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Class: Class 11
Subject. Biology

# Cell - Biology

(1.) Various endoplasmic reticulum.
→ # Rough Endoplasmic reticulum:-
→ with ribosomes attached throughout the surface
→ active in cells where there is active protein synthesis.
→ mainly made up of cisternae
→ near nuclear membrane(found)
→ ~~mod~~believed to be formed form nuclear membran
# Smooth Endoplasmic reticulum(SER
→ without ribosomes
→ lipid synthesis
→ detoxification of harmful chemical in liver cells.
→ mainly made up of tubules
→ near plasma membrane
→ modified from RER due to loss of ribosom

(2) Significance of meiosis:-
→ helps to maintain a constant numb of chromosomes by reducing the number of chromosomes in gametes.
→ Crossing over brings genetic variations in offspring which helps in evolution of organisms.
→ helps in formation of gametes an spores for sexual reproduction.

→ (n, n) → 2n → ∞

→ → genes exchange - variation

→ Essential for sexually reproducing organisms at the time of gamete formation or for alternation of generation.

| # | Cycloplasm | Nucleoplasm |
|---|---|---|
| → | Mass of protoplasm excluding nucleus | → Mass present inside nucleus |
| → | surrounded by plasma membrane. | → surrounded by nuclear membrane. |
| → | do no carry genetic information | → carries genetic information. |
| → | Cyclosis occurs | → does n't occur. |

# Mitochondria

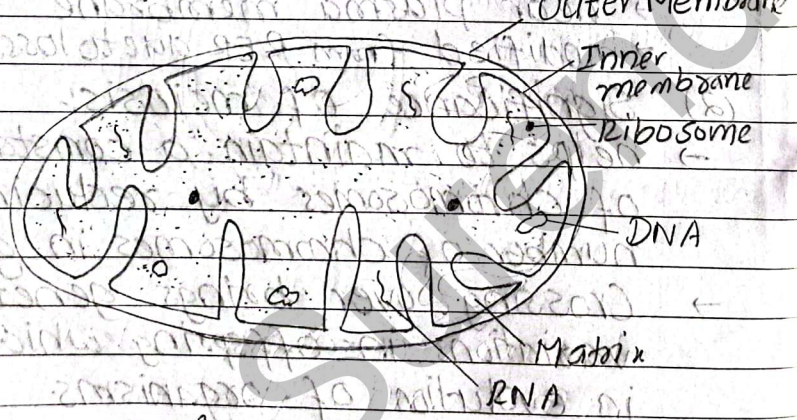



Fig: Mitochondria

Mitochondria

is Double membrane bound cytoplasmic organnel having smooth outer membrane and infolded inner membrane with matrix including DNA, RNA, Ribosome, protein, etc.

→ helps in formation of haeme of haemoglobin

→ Inner membrane associated with Kreb's cycle in aerobic respiration.

→ Store and release energy in the form of ATP. So, called power house of cell.

→ Semi-autonomous - synthesize enzymes required for its functioning.

→ Yolk of egg formation in oogenesis

→ Middle part of Spearm formation during Spermatogenesis.

# Golgi bodies

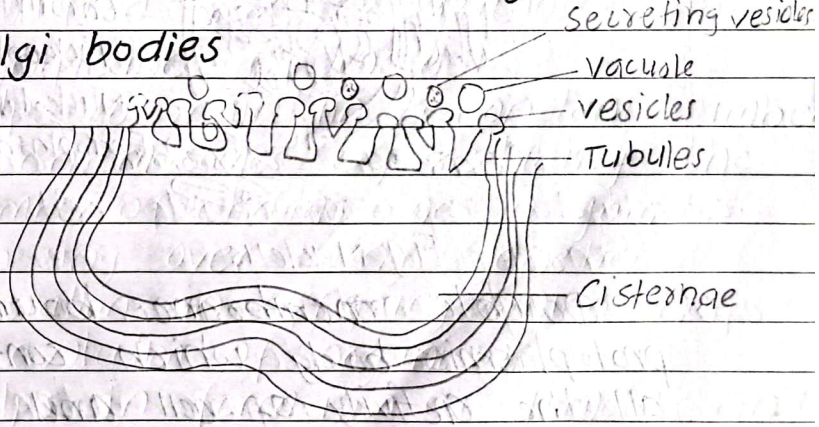



Fig: Golgi bodies

→ helps during hormone synthesis
Complex cell organnel made up of smooth cisternae with which has tubules containing vesicles and vacuoles which help in membrane transformation and secretion of complex bio-chemical.
→ Formation of glycoprotein and glycolipid
→ Transforms membrane of ER into ~~protoplast~~ plasma membrane
→ Secretes gum, mucus, tears, saliva, etc.
→ Storage, packaging and transportation of various substances.
→ ~~vesicles~~ produces lysosomes.
→ Associated with packaging and transporting various substances within the cells
#

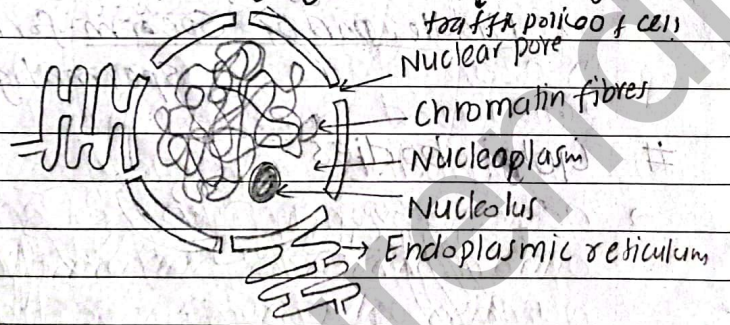



Fig: Nucleus

Double membrane bound protoplasmic body which controls all the activity of cell and helps in transmitting genetic information.

→ controls cellular metabolism.
→ helps in genetic transformation.
→ forms spindle fibres during cell division.
→ controls growth and development of organism.
→ protein synthesis, RNA synthesis.

# Chloroplast

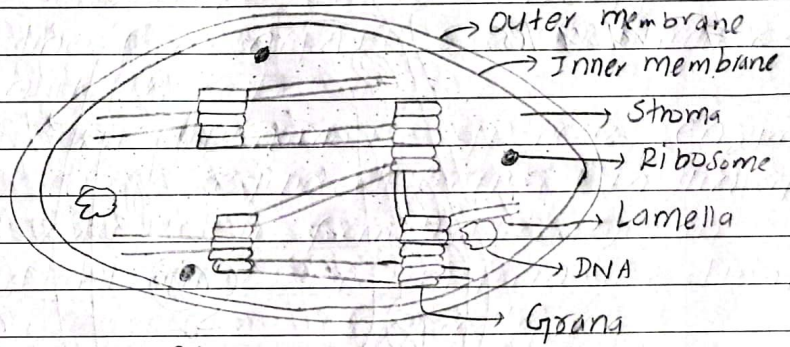
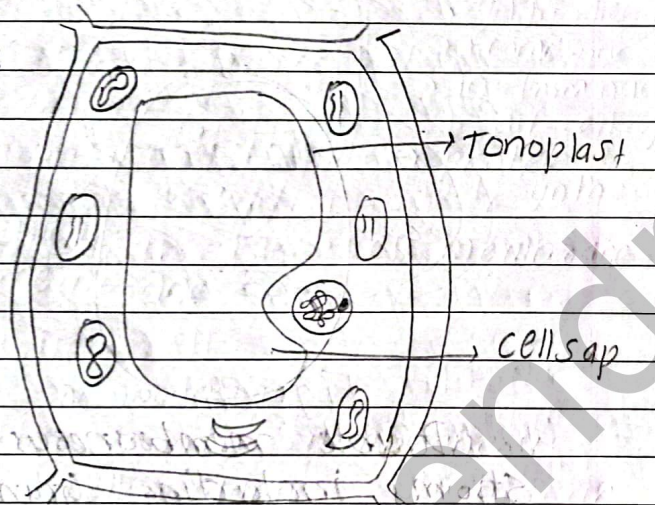



Fig: Chloroplast

Double membraneous containing stroma including Grana, lamella, DNA, ribosome, etc.
Double membrane bound discoid shaped ~~cell or~~ photo cell organell which contains photosynthetic pigments for providing green colour to the plant.

→ provides green colour to the plant
→ changes into chromoplast and gives different colour to plant for attracting pollinators.
→ Evolves $O_2$ during photosynthesis and helps in balancing $O_2$ in environment.

# Vacuoles:

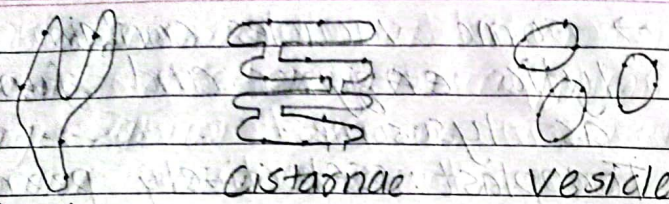



→ Membrane covered semi-fluidic spaces inside cell.
Functions:-
→ Storage: water, minerals, enzymes, pigments, etc.
→ helps in osmotic potential maintaining
→ some vacuoles contain hydrolytic enzymes and function as lysosomes.
Tonoplast: selectively permeable membrane of vacuole which is made-up of lipo-protein.
Cell sap: Fluid inside a vacuole which contains variety of dissolved substances and water.

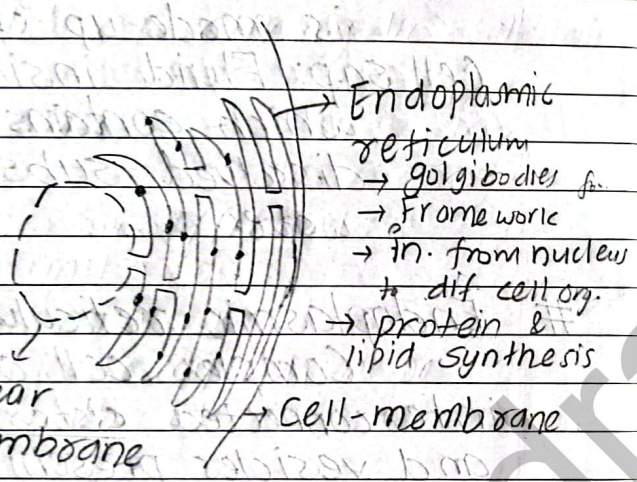
# Endoplasmic reticulum:-
Complex cell organel of interconnected cisternae, tubules and vesicles present throughout the cytoplasm.

Function:- → keeps cell organnels in fixed position
→ Skeletal framework - mechanical support.
→ helps in transporting materials in cell.
→ Transfer of information from nucleus to various cell organnels.
→ formation of golgi bodies.
→ helps in formation of plasma membrane.

→ Mem. trans
→ secre.
→ lysis
→ sto., pac., trans. of var. substan



Tubules  Cisternae  Vesicles




# Plastid ~~membraneous~~
double smooth membraneous discoid v cell organnel which can shaped
store and synthesize various org. compounds like carbohydrate, lipids and proteins.

→ prevent global warming by reducing $CO_2$ concentration.
→ Chloroplast store starch temporarily.

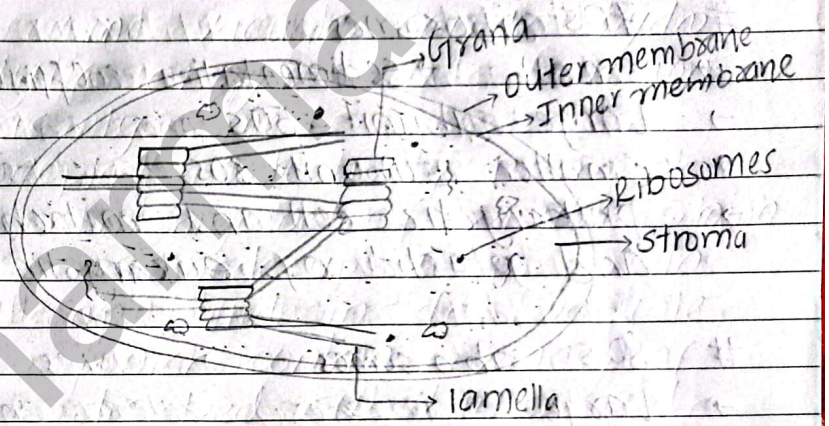



fig: Plastid

→ Chromoplast: attract insect & birds for pollination
→ provide colour to the plant
→ storage: Leucoplast
→ balance $O_2$ and $CO_2$ level
→ green colour → photosynthesis

| # Prokaryotic | Eukaryotic |
|---|---|
| → non-membrane bound organnels | → membrane bound organnels |
| → inciplent nucleus | → developed and membrane bound nucleus |
| → 70s Ribosome | → 80s Ribosomes |
| → asexual | → asexual or sexual |
| → amitosis | → mitosis or meiosis |

# 70S ribosomes
→ small → sedimentation coefficient = 70
→ Large subunit - 50S
→ Smaller subunit - 30S
→ prokaryotic cell and mitochandria and plastid of eukaryotic cell.

# 80S ribosomes
→ Large
→ sedimentation coefficient = 80
→ Large sub-unit → 60S
→ Small sub-unit → 40S
→ Eukaryotic cell's cytoplasm. or bounded with ER.

# Eukaryotic cell

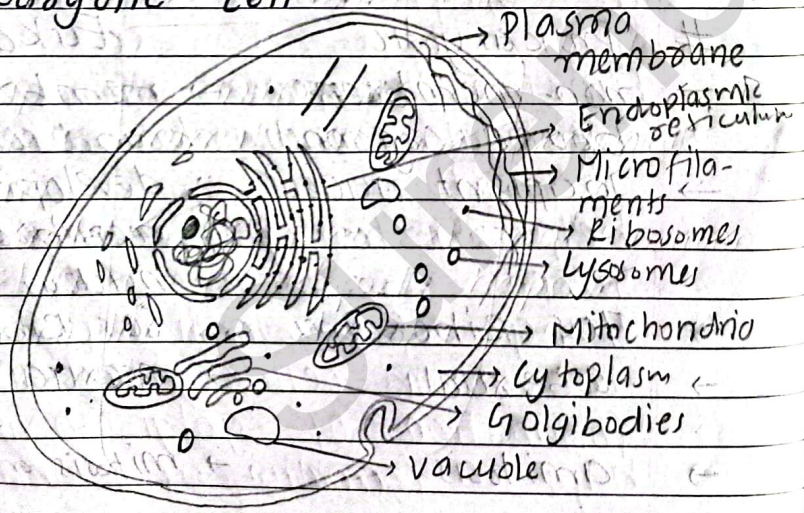



Fig:- Eukaryotic cell
→ ~~Incipient nucleus~~
→ membrane bound organnels
→ developed nucleus/True nucleus
→ DNA organized with histone protein
→ 80S Ribosome
→ sexual reproduction
→ mitosis and meiosis
→ Respiration: mitochondria

# Chromosomes:-

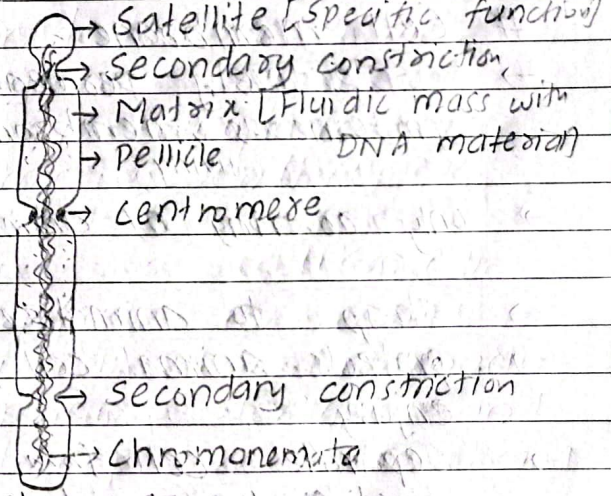



Fig: Chromosome

Functions:
→ Carry genetic information
→ responsible for growth
→ cellular metabolism

| # Plastid | Mitochondria |
|---|---|
| → both membrane are smooth | → Outer: Smooth<br>Inner: Infolded. |
| → cristae is absent | → cristae is present. |
| → provides colour to plant | → cellular respiration |
| → does not store and release energy in form of ATP | → stores and releases energy in the form of ATP. |

# Cell membrane

→ selectively permeable ~~memb~~ lipoproteineous membrane.
living

→ only covering of animal cell.

→ Shape to animal cell

→ protects animal cell from mechanical injury

→ separate cell from external environment

→ modified pseudopodia helps in locomotion in Amoeba.

# Mitosis Cell Division

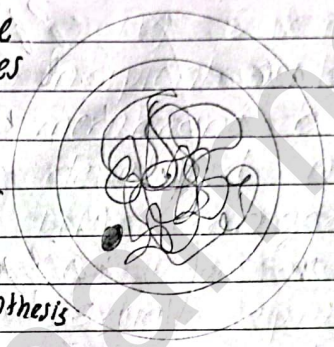
## * Interphase

→ cell-size increases

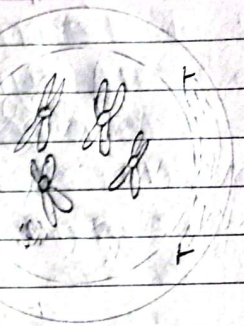
→ size of nucleolus increases

→ cell org. increases

→ DNA synthesis



## 1. Prophase



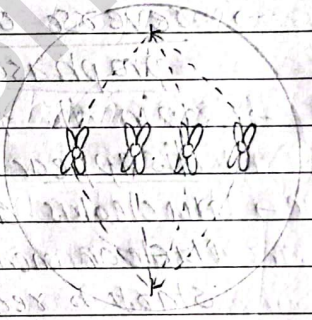
→ Chromatin fibres combined to form chromosome.

→ Chromosome thicken and become short
→ chromatid separate.

→ Nucleolus and Nuclear membrane starts to disappear.

→ At end of prophase, spindle fibres starts to appear and goes towards opposite pole.

## 2. Metaphase



→ Nucleolus and N.M completely disappear.

→ Chromosomes get alligned in the equatorial region forming metaphasic plate.

→ Spindle fibres gets attached to centromere.

## 3. Anaphase

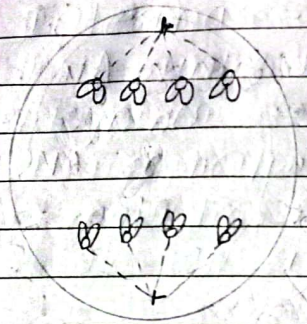


Fig: Anaphase

→ Spindle fibre contracts
→ chromosome gets separated from centromere; i.e centromere splits.
→ chromosome goes towards opposite ~~opte~~ pole
→ Chromosomes appear in the shape of I, V, V, L, I; on the basis of position of centromere

## 4. Telophase

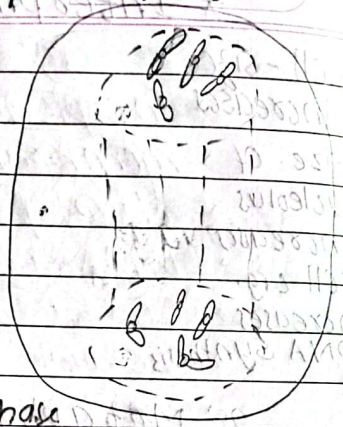


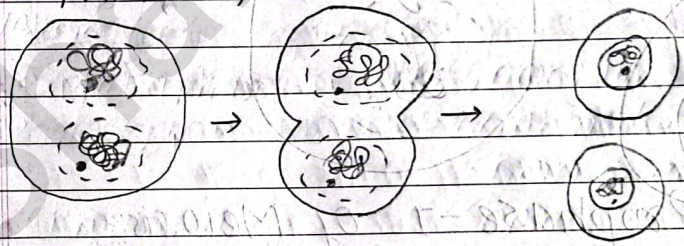
Fig: Telophase

→ reverse of prophase
→ spindle fibres disappear
→ Nucleolus and Nuclear membrane start to reappear
→ Chromosome begins to uncoil.

## # Cytokinesis

(1) Cell-cleavage method

In this method cytokinesis takes place by the constriction in the mother cell which finally divides mother cell into daughter cell having equal no. of chromosome as mother cell.



(2) Cell-Plate method

It is due to the deposition of spindle fibre, tubules of endoplasmic reticulum and golgi body to form middle lamella and primary cell-wall.

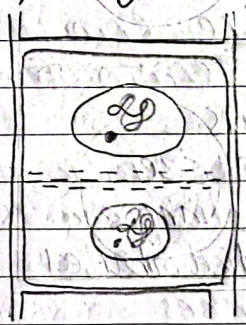


Fig:- Cell-Plate formation

## # Significance

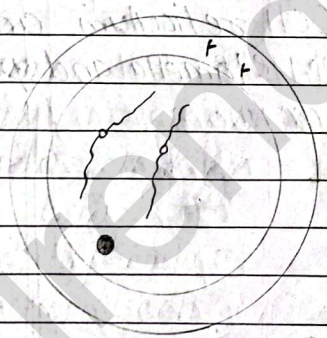
→ genetically identical cells are produced.
→ growth of organism
→ healing of wound
→ maintains no. of chromosomes in cell

Pachyte

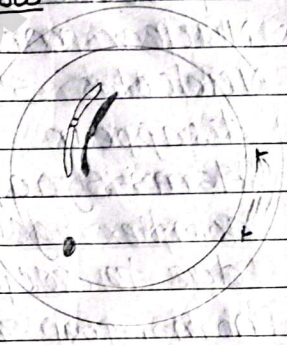
# Interphase
→ RNA synthesis, protein synthesis
→ DNA replication
→ & multiplication of cell organnels.

Prophase-I of Meiosis:-

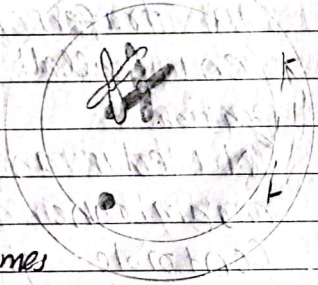
# ~~Pachytene~~ Leptotene (thin thread)
→ Nucleus and Nuclear membrane ictact
→ Chromosome are seen as thin thread like structure
→ ~~Chro~~ Nucleolus enlarges in size
→ Chromosomes are iregularly distributed.



# Zygotene (Paired thread)
→ Chromosome condenses and coils to become thicker thread
→ Nucleolus and Nuclear membrane intact
→ Homologous chromosomes come together to form homologous pair called synapsis (bivalent)



# Pachytene (Thick thread)
→ ~~Homologous pair come together to form bivalents~~
→ Further condensation takes place so that each chromosome has four chromatid; called tetrad
→ Non-sister chromatids of homologous chromosomes cross each other in multiple points and exchange their sections; known as crossing over.



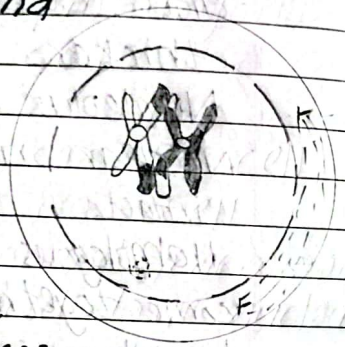
# Diplotene (Two threads)

→ Nuclear membrane and Nucleolus start to disappear.

→ ~~Homo~~ Synaptonemal complex gets broken due to repelling of homologous chromosomes.

→ Homologous chromosomes are arranged in the point of crossing over called chiasmata.

→ ~~Spindle fibre~~ Centriole move towards opposite pole.

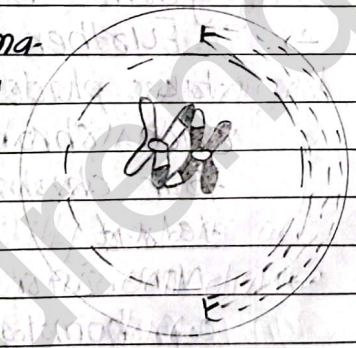


# Diakinesis (~~Esta~~ Across movement)

→ H.C. repel each other such the the chiasmata trafers to terminal end called terminalization.

→ Nucleolus and Nuclear membrane disappears

→ Centriole give rise to spindle fibres.



(A)

(a)→ The regenerative ability of vegetative cell of plant to develop into whole plant is called cellular totipotency.

(b)→ The streaming movement of cytoplasm in clockwise or anti-clockwise direction around vacuole is called cyclosis.

(c)→ Lysosomes is the cell organnels which is known as suicidal bag because under pathological condition or during starvation lysosomes feed on the cell organnels of the cell.

(d)→ The process of exchanging segments between non-sister chromatid of homologous chromosome also exchanging genetic information is called crossing over.

(f)→ There are two types of ER:-

(i) Smooth Endoplasmic reticulum (SER)

(ii) Rough endoplasmic reticulum (RER)

B.

(i) Difference between prokaryotic cell and eukaryotic cell:-

| Prokaryotic cell | Eukaryotic cell |
|---|---|
| (i) It do not have true nucleus i.e. it has incipient nucleus. | (i) It has well-organised membrane bound true nucleus. |
| (ii) It consist of 70s type of ribosomes. | (ii) It consist of 80s type of ribosomes. |
| (iii) It do not have membrane-bound cell organnels like mitochondria, plastid, etc. | (iii) It has membrane bound cell organnels in its cytoplasm. |
| (iv) DNA is not organised with histone protein. | (iv) DNA is organized with histone protein. |
| (v) Cell division occurs mostly by amitosis. | (v) Mostly mitosis or meiosis cell division takes place. |
| (vi) Respiration takes place through general cell surface. | (vi) Respiration takes place mostly in mitochondria. |

(ii) → Significances of mitosis cell-division:-

(i) It is the only method of reproduction in lower organisms.
(ii) It helps to maintain the number of chromosome constant in daughter cell as mother cell.
(iii) It helps in growth and development of organism.
(iv) It maintains the genetic identity in the cell.
(v) This daughter cell division helps in healing wounds cuts and injuries.
(vi) It helps in vegetative propagation.
(vii) It replaces old & woon out cells.

(iii) → Mitochondria:-

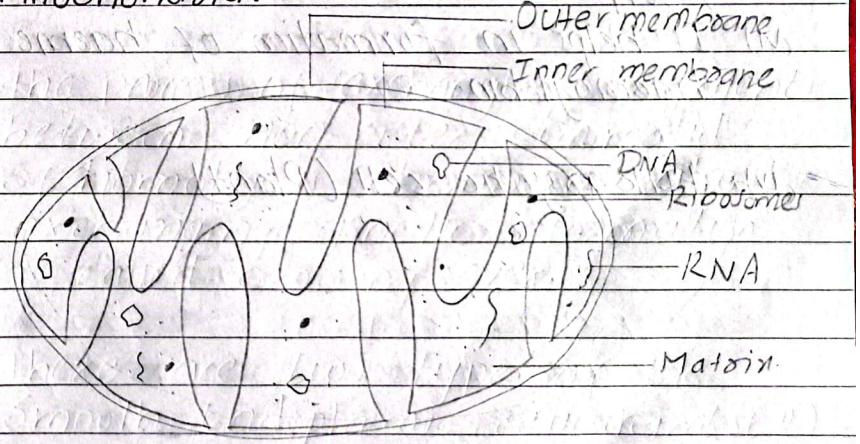



Fig: Mitochondria

Mitochondria is a double membrane bound cell organnels with smooth outer membrane and infolded inner membrane consisting DNA, RNA, ribosomes, protein, etc inside it.

Functions:

(i) It releases energy in the form of ATP. So called as power house of cell.
(ii) Inner membrane is associated with kreb's cycle.
(iii) It forms yolk of egg during oogenesis.
(iv) It forms middle part of the sperm.
(v) It is semi-autonomous cell organnels. it synthesises enzymes required for itself.
(vi) It helps in formation of haeme of haemoglobin.

(iv) Eukaryotic cell (Plant)

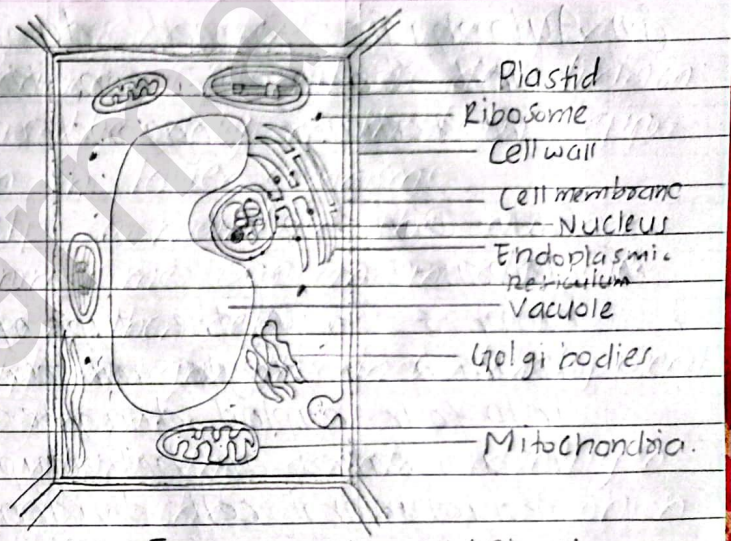



Fig: Eukaryotic cell (Plant)

# Lysosomes are membraneous vesicle containing digestive enzymes.

Types:

(i) Primary:- contains inactive hydrolytic enzymes; first formed lysosomes from Golgi apparatus. primary lysosome.
(ii) Secondary:- has digested partly active hydrolytic enzymes which help in digestion
(iii) Residual: Secondary lysosome containing undigested food which is thrown out by exocytosis.

(iv) Autophagic: formed during starvation and pathogenic condition; feeds on intracellular organnels.

Cell-Division

# Meiosis-I:-

~~Prophas~~ It is the type of cell division in which a single mother cell divide into four haploid daughter cell. So, it is also called as heterotypic or reductional cell division. It occurs in reproductive cell or germ cell.

* Prophase-I

It is the longest phase of meiotic cell division. It further consists of following five sub-stages:-

(i) Leptotene (thin thread)

→ The cell and nucleus size increases.

→ The chromosomes appear thread like and bear many bead like structure called chromomeres.

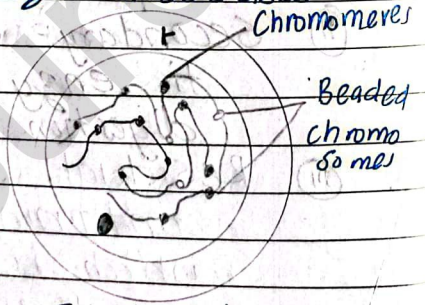



Fig: Leptotene

→ Nucleolus and nuclear membrane remains as it is.

→ This is also called bouquet stage (all chromosomes are pointed at the end).

(ii) Zygotene [paired thread]

→ The pairing of homologous chromosomes takes place (i.e. synapsis).

→ Pairing of homologous chromosome is due to synaptonemal complex (ribonucleoprotein)

→ Each pair of homologous chromosome form bivalents.

→ The paired chromosome gradually become shorter and thicker.

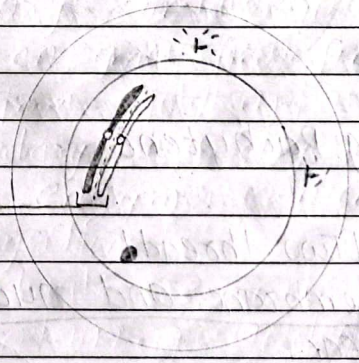



Fig: Zygotene.

(iii) Pachytene (Thick thread)

→ The chromosome ~~ch~~ continue to shorten and thicken. Hence this stage is called Pachytene i.e. thick thread.

→ Each chromosome of bivalent splits longitudinally (into sister chromatid) forming a tetrad.

→ Crossing over takes place [The process of exchanging genetic material or chromosomal segment between two non-sister chromatid is called crossing over].

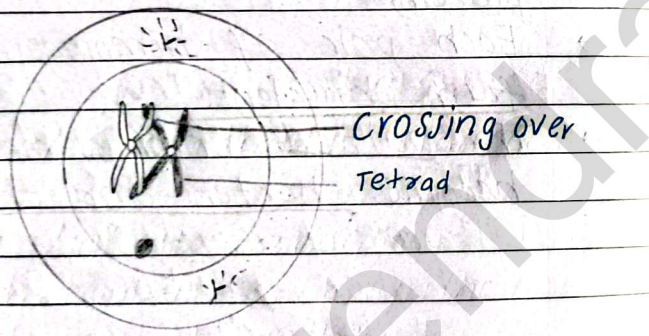



Fig: Pachytene

(iv) Diplotene [Two thread]

→ Nuclear membrane and nucleolus starts to disappear.

→ Synaptonemal complex starts to dissolve.

→ Separation of homologous chromosomes takes place except at point of crossing over called Chiasmata.

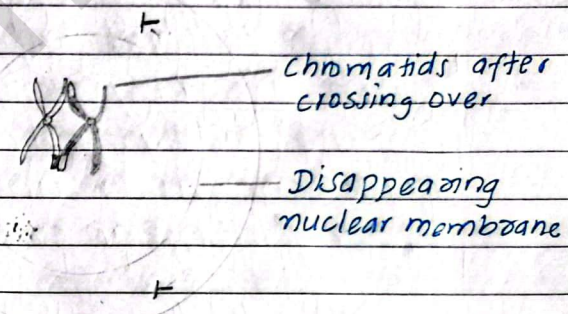



Fig: Diplotene

(v) Diakinesis [Across movement]

→ Nuclear membrane and nucleolus disappears

→ Chiasmata ~~starts~~ moves towards the tip of chromosomes called terminalization.

→ Formation of spindle fibre takes place.

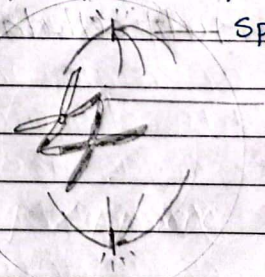



Fig: Diakinesis.

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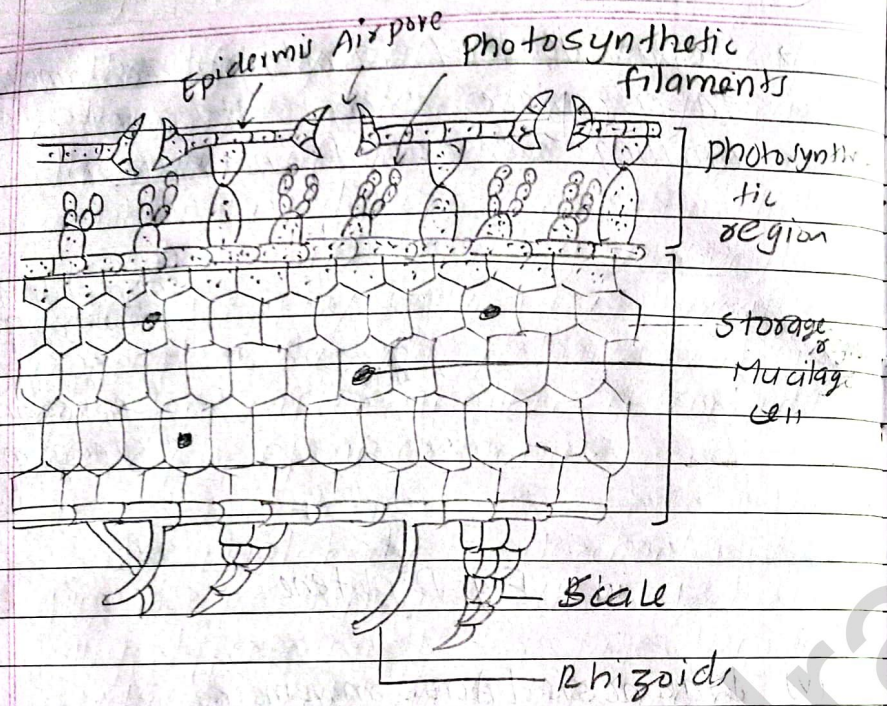



Fig:- V.S. of thallus - Marchantia.

Airpore: Gaseous exchange
Chlorenchymatous photosynthetic filaments → photosynthesis
Rhizoid - unicellular
Scale - Multicellular.

# Significances of meiosis:-

(i) Helps to maintain constant no. of chromosome in successive generation.
(ii) Helps in formation of gametes which help in sexual reproduction.
(iii) Creates variation in offspring due to successive crossing over.
(iv) Crossing over helps in the foomation of new characters in organisms and also for better adaptability and resistivity of organisms (evolution)
(v) Chromosomal and genomatic mutations occurs due to irregularities in meiotic division which is useful for natural selection.
(vi) It helps to produce spores, which help in alternation of genation.

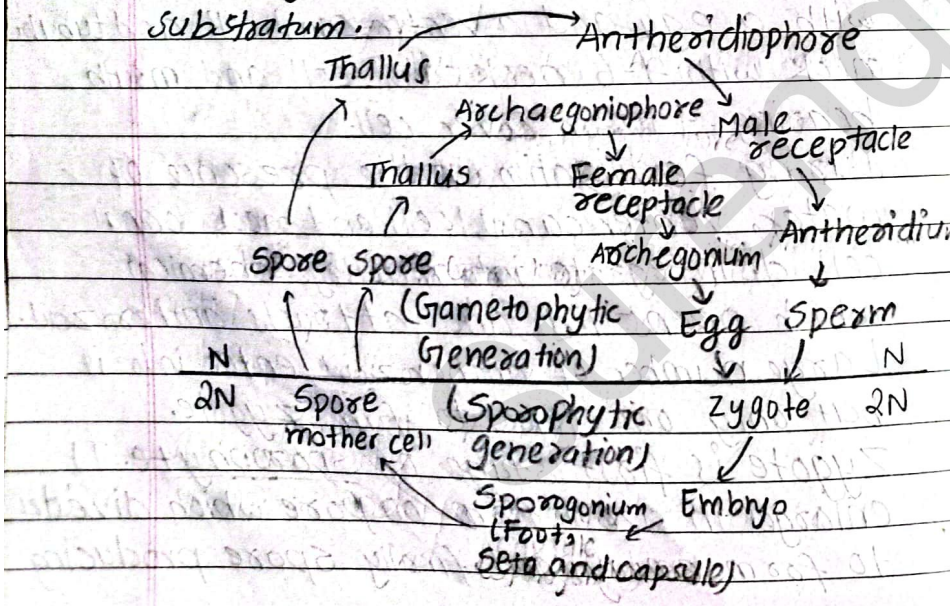
# Life Cycle of Marchantia

The life cycle of Marchantia exhibits heteromorphic alternation of generation. Alternation of generation is a phenomenon in which two distinct generation diploid sporophyte and haploid gametophyte which are ~~physically~~ physiologically, morphologically and cytologically different comes one after another to complete life cycle of an organism.

The plant body of Marchantia is gametophyte which is thalloid, dorsi-ventrally differentiated, prostrate, dichotomously branched and dark green in colour. The gametophyte reproduces vegetatively and sexually. The vegetative reproduction takes place by progressive death and decay of older portion of thallus, by adventitious branching and by gemmae. Sexual reproduction is oogamous type and takes place by fusion of male and female gametes. Marchantia is dioecious. So, male and female sex organ are found in different thalli. The gametophore bearing male sex organ (antheridia) is called Antheridiophore and gametophore bearing female sex organ (archaegonia) is called archaegoniophore. The antheridiophore consists of stalk and male receptacle (4-8 lobed) which bears club shaped antheridium. Antheridium is surrounded by single layered sterile jacket which encloses fertile mother cell (androcyte) which divides diagonally into androcytes that metamorphoses into rod-shaped biflagellate antherozoids. Archaegoniophore consists of a stalk and female receptacle (8-16 lobed, each lobe 12-14 inverted archegonia). Archegonium is flask shaped differentiated into ~~ver~~ swollen venter with a egg and a venter canal cell and tubular neck with 4-6 neck canal cell and mouth bearing 4 lid or cover cell.

During fertilization in the presence of water, venter canal cell and neck canal cell disintegrate into mucilage chemical which opens lid and attracts antherozoid. Large number of antherozoid enter into it but only one fuses to form zygote. Zygote is first stage of sporophyte. It enlarges in size to form oospore which divides to form embryo and finally spore producing

organ 'Sporogonium is formed'.
Sporogonium is diploid structure covered by three layers: calyptra, perigynium and perichaetium which has three parts foot: for fixation and absorbtion of nutrients from gametophyte; parasite, seta: connects foot and capsule and conducts food from foot to capsule and capsule bearing fertile spore mother cell and hygroscopic sterile elaters which help in dispersal of seed. Spore mother cell divides meiotically into haploid spore tetrad (i.e. first stage of gametophyte). Haploid tetrad germinate after falling in suitable substratum.



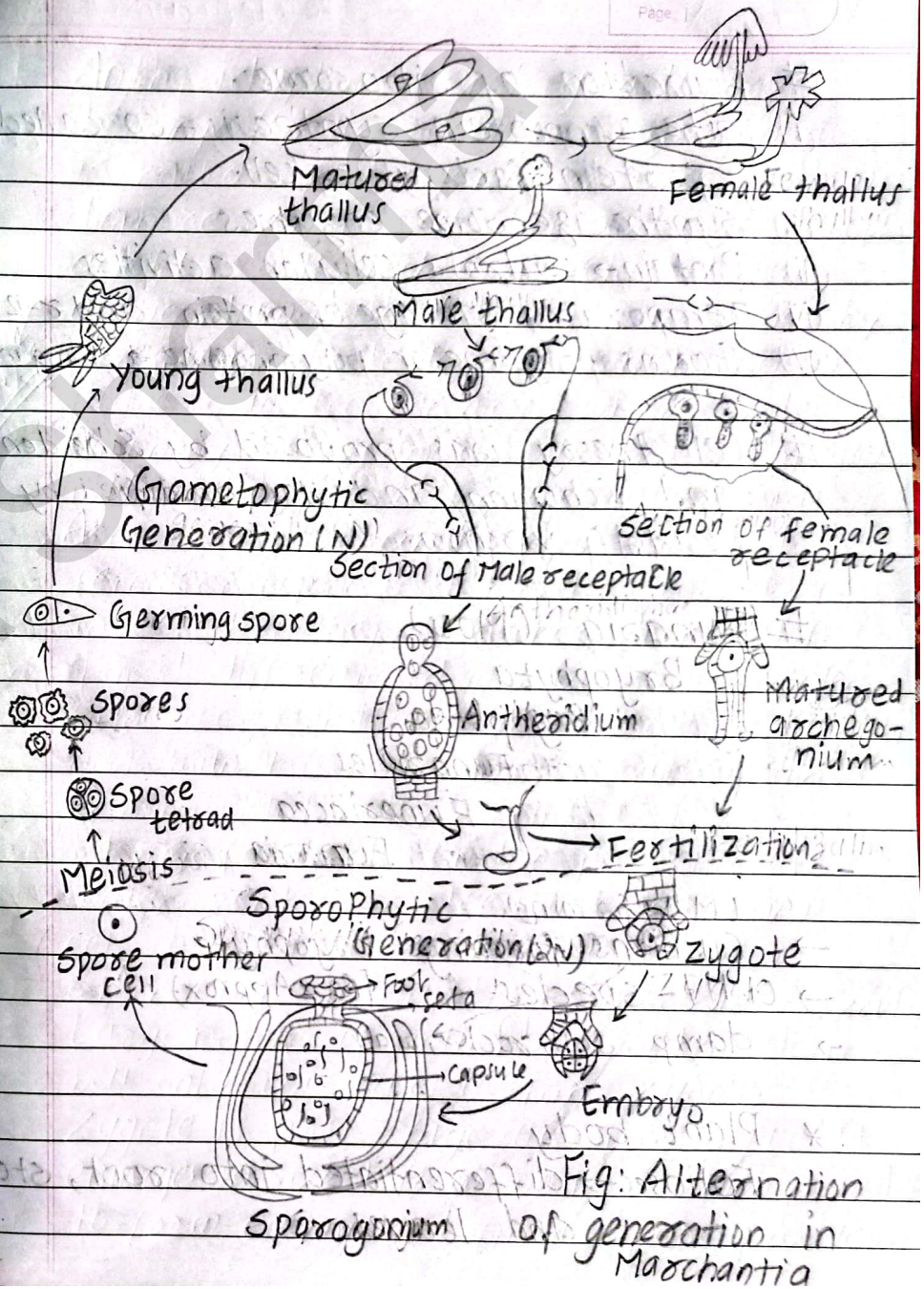




Fig: Alternation of generation in Marchantia

# Function of ribosome:-

(i) Site of protein synthesis - so called protein factory of cell.
(ii) Synthesize some enzymes
(iii) Protein → controls cellular activities
(iv) Temporary storage of protein and r-RNA
(v) Forms polysome or polyribosome → along mRNA

# Cell theory was proposed by Schleiden and Schwann and wa modified by Rudolf virchow.

# Funaria (Moss)

Bryophyta
Bryopsida
Funariales
Funariaceae
Funaria

(Mat-forming)
→ Cushions forming bryophyte
→ Ca. 117 species [Ca → Approx]
→ damp soil, rocks, wall

* Plant body
Foliose → differentiated into root, stem and leaves

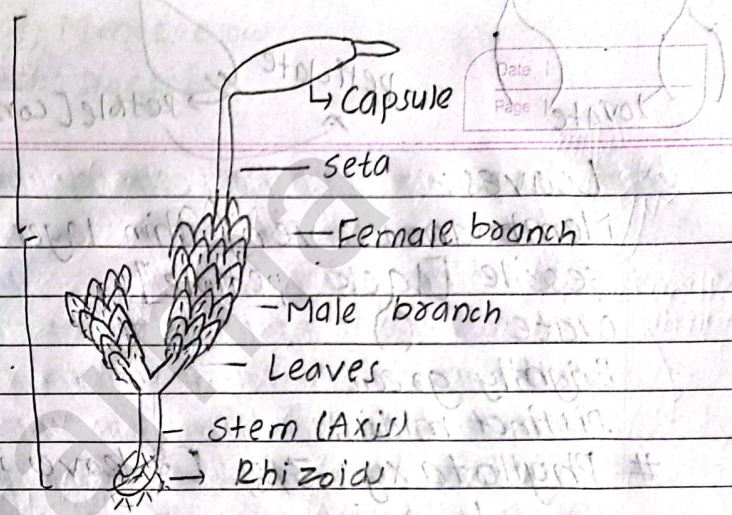
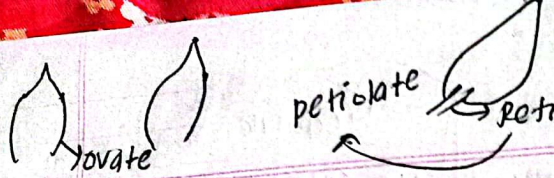



Fig: Plant body of Funaria

Rhizoids - multicellular, filamentous, branched, oblique-septa, coloured at maturity, arize from lower portion of stem
f(Root) = Anchorage + absorbtion
Septa:- dividing wall part of two cell

# Stem (Axis) → Erect [Grows ⊥ to ground]
Axiel [not prostrate]
Branched
Monopodial branching [one brach is dominant and keeps on growing surpassing other branches]
f(stem) :- Conduction
:- support plant
:- photosynthesis
Conduction: water, mineral + prepared food
Photosynthesis: contain chloroplast in epidermal regions.




Leaves:-
Membranous: very thin layer [made of single layer cell]
sessile [lack petiole]
ovate
Brightly green
Distinct midrib
# Phyllotaxy: 3/8 [8 leaves in 3 spiral] complete
↓
Term which define the arrangement of leaf in stem.

# Lower portion: smaller leaves which are sparsely distributed (closely arranged)
Upper portion: larger, compact, broader

f(leaves)
→ Photosynthesis
→ Protection of sex organ
leaves protecting male: perigonial leaves
leave protecting female: perichaetial leaves.

Plant; Monocoeious
Branch: Dioceoious

1.(a)→ Protoplasm is the semi-fluid mass of cytoplasm including nucleus.

(b)→ Mitochondria is responsible for releasing energy in the form of ATP.

(c)→ ~~In pachytene stage of~~ After crossing over, separation of homologous chromosome takes place except at the ~~place~~ of point of crossing over, that point is called chiasmata.

(d)→ The site for
(i) Protein synthesis → Ribosome
(ii) Photo synthesis → Chloroplast

(e)→ Thallus is a type of plant body which is not differentiated into root, stem and leaves.

(f)→ Scale in Marchantia is to protect the growing point.

2.

(b)→ Ribosome is the cell-organnel which is associated with protein synthesis. Ribosome consist of two sub-unit: upper cap-shaped smaller sub-unit and the lower dome-shaped larger sub-unit. These sub-unit are joined together by $Mg^{++}$. Chemically ribosome is made up of r-RNA, protein and $Mg^{++}$.

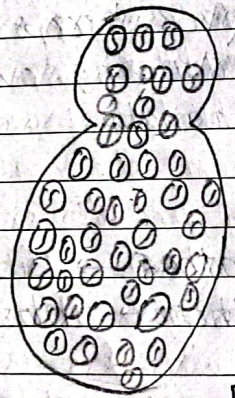



Fig:- Ribosome

# Functions

→ It is the site of protein-synthesis.
→ It even synthesises some enzymes.
→ Protein controls cellular activities.
→ It helps in formation of polysome.

(d)→ Cell theory was proposed by two scientist: Schleidenn and Schwann which was later modified by Rudolf Virchow It states that:-

(i) Cell is the structural and functional unit of life
(ii) All organism are composed of cell.
(iii) Cell is the heriditary unit of life.
(iv) All cell arises from pre-existing cell.

Some of its exceptions are:-

(i) Viruses do not have cellular composition (cytoplasm, cell organnels, etc.)
(ii) Bacteria and Cyanobacteria do not possess a true nucleus.
(iii) Rhizopus, Mucor, Vaucheria, etc cell body is multinucleate.

(e)→ The plant body of marchantia is gametophyte, prostrate, dorsi-ventrally flattened, di-chotomously branched and thalloid. The dorsal surface has mid-rib with vegetative reproduction organ gemme and apical notch which is green in colour. Whereas ventral

surface contain two different structure i.e unicellular filamentous rhizoids and multicellular scales. Rhizoids are of two types: smooth-walled rhizoids and tuberculated rhizoids with peg. Rhizoids are responsible for absorbtion of nutrients and fixation to substratum. Whereas scale are of two types: ligurate and appendiculate. Scale helps in protection of growing point.

(b) Marchantia is a unisexual plant i.e. having male and female reproductive organ in two ~~two~~ different thallus. The thallus of marchantia is the main gametophyte of the plant body. It is large and dorsiventrally flattened and consists of mid rib and cup shaped gemma cup along the mid rib. The internal structure of marchantia is discussed below.

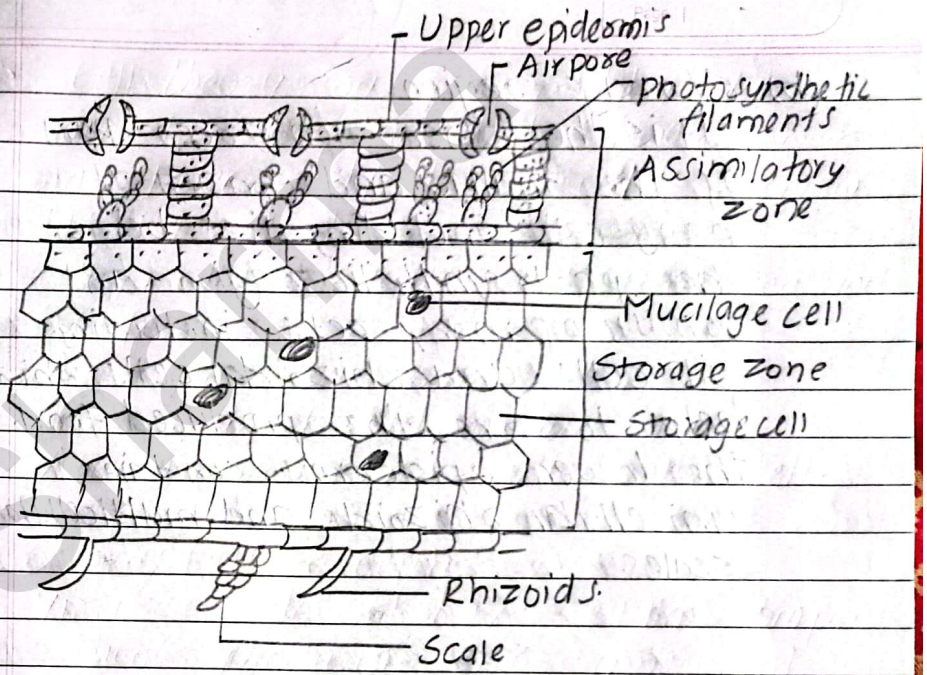
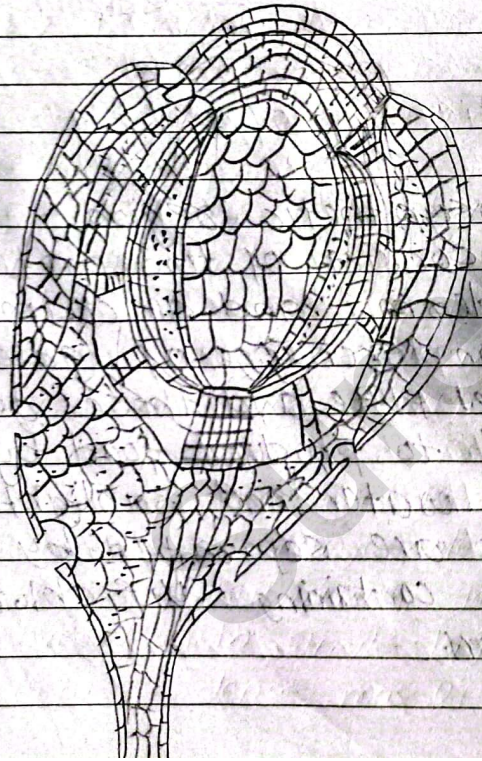


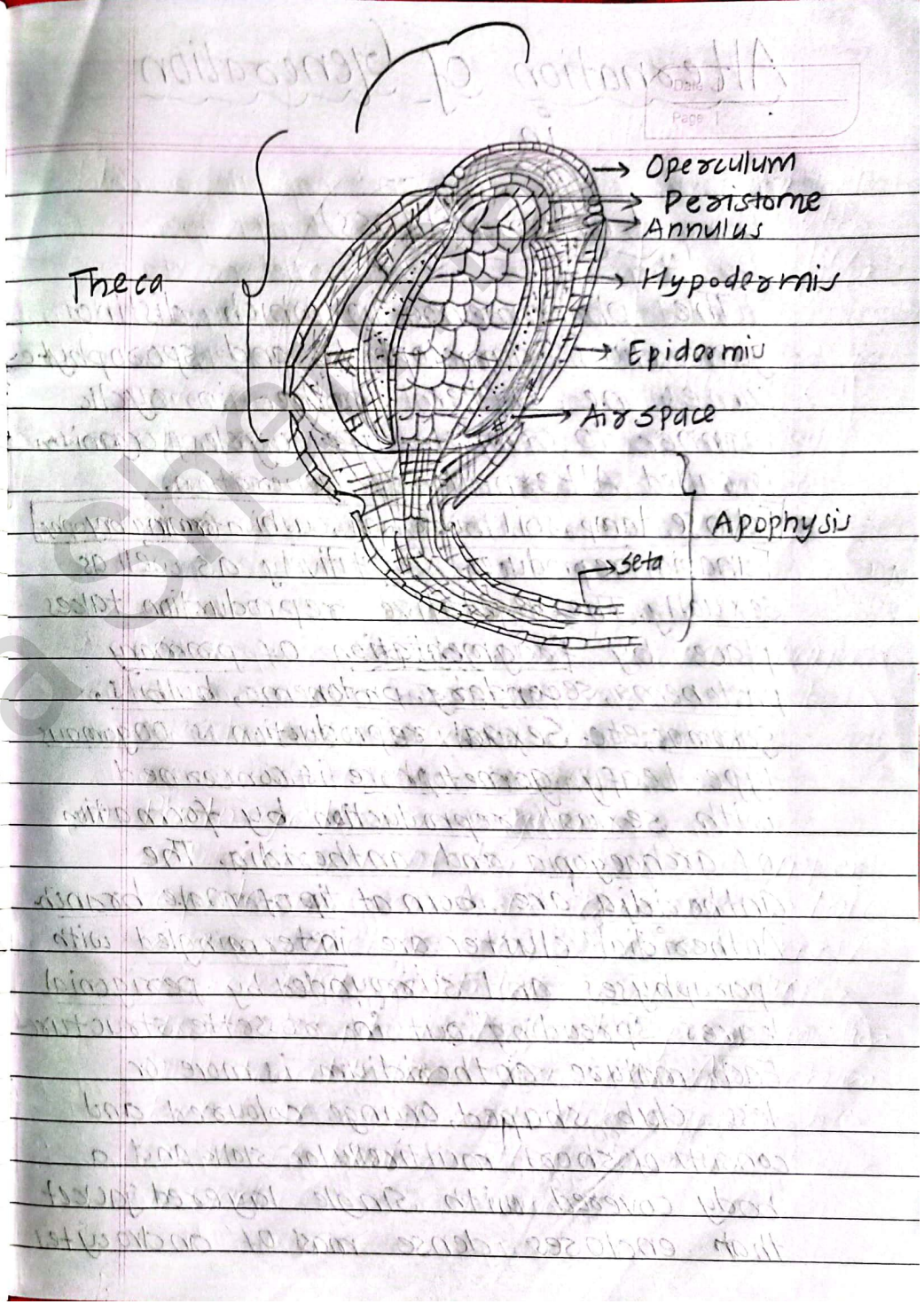

Fig:- V.S. of Marchantia thallus.

(a) Photosynthetic region.
It consists of two parts i.e. upper epidermis and air chamber. In this region exchange of gases occurs/takes place and these gases are used to produce food by conjunction with water and sunlight. Air chambers are separated by portion walls containing 4-5 chloroplast layers.

(b) Storage region

It is the lower non green part of the thallus and ~~consists of many cells including~~ lies below the photosynthetic region and consists of many cells including oil cells and rhizoidal cells which helps to store the produced food. The lower epidermis contain unicellular rhizoids and multicellular scales.





# Alternation of Generation in Funaria (Moss)

The phenomenon in which distinct generations gametophyte and sporophyte comes one after another in cyclic manner to complete life cycle of organism is called Alternation of generation.

Foliose, damp, soil, rock, wall, cushion forming bryophyte

Mor-phology

Funaria reproduces vegetatively as well as sexually. The vegetative reproduction takes place by fragmentation of primary protonema, secondary protonema, bulbils, gemmae, etc. Sexual reproduction is oogamous type. Leafy gametophore is concerned with sexual reproduction by formation of archaegonia and antheridia. The antheridia are born at tip of male branch. Antheridial cluster are intermingled with paraphyses and surrounded by perigonial leaves spreading out in rosette structure. Each mature antheridium is more or less club shaped, orange coloured and consists of short multicellular stalk and a body covered with single layered jacket that encloses dense mass of androcytes

Protonema → Green filament like structure formed either by germination of spore (primary) or by the injury of moss plant (sec.)

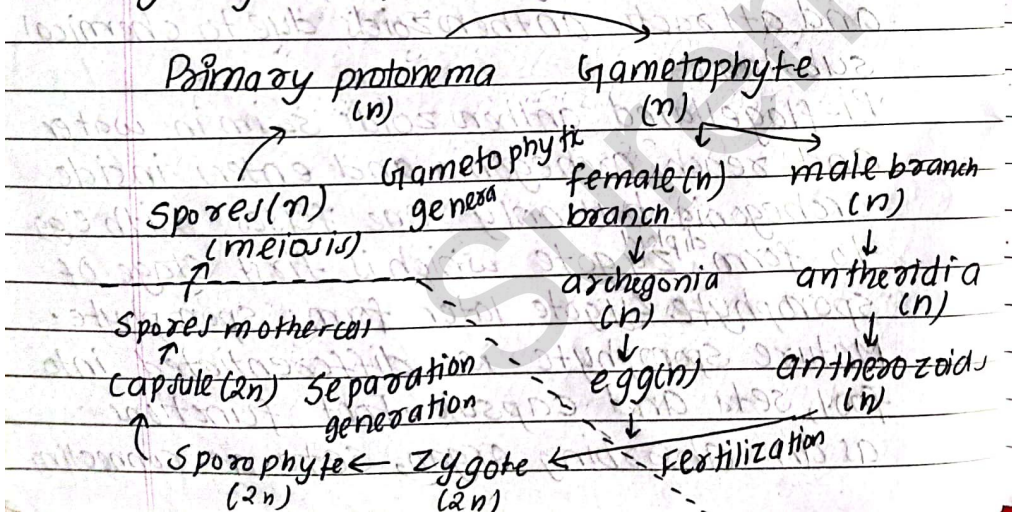
which later metamorphose in biflagellate antherozoids or spermatozoids.

Archaegonia are born at the tip of female branch. Archaegonial cluster are intermingled with paraphyses which is surrounded by perichaetial leaves in rosette manner.

The archegonia are flask shaped, with short multicellular stalk. Flask-shaped body has two-parts basal swollen venter and long slightly twisted neck whole covered with jacket layer [single layered in neck and double layered in venter]. Neck has 6-12 neck canal cell and venter has a venter canal cell and egg. Venter canal cell and neck canal cell disintegrate in access of water to form mass of mucilage which opens cover cell and attracts antherozoids due to chemical substance.

Bi-flagellated antherozoids swim in water and reach archegonia and enters inside archegonia but only one fuses with egg to form diploid zygote which is first stage of sporophyte. Zygote later forms sporophyte. Mature sporophyte is differentiated into foot, seta and capsule. Foot functions as an absorbing organ, seta as connecting

link between foot and capsule which transport food to capsule and lift up capsule for dispersal of seeds. Capsule is again divided into three parts: Apophysis attached with seta for conducting food; Theca with centrally located columella surrounded with spore sac which is surrounded by air spaces. ~~and~~ and capsule wall; and Operculum with annules, peristome (hygroscopic). In mature stage, capsule dries up, whole structure shrinks and finally hygroscopic peristome teeth disperse spores. And the spores fallen on suitable substratum germinate to form filamentous-branched structure protonema that later grows into young moss plant.



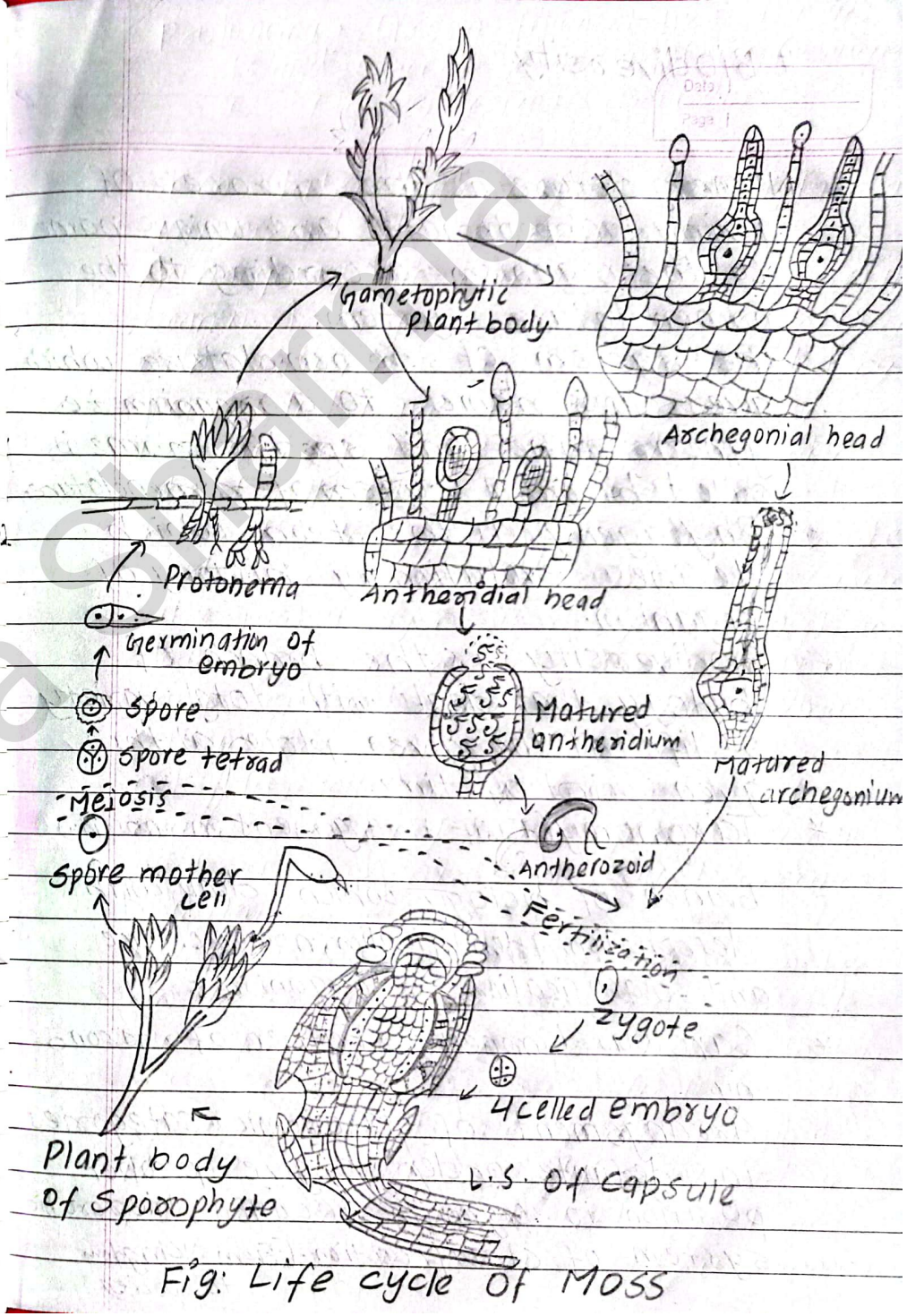




Fig: Life cycle of Moss

# Biodiversity

* Nomenclature is the process of giving appropriate and unique name to the organism according to the nomenclature system.
* The system of nomenclature which gives two names to a organism i.e. generic name and specific name is called binomial system of nomenclature.
* Phylogeny is the term which defines evolutionary history of organism.
* Biodiversity is the branch of biology that deals with total variety of life at the given place at the given point of time.
* Taxonomy (Taxis - Arrangement, nomos - law)
  ↓
  Branch of biology which deals with description, identification, nomenclature and classification of organisms.
* Carolous Linnaeus → Father of taxonomy.
* Arrangement of taxonomic categories in definite order to give proper position to organism is called hierarchic system of classification. [From kingdom to species]

(Surendra Sharma)

* Scopes of biodiversity:
  (i) Provides foodstuffs to living organism
  (ii) provides beauty to nature.
  (iii) provide valuable information to researcher and scientist.
  (iv) enhanches economic condition of people.
  (v) Raw material for medicine, clothes, e
  (vi) Aesthetic and cultural values.

* Draws backs of two kingdom system:
  (i) Prokaryotes and Eukaryotes are not separated.
  (ii) Non-photosynthetic and photosynthetic plants are kept in same group.
  (iii) Bacteria and viruses are not clarified.
  (iv) Positioning of many organisms are confusing. Eg:
    (i) Euglena (ii) Sponges (iii) Chlamyd
  (v) Unicellular and multicellular Monas. Organisms are kept in same king

# Five kingdom system (Monera, Protista, Mycota, Plantae, Animalia) → By R.H. Whittaker

Advantages

→ Prokaryotes and Eukaryotes are separated.
→ Phosynthetic and non-photosynthetic plants are separated.
→ Bacteria are kept in Monera.
→ All multicellular autotrophic eukaryotic plants i.e. producers are kept in plantae.
→ Unicellular eukaryotes are kept in separate kingdom protista.
→ All multicellular heterotrophic eukaryotes i.e. consumers are kept in kingdom Animalia.

# Species is the lowest category of taxonomic hierarchy, which consist of individual resembling each other more closely, which can interbreed freely and produce their own kinds.

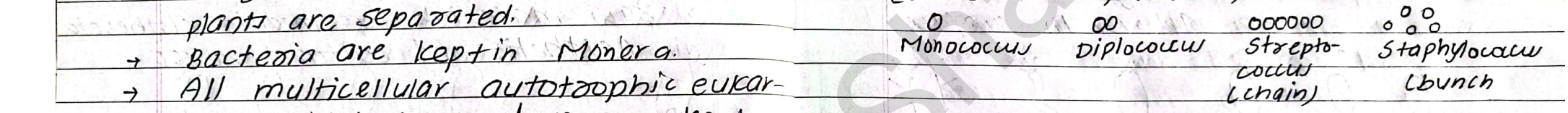
# Bacteria Kingdom-Monera

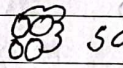
Simple, unicellular, microscopic, prokaryote and cosmopolitian in distribution.

Types of bacteria

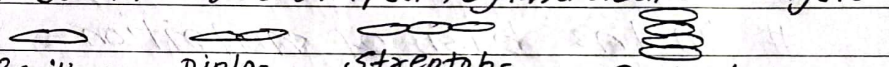
# On the basis of shape

(i) Coccu - spherical,





sarcine (cuboidal arrangement)

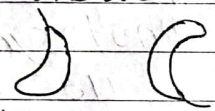
(ii) Bacilli - rod shaped, cylindrical or elongated




(iii) Spirilla (Spiral)


Spiral or cork-screw shaped

(iv) Vibrio


(C-shaped, comma shap

# On the basis of flagella (Flagellation)

pattern of flagella

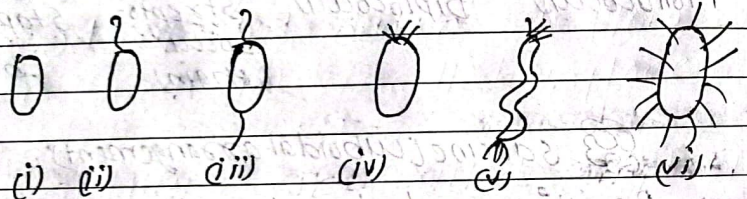
(i) Atrichous → Lack flagella
(ii) Monotrichous → have single flagella at one of the end.

(iii) Amphitrichous → have single flagella at each end

(iv) Cephalotrichous → two or more flagella at only one end

(v) Lophotrichous → two or more flagella at each end

(vi) Peritrichous → flagella are found all over the surface




# On the basis of nutrition

A. Autotrophic bacteria
Synthesize their food themselves from organic and inorganic substance.

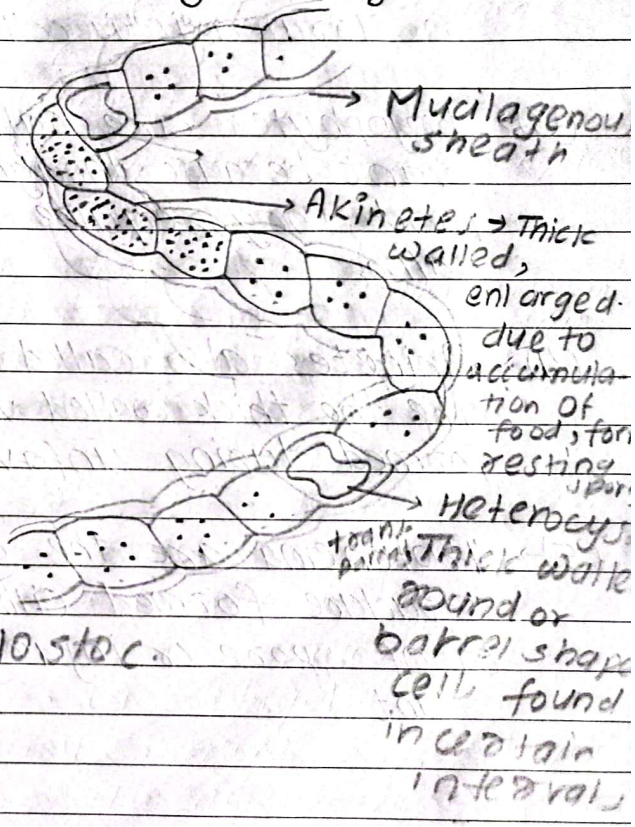
1. Photosynthetic bacteria
use solar energy for synthesizing their organic food. Pigment: bacterio-Chlorophyll and chlorobium chlorophyll.
Source of carbon → $CO_2$
Source of hydrogen → $H_2S$, other sulphur containing compounds

Eg: Green sulphur bacteria,
Purple sulpher bacteria, etc.

2. Chemosynthetic bacteria:
Synthesize food by the utilization of energy from chemical source ($NH_4$, $NO_3$, $H_2S$, etc.).
Eg: Nitrifying bacteria, Iron bacteria, Sulphur bacteria, etc.

3. Symbiotic bacteria - These bacteria are found in symbiotic relation with other organism with another organism. Eg: Rhizobium

→ unbranched
→ Trichome - individual cell
→



# very short answer questions:

(1) What is biodiversity?

→ Biodiversity is the branch of biology which deals with total variety and variability of organism at given place at given point of time.

(2) What is Inflorescence?

→ The arrangement of flowers and mode of distribution of flowers on floral axis is called inflorescence.

(3)→ Bryophytes are called amphibious plant because though they live on land, they require water for fertilization.

(4)→ Akinetes also called resting spores are the thick walled vegetative cell formed during unfavourable condition

(5)→ Protenema are the green filamentous structure formed either by germination of spore or injury of moss plant.

#

(1)→

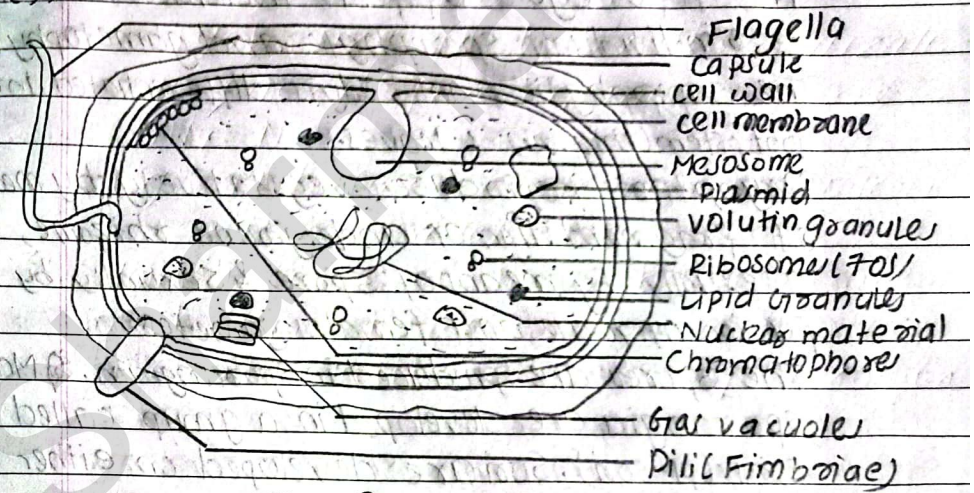



Fig: Bacterial cell.

# Significances of crossing over:-

(i) Formation of different types of gametes which brings variation in offspring.

(ii) Introduces new combination of genes.

(iii) Genetic recombination can help in evolution

(iv) Can improve adaptability in organism.

(v) might lead to mutation due to irregularity in crossing over.

# Life cycle of fern (Dryopteris)

The life cycle of fern includes two distinct individuals: sporophyte and gametophyte. The saprophytic plant body is differentiated into root, stem (rhizome) & leaves.

Dryopteris reproduces vegetatively by means of fragmentation of underground rhizome, asexually by means of spore & sexually by fusion of male and female gametes.

The spores are produced in sporangium. Many sporangia are developed in a group called sorus (pl. sori). Sori are developed on either sides of veins on ventral surface of leaf or pinnules. The sporangia of sorus are attached to swollen placenta by their stalks. And, a delicate membranous structure, indusium arises from placenta covers sorus of sporangia like a hood. Mature sporangium is composed of multicellular stalk and capsule with single layered.

## # Asexual Reproduction

It takes place by formation of spores. Spores are produced in sporangium. Sori are developed in either side of midrib of leaf. Each sorus contains number of sporangia. Sporangia are covered by delicate membranous structure called indusium. Sporangia are attached with placenta through multicellular stalk. Water gland makes sporangium moist. Sporangium is oval shaped, covered by two types of single layer sporangial wall. They are thin walled larger cells called stomium and thick walled cells called annulus. Stomium also consists of lip. In inner side of sporangial wall there are number of diploid spore mother cells which undergoes meiosis to form four haploid spores.

After maturity of spores, water gland is lost, indusium shrivels up, sporangial wall dries up and spores are dispersed by the jerking action of sporangium. Haploid spore is initial stage of gametophytic generation.

## # Sexual reproduction

Spores fallen on suitable substratum, germinate to form dorsi-ventrally flattened green independent gametophyte called prothall

It contains both male reproductive organs (antheridia) and female reproductive organs (archegonia). Antheridia are developed on posterior end of prothallus and archegonia are borne along the sides of apical notch towards anterior end.

# Antheredium

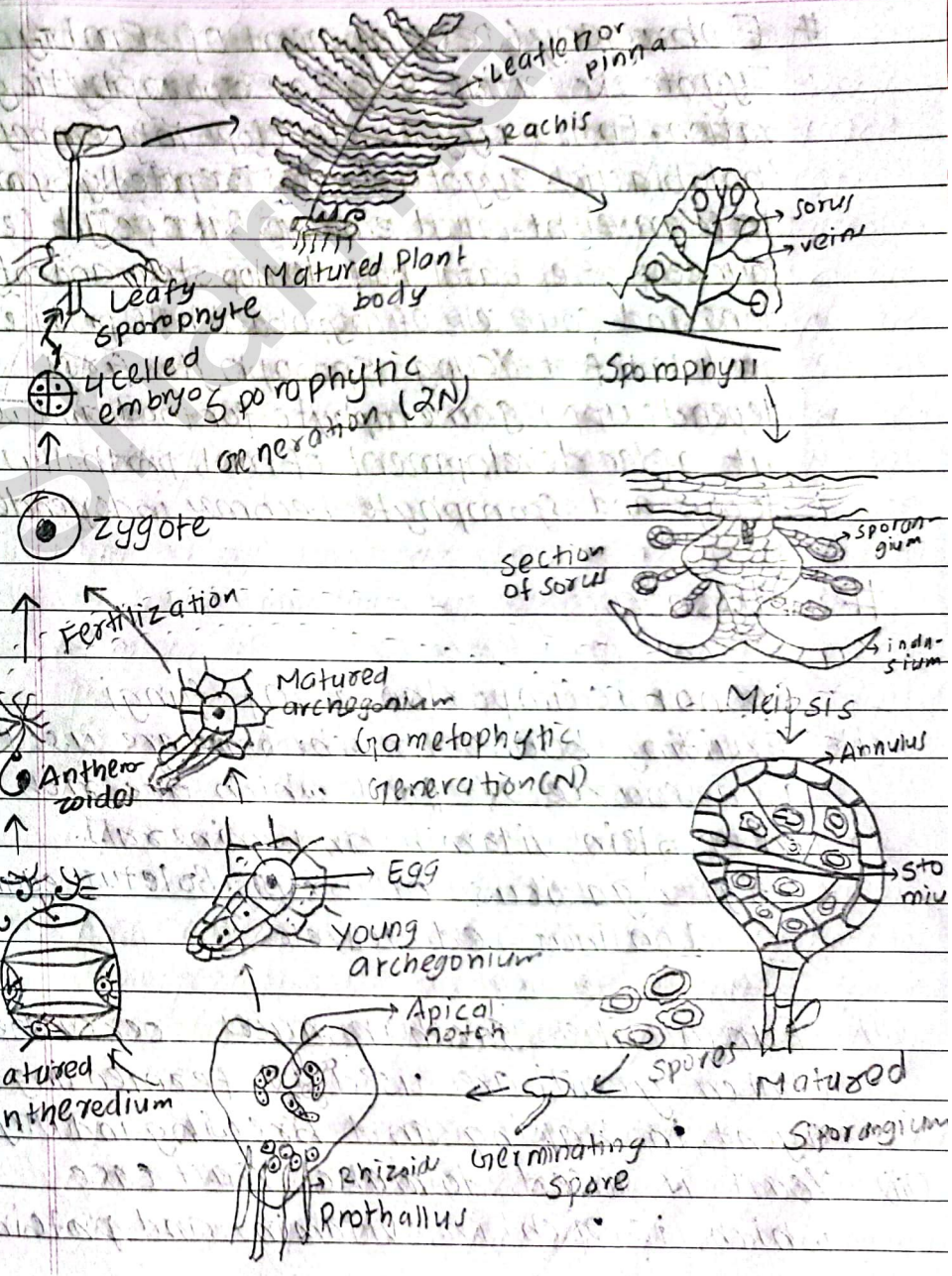
Each antheridium is multicellular oval structure directly attached with prothallial cells, covered by jacket layer. Inside jacket layer there is number of antheridial mother cell with later metamorphose into multiflagellate antherozoid or spermatozoid.

# Archegonium

It flask shaped. having embedded venter and projecting neck. Venter consists of large egg cell and a venter canal cell and neck canal with single binucleate neck canal cell. At tip, there are four lid cell.

# Dehiscence of Archegonium and fertilization

After maturity, neck canal cell and venter canal cell disintegrate to form positive chemotactic mucilaginuous mass which ooze out by opening lid cell. Number of antherozoid reach tip of archegonium through water but only one fuses with egg cell to form diploid zygote or oospore.



# Embrogeny (Development of Embryo)

Zygote is initial stage of sporophytic generation. Entire zygote develop into embryo (holoblastic). zygote divides repeatedly by mitosis to form eight-celled embryo. Out of eight cells, four cells of epibasal half develop stem and cotyledons and four cell of hypobasal half produce root and foot. Young sporophyte first depends upon gametophyte for food and water but after development of root, prothallus decays and sporophyte becomes independent.

# Mycota

Economic importance of fungi

(i) Fruiting bodies mushrooms are used as a source of food which are rich in protein, vitamin and minerals.
Eg:- Agaricus bisporus, Boletus edulis, Lentinus edodes, etc

(ii) Fungi like Saccharomyces cerevisiae (bakers yeast) are used as fermenting agent in baking and brewing industry.

(iii) Yeast is used to make yeast cake which is rich in vitamins and proteins.

(iv) Fungi like ~~Aspergillus~~ Saccharomyces cerevisiae (Invertase) Aspergillus niger (Amylase), Rhizopus sp. (Lipase) are used to synthesize different types of enzymes commercially.

(v) Some antibiotics are obtained from fungi.

| | |
|---|---|
| Natatin | Penicillium notatum |
| Penicillin B | P. notatum |
| Spinulosin | P. spinulosum |
| Albidin | P. albidum |

(vi) Saprophytic fungi increases fertility of soil by decomposing complex organic compounds into simple inorganic compounds.

(vii) Gibberella fujikuroi fungus is used to manufacture phytohormones (plant growth hormone).

# Economic importance of Yeast.

→ ~~Source of various vitamins and enzymes~~

→ Yeast cake (morcha) is rich in protein, fat and vitamins.

→ Enzyme invertase is synthesized commercia from Saccharomyces cerevisiae.

→ Different species of yeast are used to produce alcoholic products like beer, wine, vodka, etc.
→ S. cerevisae is used in baking industry for making soft, spongy and delicious bakery products.
→ Yeast is used to cure skin diseases and stomach troubles.
→ Coca bean are cured by using Yeast along with bacteria.

# Yeast
→ saprophytic fungus commonly found in sugary medium.
→ unicellular fungus
→ Each cell may be spherical, oval or elliptical in shape
→ Cell is differentiated into cellwall, cytoplasm, nucleus and vacuoles.
→ Cell wall: outermost protective layer made up of chitin
→ Cell membrane: inner to cell wall, made up of lipo-protein
→ Below cell wall granular cytoplasm containing cell organelle like E.R, mitochondria, golgibody, etc but lack chloroplast
→ Reserved food: glycogen or fat.
→ Single well defined haploid or diploid nucleus attached to one end of central vacuole. Such vacuole is called nuclear vacuole
→ Note: Under condition of rapid growth, body may form a branched or unbranched chain of many cell resembling mycelium called pseudomycelium.

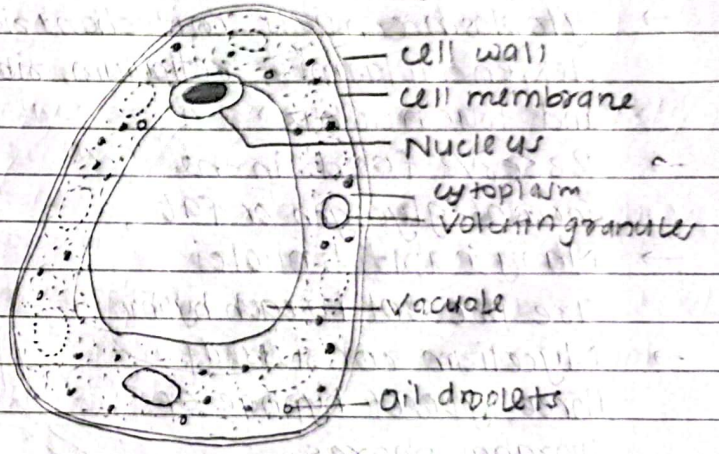



Fig: Yeast cell.

# Mucor

→ Saprophytic fungus found in dead and decaying oorganic matter.

→ body of Mucor is called mycelium.
↓
long, slender, and much branched cottony hyphae.
↓
thread like
multicellular or multinucleated st.

→ wall of hypha is made up of chitin which encloses cytoplasm.

→ cytoplasm consists mitochondria, Golgi complex, endoplasmic reticulum, ribosomes, vacuoles and true nucleus

→ Reserve food: in the form of glycogen or fat

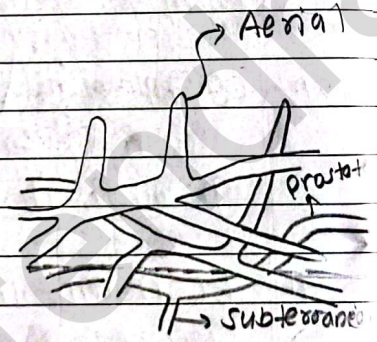
→ Many haploid nuclei are present in each hypha.

→ Mycelium consists of three types of hyphae ~~or~~ ~~sporangiophores~~

(a) Submerged hyphae: highly branched hyphae penetrating substratum (helping in anchorage and absorption)

(b) Prostate → branched hyphae spreading in all direction over the substratum.

(c) Aerial → hyphae growing erect from prostate and help in asexual reproduction.



Mycelium

# Spirogyra

→ Common name:- water silk (water scum)

→ free floating or attached to substratum by hold fast or hapteron.

→ plant body: gametophytic (n), silky, long, filamentous, unbranched, septate, multicellular

→ slippery to touch → mucilagenous mass formation by dissolving pectin of cell wall with water.

→ Protoplasm
↓
cytoplasm, central vacuole & nucleus

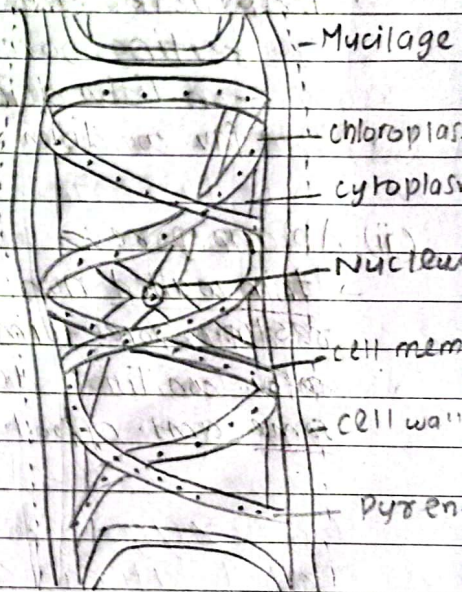
→ cell wall: pectin

→ cell membrane: lipo-protein.

→ cytoplasm: [peripheral due to large central vacuole] ~~(primordial utricle)~~

→ Chloroplast:
* (1-16) in each cell
* arranged spirally in anticlockwise
↓
Spirogyra

→ vacuole: surrounded by vacuolar membrane tonoplast
# fluid mass (water + min) → cellular

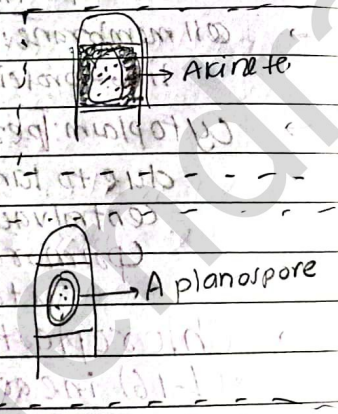


A single cell of spirogyra

# Reproduction

1. Vegetative reproduction:-
   → most common → fragmentation
   → long filament break into short segments called fragments by different ways and each grow independently into new filament.
   → mechanical stress, death and decay of intercalary cell.

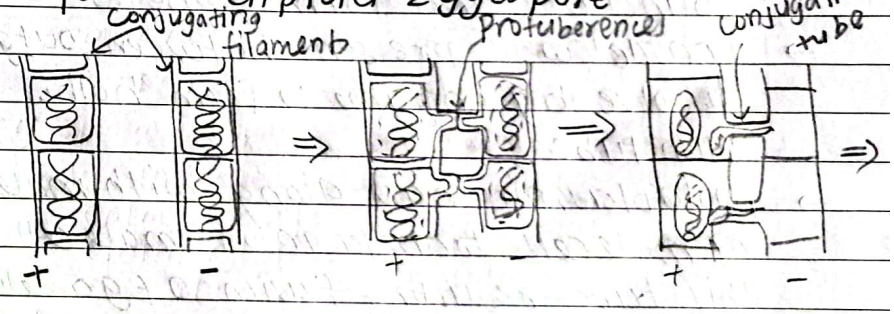
2. Asexual reproduction:- (non-common)
   → formation of non-motile mitospores.
   (i) Akinetes:→ thick walled non-motile resting spore formed during unfav. condition due to acc. of large amt. of food.
   → fav. condition → divide by mitosis to form new filament

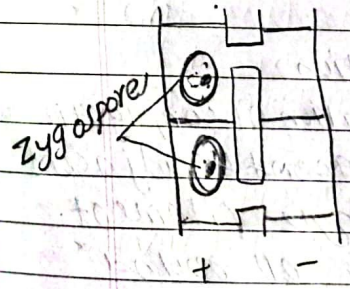



   (ii) Aplanospores:-
   → thin walled non-motile resting spores formed during unfav. condition due to acc. some amt. of food.

   (iii) Sexual reproduction:-
   → conjugation → between opp. strains.
   → isogamous (transfer of male gametangium into female gametangium)
   → through conjugation tube.

a. Scalariform conjugation → conjugation tube between two filaments give ladder like appearance
   → ladder like conjugation
   → occur in heterothallic condition (diff. filaments of opp strains +ve & -ve)
   → two filaments of opp. strains come closer and parallel to each other.
   → cell of filaments form protuberances which later form conjugation tube.
   → protoplast of conjugating cell rounds off to form gametes.
   → male gamete migrates into female gamete through conjugation tube → male cell vacant.
   → fusion → diploid zygospore



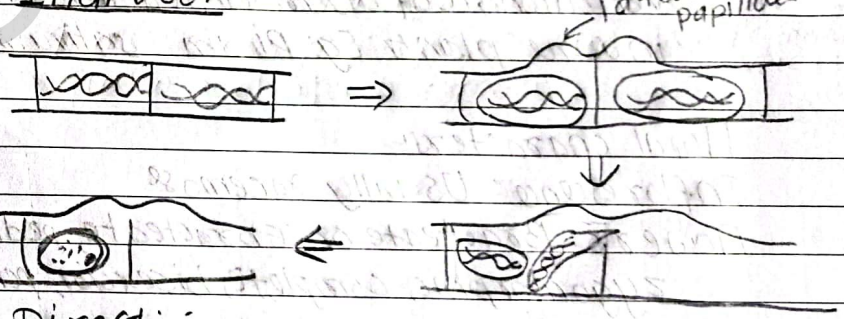



Last → Zygospore: Thick walled resting spore having three layered wall (exine, mesine & intine)
(i) Zygospore is released from female cell by decaying its wall and reaches to the bottom of pond and undergo resting period.

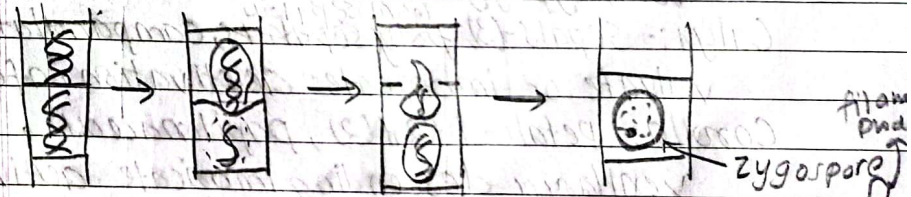
b. Lateral conjugation
→ chain like conjugation
→ takes place in homothallic condition (occurs between two adjacent cell of opposite strain (+ve and -ve) in same filament)
2 ways.
(1) Indirect lateral conjugation
→ two adjacent cell of opposite strains of same filament form protuberances from lateral wall of adjacent cell.
→ The protoplast of conjugating cells round off and form gametes.
→ Contact wall present between outgrowth dissolve by enzyme to form hollow conjugation tube.
→ protoplasmic mass along with male gamete of male cell transfer into female cell through this tube resulting fusion of gamete to form zygospore. (2n)
(2) Direct lateral conjugation
→ primitive type → no formation of conjugation tube
→ takes place in ~~single filament~~ adjacent cells of opp. strains in single filament.
→ protoplast of conjugating cell round off to form male gametes

(ii) On fav. condition (onset of rain) it undergoes meiosis to form four haploid nuclei and only one of the nuclei is functional called functional zygospore. (iii) During fav. condition, functional zygospore forms germ tube having lower rhizoidal cell and upper chlorophyllous green cell - which divides repeatedly to form new filament of Spirogyra.
→ one cell act as male and another as female.
→ penetrating or boring organ of male gamete penetrates the septum between adjacent cells.
→ protoplasmic mass of male gametangium transfer to female gametangium through this pore.
→ male gamete fuses with female gamete to form thick walled diploid zygospore in female cell while male cell become vacant.

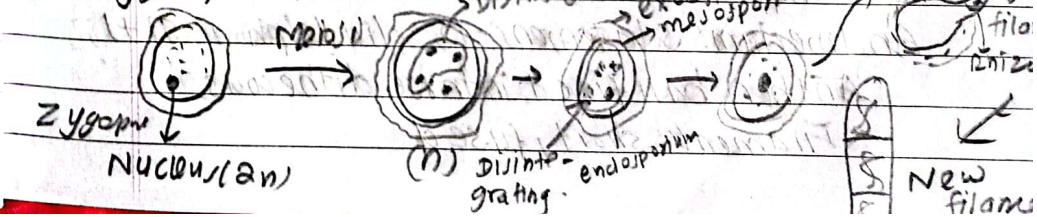
Indirect




Direct:




Zygospore:



# Family: Papilionaceae

425 Genera, 12,150 species

Habit: Herbs, shrubs trees or climbers, Annual or perennial

Root: Tap root, branched, root with root nodules containing $N_2$ fixating bacteria eg: Sesbania sp.

Stem: Erect, solid or fistular, branched, hairy or glabrous, ~~stipulate~~, cylindrical

Leaves: Cauline and ramal, stipulate, petiolate, simple or compound, reticulate venation, leaflets modified into tendrils in some plants Eg: Pisum sativum

Floral characters:-

Inflorescence: Usually racemose

Flowers: Bracteate or Ebracteate, pedicellate, zygomorphic, complete, bisexual, pentamerous, hypogynous papilionaceous.

Calyx:- Sepals-(5), ~~polysepalous~~ gamosepalous, campanulate, valvate or imbricate aestivation, inferior.

Corolla:- Petals- 1+2+(2), papilionaceous, vexillary or descending imbricate aestivation, inferior

Androecium: Stamens-10, diadelphous (9)+1, Anther: basifixed, introrse, dithecous, Filament: short, fused

Gynoecium: Monocarpellary, ovary: superior, marginal placentation, unilocular, style: short and curved, stigma: simple or capitate.

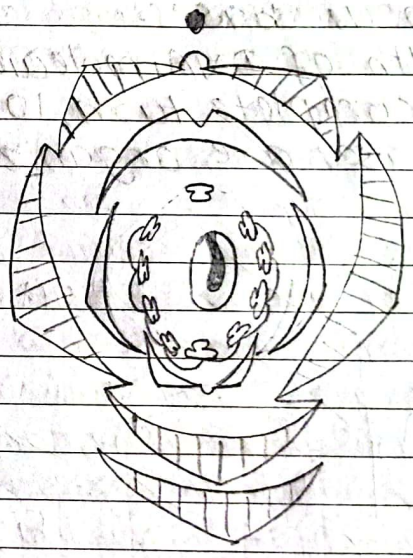
Fruit ~~Seed~~: Legume or pods or Lomentum

Seed: Large, non-endospermic

Fertilization: Self or cross

Floral formula: $Br\,Ebr\,\%\,\varphi\, K_{(5)}\, C_{1+2+(2)}\, A_{1+(9)}\, \underline{G_1}$

Floral diagram:



Economic importance:-

(1) Pisum sativum (seeds) → ~~cereals~~ pulses

(2) Sesbania sp. (root) → ⊕ manure

# Structure of DNA proposed by Watson and crick.

(a) It is a double stranded or double helically coiled structure that is spirally coiled around central axis in right handed manner.
(b) Each strand made up of phosphoric acid, pentose sugar.
(c) The central part is occupied by nitrogenous bases.
(d) The width of DNA molecule is 20A°.
(e) The one complete turn, 10 nitrogenous bases are organized.

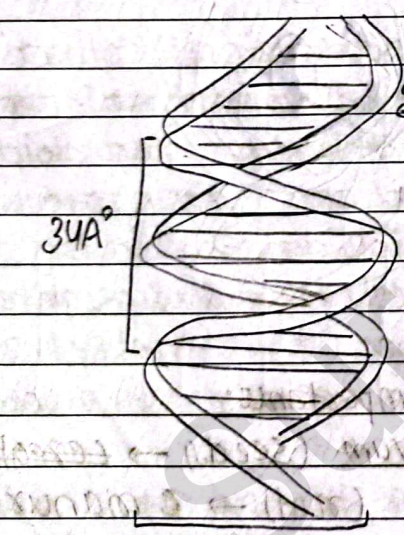



Fig: DNA

# Characteristics of family solanaceae

(a) They have tap and branched root system
(b) They are mesophyte and terrestrial.
(c) They have cauline and ramal, unicostate reticulate venation, simple, petiolate leaf.
(d) They have superior ovary with swollen placenta.
(e) They have complete, bisexual and actinomorphic flower.
(f) Inflorescence cymose type.
Eg:- Solanum nigrum, solanum tuberosum, etc.

# Mitosis and meiosis cell division.

| Mitosis cell division | Meois cell division |
|---|---|
| In it, a diploid cell divides into two daughter diploid cells. | A diploid cell divides in to four haploid cell. |
| Daughter cells have same number of chromosome as that in parent cell. | Daughter cells have half the number of chromoomes as tha in parent cell. |
| It is not responsible for the formation of gametes. | It is responsible for formation of gamete |

It occurs in somatic cell.
It is called hemotypic cell division.
It is not divided into Mitotic I and II.

It occurs in germinal cells.
It is also called reduction division.
It is divided into Meiosis I and II.

(1) Very short answer questions:-

(a)⇒ Cell is considered as structural unit of life because our body is composed of large number of cell and functional unit of life because function of organism is as a whole function of cell.

(b)⇒ The variety of flora and fauna and other species within a certain area is known as biodiversity.

(c)⇒ The function of chloroplast is to perform photosynthesis process.

(d)⇒ Bryophytes are called amphibian plants because they live on land but require water for fertilization.

(e)⇒ The function of mRNA is to carry the message of genetic material for the protein synthesis.

(f)⇒ Two Marchantia species found in Nepal are:-
(i) Marchantia polymorpha
(ii) M. nepalensis

(g)⇒ The browish scales that covers the stem in Dryopteris is called Ramenta.

(h)⇒ Phyllotaxy is the arrangement of leaves on stem.

(i)⇒ The bacteria having two or more flagella in both end is called lophotrichous bacteria.

(j)⇒ The meaning of $A_{2+4}$ is that the sta are arranged in two whorls, two outer short and four inner long.

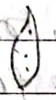
# In racemose inflorescence, the flowering axis give rise to large and indefinite number of lateral branches ending in flower and the growth of axis may be indefinite. The oldest flowers are open earlier and the youngest are at the apex. There are different types of racemose inflorescence; raceme, Spike, spikelet, umbel, corymb and head or capitulum. The flower axis is elongated in raceme, spike and spikelet and shortened in corymb and umbel while flattened in head or capitulum.

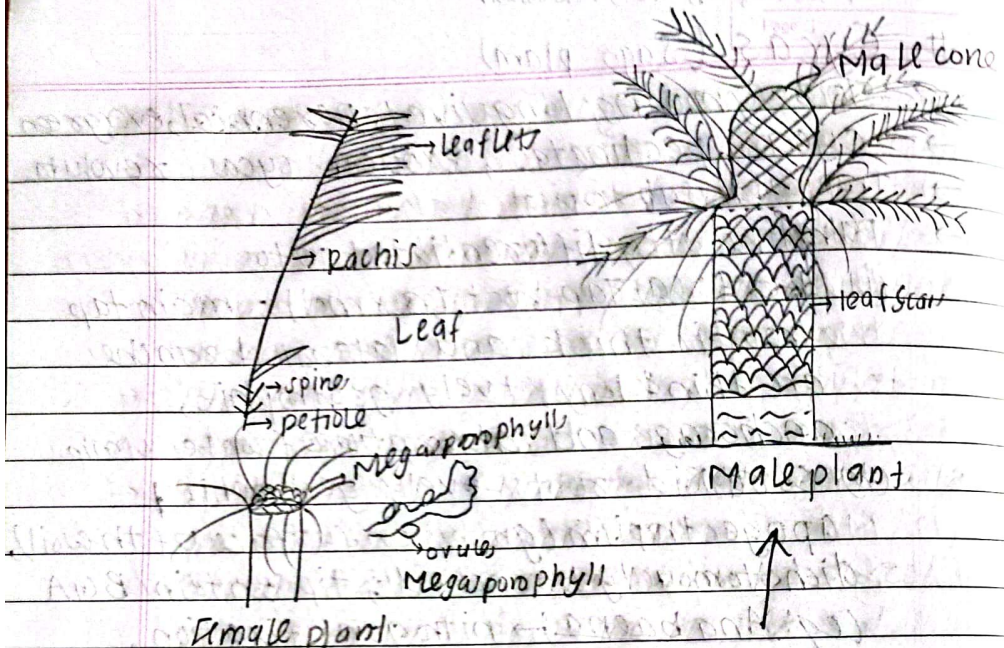
# Gymnosperm (Gymno-naked, sperma-seed)
→ non-flowering seeded plant in which sporophyll are aggregated to form cones and seeds develop in exposed state.
→ ovule are not covered by ovary wall.
⇄ Tap root → ovary absent
→ medium / tall trees – sequoia gigantica (largest tree) / shrub
→ coralloid root in cycas → symbiotic association with BGA
→ stem: unbranched (Cycas) or branched (Pinus)
→ conifere → needle like leaf
→ Heterosporous → micro-male
↳ mega-female
→ flower are replaced by cones
→ xerophytic, vascular

# Cycas (Sago plam)
→ slow growing, long lived, perennial, evergreen
→ cycas pectinata, exotic sp. cycas revoluta.
→ Tropical & sub-tropical
→ Palm like st., differentiated into
(i) Root: (a) Tap-root (normal): main tap root is thick and lateral branches are thin & long, +vely geotrophic, anchorage and absorption of water & min.
(b) Coralloid root: -vely geotrophic, apogeotropism (grows on surface of the soil), dichotomously branched; tip contain BGA (eg: Anabaena) → nitrogen fixation, porse lenticel → help in respiration, Root hair and root cap are absent.

(ii) Stem: → sago (nutritious food rich in starch) is present in the pulp of stem
Young stem: tuberous and underground
Mature stem: erect, unbranched & columnar covered by persistent leaf base.


(iii) Leaf: (a) Scale leaves: small, triangular, brownish, provides protection.
↓ Dimorphic
(b) Foliage leaves: Green, photosynthetic






# Cycas

Structure:-

→ slow growing. long lived palm like evergreen tree

~~→ Palm like?~~ → Tap root system which is positively geotrophic and help in anchorage and absorption (normal)

→ and dichotomously branched coralloid roots which show negative geotropism (help in respiration) & exist in symbiotic association with BGA.

→ Stem covered by persistent leaf bases.

erect ← → unbranched

→ Dimorphic leaves: Small, triangular scale leaves (provide protection) Green photosynthetic foliage.

Eg: Cycas pectinata

# Male cone:- Of Cycas (Not important)

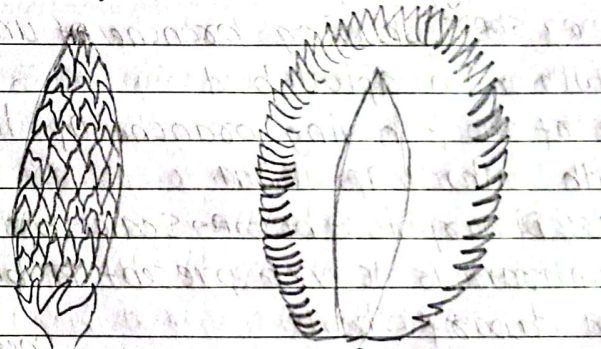
→ Shortly stalked, oval or conical woody structure developed at the apex of stem between crown of foliage leaves.

→ consists several microsporophylls arranged spirally around a central cone axis.

→ microsporophyll is woody, flattened and nearly triangular structure.

↳ differentiated into upper wedge shaped fertile part and lower sterile part.

→ Each microsporophyll consists of number of microsporangia on its lower sides.



Male cone

L.S. of Male cone

~~# Female~~

# Pinus

→ fast growing, long lived, perennial tall tree with excurrent habit (conical shape) ∧

→ Plant body is differentiated into root, stem and leaves.

→ Tap root with lateral roots, help plant to keep firmly in soil.

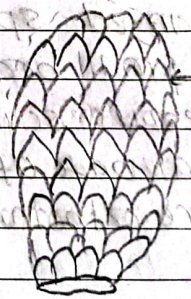
→ Root ~~bo~~ has symbiotic relationship with fungi called mycorrhiza.

→ Stem: erect, branched, woody
Bear two types of branches
(i) Long shoot having branches of unlimited growth with apical bud.
(ii) Dwarf shoot having branches of limited growth without apical bud.

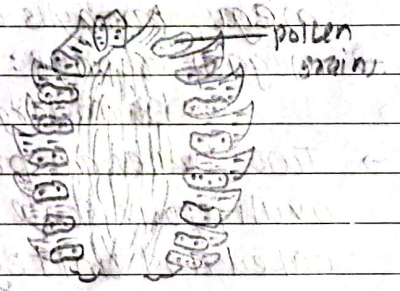
→ Leaves: Dimorphic :- ~~brown~~ → Scale: brown membranous leaves present in both long and dwarf shoots
→ ~~Foliage~~ → Photosynthetic foliage (needle like) leaves developed at apex of dwarf shoots

# Male cone

→ ~~developed in the~~
→ clusters of loosely arranged Male cones are present on lower long shoots just behind apical bud.
→ small oval structure
→ development starts before female cones
→ consists of a centrally located cone axis surrounded by numerous spirally arranged microsporophylls.
→ Microsporophyll: membranous, stalked and roughly triangular structure.
→ Each microsporophyll consist two microsporangia ~~at the~~
→ Each microsporangium has numerous microspores
→ Microspore or pollen grain represents first stage of male gametophyte.



Male cone



L.S. of male cone

# Female cone of pinus

→ arises in the axil of scale leaves at the tip of young upper long shoots singly or in groups.

→ dry, hard and woody

→ takes about 3 years to complete mature.

→ larger than male cone.

→ has central axis on which number of paired scales are arranged spirally.

→ The first year cone is compact with closely arranged sporophyll

→ Second year: large, woody and compactly arranged sporophyll

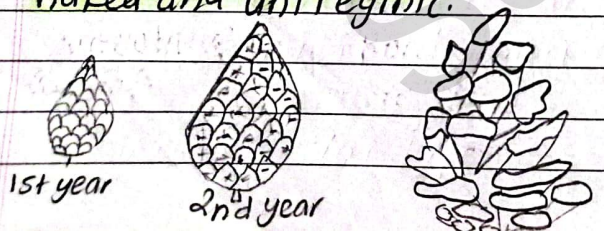
→ Third year: loose and sporophyll separate from one another.

→ ~~comp~~ → female cone has complicated st..

→ has central axis around which many megasporophylls are arranged spirally.

→ megasporophyll: consist small bract scale and large ovuliferous scale

→ Two ovules are present at base of each ovuliferous scale which are orthotropous (straight), naked and unitegmic.




16→ Chem.
17→ Phy
18→ Biology

# Biodiversity (3 marks)

# Nostoc

→ ~~simple unbranched filamentous structure without sheath which is called trichome~~

→ → unbranched filamentous cyanobacterium present in colony. → Each colony appear bluish green mass of jelly.

→ colony covered by gelatinous sheath.

→ each colony consist number of twisted ~~oval or round cells~~ trichomes

→ Trichome with its gelatinous sheath :- filament

→ Trichome bears three kinds of cell

(i) Normal vegetative cell

(ii) Small thick walled akinetes ✓ formed due to storage of large amt. of food.

(iii) large thick walled heterocysts, intercalary in position or sometime terminal barrel shaped ; $N_2$ fixating cell

→ heterocyst take part in $N_2$ fixation. & ~~also~~ sometimes take part in vegetative reproduction.

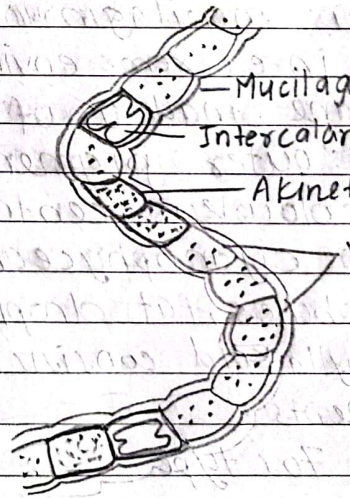



Fig: Nostoc filament.

# Economic importance of ~~Nostoc~~ Cyanobacteria:

(i) Large colonies of Nostoc is used as food.
(ii) They act as producer in the ecosystem due to oxygenic photosynthesis.
(iii) They increase soil fertility due to their nitrogen fixating action.
(iv) Anabaena prevent growth of mosquito.
(v) Different species of cyanobacteria are used to produce anti-inflammatory substance.
(vi) Extract of Lyngbya is used as antibiotics.

# Cellular structure of Nostoc

→ Oval, rounded or spherical in shape.
→ Cell wall: rigid protective covering; made up of peptidoglycan; covered by gelatinous mucilaginous sheath which protects cell in extreme environmental cond.
→ cell-membrane: made up of lipo-protein
→ Protoplasm: outer pigmented chromoplasm inner colourless centroplasm.
→ Chromoplasm: cyanophycean starch, protein globules, fat droplets and gas vacuoles; thylla koid consists of photosynthetic pigments
→ Ribosomes: 70s type
→ Centroplasm: incipient nucleus with double stranded circular naked DNA.

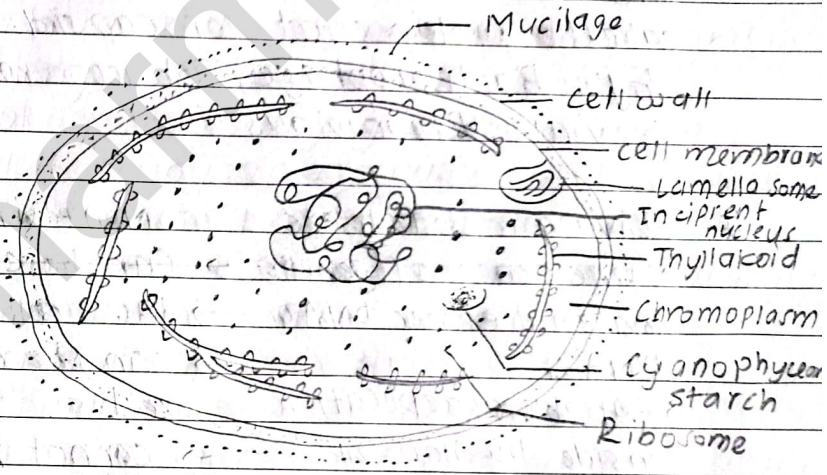



Fig: Ultrastructure of Nostoc cell.

# Viruses

Characteristics:-

→ Ultra-microscopic structure which do not have cellular structures.
→ Obligatory parasite: metabolically inactive outside the host but become active inside the host.
→ Nucleic acid is either DNA or RNA.
→ highly infectious: can transfer diseases in plants and animals.
→ can be crystallized.

→ are in the boundary of living and non-living.
→ protein surrounds the nucleic acid called protein coat or capsid.
Eg:- Bacteriophage, Tobacco mosaic virus, Rhino virus

| # Living characters | Non-living characters |
|---|---|
| → presence of genetic material either DNA or RNA. | → Can be crystallized |
| → capable of replication inside the host cell | → lack cell organelles |
| → can transfer disease | → can be crystallized. |
| → have organic compounds. | → cannot multiply outside the host |
| → can show mutation | → lack of energy storing and using system |

#

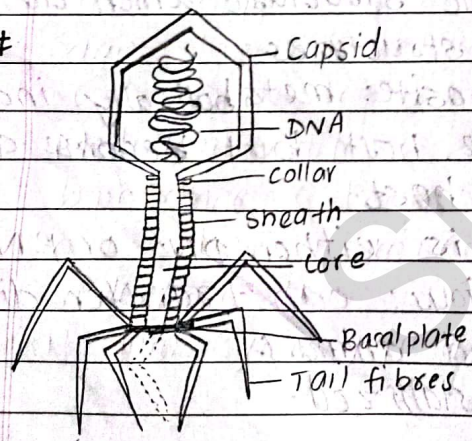



Fig: Bacteriophage

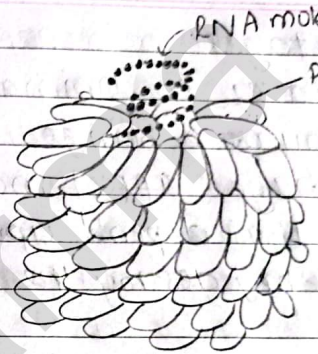



Fig: Part of Tobacco Mosaic Virus

# Economic importance of viruses.
Advantages
→ Tulip mosaic virus makes the tulip flower attractive which can be sold in high price.
→ DNA of bacteriophage is used for the treatment of several disease like cholera, plague, dysentary, etc.
→ Vaccines of several diseases can be produced from antigen of viruses.
→ Viruses can be used as the vectors of gene transfer in genetic engineering.
→ Viruses may destroy the bacterial cell and make water free from bacteria.
→ Detailed features of virus are still unknown. So, virus has good field of study and research.

Disadvantages:
→ Cause diseases in animal and plants including human beings
→ Bacteriophages affect many biochemical industries that depend upon the bacteria because they destroy the useful bacteria.

Eg:- Common cold (Rhino virus),
Ebola (Ebola virus),
corona (corona virus), etc.
Tobacco Mosaic (Tobacco Mosaic Virus),
Bean Mosaic (Bean Mosaic virus), etc.

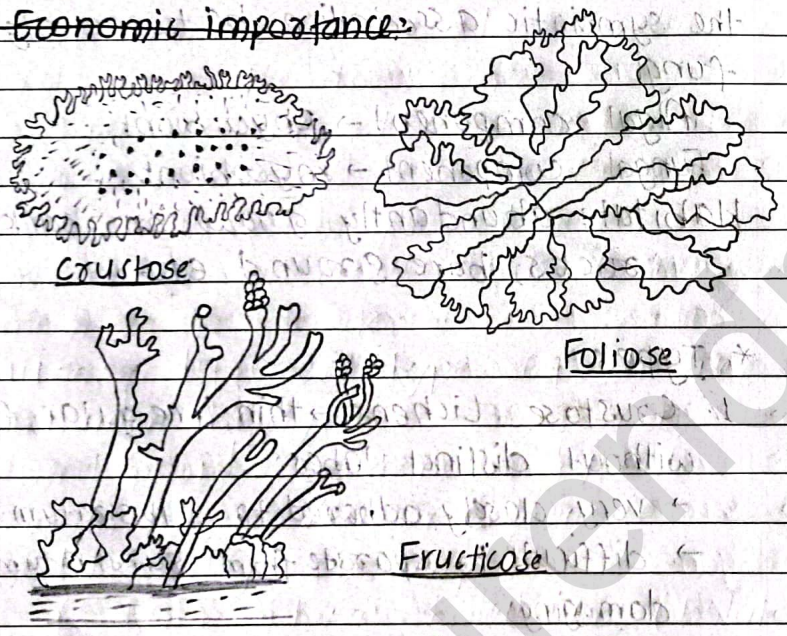
# Economic importance of Gymnosperms.
1. Ornamental values:
Gymnosperms are grown as ornamental plant
Eg: Cycas, Thuja, etc.
2. Food value
'Sago starch' is obtained from stem of C. revolute, C. rumphi, etc.
3. Medicinal value:-
Ephedrine extracted from Ephedra is used in treating asthma, cough, bronchitis, etc.
4. Industrial uses:-
(i) Gum: Cycas gum used as adhesive
(ii) Paper: produced from the wood pulp of Pinus, Picea, etc.
(iii) Timber: Eg: P. roxburghii, sequoia, P. Wallichana, etc.
-used for furnitures, railway sleepers, etc.

# Lichen
→ dual or composite organisms formed by the symbiotic association between algae and fungi
Algal component → phycobiont
Fungal component → mycobiont
Habitat: abundantly grows on bark, leaves, rocks, bare ground, etc.

* Types
1. Crustose Lichens:→ thin, irregular, flat without distinct lobes.
→ very closely adhered to substratum.
→ difficult to separate from substratum without damaging
Eg:- Graphis, Lecanora, Lecidia, etc.
2. Foliose Lichen → flat, much lobed, leaf like
→ loosely attached to substratum with the help of rhizoids like structure called rhizines.
→ easily separated from substratum without damaging Eg:- Parmelia, Physcia, etc.

3. Fructose (Fruticose) Lichens:-
→ branched, cylindrical, bushy
→ tip of branches bear fruiting bodies called apothecia
→ basal portion of thallus attached to substratum by hold fast.
Eg:- Cladonia, Usnea, etc.

~~* Economic importance:-~~




* Economic importance of Lichen:-
(i) Pioneer of vegetation:-
When lichen growing on rock die, they decay to form humus soil on which different vegetation can be grown.
(ii) Bio-indicator of pollution
As the level of $SO_2$ pollution increases, their number decreases. By this trend, degree of air pollution can be predicted.
(iii) Raw materials for medicine:-
Lobaria pulmonaria → Lungs disease
Parmelia saxatilis → epilepsy
(iv) Dyes:- Parmelia, Evernia, etc. are used to manufacture high qualities of dyes.
(v) ~~Be~~ Raw material for perfumes:
Evernia prunastri.
(vi) Food and fooder
* Human food → Sp. of Parmelia, Lecanora.
* Cladonia rangiferina (Reindeer moss) - only food for reindeer in Alpine condition.
* Certaria islandica (Iceland moss)

# Harmful
(i) Cause forest fire (Dry thalli of Usnea in forest easily catch fire)
(ii) Usnea causes allergies ~~and~~ in human.
(iii) Lichenic acid secreted by Lichen damage matter.

# Economic importance of Bacteria:-

→ Bacteria like Azobacter, Rhizobium, etc convert atmospheric nitrogen into different nitrogenous compound and increase soil fertility.

→ Acetobacter aceti produce vinegar.

→ Streptococcus lactis (Lactic acid bacteria) are used in cheese industry.

→ Riboflavin, $B_{12}$, etc like medicine are made from bacteria.

→ E. coli are used in sewage disposal

→ Bacillus mycoides are saprophytic ~~bacteria~~ ammonifying bacteria which convert amino acids of dead organism to ammonia and increase soil fertility.

→ Causes different types of disease in human beings

(i) Typhoid : Salmonella typhi

(ii) Cholera : Vibrio cholera

→ Food ~~spoilage~~ poisoning

Clostridium botulinum (Botulism)

→ Loss of fertility of soil:

Denitrifying bacteria convert nitrite of soil into atmospheric free nitrogen by process of denitrification and reduces $N_2$ content of soil.

Eg: Bacillus denitrificans

# Morphology of Angiosperm:-

Root:- It is generally non-green underground part of plant which help in anchorage and absorption.
It shows positive geotropism and negative phototropism.

Stem:- Cylindrical axis of plant body that develops from the plumule, negatively geotrophic and positively phototrophic.
It consists of nodes, internodes, buds, leaves, flowers, fruits and seeds.

Leaf:- Flattened exogenous lateral outgrowth, developed from nodes of the stem and helps in photosynthesis, transpiration and exchange of gasses.

Phyllotaxy:- Patterns of attachment or arrangement of matured leaves on the stem and its branches.
The leaves are so arranged that they get appropriate amount of sunlight for photosynth

Venation: Arrangement and distribution of vei and veinlets in leaf lamina.

Inflorescence: The arrangement and distribution of flowers in floral axis or peduncl
Types: Solitary, racemose, cymose and specialized.

(i) Solitary inflorescence: consist of single flower instead of group of flowers.
Types: Solitary axillary and solitary terminal.

(ii) Racemose inflorescence: There is indefinite or unlimited growth of floral axis and flowers are developed in acropetal or in centripetal manner.

(iii) Cymose inflorescence: In cymose inflorescence, there is limited growth of floral axis. The growth of floral axis is checked due to development of a flower at its apex.

Flower: Modified shoot of angiosperms that help in sexual reproduction.
They are developed from thalmus or receptacle.

Corolla: Second floral whorl which is colored structure that attracts the pollinating agent towards the flower during pollination. Individual segments of the corolla are called petals.

Androecium: The male reproductive whorl of flower which is present in between gynoecium and corolla. It consist of stamens.

Gynoecium: The fourth and innermost whorl of a flower. It is the female reproductive part of flower. The free unit of gynoecium part of flower is called pistil.

Fruit & Seed: ripened ovule formed after fertilization.

# Lysosomes

Tiny single membrane bound organelles which contain digestive or hydrolytic enzymes. It is generally spherical or rounded in outline. It is surrounded by a single unit membrane made up of lipoprotein.

Types:-

1. Primary lysosomes: first formed lysosomes produced from the Golgi apparatus. It contain inactive hydrolytic enzymes.
2. Secondary lysosomes: Formed from primary lysosomes. It contains active hydrolytic enzyme. So, digestion occurs here. Ultimately, secondary lysosomes is left with undigested food materials. ~~or digestible~~
3. Autophagosomes or autolysosomes: These are formed when the cell feeds on its intracellular organelles such as mitochondria and endoplasmic reticulum by the process of autophagy. They are formed during the deficiency of foreign foods or starvation of the organisms.
4. Residual bodies: They are secondary lysosomes ~~formed~~ ~~food~~ with undigested food. These are generally thrown out of the cell by exocytosis.

# Mitosis Cell Division

→ It is the type of cell division in which single parental cell divides to form two quantitatively and qualitatively similar daughter cells having same number of chromosomes as that of parental cell.

→ It is also called equational cell division or homotypic cell division.

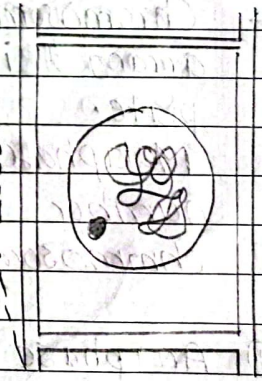
→ It generally occurs in somatic or vegetative cells.

Mitosis completes in two steps:

(i) Karyokinesis
(ii) Cytokinesis

(i) Karyokinesis
- → Division of nucleus
- → completes in four phases

(a) Prophase [Pro-first phase-stage]
- → longest phase of mitosis
- → Chromatin fibres shorten and thicken to form chromosome.
- → nucleolus begins to degenerate along with nuclear membrane
- → Spindle fibres begin to appear



Interphase

(ii) Metaphase [Meta-after or second phases-stage]

→ Nucleolus and nuclear membrane completely disappear.

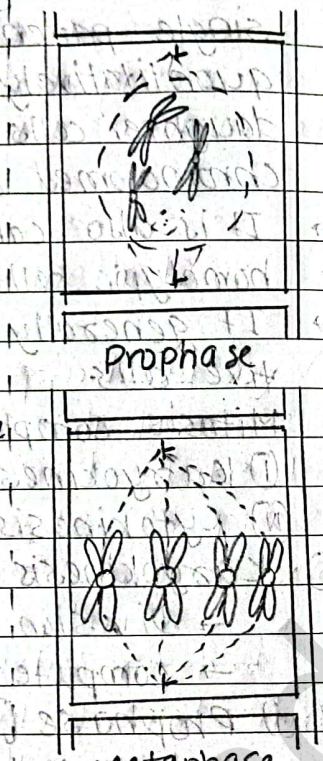
→ Spindle fibres are formed completely and goes towards opposite poles.

→ Spindle fibres of opposite pole get attached to the centromere of chromosome making the chromosome to be arranged at equator

→ The proces by which chromosomes are brought into equator is called congression.

→ Chromosomes are arranged in single line called metaphasic plate.

Metaphase is the best phase to count the number and study the morphology of chromosomes.



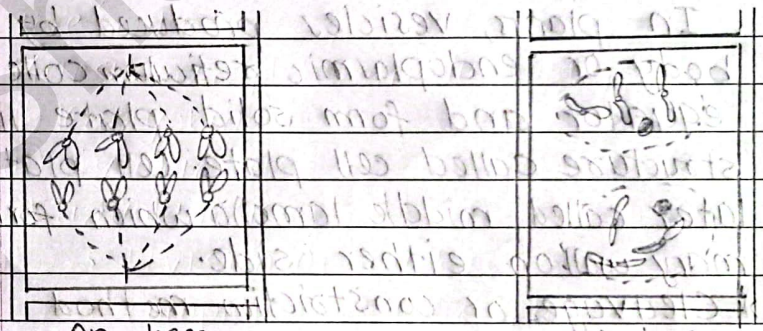

(iii) Anaphase

→ The centromere of each chromose divides into two such that each daughter chromosome has its own centromere.

→ Chromosomes move towards opposite poles due to contraction of spindle fibres such that arms of chromosomes faces equator and centromere towards pole.

→ Chromosomes appear J, U, V, I or I shaped depending upon position of centromere.

→ It is the shortest phase of mitosis.




(iv) Telophase [Telos-end phasis-stage]

→ Last stage of karyokinesis and is reverse of prophase

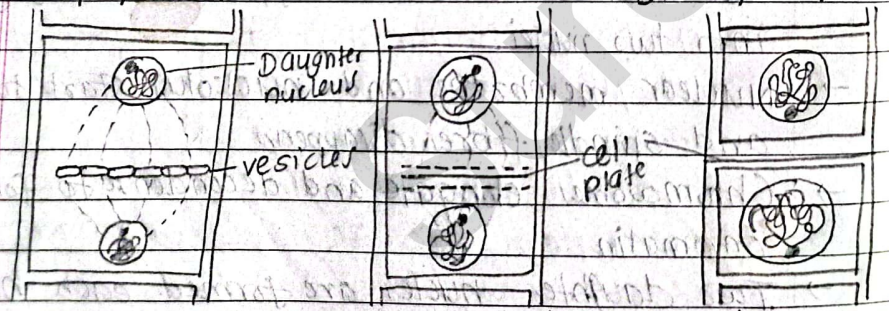
→ Chromosomes lie in two opposite poles organize into two nuclei

→ Nuclear membrane and nucleolus start to reapp and spindle fibres disappear.

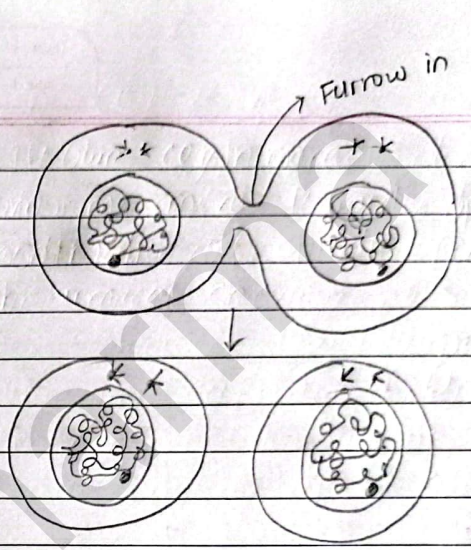
→ Chromosomes elongate and decondense to form chromatin

→ Two daughter nuclei are formed each having same number of chromosome to mother cell.

(ii) Cytokinesis
→ Division of cytoplasm
→ begins from mid-anaphase and generally completes along completion of telophase.
~~Animal cytokinesis:~~
→ Takes place by two methods
(a) Cell plate method
In plants, vesicles produced by Golgi body or endoplasmic reticulum collect at equator and form solid plate like structure called cell plate. Cell plate is later called middle lamella which forms primary wall on either side.
(b) Cleavage or constriction method
→ occurs in lower plants and animals.
→ centripetal constriction appears in the middle of cell at cell membrane.
→ Constriction deepens inside till the division of protoplasm into two daughter protoplasm.



(a) Cellplate method of cytokinesis



(b) Cytokinesis by cell furrow method

Unit-4:

Biota and their Environment

Biota (living component of environment)

# Ecology

Oikos-house logos- the study

Ecology is the study of reciprocal relationship between organisms and their environment.

Types:-

* Autoecology → study of the relation of individual species to its environment (ecology of individuals)
* Synecology → study of the relation of group of organisms to ~~its~~ their environment i.e. between individual of different species with their environment (ecology of community)

* Ecological factors (Environmental factors)

# Abiotic factors:-

↓

non-living factors of the ecology

Types:-

(1) Climatic factors

→ related to aerial environment

(a) Light: photosynthesis; transpiration; chlorophyll formation; growth of flowers, fruits and seeds, movement of animal (Phototaxis) eg: Amoeba, euglena, etc, affect migration among birds.

↑ Ultimate source of energy of all living org.



(b) Temperature: (i) rate of transpiration ∝ temp↑

(ii) rate of photosynthesis ∝ temp

(iii) germination of seed

(iv) absorption of water from soil ∝ temp

(v) Flowing Floweing in plants

(vi) Affects growth & development (extreme low and high temp → adverse effect)

(vii) Hibernation & aestivation

(c) Precipitation (Rainfall): Moisture falling on an area in the form of rain, snow, hail and dew.

~~→ determined by~~ → determines pop. of vegetation and animals.

→ photosynthesis.

(d) Wind (moving air)

→ pollination → dispersal of seeds, spores, etc.

→ mechanical injury → in strong wind increases rate of evaporation & transportation leading desiccation in plants.

→ soil erosion

(e) Atmospheric Humidity: amount of water vapour present in the atmosphere.

→ affects transpiration

→ controls growth of epiphytes: orchid.

(f) Fire: caused naturally due to lightning or volcanic activity and due to human activity.

→ kills many lives and destroy vegetation

Ecology (Biota and the Environment)
↳ term 'Ecology' was given by Ernst Haeckel. in 1869.
→ The literal meaning of Ecology mean the study of Home
Oikios = Home ; logos = study

Ecological factors (Environmental factors)
→ Any external agent, substance or condition which surrounds the living organism and (influences) the life of organism is known as ecological factors.

Ecological factors
- ABIOTIC (Non-living)
  - Climatic factors (factors governing climate of area)
    - ↳ light
    - ↳ Temperature
    - ↳ precipitation (Rainfall)
    - ↳ Atmospheric Humidity
    - ↳ Wind
    - ↳ Fire
  - Edaphic (soil factors) factors
    - ↳ Soil pH
    - ↳ Soil Texture
    - ↳ Soil air
    - ↳ soil water
    - ↳ soil organic matter
    - ↳ Soil minerals
  - Topographical (phy. st. of land) factors
    - ↳ Altitude (Ht. of place from sea level)
    - ↳ Steepness
    - ↳ Direction of slope
- BIOTIC (living)
  - ↳ Animals (Heterotrophs)
  - ↳ Plants (Autotrophs)

OR

Producers
Consumers
Decomposers

brings variation in distribution of plants, animals and microbes

CHONPK CaMg

Edaphic factors (Soil factors)
(i) Soil pH → hydrogen ion concentration of soil.
→ growth and development of every organism is determined by pH.
→ determines fertility of soil.

(ii) Soil texture → directly influences soil water, soil penetration, soil aeration.
→ Loamy soil is best for plant growth due to good mineral, aeration and hydration.

(iii) Soil air → gases present between soil particles.
→ contain three gases mainly $O_2$, $N_2$, & $CO_2$
→ $O_2 \downarrow$ → kills aerobic bacteria

(iv) Soil water → fulfills water requirements of plants

(v) Soil organic matter → makes soil porous & increases aeration of soil.

~~(vi) Soil mine~~

Topographic factors (physiographic factors)
(i) Altitude → ↑ Altitude ↑ → Temp ↓ → rainfall ↑
(affect vegetation of place.)

(ii) Slope of land → affect amount of solar radiation received
→ rain water runs rapidly on slope → no absorption of water & soil remains dry
→ Possibility of soil erosion increases
→ Less plants on slope.

(ii) Direction of slope → dry air
If slope receive less light → best for Xerophytic plants
(north facing slope of Himalayas)
If slope receive more light → dense vegetation
(south facing slope of Himalayas)

# ~~Biotic~~ # Biotic factor (Living component)

(a) Autotroph → Green plants photosynthetic bacteria and cyanobacteria
→ producer

(b) Heterotrophic components (consumers)
→ fed on producers for consuming organic food prepared by them.

(i) Primary consumers → first order consumers directly fed upon plants.
→ herbivours

(ii) Sec. → carnivorous and omnivorous
→ feed upon producers or primary

(iii) Tertiary → take food directly from sec. & indirectly from primary or producers
→ tiger,

(c) Decomposers:- Microscopic org. converting dead and decaying complex organic matter into simple inorganic compounds
→ Bacteria & fungi

# Biotic interactions

→ interaction between organism of particular environment with respect to physical factors
→ may be harmful or beneficial.

Two types:-

(1) Interspecific interaction: between two different species

(2) Intraspecific: between individuals of same species

① Positive interaction (Help)
② Negative Interaction (Harm)

Positive interaction

↙ Interspecies P.I (Between 2 species)

* Mutualism:- (Both the species in the relationship is Benefited, the relationship is obligatory)
Obligatory - Essential for life.
Eg:- Relationship between Algae & Fungi of Lichen. Rhizobium (sp.) & leguminous plant
* Protocooperation: (same as mutualism, but not obligatory)
Eg:- Relationship bet" cattle and Insect picking birds.
* Commensalism: (One sps is benefitted whereas another neither Benefitted nor harmed
*eg: (i) Orchid and host (ii) Hermit crab & sea anemone

→ Intra specie P.I (with in same sps.)

* Colonization: The tendency of a sps. to form a colony
eg:- Volvox, Nostoc
* Social organization: Division of labor within the individuals of same sp.
Eg:- Division of labor bet" Bees a hive (i) Queen (ii) Worker Bee (iii) Drone).
* Aggregation ✓
Concentration of individuals of SP by their conscious effort
Eg:- → Birds migrate in large fl
→ shelter Eating group
* Neutralism: (Tw species interact, hou neither of two species Benefitted or harmed.
eg:- Leaf eating insect

Mutualism (+,+, Obligatory), Proto-cooperation (+,+, Non-obligatory), Commensalism (+,0), Neutralism (0,0), Scavenging (+,0, scavenger), Mimicry (+,0, mimic).

# Negative interaction (Harm)

(+,0 - predator, prey)

* Predation: (One sp kill another for food) Relation between predator and prey.
(+,-) Eg:- Tiger and deer

* Competition: Competition is race between individual of a species or between two species to obtain Nutriet, feeding ground, Mating right, etc.

* Parasitism: ↳ Eg: Bet~ rice and weed
(+,-, parasite, host)
One Specie inhabit the body of another species and extract Nutrients from the body of Host.
Eg:- Sheep and liverfluke

(Amensalism (-,0), chemical)

* Antibiosis:- It is a phenomenon, where one species create specific condition which is harmful to another
Eg:- Betn different Bacteria

Aggregation:- Type of interspecific interaction in which Organisms live together in large number, but there is no division of labour.
Eg:- Swarming in flies, mosquitoes, etc.

# Ecosystem

↳ The term ecosystem Ecology is proposed by A.G. Tansley
↳ Eco-Environment System: Inter ~~relation~~ reacting System/unit
↳ In simple term Ecosystem can be defined as the interaction between biotic and abiotic factors (components) of Environment.
↳ Self sustaining and self-regulating unit of Environment is known as Ecosystem.
↳ unit of Ecology

* Types of Ecosystem:
~ Artificial (Manmade)
Eg:- Farm Land or crop land, Aquarium, Zoo, etc.
~ Natural (Non-Manmade)
- Terrestrial
  Eg:- Grassland Ecosystem, Forest ecosystem
- Aquatic
  - Freshwater
    Eg: Pond Ecosystem
  - Marine
    Eg: Ocean Ecosystem

# Trophic (level)/Feeding Group/Energy group
↳ It is the group of living organism based on feeding Nature.
(mode of getting/obtaining Energy)

Producer
Consumer → Primary consumer
→ Sec consumer
→ Tertiary consumer.

Decomposer → Bacteria
↳ Fungi

# Food chain
The process of transfer of energy from one trophic level to another trophic level by the process of Eating or being eaten in a simple way or one direction is known as food chain.

* Grazing food chain/Predatory
→ starts from green plant (Producers)
→ source of energy is the sun/solar radiations.

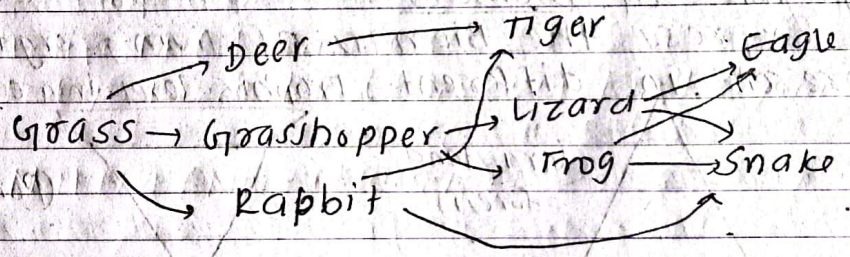
Grass → Grasshopper → Frog → Snake → Eagle

* Parasitic food chain (Producer or consumer)
↳ starts from host body (Plant/Animal)
→ source of energy is the host itself.
→ Sheep → liverfluke.

* Detritivorous food chain
↳ starts from a dead body (Plant/Animal)
→ source of Energy is the dead body.
→ Detritus → dead bodies of plant or animal.

→ Dead body → Detritivorous
Dead body → Magus → Beetle → Frog

# Food web
The process of transfer of energy from one trophic level to another trophic level by the process of eating or being eaten in complex way or in multiple direction is called food web.

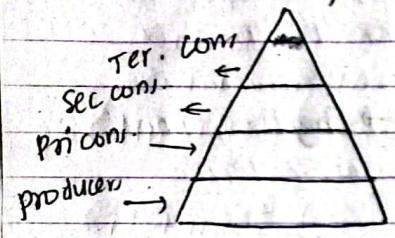



→ Network of interconnected food chain

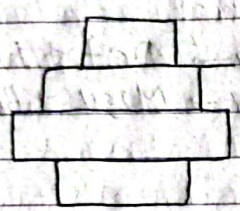
# Ecological Pyramid
The graphical representation of different ecological parameter like number, biomass or energy of different trophic level is known as Ecological pyramid.

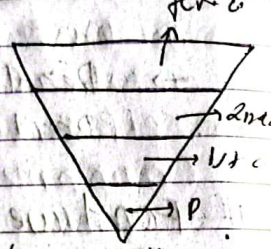
* Types

# Pyramid of Number
→ Expres the no. Of living organism of Each trophic level in a ecosystem



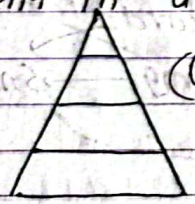
(Grassland, Pond)
(Upright)

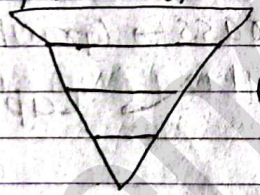

(Forest)
(Spindle shaped)



(Parasitic food chain)
(Inverted)

# Pyramid of Biomass → dry weight per unit area of living org.
→ Expres the Biomass of living organism present in different trophic level in a ecosystem


(Grassland forest)


(Pond)

# Pyramid of Energy
→ Expres the energy content of living organism in Diff. TL
→ ~~10%~~ only 10% of energy is transferred from one trophic level to next trophic level


(All Ecosystem)

Defn. + . . .
St. com, Biotic com
Func. Eco. Py.

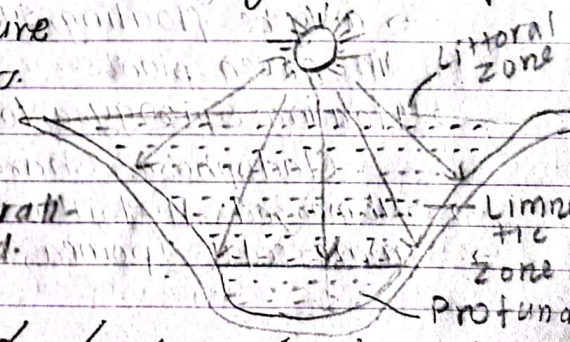
# Pond Ecosystem
Pond represents a self sufficient and self regulatory lentic (stagnant) fresh water ecosystem where there is interaction of abiotic and biotic component. Pond are small bodies of shallow water that receives water either from rain or from runoff water.

* On the basis of availability of light for photosynthesis, ponds generally have three zones.

(i) Littoral zone → It is large and shallow water region, which gets sufficient light, so it is best for photosynthetic organism.
→ There is wide fluctuation of temperature.

(ii) Limnetic zone
→ central region of pond
→ Less intensity of light, & less fluctuation of temp.
→ best for heterotrophic consumer

(iii) Profundal zone
→ deepest part
→ no effective penetration of sunlight & least fluctuation of temperature
→ best for Decomposers.



Horizontal stratification of pond.

# Components of pond ecosystem

* Structural components

It may be

(i) Abiotic factors or components

→ non-living component which include climatic factors, chemical factors, edaphic factors, etc.

Climatic factors:- sunlight, temperature, air (dissolved oxygen and carbondioxide), rainfall, etc.

Chemical factors:- include inorganic substances such as water, $CO_2$, $O_2$, nitrogen, calcium, etc. and their compounds and organic substance like amino acids, lipids, nucleic acids, etc.

Edaphic factor:- soil water, soil texture, humus, etc.

Physiographic factor: altitude, latitude, longitude, depth of water, exposure of areas, etc.

(ii) Biotic components

comprises producers, consumers and detrivores.

Producers: can prepare their own food by the process of photosynthesis.

→ may be floating, submerged or immersed aquatic green plants.

→ Floating: Spirogyra, Volvox, Anabaena, diatoms, Cladophora, Chara, Wolfia, etc.

→ Submerged: Hydrilla, Potamogeton, etc.

→ Immersed: Ipomea, Typha, etc.

Consumers: (i) Primary consumers: tadpole (larval) of frog, fishes, insect larval, zooplanktons (Amoeba, Paramecium, etc.) which directly take food from producers.

(ii) Secondary consumers: includes water insects, fishes, frogs, crabs, water beetle, etc which take food directly from primary consumers and indirectly from producers.

(iii) Tertiary consumers: Take food directly from secondary consumers and indirectly from primary consumers and producers

→ include water snakes, large fish, crocodile, water birds, etc.

Decomposers:-

→ microscopic organisms that convert dead and decaying complex organic matter into simple inorganic compounds.

→ Eg:- Aquatic bacteria and fungi.

* Functional components:-

Food chain: It is the process of transfer of energy from one trophic level to another trophic level by the process of eating or being eaten in simple form or in single direction in pond ecosystem.

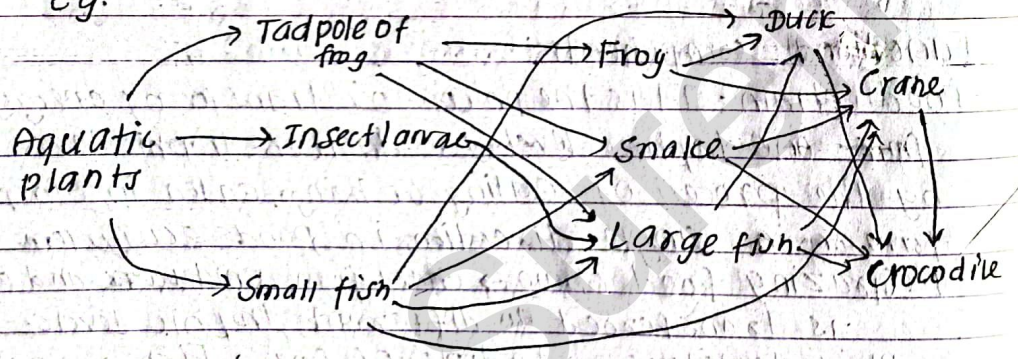
1. Grazing food chain → start from producers and energy is transferred to different trophic levels.

Phytoplanktons → Tadpole of frog → Fish → Snake

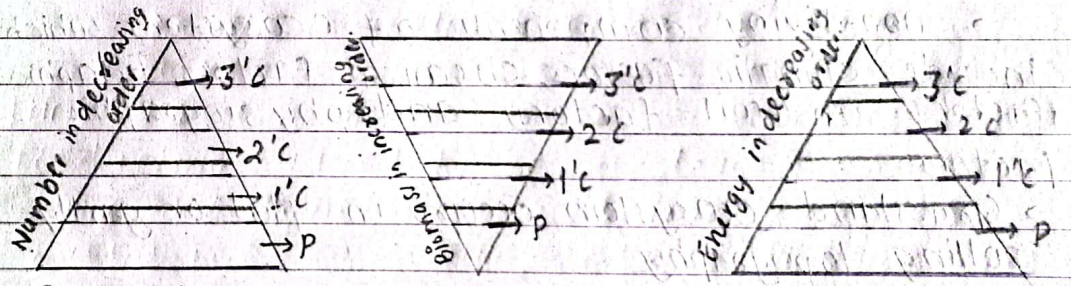
2. Detritus food chain:
→ Starts from dead and decaying matter and transfers to detrivores and their predators.
Eg: Dead bodies (Detritus) → Detrivores (bacteria, fungi) → Detritus consumers (mollusca, insect larvae, etc.)

3. Parasitic food chain
→ starts from producer or consumers and is transfered to parasite and then to hyper-parasite.
Fish → Parasite → hyperparasite.

Food web: It is the transfer of energy from one trophic level to another trophic level by the process of eating or being eaten in complex form or in multiple directions in pond ecosystem.
Eg.




Ecological pyramids:
They are diagramatic representation of different parameters of ecosystem like biomass (dry weight of living organism), energy or number at different trophic levels. Thus, such pyramids are divided as:-
(i) Pyramid of number representing numbers of organisms in different trophic levels in pond ecosystem which is upright as number of organism goes on decreasing order from producers to top consumers.
(ii) Pyramid of biomass representing biomass of organisms in different trophic levels which is inverted as biomass of organism goes on increasing order from producers to top consumers.
(iii) Pyramid of energy representing energy of organism in different trophic levels which is upright as only 10% of total energy is transferred from one trophic level to another.




Pyramid of number | Pyramid of biomass | Pyramid of energy

P → producers
1'c → Primary consumers
2'c → secondary consumers
3'c → Tertiary consumers.

# Grassland Ecosystem

→ Open type of terrestrial ecosystem that occurs in those areas where annual rainfall is low having the dominant vegetation of different type of grasses along with herbs, shrubs and few scattered trees.

→ exhibits a self sufficient and self regulating system where there is interaction between abiotic and biotic components.

Eg: Savannah grassland of Africa.

## Components of grassland ecosystem.

→ consists of structural component and functional component.

### * Structural components

→ consist Abiotic components and biotic components

### Abiotic component:

→ non-living components of ecosystem which include climatic factors, chemical factors, Edaphic factors (soil factors) and physiographic factors.

→ Grassland ecosystem occurs in flat or gently rolling topography

→ Climate is continental with hot summer and cold winter. Fires occur occasionally.

→ Rainfall is 25-75cm/year

→ Top soil of grassland ecosystem is rich in nutrients and porous.

→ The pH is usually neutral, which makes the top-soil favourable for grass growth.

### Biotic components

→ living components

(i) Producers → organisms which can prepare their own food by the process of photosynthesis.

→ Different type of short and tall grasses are dominant. → herbs, shrubs & few scattered trees.

Eg:- Buffalo grass (Buchole), rice grass (Oryzopsis), Burmuda grass, slough grass (Spartina sp.), Poa sp., etc.

(ii) Consumers → depend upon the producers for food directly or indirectly.

(a) Primary consumers :→ take food directly from producers. (herbivores)

→ deer, snail, rabbit, grasshoppers, flies, bugs, etc.

(b) Secondary consumers :→ take food directly from primary consumers and indirectly from producers. (carnivores)

→ birds, spiders, lizards, toads, beetles, etc., tiger, lion, etc.

(c) Tertiary consumers → omnivores

→ snakes, lions, tiger, owl, hyena, hawk, leopard, etc.

(iii) Decomposer → microscopic organisms that convert the dead and decaying complex organic matters into simple inorganic compounds & increase soil fertility.

→ Terrestrial bacteria and fungi.

## Functional components

→ include food chain, food web and ecological pyramids.

## Food chain

→ It is defined as the process of transfer of energy or food from one trophic level to the another trophic level by the process of eating or being eaten in simple form or in single direction.

→ Three types

(1) Grazing food chain starting from green plants
Grasses → grasshopper → Frog → Snake.

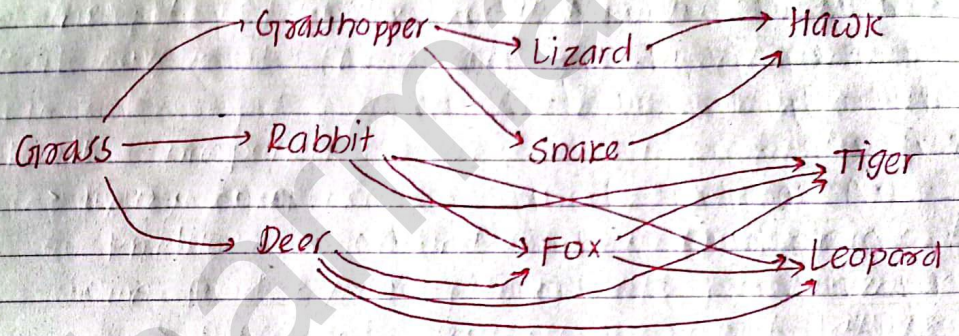
(2) Detritus food chain starting from dead and decaying matters.
Fallen leaves and dead bodies (detritus) → Detrivores (bacteria, fungi) → Detritus consumers (insect larva, crustaceans, etc.)

(3) Parasitic food chain starting from other producers or from any consumers.
Rabbit → Parasites → hyper parasites.

## Food web

→ It is defined as the process of transfer of energy or food from one trophic level to another trophic level by the process of eating and being eaten in complex network like form or in multiple directions.

→ network like interconnections of food chains.




## Ecological pyramid

→ The graphical representation of ecological parameter like number, biomass or energy of organisms at different trophic levels is called ecological pyramid.

→ Depending upon parameter ~~it is of~~ there are three ecological pyramids in pond ecosystem. They are pyramid of number, pyramid of biomass and and pyramid of energy.

→ In pond ecosystem, all three pyramids are upright or erect which denotes that number, biomass or energy of organisms is in decreasing order from producer to different level of consumers.

# Community & Succession:

# Community: A group of individuals of different species of plants and animals living together with mutual adjustment and beneficial interactions in an ecosystem.

→ A community has its own structure, developmental history and behavior.

Eg:- A forest, grassland, pond, etc.

# Succession:

Ecological succession:

The gradual process in which communities of plants and animals species in a particular area are replaced by a series of different communities that are more complex is called ecological succession.

→ It is complex, gradual and continuous which never stops unless a stable community is formed. The final stable community is called climax community.

→ Seral stages:- Dif. intermediate stages of succession

→ Sere: All stages of succession from pioneer community to the climax community.

## * Causes of succession:-

Landslide, earthquake, volcanic eruption, flood, deforestation, forest fire, urbanization, etc.

## Types of Succession

(i) Primary succession:

| Primary succession | Secondary succession |
|---|---|
| (i) Succession that starts from nude or barren area where there is no previous life. | (i) It starts from nude area where there is previous life. |
| (ii) Longer period of time is required to ~~start~~ develop first life. | (ii) Shorter period of time is required to develop first life. |
| (iii) It needs thousands of years to develop climax community. | (ii) It takes 50-100 years to develop climax community. |

## * General process of Succession:-

All processes of succession occur in sequential steps which follow one after another.

The various steps in sequence are:-

1. Nudation: This is the process of development of nude or bare area. It is caused by natural causes and artificial causes.

(a) Natural causes:- Landslide, Earthquake, volcanic eruption, flood, natural forest fire, hail and storm, etc.

(b) Artificial causes: Deforestation, overgrazing, urbanization, forest fire by human beings etc.

2. Invasion: This is the successful establishment of life in bare area.
It includes following stages:
a. Dispersal (Migration): The seeds, spores and propagules are carried by animals water or wind to the bare areas. This is called migration or dispersal.
b. Ecesis (Establishment): The process of successful establishment of life in nude area by dispersal or migration of seeds, spores or propagule is called ecesis.
c. Aggregation: After ecesis, the individuals of species increase in number due to reproduction and come close to each other. This is called aggregation.
3. Competition and coactions:
After aggregation, large number of individuals of the species at the limited place start competition for food/space. Individuals of a species affect each other's life in various ways called coaction. The species that are unable to compete each other are discarded.
4. Reaction: Reaction is the mechanism of modification of environment through the influence of living organisms. As a result of reaction, environmental condition is modified which is unsuitable for existing community. So, it is replaced by another community.
5. Stabilization: It is a process of development of final stable or equilibrium community (climax community) which cannot be replaced by other community for long period of time.

## * Process of succession in Hydrosere.

Hydrosere is a type of succession that starts from water bodies like ponds, pools, or lakes. Various stages involved in hydrosere are described below

(1) Phytoplankton stage (pioneer stage):
Phytoplanktons (some blue green algae, green algae, diatom etc.) are colonized in water body as pioneers or first community organisms. After death and decay of phytoplankton there is formation of thin layer of soil which is unsuitable for survival of existing community.

(2) Rooted submerged stage:
The soft mud at the bottom of pond is suitable for the growth of rooted submerged hydrophytes like Hydrilla, Chara, Utricularia, etc. They form dense growth. After death and decay of these plants, they deposit at the bottom of pond and decrease water level of pond which is unfavourable for the survival of existing community.

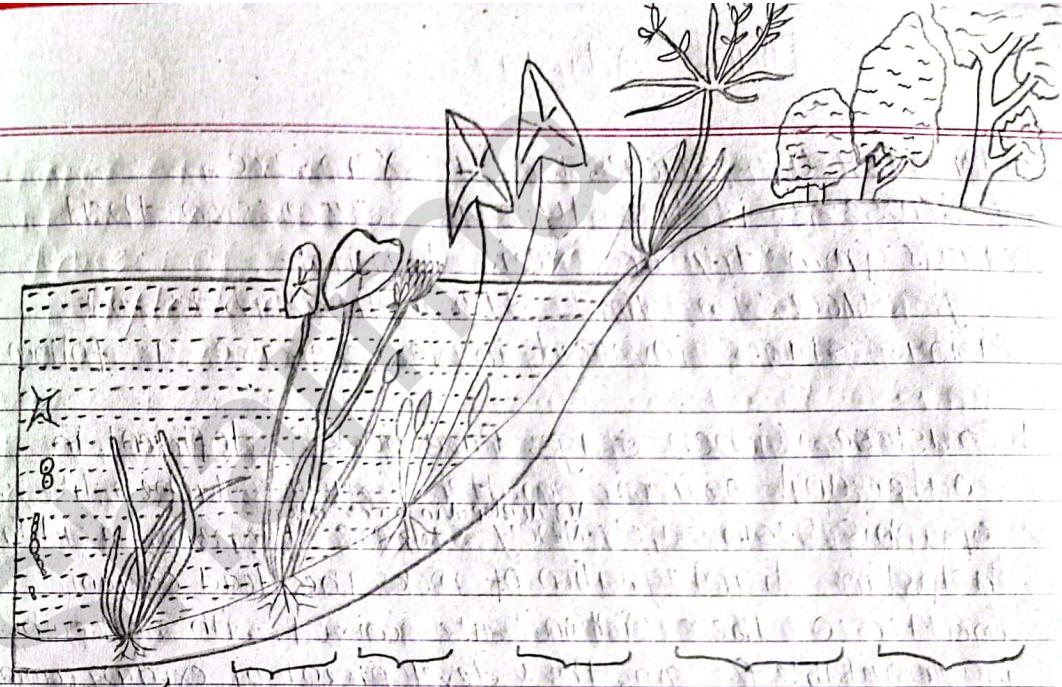
(3) Rooted floating stage:
The new habitat creates the favourable condition for the growth of rooted floating hydrophytes like Wolfia, Pistia, Nelumbo, Azolla, etc. Again, after their death and decomposition in the substratum, water level decreases and rooted floating hydrophyte are replaced by amphibian plants.

4. Reed-swamp stage (Amphibian stage):
Amphibian plants like Typha, Sagittaria, Phragmites, etc. are rooted at the bottom of pond but shoot remains exposed to air in this stage. Such habitat stage is called reed swamp stage. After, their multiplication, large amount of decaying organic matter are deposited at bottom of pond by their death so marshy habitat changes to moist soil which is unsuitable for their growth.

5. Sedge-Meadow stage:- In the moist soil plants like Juncus, Carex, Cyperus, etc appear. Because of high rate of transpiration of these plants, water is lost rapidly and sooner or later the mud gets exposed to air and becomes drier. Ultimately, these vegetation gradually disappear.

6. Woodland stage:- In the drier soil, there is growth of terrestrial plants like shrubs and small trees like Acacea, Salix, Cornus, Populus, Alnus, etc.

7. Climax or forest stage: The Woodland community is rapidly replaced by several trees by the progressive accumulation, of humus rich with microbes. Then dominant vegetation of large sized woody trees is developed along with herbs and shrubs which cannot be changed for longer period of time.



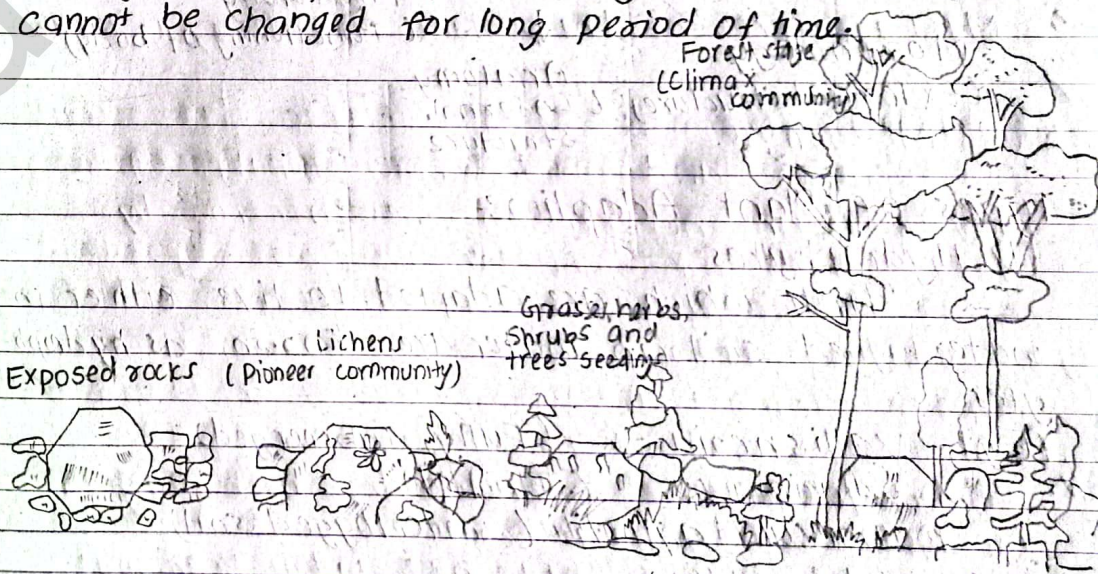
## * Process of succession in Xerosere

Xerosere is the type of succession that starts from dry or xeric habitat.

Eg:- Succession that starts from bare rock.

Various stages involved in xerosere are as follows:-

1. Crustose Lichen stage: Bare rock is deficient in water and organic matter. Crustose lichen like Graphis, Lecanora, etc. are developed in bare rock. They secrete Lichenic acid that helps in disintegration of rocks. The dead organic matters of these lichens are mixed with rocks which is unsuitable for growth & development of existing community.
2. Foliose lichens stage: Foliose lichens like Parmelia, Lobaria, Xanthoria, etc. appear on the substratum formed by the death and decay of crustose lichens. Further disintegration of rock particles and death and decay of lichens result in formation of fine thin soil layer on rock surface which is unsuitable for growth and development of existing community.
3. Mosses stage: Mosses like Polytrichum, Funaria, Tortula, etc. grow and develop on thin soil layer on rock surface. Further thickening of soil layer takes place due to death and decay of these mosses, which is unsuitable for growth and development of existing community.
4. Herbs stage: In the thick soil layer, there develops and grows herbs as well as grasses like Aristida, Festuca, Poa, Solidago, etc. The thickness of soil layer is further increased due to death and decay of herbs and increase the organic matter in the soil.
5. Shrubs stage: In thus formed soil surface growth and development of shrubs of species Rhus, Phytocarpus, etc. take place. Due to their death and decay, there is further increasing the organic matter in the soil which is suitable for the growth of trees.
6. Forest stage or climax stage: In thus formed soil, xerophytic trees develop and grow. Further weathering of rocks and increasing humus content of soil favour arival of more mesophytic trees and other vegetation. Finally, climax of forest community is developed which cannot be changed for long period of time.




Process of Xerosere Originating in bare rock.

# Plant Adaptation

**Adaptation:-** Process of change by which an organism or species becomes better suited to its environment.

OR

Feature of plant or animal that help them to live successfully in their habitat.

Thus,
The development of special features/characters in response to its environment, which help it to live successfully in that particular environment or habitat.

Adaptation
↓
Change → Physiology (Functioning of body)
↙ ↓
Morphology (External structure) Anatomy (Internal structure)

## Types of Plant Adaption:-

### (1) Hydrophytes

Plants which are adapted to live either in waterlogged soil or in water are known as hydrophytes.

Eg:- Vallisneria Sp. (Fully submerged)
Salvinia sp. (Floated)
Ranaculus aquatilis (waterlogged soil)

**Roots:-**

- Roots are completely absent or poorly developed.
- Roots are generally fibrous types which usually lacks root hairs and root caps.

Root is for anchorage and absorption. As hydrophytes do not face scarcity of water they have poorly developed root (and absorb water through body surfaces)

**Stem:**

- In some hydrophytes the stem is long and slender, whereas in some it is spongy.
- In other stems may be modified into rhizome or runner.

**Leaves:**

- Leaves of floating hydrophytes are smooth, shining and coated with wax. (larger to keep plant afloat)
- Leaves of submerged species are reduced and thin.
- Cuticle is absent or poorly developed in stem and leaf.
- Stomata are totally absent in submerged part.

Cuticle: layer covering skin of plant
↳ prevents water loss

- Tissues with air spaces (Aerenchyma) are present in the leaves and stems.
- Aerenchyma help in gaseous exchange and provide buoyancy to the plant.
- Mechanical tissues are poorly developed to provide flexibility to stem.
- Vascular tissues are also poorly developed. In some cases xylem consist of few tracheids.
- Pollination and dispersal of fruits and seeds are done through water.
- Fruits and seeds are light weighted so they can float in water.
- Transpiration is absent in submerged parts.
- Mucilage prevent the plant from decay in water.

# (2) Mesophytes

Common land plants which inhabit those places that are neither too wet nor too dry.

Eg:- Impeorata sp.
Rosa sp.
Salix sp.

## Root

- Root system is well developed, which may be tap root or adventitious root.
- Roots are highly branched and it bear root caps and root hairs.

## Stem

- Stems are generally aerial, rigid and branched or unbranched.

## Leaves

- Leaves are usually large, broad and varied in shape.
- Cuticle is moderately developed all over aerial part.
- Numerous superficial stomata are present in both surfaces of leaves.
- ~~Vascular~~ Vascular and mechanical tissues are ~~poorly~~ properly developed.
- Pollination occurs through air and agents like insects, birds, etc.

# Xerophytes

Plants which grows in dry environment or habit at (xeric condition).

Eg:- Euphorbia virosa
Agave americana
Dudleya pulverulenta

## Root

- Root system is well developed and profusely branched.
- Root hairs are densely developed around the tip of the roots.

## Stem

- Stem may be aerial or subterranean.
- Stems of some xerophytes may be hard and woody, where as other may be phyllocade (fleshy stems which store large amount of water).

## Leaves

- In many xerophytes, leaves are generally reduced (scales, needles or spines) and are provided with thick cuticle and dense wax coating.
- Leaves are small and finely divided ~~leaves~~ which falls during dry seasons.

Modification in leaf is mainly to avoid transiration (process of loring water from aerial part of plant).

- Adaptation for water storage include ~~wood~~ succulent leaves, succulent stems, and underground structures such as tubers.
- Heavy cutinisation, lignification and wax deposition on the surface of plants parts are common adaptation to avoid the water loss through transpiration.
- Sunken stomata are also very important features of xerophytes to restrict transpiration.
- Vascular and mechanical tissues are well developed in the xerophytes.
- Flowers develop in the favourable conditions.
- Fruits and seeds are covered by very hard shells.

# Bio-geochemical Cycle

Biogenetic nutrients:- Elements required for the proper growth and development of living organisms.

The cyclic movement or circulation of biogenetic nutrients of the biosphere in between the abiotic components and biotic components is called bio-geochemical cycle.

## # Nitrogen cycle

→ The cyclic movement or circulation of nitrogenous nutrients of the biosphere in between the abiotic components and biotic components is called nitrogen cycle.

→ gaseous cycle

→ Nitrogen: constituent of dif. organic molecules like amino acid, protein, nuclei acid, vitamins, etc.

→ major constituent of atmosphere (78% of total volume)

### Steps:-

1. Nitrogen fixation: Process of conversion of atmospheric free nitrogen into biologically acceptable nitrogenous compounds like ammonia, nitrites, nitrates, etc.

It occurs ~~by~~ in following ways:

(i) Non-biological or physio-chemical nitrogen fixation:

In this process, atmospheric free nitrogen combines with oxygen and forms oxides of nitrogen during lightning. Oxides of nitrogen dissolve in rain water

or moisture and forms nitric acid which combines with salt and form nitrates compounds on reaching in land.

$O_2 \rightarrow O + O$

$N_2 + 2O \rightarrow 2NO$

$NO + O \rightarrow NO_2$

$N_2 + O_2 \rightarrow 2NO$

$2NO + O_2 \rightarrow 2NO_2$

$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

$HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$

(ii) Biological nitrogen fixation:-

Atmospheric free nitrogen is converted into nitrogenous compounds by bacteria and cyanobacteria. $N_2$ fixating fixing microorganisms may be free living or symbiotic.

Free living: Azobacter, Clostridium, Nostoc, Anabaena, etc., etc.

Symbiotic: Cyanobacteria (Nostoc, Anabaena), Rhizobium bacteria found in leguminous plants, etc.

2. Nitrogen assimilation:-

Process of conversion of one form of nitrogenous matter of organism to other form of nitrogenous matter of same or different organisms.

Inorganic nitrogenous compounds formed after nitrogen fixation is absorbed by plants and converted into nitrogenous organic compounds (amino acids, proteins, enzymes, nucleic acid, etc) then after absorbing protein of plant by animals, it is changed into protein of animal and broken down into nitrogenous wastes such as urea, uric acid, and ammonia and excreated out.

3. Ammonification: Process of conversion of nitrogenous compounds contained in dead bodies of plants and animals and animal excreta into ammonia by the action of decomposers is called ammonification.

Ammonifying bacteria:- Bacillus racemos, B. vulgaris, B. mycoides, etc.

4. Nitrification: Process of formation of nitrites of soil and then nitrate of soil from ammonia by nitrifying bacteria such as Nitrosomonas, Nitrococcus, Nitrobacter, Nitrocystis etc is called nitrification.

$2NH_3 + 3O_2 \xrightarrow{\text{Nitrosomonas}} 2NO_2^- + 2H^+ + 2H_2O$

$2NO_2^- + O_2 \xrightarrow{\text{Nitrobacter}} 2NO_3^- + \text{energy}.$

5. Denitrification: Process of changing ammonia and nitrates of soil into atmospheric free nitrogen by the denitrifying bacteria like Thiobacillus denitrificans, Bacillus denitrificans, Micrococcus denitrificans, etc.

$2NO_3 \rightarrow 2NO_2 \rightarrow 2NO \rightarrow N_2O \rightarrow N_2$