C. Hadal or aphotic zone:it is the deepest zone, ranging from 7000m, The water is dark and cold, i.e no light penetration, and no photosynthetic activities.

Sub-Topic 3: DISTRIBUTION OF THE ORGANISMS IN THE HABITAT AND THEIR ADAPTIVE FEATURES

1. **Splash zone/Shore organisms**: On rocky shores, periwinkles and shore slaters are found in the area that water splashes when waves break (also called splash zone). Barnacles, oysters, mussels and limpets are found on the intertidal zone of the rocks. Anemones, sponges and seaweeds are found on sheltered parts of rocks. Sea urchins, sea cucumbers and seaweeds are found in rock crevices. Most of these organisms have adhesive structures so as to be able to withstand wave and tide action. Example;
(i) Sargassum(a seaweed) is attached to rocks by holdfasts.
(ii) Barnacles are cemented to the rocks
(iii) Limpets have feet with which they hold unto rocks.

Sandy shore organisms include starfish, ghost crabs, bivalves and annelids. Their major adaptation is to burrow into the sand so as to escape being washed away by waves and tides.
(i) The shell of the starfish prevents it from drying up and it has tube feet which enable it to hold onto rocks.
(ii) Periwinkles have lungs to breath and foot for attachment.
(iii) The ghost crab has gills for breathing in water and a spongy structure for breathing on land.
(iv) Crabs can burrow into the mud quickly to protect themselves against predators, strong waves and tides.

Star fish holding unto a rock.

Mussels in a tide pool.

2. Intertidal organisms: These include bivalves, mollusks, barnacles, anemones, worms, etc.
These organisms face the challenge of exposure and drying out. To overcome this;
(i) Barnacles, mollusks and worms on rocky areas withdraw into their shells or tubes which hold some water.
(ii) Bivalves have special feet for digging into the sand or mud.
3. Sub-tidal organisms: These include lobsters, crayfish and fishes like the sting ray and sole.
The sting ray's body is flattened from top to bottom and so it lives on the sea floor. The sole is also flat, it lies on its lower side and has both eyes on the upper side. These fishes lie buried in the sandy sea floor and hunt for small animals there.
The lobsters and crayfish have claws for seizing prey.

Crayfish

Lobster

4. Benthic organisms: These are mainly consumers and decomposers. Fishes that live in the deep sea are adapted to live under conditions of great pressure. Some have expandable mouths and stomachs for swallowing large prey. Most live on dead remains of organisms from surface waters above.
The open waters support planktons and nektons.
Planktons are microscopic organisms which float, drift or swim slowly on the surface waters. They include producers like diatoms and seaweeds and consumers such as protozoa, copepods, worms, larvae and mollusks. Adaptations of planktons that help them stay afloat include; oil globules inside the body; gas-filled external floats and bubble rafts; external spines and hair which (provide friction and prevent sinking).
Nektons are actively swimming animals e.g. fishes, whales, prawns and squids. Adaptive features of fishes include;
(i) a streamlined muscular body coupled with fins which help them move swiftly in water.
(ii) bony fishes have gas-filled swim bladders which help them to move to different depths in water.
(iii) Sharks and dogfish have the ability to retain urea in their body to cope with high salinity.
(iv) The herring take in salt water to maintain osmotic balance between their tissue fluids and the salt water.
(v) Some bony fishes possess salt secreting glands in their gills for osmoregulation.

ASSIGNMENT

1. Make a food chain with six of the organisms in a marine habitat.
2. Describe the structure of a named marine habitat.
3. From page 343 of the Modern Biology for Senior Sec. schools, draw the Zones of a marine habitat.

TOPIC: AQUATIC HABITAT : ESTUARINE HABITAT

CONTENT:

1. Characteristics of Estuarine Habitat,
2. Types of Estuary
3. Distribution of the plants and animals in estuarine habitat
4. Adaptive features of the plants and animals in the estuarine habitat.

Sub-Topic 1: CHARACTERISTICS OF ESTUARINE HABITAT:

An estuarine habitat is ecological zone where river and sea water meet, thus to establish brackish conditions. Brackish water has a salinity which fluctuates with the tides and the wet and dry seasons. It is neither salt water nor freshwater, but the intermediary between both. It occurs where freshwater interact with salt water.

Characteristics of Estuarine Habitat

Some characteristics of estuarine habitat include:

i. It has a fluctuating salinity
ii. It has Poor aerated substratum or saturated soil that lack oxygen.
iii. There is mild wave action.
iv. There is high and low tidal influence.
v. Soil erosion is prominent.
vi. It is exposed and prone to flood periodically.

Sub-Topic 2: TYPES OF ESTUARY

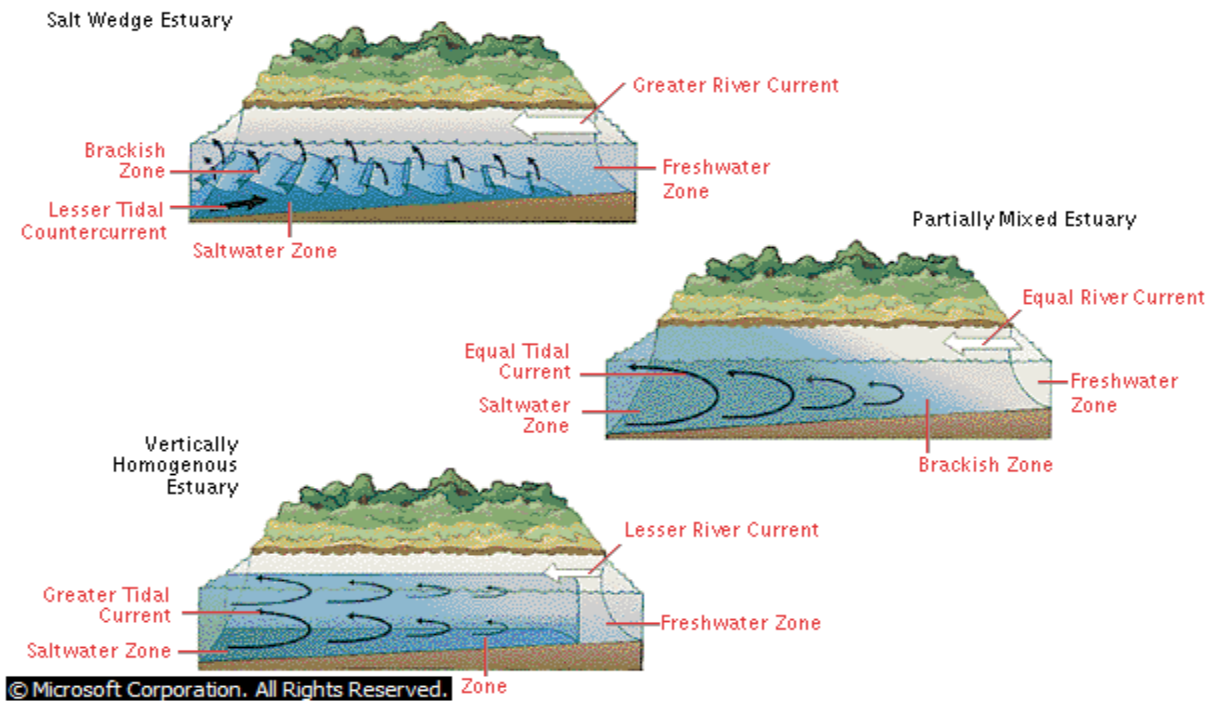
1. **Mashes**
2. **Deltas**
3. **Lagoons**
4. **Bay**
5. **Swamps**

1. **Mashes:** brackish water mash is usually found in intertidal areas which are periodically flooded and drained by the tides. They are especially common along the coastal areas near estuaries
2. **Deltas:**this is where a river divides into many channels before entering into oceans or sea.it is formed at the mouth of a river as it enters the sea.
3. **Lagoon:**a body of ocean water that enters into the land through a canal therefore has the opportunity of mixing with fresh water from rivers and streams.
4. **Bay:** it is a small body of sea water which enters into land and mixes up with fresh water from rivers and streams.
5. **Swamps:** a swamp is wetland with vegetation found in temperate and tropical regions. Brackish water mash is usually found along coastal areas or intertidal areas which are periodically flooded and drained by the tides.

Types of Estuary based on salt mixing

We have the following:

a. Salt wedge estuary.
b. Vertically homogeneous estuary.
c. Partially mixed estuary.



Sub-Topic 3: DISTRIBUTION OF ORGANISMS IN AN ESTUARY
Plants: we have

a. **Red mangrove,Rhizophora sp.** which is the main species of flowering plant in the lagoons or estuaries**and**
b. **White mangrove, Avicennia sp. occur in areas of higher salinity and drier land than the red** plants.
c. **Plankton protists such as diatoms, and flamentous algae**.
d. **Fern plant,**Acrostilchumaureum (the only fern able to withstand salt water) **grows in this habitat, so also are**
e. **Numerous grasses (paspalum sp.)*Animals:***

a. **Invertebrates**: mitten crabs, starfish, arenicola, mudskipper, lancelet and barnacles. The animals commonly found in the estuaries or lagoons are those that can withstand salinity variations and they include the bloody clam, common lagoon crab, hermit crab, the hairy mangrove crab, the fiddler crab, cichlids, the prawns, Ethmalosa, Arins, and the grey mullet (Mugil).
b. **Birds**: such birds as the herons, waders and palm nut vulture are found here.
c. **Mammals** include bats and monkeys.

Sub-Topic 4:ADAPTATIONS OF ESTUARINE ORGANISMS
PLANTS:
White mangrove has **breathing roots** to permit intake of atmospheric air and their **leaves can excrete salts**.
The **red mangrove** has **still roots to enable it to withstand strong ocean winds**
To ensure development of the seedlings and to avoid being swept off by ocean current, **some seeds germinate on the parent plant**.
ANIMALS:
Crabs have **air-breathing lungs-like structures** for breathing.
Starfish have **tube feet to hold fast**.
Barnacles and starfishhave shell- like covering to protect them from drying up.

Food Chain in Estuarine Habitat
1. Diatoms → Smalfish → Shark → Man. →

2. Detritus → Shrimp → Fish → Bird. → →

WEEK 6
TOPIC: FRESHWATER HABITAT AND TERRESTRIAL MASH
Sub-Topic 1: CHARACERISTICS OF FRESHWATER HABITAT
The freshwater habitat includes the lakes, ponds, streams, springs, and rivers. These water bodies are known for low salt content or low salinity. The animals and plants in freshwater habitat vary from the ones in the estuarine habitat. This is due to the salinity factor.
Some characteristics of freshwater habitat include:

1. It has low salt content.
2. Relatively small body of water.
3. The water is shallow.
4. Its temperature varies with depth and season.
5. Low density water.
6. Turbidity depends on season.
7. There is available oxygen in all parts of water but more at the surface.
8. Freshwater habitat accommodates bony fishes like tilapia.

TYPES OF FRESHWATER
Freshwater is divided into two broad types:

1. **Stagnant water (lentic):** pools, pond, puddles, and lakes.
2. **Running water(lotic)**: Springs, streams, and rivers.

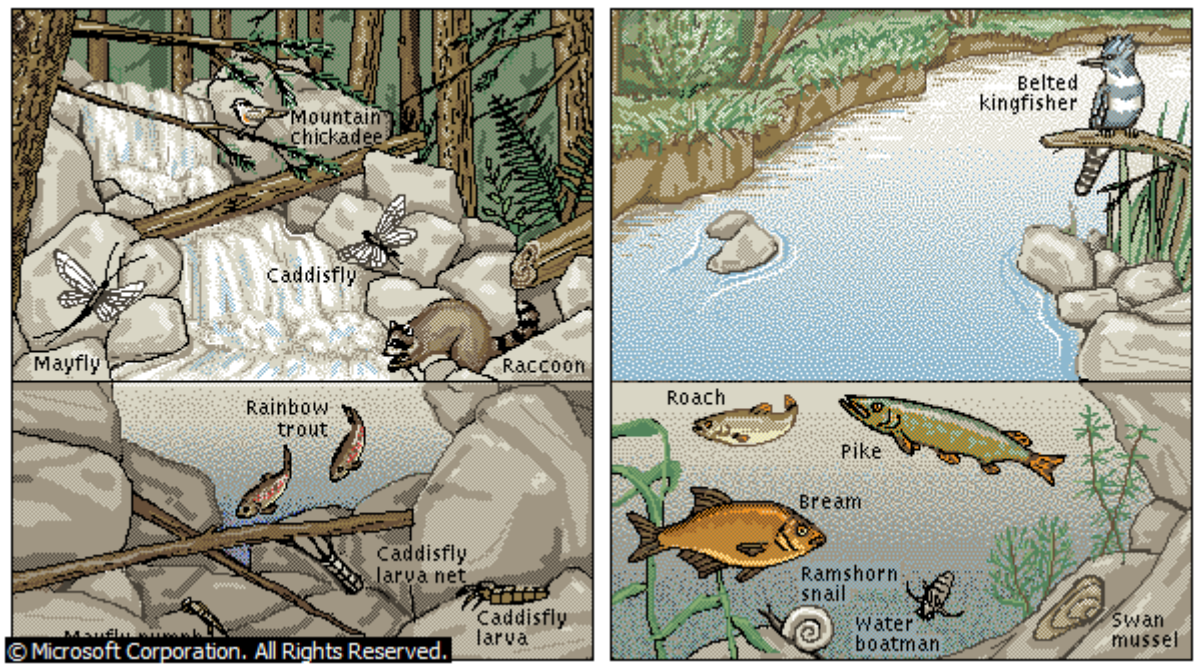
Sub-Topic 2: FRESH WATER ORGANISM

Zones in FreshWater Habitat
In freshwater habitat, four major zones are considered:

1. The edge of the water.
2. Water surface.
3. Body of water.
4. Bottom of water.

Fresh Water Organism
Some organisms in freshwater habitat include:

PLANTS: grasses, raffia palm, algae, bamboos, sedges, water lettuce, duckweed, microscopic plankton, water hyacinth, submerged plants such as phytoplankton(algae), ceratophylum, , bacteria, water lilies, spirogyra, hornwort and bladderwort.
ANIMALS: crabs, water snails, dragon flies, water snakes, toads, frogs, mosquito larvae/pupae, water scorpion, tadpoles, water bugs, diving beetles, fishes such as tilapia, flatworms, insect larvae, molluscs, worms, copepods, water skaters, water beetles, mud fish and cat fish, planarian, and dragonfly nymph.



Stream Life

Adaptation of Organisms to Fresh Water

Those features of organisms which structurally, physiologically, and behaviorally fit them for life in their particular habitats and improve their chances of survival are known as adaptations. They are adapted to the environment in the following ways:

1. **Some animals attach to stationary objects by adhesive structures** like **suckers** (leech), foot (water snail) and hooked claws (mayfly nymph).
2. **Most submerged water plants have extensive parenchyma** with large air spaces which **enable oxygen to diffuse to all parts of the plants during photosynthesis.**
3. **Crustaceans** use **antennal gland as osmo-regulatory organ**.
4. The **lung fishes (protopterus) use gills for respiration** but when the water dries up, they dig into the mud and breathe with lungs until the rains.
5. The presence of **chloroplasts even in the epidermal cells of leaves and stems of submerged plants** for photosynthesis.
6. A **streamlined body is typical of many animals from insect larvae to fish** for swimming
7. **Roots are shorter and less branched**, while **rootless are devoid of root hairs** for support.
8. **Submerged plants absorb water and nutrients directly due to lack of cuticle**.

Pond and Lake Life

Still water, in general are much warmer than rivers and streams, and can support many different kinds of plant and animal life. The silty bed of ponds and the shallower parts of lakes support rooted plants and burrowing larva, food for free-swimming animals such as fish and frogs. In deeper zones, where oxygen is less abundant, only animals adapted to the cold environment exist. Plankton develops at all levels.

SUB-TOPIC3: TERRESTRIAL HABITAT- MARSH

Marshland is a treeless land in which the water table is at, above, or just below the surface of the ground; it is dominated by grasses, reeds, sedges, and cattails. These plants typify emergent vegetation, which has its roots in soil covered or saturated with water and its leaves held above water.

Marshes may be freshwater or salt. Freshwater marshes develop along the shallow margins of lakes and slow-moving rivers, forming when ponds and lakes become filled with sediment. Salt marshes occur on coastal tidal flats. Inland salt marshes occupy the edges of saline lakes. The nature of a marsh—its plant composition, species richness, and productivity—is strongly influenced by its relationship to surrounding ecosystems. They affect the supply of nutrients, the movement of water, and the type and deposition of sediment.

In the prairie pothole country of glaciated central North America, freshwater marshes undergo a cyclic renewal that is induced by periodic drought and dependent on the feeding habits of muskrats. The cycle begins with a nearly dry marsh in which seeds of aquatic plants germinate in the mud. When the marsh fills, the aquatic plants grow densely. Muskrats eat large areas of the emergent vegetation, creating patches of open water. This causes the shallow-water emergent to decline, but the submerged and floating species persist. When the next drought comes, the cycle begins again.

IMPORTANCE

Freshwater marshes provide nesting and wintering habitats for waterfowl and shorebirds, muskrats, frogs, and many aquatic insects (*see* Freshwater Life). Salt marshes are wintering grounds for snow geese and ducks, a nesting habitat for herons and rails, and a source of nutrients for estuarine waters (*see* Estuary). Marshes are important in flood control, in sustaining high-water tables, and as settling basins to reduce pollution downstream. Despite their great environmental value, marshes are continually being destroyed by drainage and filling.

Characteristics of Marshland

i. Marshes are low-lying wetlands covered under shallow waters for long periods of time.
ii. They are usually formed in lowlands and plains near lakes and creeks, river banks or river mouths where water drainage is poor.
iii. They consist of grass-like vegetations which is able to grow in a waterlogged soil.
iv. Due to abundance of nutrients and mineral present in the water, marshes are breeding and nursing grounds for wide variety of organisms.
v. The relative humidity in the atmosphere over the habitat is usually high.
vi. The water bodies usually contain much decaying organic matter.
vii. The decay of organic matter takes place on a large scale in a marsh and this causes a decrease in the oxygen content of the water. Under the mainly anaerobic conditions in the water or soil, foul smelling gases may be produced in which hydrogen sulphide and methane may be present. The products of this decomposition change the chemical properties of the marsh. For instance, some marshes are very strongly acidic.

TYPES OF MARSHES

Marshes may be either *saltwater* or *freshwater* marshes. In Nigeria, salt water marshes are found along the Atlantic coast, which is influenced by the tides. Usually, freshwater flowing down the river, which empty into the sea, mixes with tidal sea water in the estuaries, creeks and lagoons. However, in the dry season, the volume of river water is relatively small, and large in the rainy season.

Freshwater marshes occur inland, just beyond the limits of the saltwater marshes and beyond the areas influenced by tides. In this zone, only the freshwater of the rivers overflows the river banks to flood the adjoining lowland, forming freshwater marshes.

PLANTS AND ANIMALS IN THE MARSHES

Plants found in saltwater marshes include various grasses and also algae that float on the water surface. Major animals include mangrove crab, lagoon crab, hermit crab, mudskipper fish, bloody calm (Arcasenillis), oysters, barnacles and angel-fish.

Freshwater marshes also have floating plants in standing water like algae, water lettuce, Lemna and Salvinia (water arum), various ferns and varieties of sword grass. The animals include frogs and toads, as well as fishes and birds that wade into the water to feed on fish for example, the heron.

ADAPTIVE FEATURES OF PLANTS AND ANIMALS IN MARSHES

The varying condition of the marsh makes the organisms ready to adapt to all kinds of condition:

a. A soft muddy bottom that provides little support and anchorage;
b. Low oxygen levels or an anaerobic environment in the soil;
c. High salinity in salt marshes and
d. Change in water levels due to the ebb and flow of tides.

Animals

a. Invertebrates such as clams, shellfishes, shrimps and oysters;
b. Reptiles like the salt marsh snakes and diamondback turtles;
c. Amphibians such as frogs and salamanders;
d. Birds like the great blue herons and clapper rails and
e. Mammals such as muskrats, racoons, rabbits, and river otters.

TOPIC: TERRESTRIAL HABITAT – FOREST,GRASSLAND AND ARID LANDS

CONTENTS:

1. **FOREST.**
   i. Characteristics of forest
   ii. Strata in a rain forest
   iii. Distribution of organisms in a forest

iv. Adaption of plants and animals in a forest.

2. GRASSLAND

i. Characteristics of grassland
ii. Distribution of plants and animals in grassland
iii. Some adaptation of grassland communities

3. ARID LAND

i. Characteristics of arid lands
ii. Types of arid lands
iii. Distribution of the organisms to arid Lands
iv. Some adaptation of organisms to Arid lands

1. FOREST

A forest is a plant community in which tree species are dominant. There are different kinds of forests, whose distribution is determined mainly by climate (particularly rainfall and temperature), but sometimes by elevation, soil factors and the activities of man, such as farming lumbering, cutting of firewood, bush burning, road construction and building construction. Forest used to cover most of southern Nigeria but the area covered by forest has been reduced by human activity. The rain forest is the major type of forest in Nigeria.

CHARACTERISTICS OF THE TROPICAL RAIN FOREST

i. The forest is rich in epiphytes and climbers.
ii. The interior of the forest has high humidity, low light intensity and damp floor.
iii. Tall trees with canopy strata.
iv. Trees are mesophytes with broad leaves.
v. Leaves of all trees have long drip tips to facilitate dripping off of water.
vi. The vegetation has a pattern of arrangement in storeys or layers.
vii. The forest floor is usually open with little vegetation.
viii. There is usually a large amount of leaf litter on the forest floor
ix. Leaves of all trees have long drip tips to facilitate dripping off of water.
x. Rainfall is usually very high.

STRATA IN A RAIN FOREST

The plants in a forest may be classified into five storeys or layers which are briefly described as follows:

1. The Emergent layer
2. The Upper layer
3. The Middle layer
The lower layer
4. The Ground layer/forest floor

1. **The Emergent Layer:**This is the topmost layer or storey made up of the tallest trees, over 40m tall, called emergents. The crowns of the emergents do not normally touch one another.
2. **The Upper Layer:** this is the second storey or layer and is made up of tall trees, between 20m and 40m tall. Their crowns touch, forming **a continuous canopy** below the emergents.
3. **The Middle Layer:** The third layer is made up of small trees, less than 20m tall, which also form a continuous canopy below the second or upper storey.
4. **The Lower Layer:** Below the third layer of trees is the shrub layer.
5. **The Ground Layer/forest floor:** the ground layer consists of shade-tolerant plants, including mosses and ferns.

DITRIBUTION OF PLANTS AND ANIMALS IN THE RAIN FOREST

Plants: Plants such as Mahogany, Mango trees, Coconut trees, Oil palm, Orchids Ferns and herbs.

Animals: There are Birds, Squirrels, Snakes, Toads and Snails.

ADAPTIVE FEATURES OF TROPICAL RAINFOREST ORGANISMS

Plants (Morphological features)

1. Trees have broad leaves to increase rates of transpiration or gaseous exchange of leaves pointed to increases exposure to sunlight.
2. Leaves have pointed draw-out tips, for easy dripping of water or to prevent growth of fungi or algae underneath.
3. Trees have thin back, to facilitate transpiration or gaseous exchange.
4. Plants with twining stems, for climbing up to source of light.
5. Presence of hydathodes, for guttations etc.

Animals: These include animals with gasping pads, e.g. tree frogs, grasping scales, e.g. snakes, the ability to fly, e.g. birds, ability to jump, e.g. monkeys.

SUB TOPIC 2: GRASS LAND

Grasslands are areas where the vegetation is dominated by grasses and other herbaceous plants. In West Africa, savannah vegetation is about the most important types of vegetation. In Nigeria, over 80% of the vegetation is one type of savannah or another.

CHARACTERISTICS OF GRASSLAND

1. The savanna vegetation is typified by tall grasses and scattered trees and shrubs. The species of grasses in the sudan and sahel savannah are annuals which often have cylindrical leaves to reduce transportation. During the dry season, the leaves of the grass turn yellow and die but the roots remain dormant. The grasses are deciduous.
2. Savannah trees have thick barks which protect them from the effect of fire. Most of the trees are deciduous; they shed their leaves in dry season to reduce loss of water by transpiration and because of annual fire. The trees have long roots (e.g. acacia) to search to search for ground water.
3. Savannah vegetation is usually not as luxuriant as the forest vegetation. This is because the trees are fewer, smaller in structure and scattered within the savannah habitat.
4. The annual burning and fire in the savanna reduce the quality of the humus in the soil, while the ash retains some minerals salts which are washed into the soil during rains.
5. Rainfall is usually moderate (1000 -1500 min per year) distributed over 6 to 8 months of the year. The dry season is longer in the savanna than the forest region.
6. Savannah soil is usually sandy, shallow of relative lower fertility than the forest soils.
7. Dry seasons bush fires and livestock grazing are common in the tropical savannah.

DISTRIBUTION OF PLANTS AND ANIMALS IN GRASSLANDS

Grass is the dominant vegetation of the savanna. These shrubs and herbs are scattered in the savanna while grasses cover the soil within them. In the guinea savanna are broad leaved trees, while further north in the sudan and sahel savanna the trees are more scattered and shorter. There are thorny trees with narrow leaves- to reduce transpiration and withstand the prolonged drought.
Palms which cannot withstand the drought are restricted to the wettest area or along the rivers.

Tropical savanna is the home of wild animals. The animals population include herbivores like caterpillars, grasshoppers and birds which feed on grass seeds, grazing animals like cows, goats, sheep and wild herbivores like antelope, deer, elephant, giraffe and okapi.
Carnivores include lion tiger, leopard panter, jacka; and cheetah. Along the rivers and marshy lakes are several species of reptiles such as alligators, crocodiles, giant and monitor lizards; and mammals such as hippopotamus and rhinoceros. There are also numerous species of birds, butterflies, moth and other insects.

SOME ADAPTATION OF GRASSLAND COMMUNITIES

The main adaptations of savanna animals include the following:

i. Adaptation for drought which include burrowing into the ground by animals such as the rats and building of well ventilated terminals by termites.
ii. Adaptations such as sharp claw and teeth of the carnivores for catching their prey; and fast movement to catch them.
iii. Sharp vision, sharp hearing and fast movement of prey to escape from the predators and living together in groups or herd to ensure protection for their members.

The main adaptations of the savanna plants include the following:

1. Adaptation of savanna plants for drought include shedding of leaves, possession of tiny leaves with highly reduced surface area, possession of thick cuticle over the leaf surface and reduction in the number of stomata on the leaves. Many plants possess underground stem through which tides them over the drought period.
2. Adaptation of savanna plants for annual fire include: the thick and cropybarts of thewoody plants, possession of fire – restricted twigs; rapid regeneration shortly after fires by suckering and coppicing, possession of various methods of regeneration vegetative after fires by herbs. This is by the use of organs such as bulbs, tubers, corms and rhizomes, which are buried below. The plants also produce numerous seeds which can remain buried in the soil and sprout quickly during the rains.

SUB-TOPIC 3: ARID LAND

Arid lands are places of water scarcity or where water remains frozen. Tropical hot desert is known for excessive heat and inadequate rainfall resulting in dryness. In the cold deserts the soil is frozen for most of the year. The heat of the sun is so weak that the ice does not melt in many places. As a result water is not available for plant use.

CHARACTERISTICS OF ARID LANDS

i. They are characterised by very little rainfall which is very irregular in distribution, therefore water is very and shortly supply.
ii. The temperatures are usually in the extreme, very high in the day time and very low in the night time.
iii. Atmospheric humidity is very low.
iv. Sunshine is very intense and penetrating in the hot deserts.
v. The mean annual evaporation is very high.
vi. The environment is naturally very windy.
vii. They have very scanty vegetation
viii. The ground may in many places have sand dunes.

The tundra is covered with ice in most periods of the year.

TYPES OF ARID LANDS

Arid are terrestrial habitats without water. There are two types of these arid lands.

i. Hot and dry deserts: here the temperature is usually as high as 80%. These include the hot deserts of the world such as Sahara desert of North Africa, Kalahari and Namib desert of Peru in south America.
ii. Cold and frozen desert: they have very low temperature of below 0^0 during winter. The top soil is frozen all the year round and the long winter lasts about 9 months annually. Cold desert include Gobi desert in china, the Pantagonian desert of south America, and the Tundra in Greenland and USSR.

DISTIBUTION OF ORGANISM IN ARID LANDS.

Very few plants survive in the arid lands and include the cactus family, grasses and thorny shrubs. As soon as rain falls the seeds germinate and make food available for a short time for primary consumers. Grasses grow during the short wet periods.

Fewer animals live under vegetable litters or branches, leaves and trunk of trees and shrubs while many more live in burrows in the soil. Among the primary consumers are bettles, larvae of insects, ants, grasshoppers and small animals like rodents. They feed partly on seeds and partly on dry remains of desert vegetation. Higher – order consumers are centipedes and scorpions. The predators are carnivores such as lizards, geckos, vipers and spiders.

SOME ADAPTATION OF ORGANISMS TO ARID LANDS.

The adaptation of plants and animals in arid lands are similar to those exhibited by the savanna plants and animals to survive drought and high temperatures. Many of the arid land plants also have their modified into scales or thorns. Some such as cactus also store water. The carmel is an example of arid land animal which can go about for a long time without water.

ADAPTIVE FEATURES OF PLANTS IN ARID LAND

Plants that are adapted to dry habitat are called Xerotypes. They possess the following characteristics.

i. Elongated, slender, branching and roots capable of penetrating great depths.
ii. Possession of water storage tissue in their stem.
iii. Possession of adaptive features such as waxy leaves with thick waterproof cuticle, sunken stomata covered with air and thick layer over stems and roots which help to reduce transpiration.

ADAPTIVE FEATURES OF ANIMALS IN ARID LANDS ARE:

i. Body covering is dry and impermeable to water
ii. Engaged in burrowing during the day and are active at night to avoid daytime heat.
iii. Possession of excretory system that reabsorb water efficiently and only excrete concentrated urine and faeces.
iv. Possession of mechanisms of reducing water lost with exhaled air.
v. Possession of fringed feet and toes to enhance walking on loose sand.
vi. Possession sand coloured body to aid camouflage and to remain undetected by predators.
vii. Examples of animals in arid lands include camels, Lizards, snakes, locust, birds, fox, antelopes and jerboa.

WEEK 9

TOPIC: REPRODUCTION IN UNICELLULAR ORGANISMS AND INVERTEBRATES

CONTENT:

1. **Reproduction in Amoeba by Asexual Reproduction by**

SUB – TOPIC1: REPRODUCTION IN AMOEBA

Amoeba is a unicellular protozoa. Its mode of reproduction is asexual by fission and multiple fission.

Binary Fission

It occurs under normal condition in water when the organism grows to a particular size, the nucleus divides into two equal daughter nucleus divides nuclei and each of the daughter nuclei become enclosed by half of the protoplast leading to the production of two daughter cells. The cell division is simply mitotic.

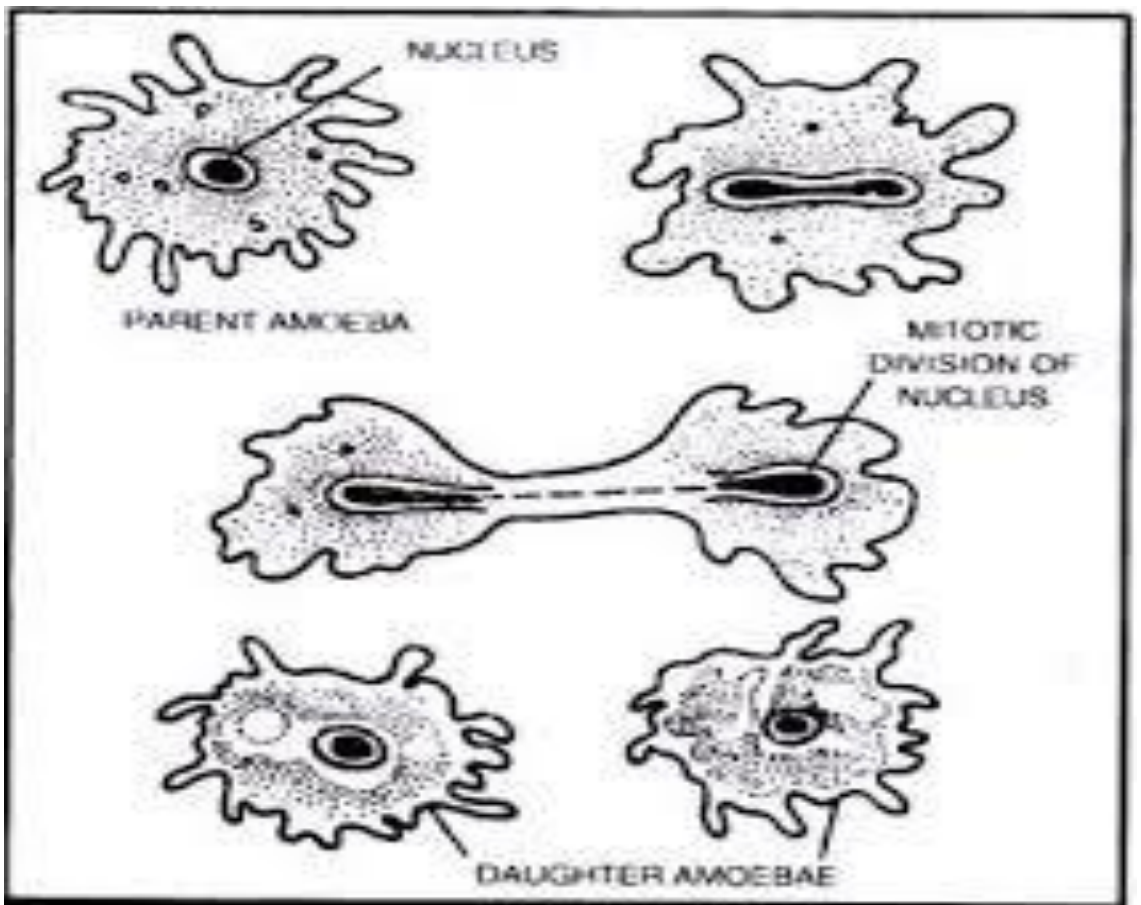
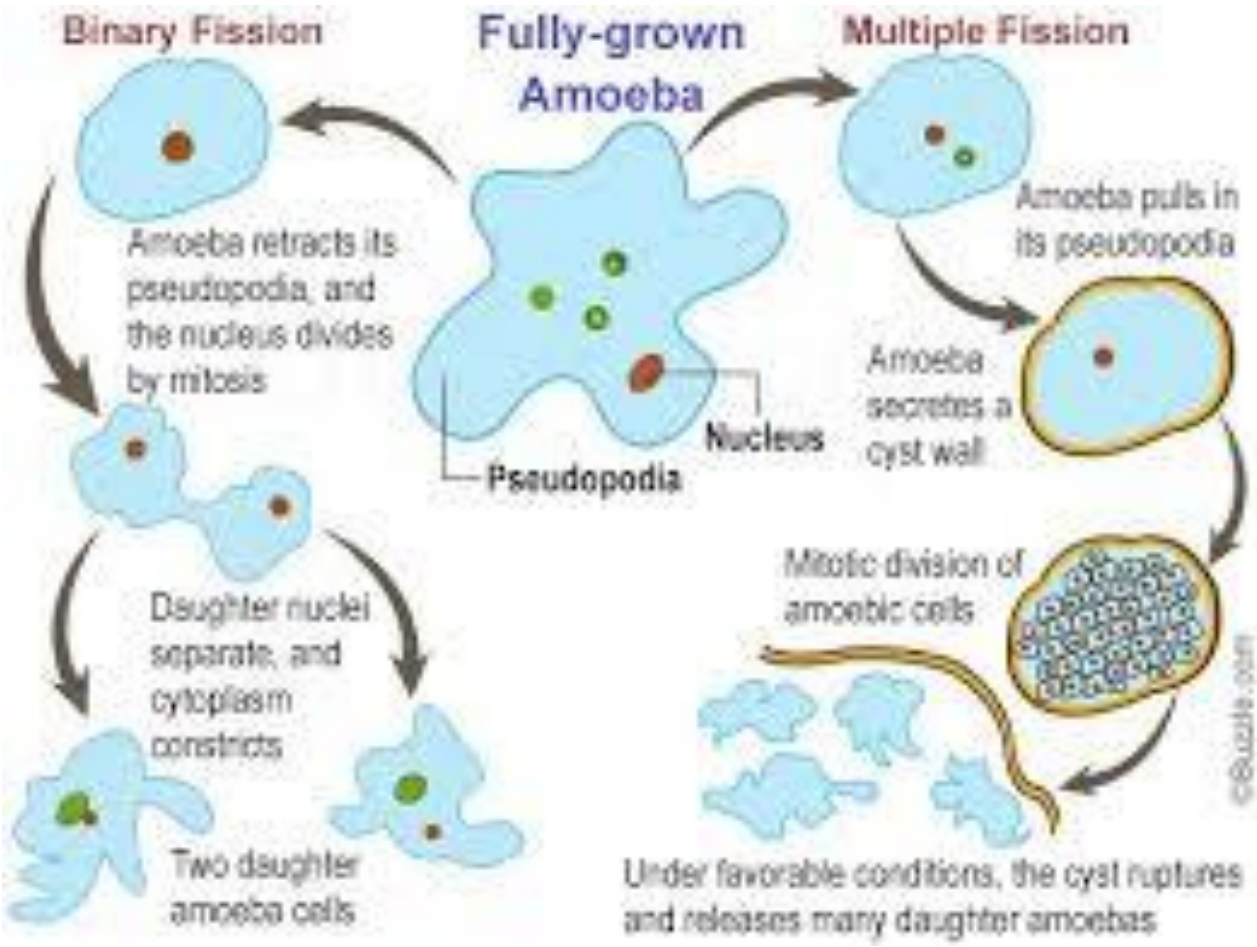


Fig. 3(A).1 Simple Binary Fission in *Amoeba*

Diagram of binary fission in amoeba

Multiple fission

In some unicellular organisms such as Amoeba, the cells rounds up to a cyst-like structure. The protoplasm undergo fission as the nucleus of the parent divides into several daughter nuclei by amitosis (repeated divisions). This is followed by the enclosing one nucleus. Several cells are released from the cyst. The type of asexual reproduction occurs under adverse condition.



A diagram showing binary and multiple fission in amoeba

SUB-TOPIC 2 : REPRODUCTION IN PARAMECIUM

Paramecium is a protozoa that is more developed than Amoeba. It reproduces both sexually and asexually. Asexual reproduction is by binary fission and sexual reproduction is by conjugation.

(a) Binary fission in paramecium

At maturity the cell stops moving. The two nuclei (macro nucleus and micro nucleus divide mitotically to give four nuclei). This is followed by the movement of the daughter nuclei in opposite direction to the anterior and posterior ends respectively, of a now elongated cell. After this the cell divides transversely along the region of the oral groove and the daughter cells become separated under normal condition this occurs after 8 to 12 hours.

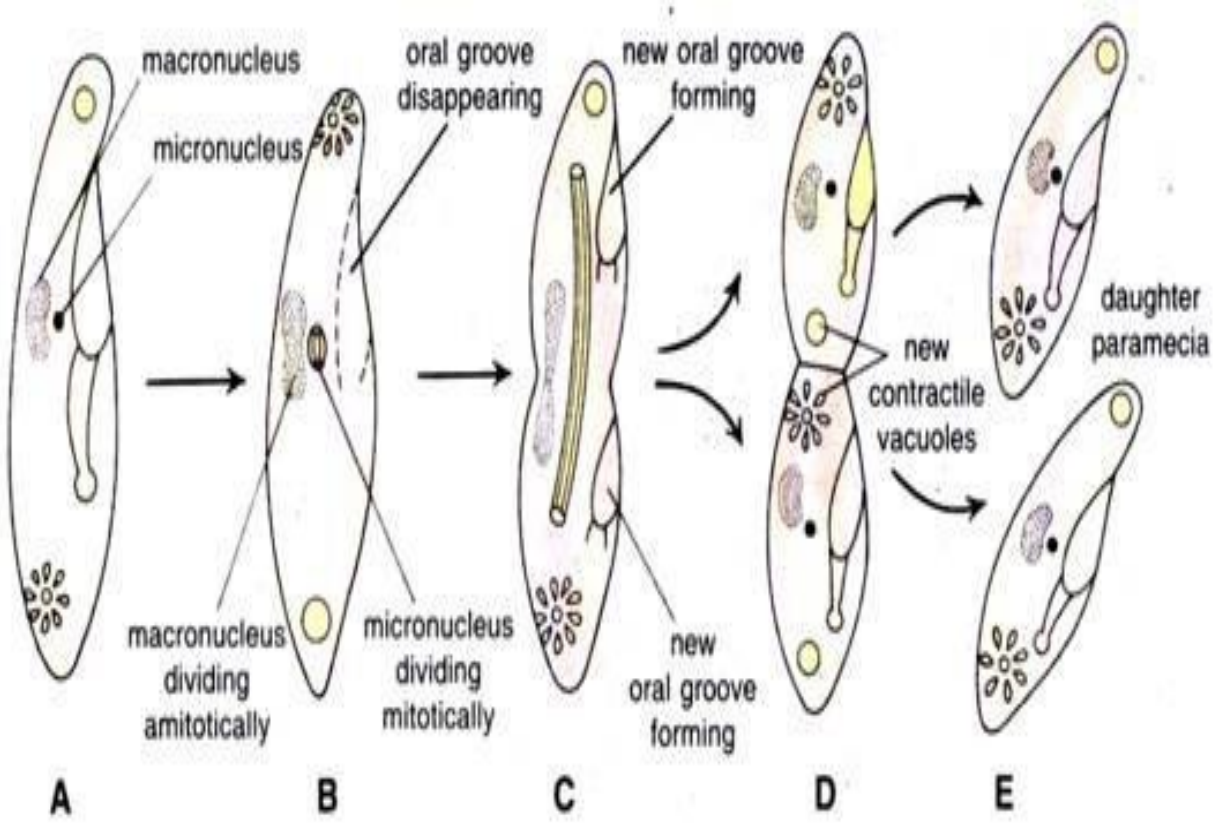


Fig. 20.20. *Paramecium caudatum.* Binary fission.

Sexual reproduction in Paramecium

Sexual reproduction by conjugation takes in Paramecium in the following steps:

1. Two individuals called conjugant come together and lie side by side.
2. The meganucleus of each conjugants disintegrate.
3. The micronucleus of each conjugants divides into two parts twice, forming four micronuclei. Three of the four micro – nuclei in each conjugant disintegrate. The remaining micronucleus again divides into two.
4. One micronucleus from each conjugal migrates into the other conjugant. In other words, the conjugants exchange nuclear material.
5. The migratory nucleus of one conjugant and the stationary nucleus of the other conjugant fuse in each individual to form a fusion nucleus in each ex-conjugal divides into four new individuals, each with a new
6. The fusion nucleus in each ex-conjugant divides into four individuals each, with a new meganucleus and micronucleus.

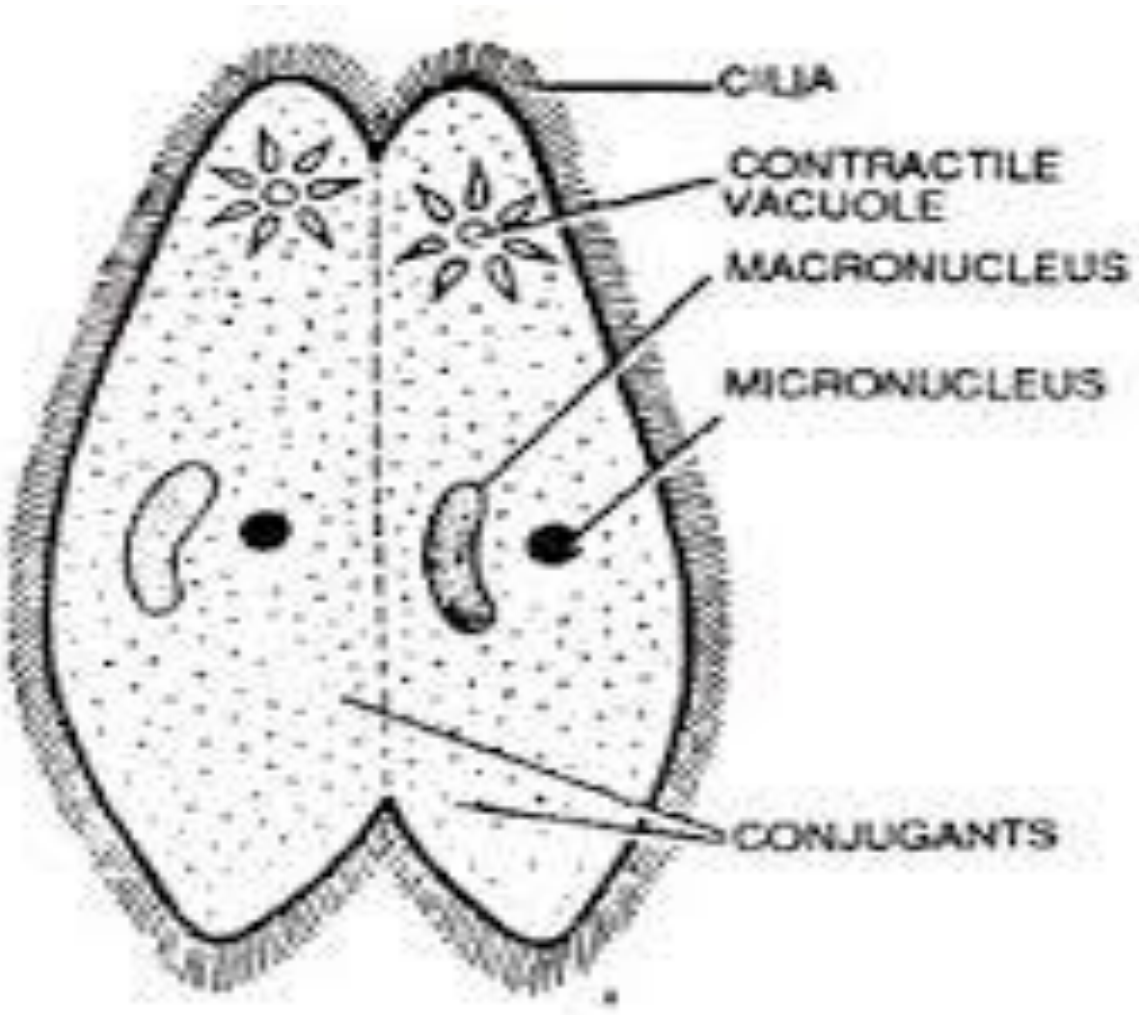
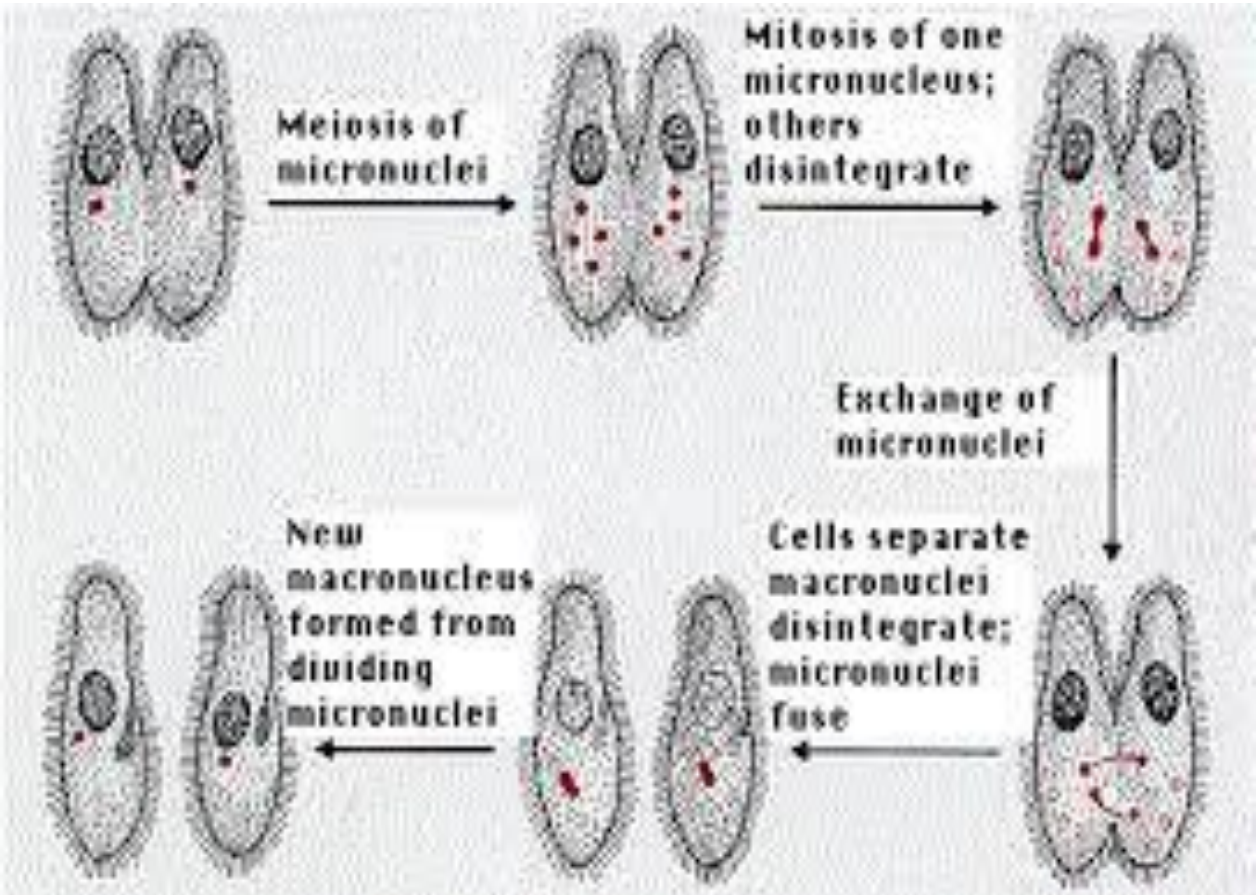


Fig. 82 PARAMAECIUM IN CONJUGATION

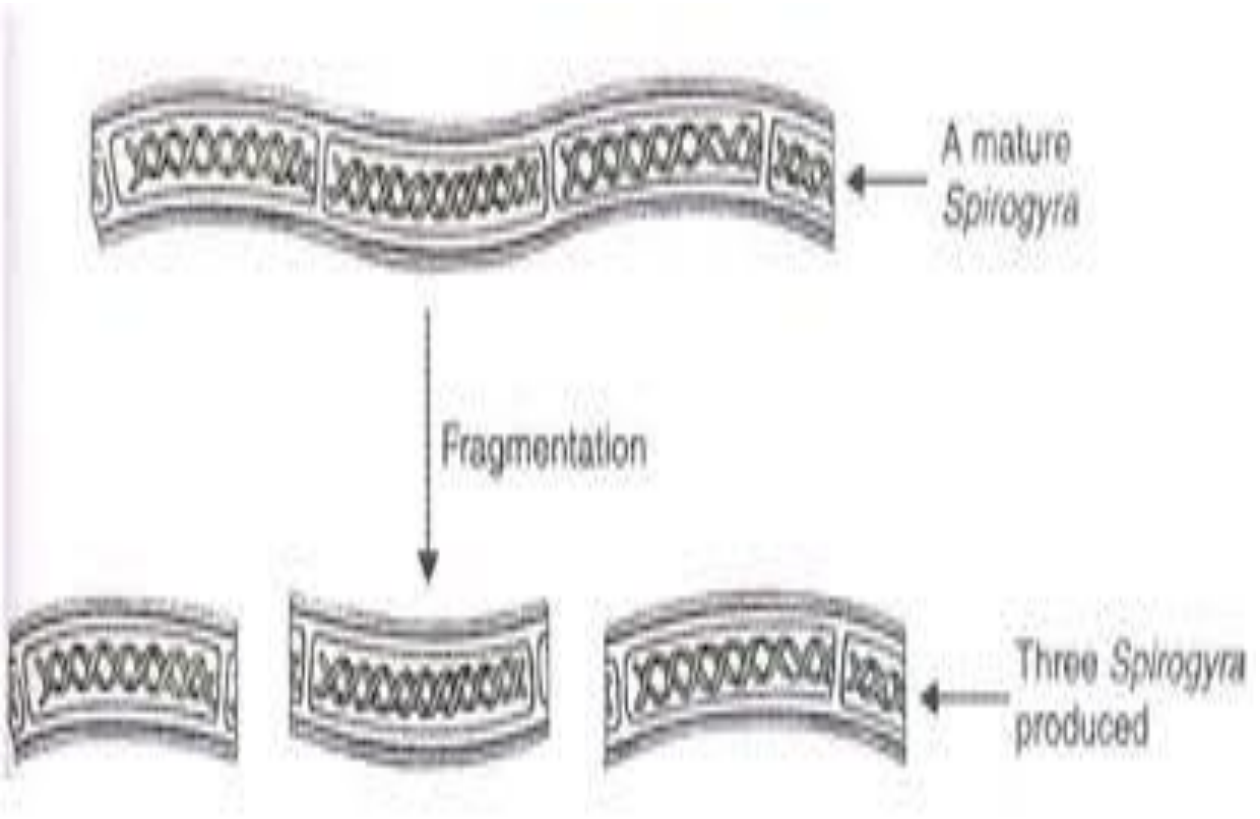


Stages in conjugation in paramecium

SUB-TOPIC 3: REPRODUCTION IN SPYROGYRA

Spirogyra is a filamentous algae. It reproduces asexually by conjugation.

1. **Asexual reproduction in spirogyra:** fragmentation under ideal condition of food, sunlight and water a mature filament of spirogyra simply breaks into pieces. Each fragment forms a new filament.



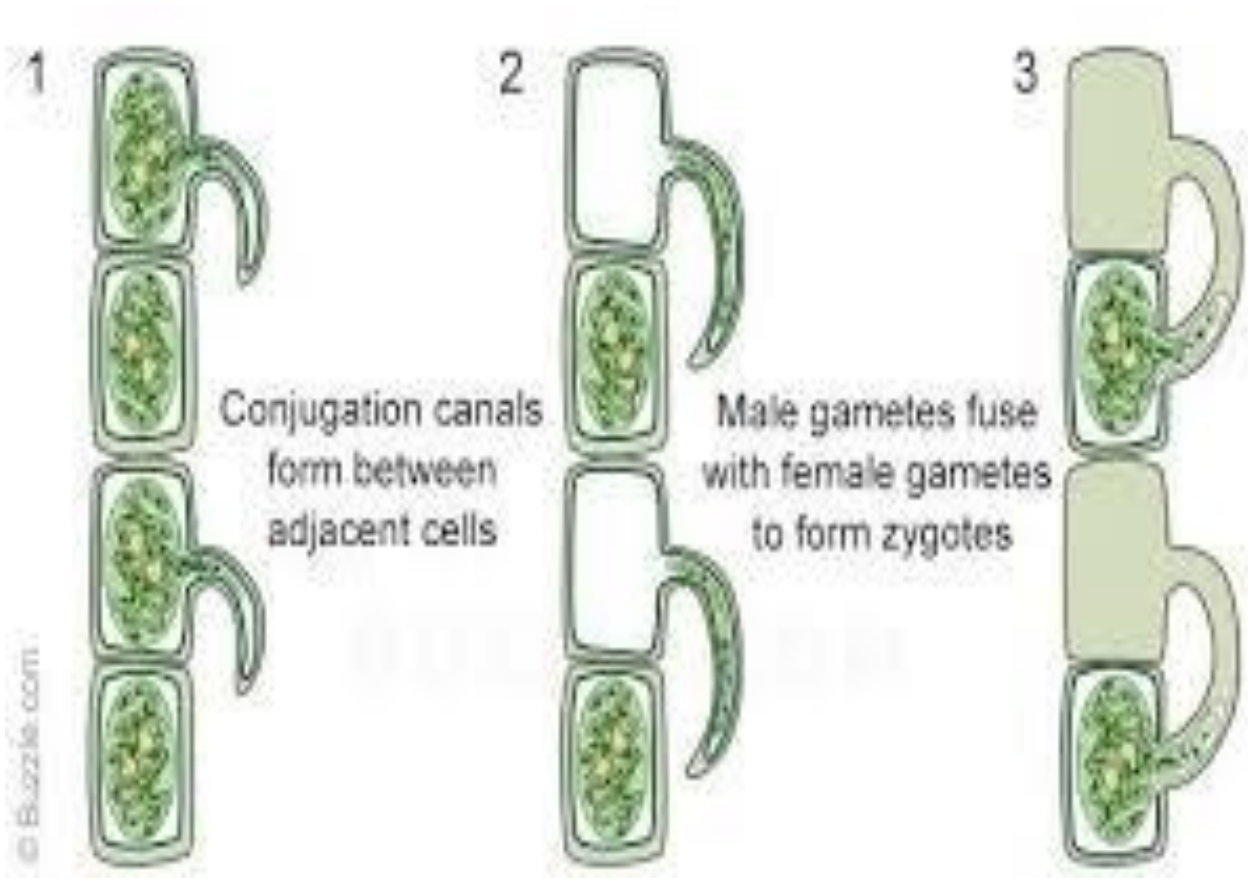
Fragmentation in spirogyra

2. **Sexual reproduction in spirogyra**: there are two types of sexual reproduction in spirogyra. These are: lateral conjugation and scalariform conjugation.

a. **Scalariform conjugation**: in this, two filaments lie side by side, particularly or fullyalong their lengths. One cell from each filament produces tubular protuberances called conjugation tubes. These elongated and fuse to form conjugation canal. The mobile cytoplasm (male cytoplasm) moves through the canal and fuses with the cytoplasm of the other filament. The gametes in both fuses to form a zygospore. The zygospore germinates and forms a new filament.

Scalariform conjugation in spirogyra

b. **Lateral conjugation:** conjugation occurs between two adjacent cells on the same filament. Two common adjoining cells near their common transverse wall produce protuberances called conjugation tubes, which further form conjugation canal upon contact. The male cytoplasm migrates through the conjugation canal, fuses with the female. This union produces a zygospore. Each zygospores germinates and forms a new filament.



Lateral conjugation in spirogyra

SUB-TOPIC 4: REPRODUCTION IN EARTHWORM

Earthworms are hermaphrodites. Each earthworm has both tests and ovaries. The sexual organs and their ducts are paired on each side of the worms' body.

Sexual reproduction in Earthworm

Copulation usually occurs only at night. Two copulating earthworms lie head to tail and side by side. In this way the clitellia secrete a mucus tube that surrounds the worm from before the reproductive segment to the clitellia segments. Sperms receive from a partner worm is stored in the spermathecal openings and then the two worms separate. Both secret a new mucus tube that is enriched with album from the clitellum and wrapped in a membrane.the eggs are shed into this tube along with some sperm. The worm then backs out of the tube which now becomes the egg cocoon. Fertilization occurs inside the cocoon. The cocoon is left there, underground to attach to some leaves. It often changes shape. Becoming darker small and harder, the fertilised egg grows into a tiny earthworm.

Copulation in earthworm

parent earthworm and cocoon

Earthworm in cocoons

Parent earthworm and emerging earthworms

Emerged earthworm

CLASS: SS1

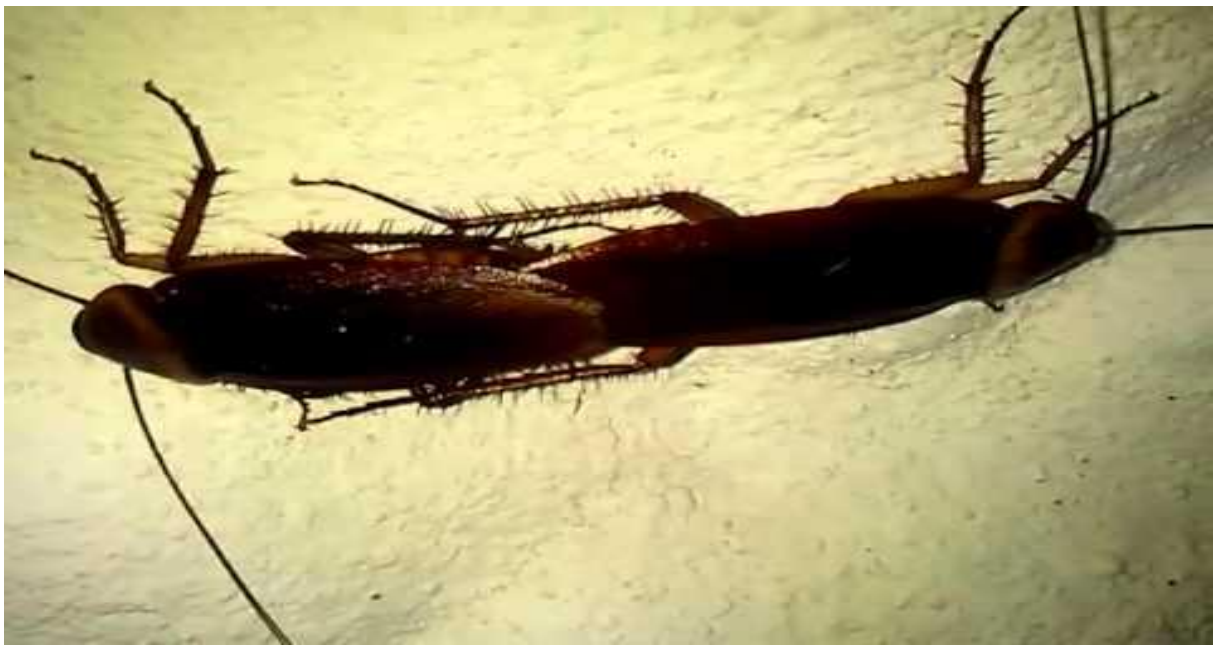
TOPIC: REPRODUCTION IN INVERTEBRATES

1. **REPRODUCTION IN COCKROACH**

Reproduction in cockroach is sexual. The process occurs as follows:

1. Male and female mate. Sperm cells from the male are stored in a pouch on the 7th abdominal segment of the female cockroach. This pouch is called Spermatheca.

2. Fertilisation occurs in pouch.
3. Spermatheca (Sperm pouch) forms the egg case called Ootheca. Ootheca contains between 10-16 eggs.
4. Ootheca is carried about by the female between its two hind legs for a number of days.
5. Female eventually deposit Ootheca containing the fertilised eggs in a suitable place like dark cornear of a cupboard for incubation.
6. Incubation period is about 30 days. At the end of incubation, the eggs hatch to give small ones that are similar to the adult except for the absence of wings, small size and pale colour. This small cockroach is called Nymph. Nymph moults a number of times to get to a full grown cockroach.



Cockroaches Mating

Ootheca between the hind legs

Ootheca of a cockroach

Emerging nymph

Emerging nymph

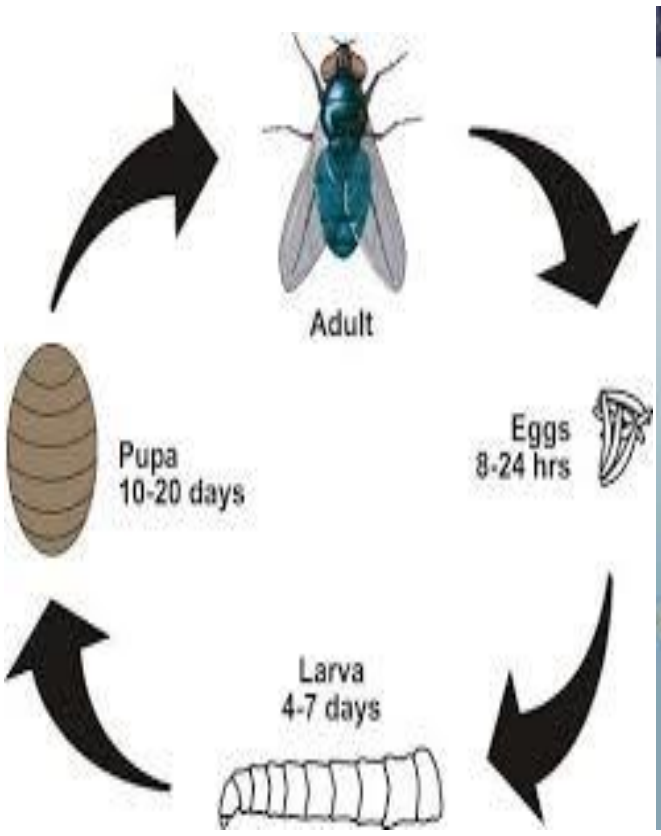
Emerged nymph

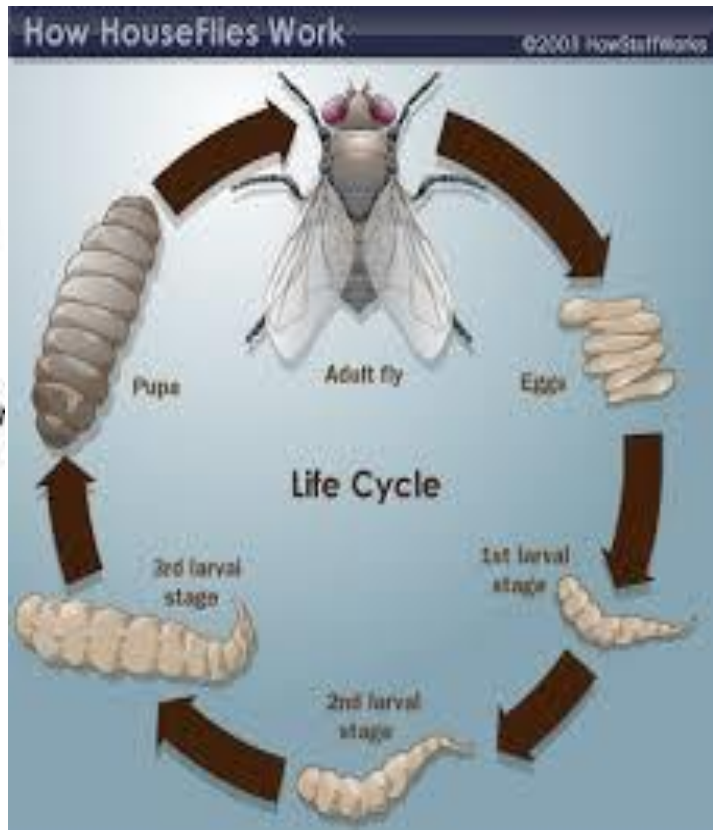
Nymph and Adult cockroaches

2. REPRODUCTION IN HOUSEFLY

Housefly reproduces sexually, fertilisation is internal and it undergo Complete Metamorphosis Mating occur between adult male and female housefly. Sperms mature before the eggs thus sperms are stored in sperm sacs until eggs are matured for fertilisation.

Mating in housefly





Life cycle of a housefly

STAGES OF DEVELOPMENT AND IN HOUSEFLY

1. <u>Egg stage</u>: after mating and fertilization, eggs are laid in batches of about 100 – 150 eggs.

2. <u>Larva stage:</u>under favourable conditions, eggs hatch after about 24 hours into larva. Another name for larva is maggot. Maggots are cylindrical in shape; they are layer towards the anterior region and have 12 segments. At this stage, the maggot (Larva) has two spiracles, one on the 2^{nd} segment and the other on the 12^{th} segment for respiring. It has a mouth on the first segment which has a hook. Larvae grow very fast and start moulting two days after hatching from the egg. Ventral pads for movement are located on the 8^{th}, 9^{th}, 10^{th} segments of the larva. The larva moults twice before metamorphosing into a pupa.

3. <u>Pupa</u>: By covering itself with a case known as pupa case after 3 moulting the larva changes into a Pupa. Pupa is barrel-shaped and inactive. The cylindrical shape of the larva shortens and burrows into the soil. The skin hardens up and twin dark brown. Within 3-5 days under favourable conditions, the pupa hatches to give a young housefly. Cold weather however could delay hatching.

4. <u>Imago or young adult</u>: fully formed adult emerges from the pupa is the pupa case breaks open out of decaying matter. The imago step for a few houses on a spot for its wings to dry up, harden and expand and flies off in search of food.

Housefly laying its eggs

Eggs laid in batches

Larval form(maggot) of a housefly

Pupal stage of a housefly

3. REPRODUCTION IN SNAILS:

Terrestrials snails are hermaphrodites, a few aquatic species have separate sexes. However, self-fertilization does not occur. Mating occurs and fertilization is internal.

To replace, two matured snails pair up to inseminate each other. Each member produces a special structure called spermatophore. The spermatophore is pushed into the partner's body thereby transferring sperm cells into the sperm pouch of each other each partner's egg are then fertilised with the sperm cells from the copulating partner when each is ready to lay eggs. Eggs are laid in shallow top soil while

the weather is warm and damp. After about 2-4 weeks, the eggs hatch and the young ones emerge. Snails are prolific breeders. They can lay up to 100 eggs in a single breed and can lay eggs once every mouth.

Mating in snail

WEEK 11---------- REVISION
WEEK 12 ----------EXAMINATION