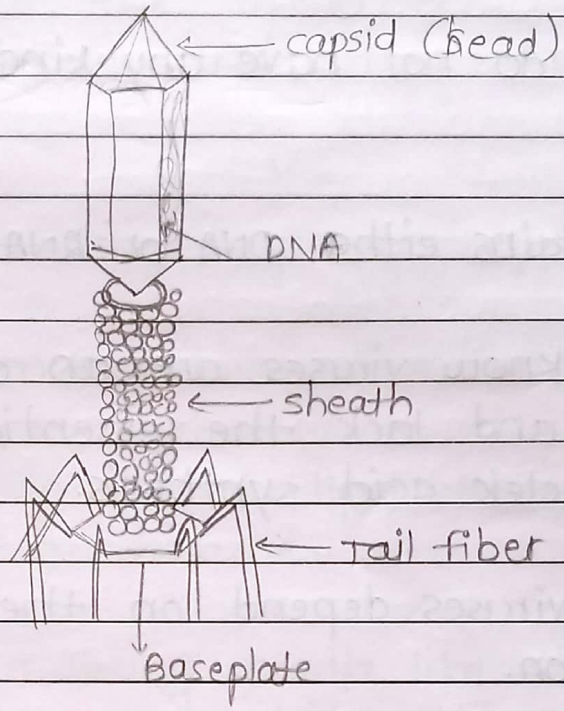
1.1 Viruses

Date
Page

* **virus :**

obligate intracellular parasite composed of : Nucleic acid either DNA or RNA Protein coat.



virus.

* **Characters of viruses :**

1. Viruses are obligate intracellular parasite they require a living cell or organism for its multiplication.
2. It can infect ~~cell~~ all living forms including plants, animals and bacteria.
3. Viruses can be observed by electron microscope.
4. They are 10 to 100 times smaller than bacteria and its size oranges from 20 to 300 nm so these viruses can pass easily through bacteriological filter paper.

5. size of viruses is measure with the help of ultrafilteration, ultracentrifugation and electron microscopy.

6. viruses do not have any kind of cellular organizati-on.

7. It contains either DNA or RNA as a nuclear material.

8. As we know viruses are an obligate intracellular parasite and lack the essential enzyme for protein and nucleic acid synthesis.

9. These viruses depend on the host cell for its replication.

10. viruses are unaffected by antibiotics, drugs.

11. viruses are of great concern in the field of medical microbiology because they are responsible for various human diseases.

12. Examples of diseases caused by viruses are rabies, AIDS, mumps, hepatitis, influenza, dengue, etc... are caused due to viruses.

13. viruses are responsible for cancer in humans, birds and animals.

14. virion is an extracellular infectious particle of the virus.

15. Virion contains essential nucleic acid which is protect -ed by the protein coat called capsid.

16. The function of the capsid is to protect nucleic acid from nucleases and other environmental factors.

17. The capsid is made up of polypeptide molecules.

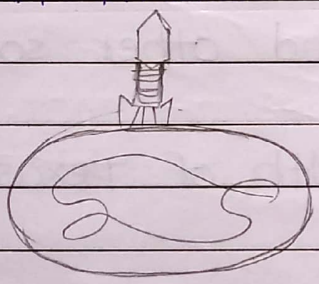
18. viruses may enveloped or non enveloped.

19. Envelop is made up of lipoprotein and is derived from host cell membrane.

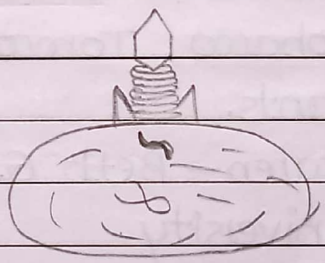
20. viruses require a living media like the embryonic egg, cell culture or bacterial cell.

21. There are two types of viruses i.e. DNA and RNA viruses.

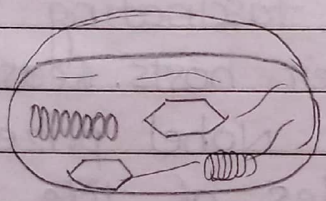
Lysogenic cycle.



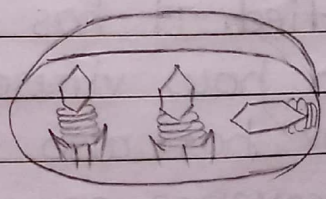
1. Attachment



2. Entry of phase DNA and degradation of host DNA.



3. synthesis of viral genome and proteins



4. Assembly

* Economic importance virus :

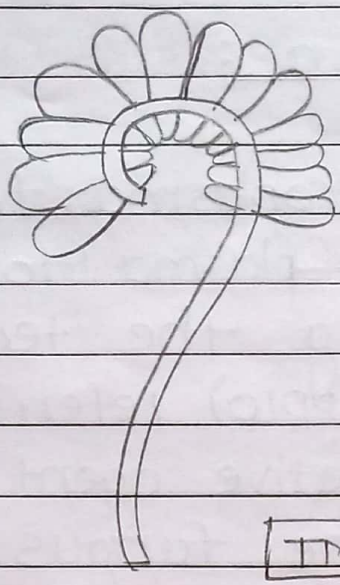
1. Medicine and diagnostics
2. Vaccine production.
3. Gene Therapy or Ex-vivo somatic gene therapy
4. In-vivo somatic gene therapy
5. Germ line gene therapy
6. Cancer therapy
7. Bacteriophage therapy
8. Role of virus in diagnosis
9. Role of virus in Research.
10. Viruses as biopesticides.
11. viruses as causal organisms of plant diseases.
12. Biological pest control.

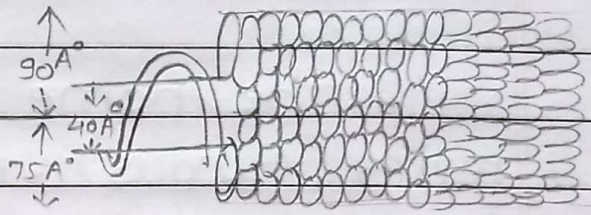
* Tobacco Mosaic virus :

Disease ⟶ Tobacco Mosaic virus
Pathogen ⟶ Tobacco Mosaic virus
Hosts ⟶ Tobacco, Tomato and other solanaceous plants.
Author ⟶ Karen-Beth G. Scholth of Texas A and M university.

TMV was the first virus to be discoved over a centuary ago and was the first virus ever purified. It has since yielding fascinating insights into how viruses infect their hosts. Research on TMV has also led to major Nobel prize winning discoveries on general principles of life.

Data
Page





TTMV

1.2. Mycoplasma.

Date
Page

* History of mycoplasma :

The name Mycoplasma, from the Greek word mykes (fungus), ~~fungi~~ plasma (formed), was proposed in the 1956s, replacing the term pleuro pneumoni-a-like organisms (PPLO) referring to organisms similar to the causative agent of CBPP. It was later found that the fungus like growth pattern of M. mycoides is unique of the species.

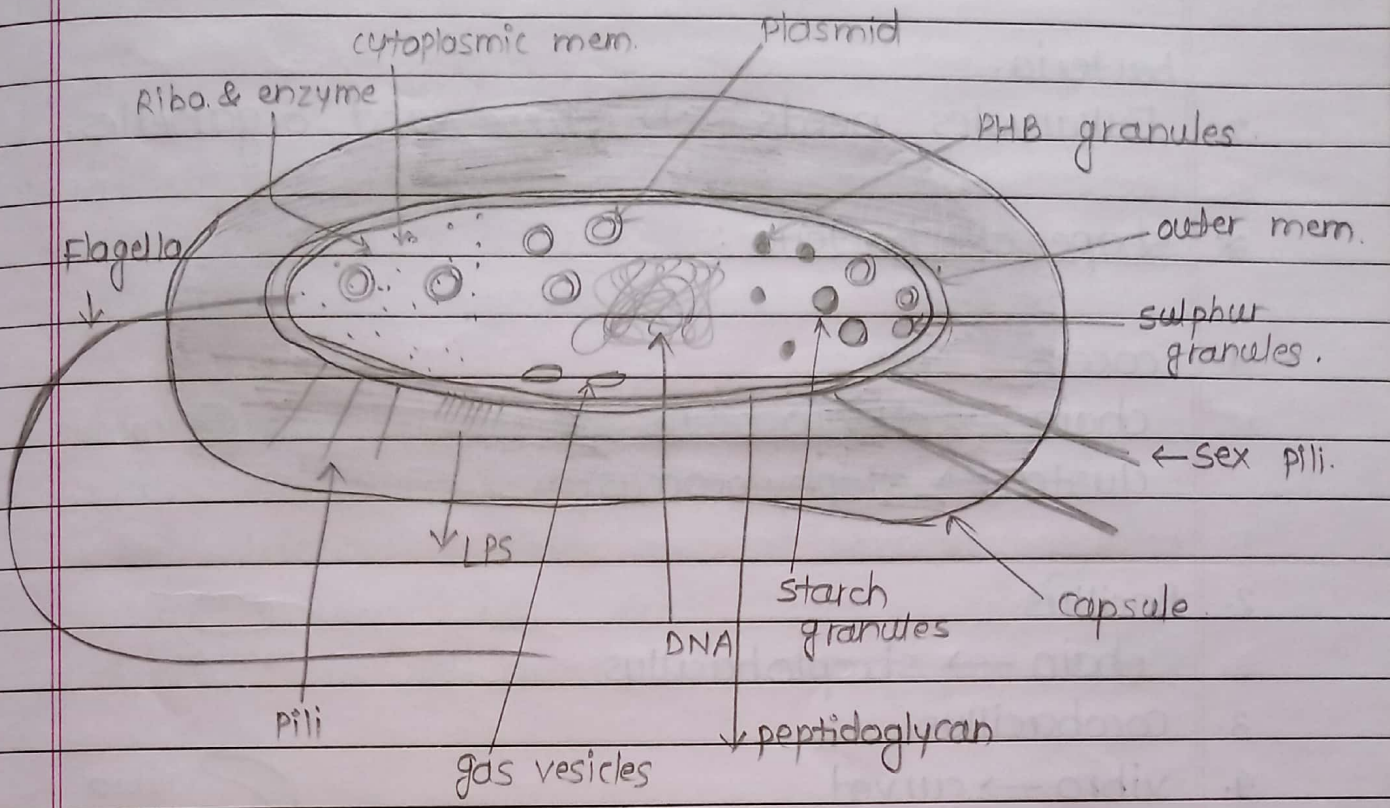
* Mycoplasma:

1. Mycoplasma species are the smallest free living organism.
2. These organism unique among the prokaryotes in that they lack cell wall.
3. size of 150 – 250 nm
4. sterol containing cell membrane.
5. Fastidious growth requirements
6. Fried egg or mulberry colonies on agar.

* Resistance:

1. They are normally destroyed by heat at 45°C in 15 min.
2. They are releatively resistant to penicillins and cephalosporins.
3. Sensitive to tetracyclenes, and several other antibiotics.

1.3 Bacteria.



* What are bacteria?

single celled organisms, very small, need a microscope to see, can be found on most materials and surfaces, billions on and in your body right now.

* size of bacteria:

1. Average bacteria 0.5 – 2.0 um in diameter. RBC is 7.5 um in diameter.
2. surface area ~ 12 um^2
3. volume is ~4 um
4. Surface area to volume is 3:1.
5. Typical eukaryotic cell SA/vol is 0.3:1.
6. Food enters through SA, quickly reaches all parts of

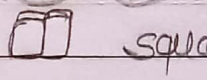
bacteria.

7. Eukaryotes needs structure and organelles.

* shape of bacteria :

1. coccus
   chain → streptococcus
   cluster → staphylococcus.

2. Bacillus
   chain → streptobacillus
3. cocobacillus
4. vibro → curved
5. spirillum
6. spirochete
7. square
8. star.



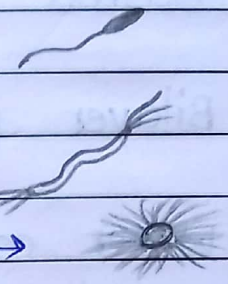
* Bacterial structure :

1. Flagella
2. Pili
3. Capsule
4. plasma membrane
5. cytoplasm
6. cell wall
7. Lipopolysaccharides
8. Teichoic acids
9. inclusions
10. spores

1. Flagella :

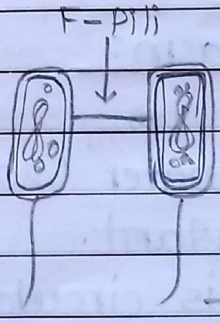
1. Motility – movement
2. swarming occurs with some bacteria
   spread across petri dish
   Proteus species most evident

3. Arrangement basis for classification
   Monotrichous ; 1 flagella. →
   Lophotrichous ; tuft at one end
   Amphitrichous ; both ends →
   Peritrichous ; all around bacteria. →



2. Pili :

1. short protein appendages
   smaller than flagella.
2. Adhere bacteria to surfaces.
   K88, K99, F41, etc...
3. F-pilus ; used in conjugation.
4. Flotation ; increases boyancy
   pellicle (scum on water)
   More oxygen on surface.



Bacterial reproduction by F-Pili attachment

3. capsule or slime layer:

1. Glycocalyx – Polysaccharide on external surface

2. Adhere bacteria to surface.
S. mutuans and enamel of teeth.

3. Prevents phagocytosis i.e. complement can't penetrate sugars.

4. Plasma membrane:

1. Bilayer phospholipid.

2. Water can penetrate

3. Flexible

4. Not strong, ruptures easily.
osmotic pressure created by cytoplasm.

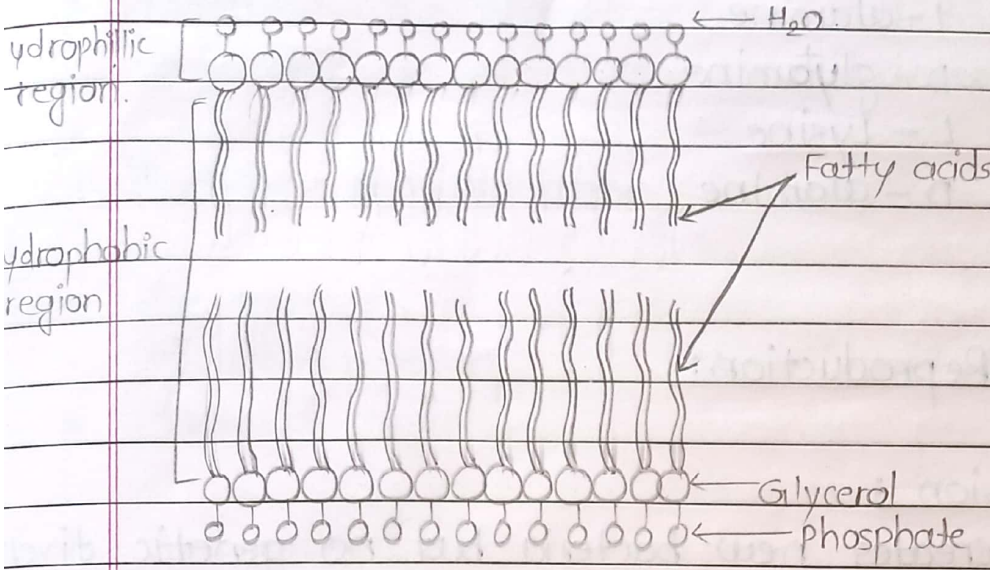
5. cytoplasm:

1. 80% water (20% salts, proteins) osmotic shock important.

2. DNA is circular; Haploid
Advantages of 1N DNA over 2N DNA
More efficient; grows quicker.
Mutations allow adaptation to environment quicker.

3. Plasmids; extra circular DNA
Antibiotic resistance.

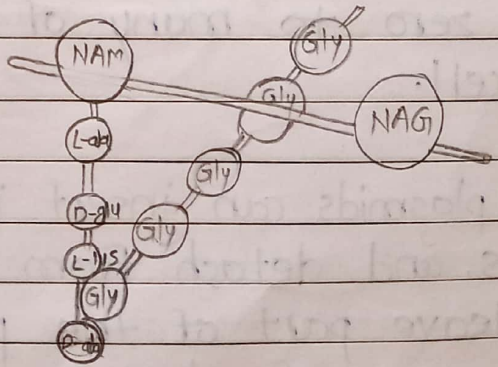
4. No organelles.



Plasma membrane.

6. Cell wall:

1. Peptido – glycan polymer (amino acids + sugar).
2. Unique to bacteria.
3. Sugars ; NAG and NAM
   N – acetylglucosamine
   N – acetymuramic acid.
4. D form of amino acids used not L form
   Hard to break down D form.
5. Amino acids cross link NAG and NAM.

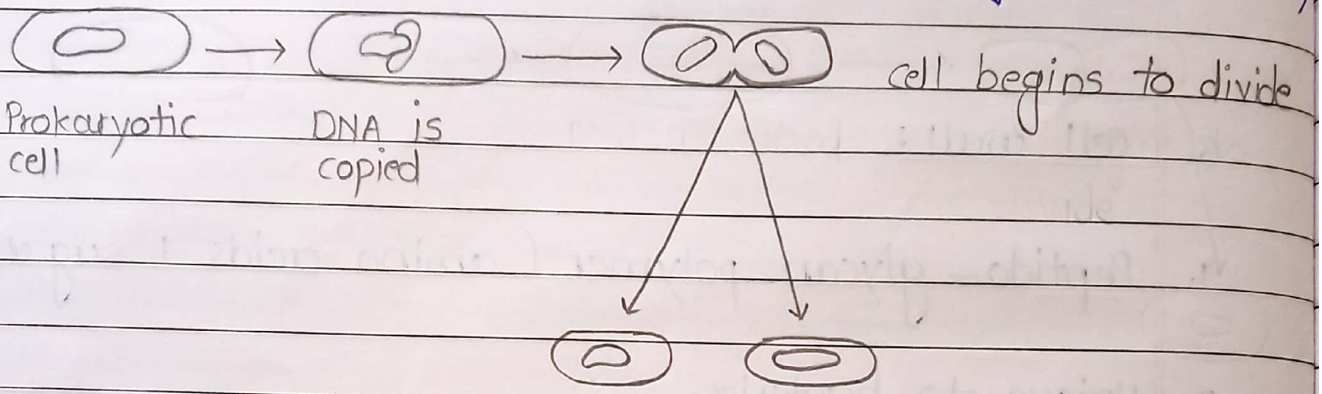


L-ala ⟶ L-alamine
D-glu ⟶ D-glutamine
L-lys ⟶ L-Lysine
D-ala ⟶ D-alamine

* Bacterial Reproduction:

1. Binary fission :

creates new bacteria but no genetic diversity



2. Sexual reproduction:

sex in bacteria differs somewhat from what we consider sex in eukaryotes. It involves the plasmid, which has several important characteristics:

1. A plasmid is a loop of DNA. Plasmids can multiply autonomsly within the cell. Thus we may find from zero to many of one or more plasmids in each cell.

2. Many plasmids can insert into the DNA of the nucleus. and detach from it. In doing so, the plasmid may leave part of the plasmid DNA behind. and take some of the.

3. Plasmids can transfer from cell to cell. the cells need not be of the same bacterial 'species'.

* Bacterial recombination:

1. conjugation.
2. Transformation
3. Transduction.

1. conjugation:

one bacterium connects itself to another through a protein tube structure called a pilus. Genes are transformed from one bacterium to other through this tube.

2. Transformation:

The bacterium binds the DNA and transports it across the bacterial cell membrane. The new DNA is then incorporated into the bacterial cell's DNA.

3. Transduction:

Involves the exchanging of bacterial DNA through bacteriophages.

Bacteriophages:

viruses that infect bacteria. There are two types of bacteria : generalized and specialized.

Date
Page

* Economic importance of bacteria :

1. Beneficial Aspects :

a. Role in agriculture.
b. Decaying of organic substance.
c. Fertility of the soil
d. Ammonifying bacteria.
e. Nitrifying bacteria.
f. Nitrogen fixing bacteria.

2. Role in industry and Medicine :

a. Preparation of alcohols
b. Preparation of vinegar.
c. Preparation of butter, cheese, etc...
d. Preparation of tea, coffee,.
e. Preparation of Tobacco.
f. Preparation of Hemp fibres
g. Preparation of Leather, Taining.
h. Preparation of antibiotics.

3. Harmful aspects :

a. ~~An~~ Animal pathogenic disease.
b. Plant Pathogenic disease.
c. Food pathogenic disease.
d.

1.4 Cryptogam

Data
Page

* Cryptogam:

A cryptogam (scientific name: cryptogamae) is a plant that reproduces by spores, without flower or seeds. cryptogamae is a greek word. (kryptos: hidden + gameein: ~~repro~~ to marry) means hidden reproduction, referring to the fact that no seed is produced, thus cryptogams represent the non-seed bearing plants.

other names, such as "thallophytes", "lower plants" and "spore plants" are also occasionally used.

* What is a cryptogam?

As a group, cryptogams are "lower plants" that use spores to reproduce. They don't have the structures we normally associate with plants, like true stems, roots, leaves, flowers or seeds, and their reproductive parts are hidden, so we call them "plant-like" organisms. They have some characteristics with plants. yet they are still diff. enough to not fall into the same group as plants

1.5 Lichen.

* Lichens: General structures.

1. Fungal component is prominent in lichen than algal component (~90%).

2. Plant body of lichens neither resembles algal or fungal morphology.

3. Theophrastus (371–284 BC) first time used them lichen to denote the superficial growth on the barks.

4. Lichens are included in cryptogams.

5. Acharius : Father of lichenology.

6. Growth of lichen is very slow.

7. ~~Lichen : structurally organized permanent~~

7. Lichen produce a specific acid known as lichen acid.

8. Lichen : structurally organized permanent symbiotic association of fungi & algae.

9. Lichenology: study of lichen

10. Mycobiont: Fungal component of lichen.

11. Phycobiont : Algal component of lichen.

12. symbiosis : association/interaction.
organisms where both partners are mutually associated./benefited.

13. Fungus protect algae from unfavourable (drought conditions.

14. Algae in turn supplies organic food to fungus.

15. this type of symbiosis is called as heliotism.

16. Distribution : World wide distribution, 500 genera and 13500 species.

17. Lichens do not grow near polluted areas.

18. Thus Lichens are pollution indicator. (Lobaria)

19. They can tolerate extreme heat and can bury in snow for long years.

20. Habitat : Most usually on tree barks, decaying wood and rocks.

1. saxicolous : growing on stones
2. corticolous : on tree barks.
3. Folliocolous : on leaves
4. Terricolous : on soil surface.

21. Few species of lichen are aquatic. (Peltigera)

22. Cladonia rangiferina (reindeer moss) grows luxurious in Tundra.

23. In India Lichen found in Himalayas and higher hills of south India.

24. Lichens are highly pigmented and have various

colours (green, red, black, yellow, orange, white).

25. coloration is due to the pigmentation of algal component.

* Composition of plant body of lichens:

1. composition of plant body:

a. Mycobiont: belong to either Ascomycotina or Basidiomycotina or Deuteromycotina

b. Phycobiont: belong to

i. Cyanophyceae – 8 genera. (Gloeocpsa, Nostoc)
ii. chlorophyceae – 18 genera. (Trebauxia, cladophora)
iii. Xanthophyceae – 1 genera
iv. Phaeophyceae – 1 genera.

* classification of lichens:

According to International Code of Botanical Nomenclature ~~(IBCN)~~ (ICBN) name of lichen should be on the basis of fungal component. Lichens are divided lichens to 3 classes:

1. Ascolichen
2. Basidiolichen
3. Lichen – imperfecti.

* Diversity in thallus morphology :

Based on thallus morphology, lichens are divided into three major groups :

1. crustose :

1. They have flattened thallus.
2. closely attached to the substratum as crusts.
3. Thallus may be partly or completely embedded to the substratum.
4. Thallus is very closed attach to substratum.

eg... ~~Thallus~~ Graphis, Lecanora, Lecidia.

2. Foliose :

1. They are falt, dorsi-ventral, leaf like lobed thallus.
2. They look like the thallus of liverworts (bryophyt-es).
3. Attached to substratum by rhizoid like structures called rhizines.

eg... Parmelia, Peltigera, collema.

3. Fruticose :

1. Well developed shrub-like, cylindrical and branched thallus.
2. They grow or hang from the substratum.
3. Plant attached to the substratum with the help mucilagenous disc. eg... usnea, cladonia.

* Lichen reproduction:

1. Reproduction is by sexual and asexual methods.
2. Asexual reproduction : by various types of spores (oidia, picnidia).
3. sexual reproduction : ~~by~~ only fungal componen reproduce sexually
4. Female sex organ is called as carpogonium.
5. Carpogonium is differentiated into basal ascoga -um and an elongated trichogyne.
6. Male reproductive organ is spermatogonia which produce spermatia.

* Fruiting bodies of lichen are :

1. Disc shaped appothecium (appothecia)
2. Flask shaped perithecium (perithecia)

* Economic importance of lichen:

1. Lichens are the pioneers of rock vegetation.
2. Lichen initiates xerarch type of plant succession on rock.
3. Lichen acid cause weathering of rock into soil particles.
4. some lichens are ecological indicators, they acts as indicators of pollution.
5. cladonia rangiferina, which is luxiriously grows in

polar region acts as the food source for some animals such as reindeers.

6. Lecanora is consumed as food by human.
7. Peltigera canina and Lobaria pulmonial are medicinally used.
8. Parmelia is used as a spice or condiment in some parts of India.
9. Rocella and Lecanora yield dye called orchil or orcein or Cudbear which are used for colouring woolen and silk fabrics.
10. orecin is an excessively used chromosomal stain, it is used for the 'o' banding of chromosomes.
11. Lobaria pulmonaria is used in tanning, perfumary industry. It is also used as 'hope' in brewing industry.

2.1 Algae

The term algae (Latin = seaweeds) was first introduced by Linnaeus in 1753, meaning the Hepaticeae. The algae comprise of a large heterogenous assemblage of plants which are diverse in habitat, size, organisation, physiology, biochemistry and reproduction.

It is an important group of Thallophyta (Gr. thallos - a sprout) the primitive and simplest division of the plant kingdom. The orderly systematic study of algae is called Phycology. (Gr. Phycos - seeweeds; logos - study).

The algae are chlorophyll containing primitive plants, both prokaryotic and eukaryotic, with wide range of thalli strating from unicellular or multicellular organisations. Autophytic and thalloid plant bodies are also found in the Bryophytes.

* Defination:

1. Fritsch, F. (1935) defined algae as the holophytic organisms as well as their numerous colourless derivatives that fail to reach the higher level of ~~organization~~ differentation characteristic of the archegoniate plant.

2. Smith, G. M. (1955) defined algae as simple plants with autotrophic mode of nutrition.

3. Champman, V.J. (1962) defined algae sea-weeds of the seashore and green skins in stagnant fresh water, ponds and pools as among the simplest in the ~~animal~~ plant kingdom.

* Characteristics of algae :

1. Algae are chlorophyll bearing autrotrophic thalloid plant body.

2. Almost all the algae are aquatic.

3. The plant body may be unicellular or large robust multicellular structure.

4. The multicellular complex thalli lack vascular tissue and also show little differentiation of tissues.

5. The sex organs are generally unicellular but when multicellular all cells are fertile and in most cases the entire structure does not have any protection jacket.

6. The zygote undergoes further development either by mitosis, meiosis but not through embryo formation.

7. Plants having distinct ~~alternation of~~ generations. Both gameto-phyte and sporophyte generations - When present in life cycle are indepedent.

* Occurance of Algae :

The algae are ubiquitous (present every where) in distribution ie. they are found in fresh water as well as in marine water, on soil, on rock, as epiphytes or parasites on plants and animals, in hot springs, in desert, on permanent snow-fields etc.. But they mainly dwell in aquatic environments.

Based on habitat the algae may be categorized as :

1. Aquatic algae
2. Terrestrial algae
3. Algae of remarkable habitats

1. Aquatic algae :

Aquatic algae may be fresh water (When salinity is as low-as 10 ppm) or marine (When salinity is 33-40%). Again, certain algae grow in brackish water which is unpalatable for drinking, but less salty than sea water. The fresh water algae usually grow in ponds, lakes, pools, tanks, ditch-es etc...

2. Terrestrial algae :

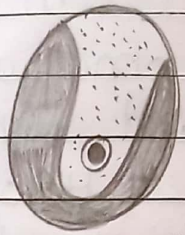
Some algae are found to grow in terrestrial habitats like soils, rocks, logs, etc... The algae that

stem-like, leaf-like structures giving a higher plant-like appearance. Their size ranges from a few micron to several meters.

The algae thalli are grouped into the following, based on their organisations:

A. Unicellular algae:

(motile) chlamydomonas



eg.. chlorella
(non-motile)

B. Multicellular algae:

1. colonial
2. Filamentous
3. siphonaceous forms
4. Parenchymatous forms

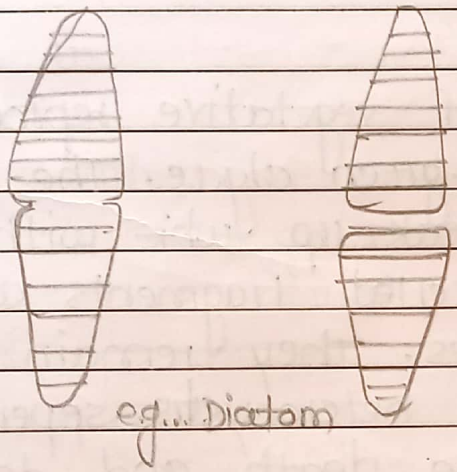
* Reproduction in algae:

1. Vegetative reproduction:

In this type, any vegetative part of thallus develops into new individual. It does not involve any spore formation and there is no alternation of generations. It is the most common method of reproduction.

a. cell division or fission:

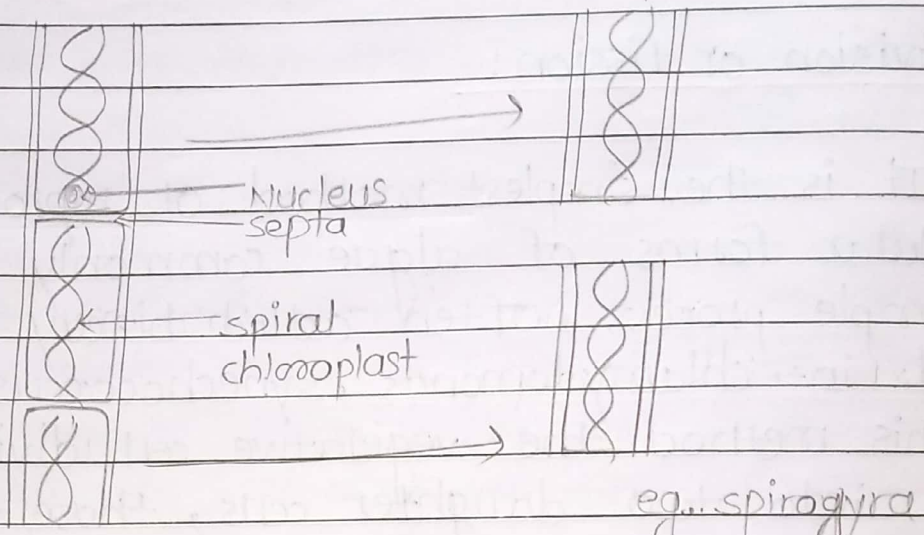
It is the simplest method of reproduction. The unicellular forms of algae commonly reproduce by simple process, often called binary fission as found in chlamydomonas, synechococcus, diatoms. In this method the vegetative cell divides mitoti-cally into two daughter cells, those finally above behave as new individual.



eg... Diatom

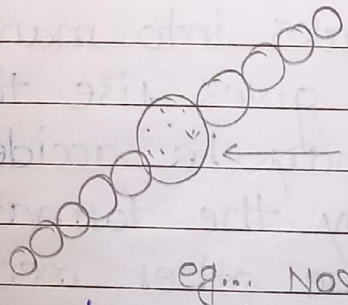
b. Fragmentation:

In this method, the multicellular filamento-us thallus breaks into many celled fragments, each of which gives rise to new individual. The fragmentation may be accidental ~~or by the accidental~~ or by the formation of seperation discs or by some other mechanical force or injury. It is found in spirogyra, Ulothrix, oedeo-gonium, zygnema, cylindospermum.



c. Hormogonia:

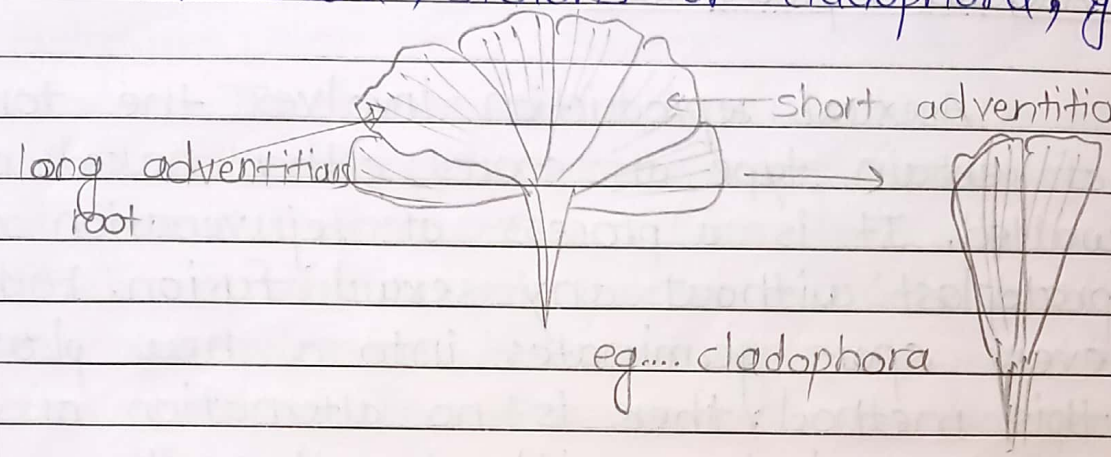
The method of vegetative reproduction, is found in the blue-green algae. The trichomes of blue-green algae break up within the sheath into many-celled fragments called hormogonia or hormogones. They remain delimited by the formation of heterocysts. seperation discs or neridia or by the death and decay of intercalary cells of the trichome. Hormogonia are commonly found in Nostoc, oscillatoria, cylindrosporium, etc...



d. Formation of Adventitious branches:

Adventitious branches are formed in different large thalloid algae, which when detached

from the plant body develop into new individual -s (eg... Fucus, Dictyota). Protonema-like adventitio -us algae are ~~found~~ formed from the internod -es of chara, stolons of cladophora, glomerata.



e. Bulbils :

Tuber-like outgrowths of the are developed due to storage of food at the tip of rhizoids and on the lower nodes of chara, called bulbils. After detachment from the plant body bulbils grow into new plant. eg... Amylum star.

star-shaped aggregation of starch containi -ng cells develops on the lower nodes of the chara. These structure are called amylum-stars. When detached from the plant body, they grow into new plants.

f. Budding :

In Protosiphon bud like structures are formed due to proliferation of vesicles delimited

from the parental body by a septum which are detached and grow into new plant.

2. Asexual reproduction :

Asexual reproduction involves the formation of certain type of spores either naked or newly walled. It is a process of rejuvenation of the protoplast without any sexual fusion. Each and every spore germinates into a new plant. In this method, there is no alternation of generations. Protoplast — without cell wall.

The asexual spores may be of various types:

1. zoospores
2. Aplanospores
3. Tetraspores
4. Akinetes
5. Exospore
6. Endospore.

3. sexual reproduction :

Depending on the structure, physiological behaviour and complexity of sex organs, reproduction are of the following types:

1. Autogamy :

In this process the fusing gametes are developed from the same mother cell and after fusion they form zygote. For the above, plant

developed through autogamy does not show the introduction of any new characteristic. eg. Diatom (Amphora normani).

2. Hologamy:

In some unicellular members the vegeta-tive cells of different stains (+ and -) behave as gametes and after fusion they form zygote. It is an inefficient process considering the point of multiplication, but new genetic combinations are developed by the process of hologamy. eg. chlamydomonas.

3. Isogamy:

It is the process of union, bet^{n} two gametes which are morphologically and physiologi-cally similar. After fusion they form zygote. The gametes are called isogamete. Usually they are flagellated. eg. chlamydomonas, eugametos, Ulothrix, etc...

4. Anisogamy:

In this process the uniting gametes are morphologically and physiologically different. The smaller and more active one is the microgamete (male), whereas the larger and less active one is the macrogamete (female) eg. chlamydomonas braunii.

Deviating from the typical ~~angio~~ anisogam-y, when the uniting gametes show morphologi

-cal similarity with physiological difference. It is called physiological anisogamy eg. zygnema, spirogyra

5. Oogamy :

It is an advanced process where fertilizat-on takes place bet^n a small motile (non-motile in Rhodophyceae) male gamete (sperm or antherozo-des) with a large non motile female gamete (egg or ovum). Male gametes develop within antheridium whereas the female gametes within the oogonium. eg.. oedogonium, Vaucheria, Chara, Laminaria, Sargassum, Poly-siphonia, Batrachospe-rmum, etc..

* Economic importance of algae :

1. Algae constitute the tim link of food chain.
2. It is useful in fish culture.
3. Algae is used for recreational purpose.
4. Algae is useful in sewage treatment plants.
5. Algae and water supplies.
6. Algae as the origin of petrolium and gas.
7. Algae and limestone formation.
8. Algae is used in space Reasearch and other Fundamental studies.
9. Algae is used as food, fodder, fertilizers, medic-ine.
10. Industrial utilization of algae.

* Life cycle in algae :

Different types of life cycle have been recog-nised in the algae :

1. Haplontic :

In this, the parent is haploid and the zygote represents the diploid phase with reductio-n division occuring at the time of the germi-nation of zygote. eg... volvox, oedogonium.

2. Diplontic :

The parents is a diplont and sexual spores (gametes) constitute the haploid phase. Reduction division takes place at the time of gametogenesis. eg... Diatoms.

3. Diplo-Haplontic :

There will be an alternation of diploid sporophyte with the haploid gametophyte. Reduc-tion division effected at the time of form-ation of spores by the sporophyte. eg... cladopho-ra.

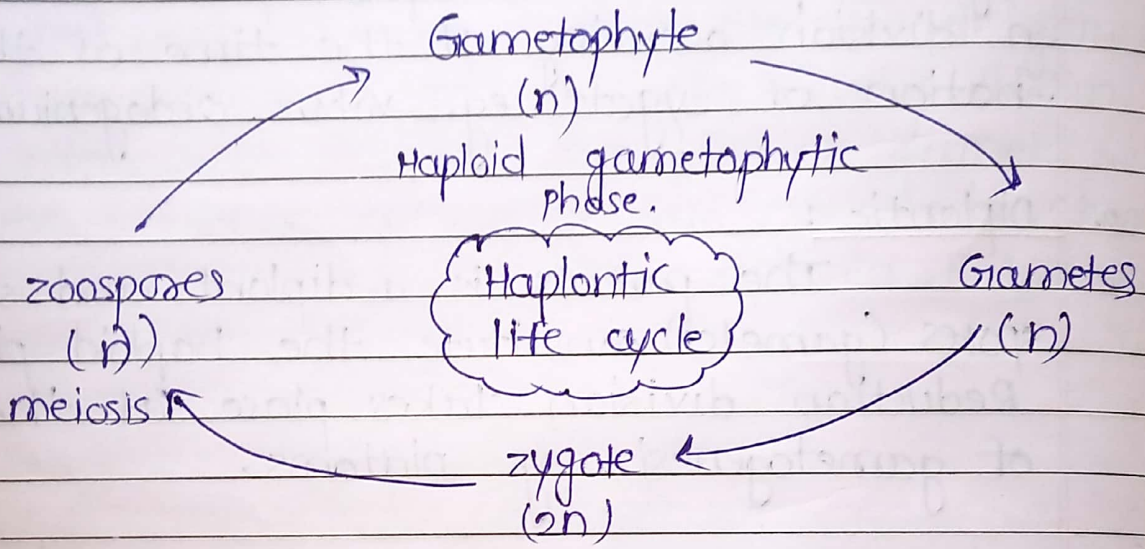
4. Haplo-biontic :

Two haploid generations (gametophyte and car-sporophyte) alterning with a diploid are represented by the zygote. eg... Batrachospermum.

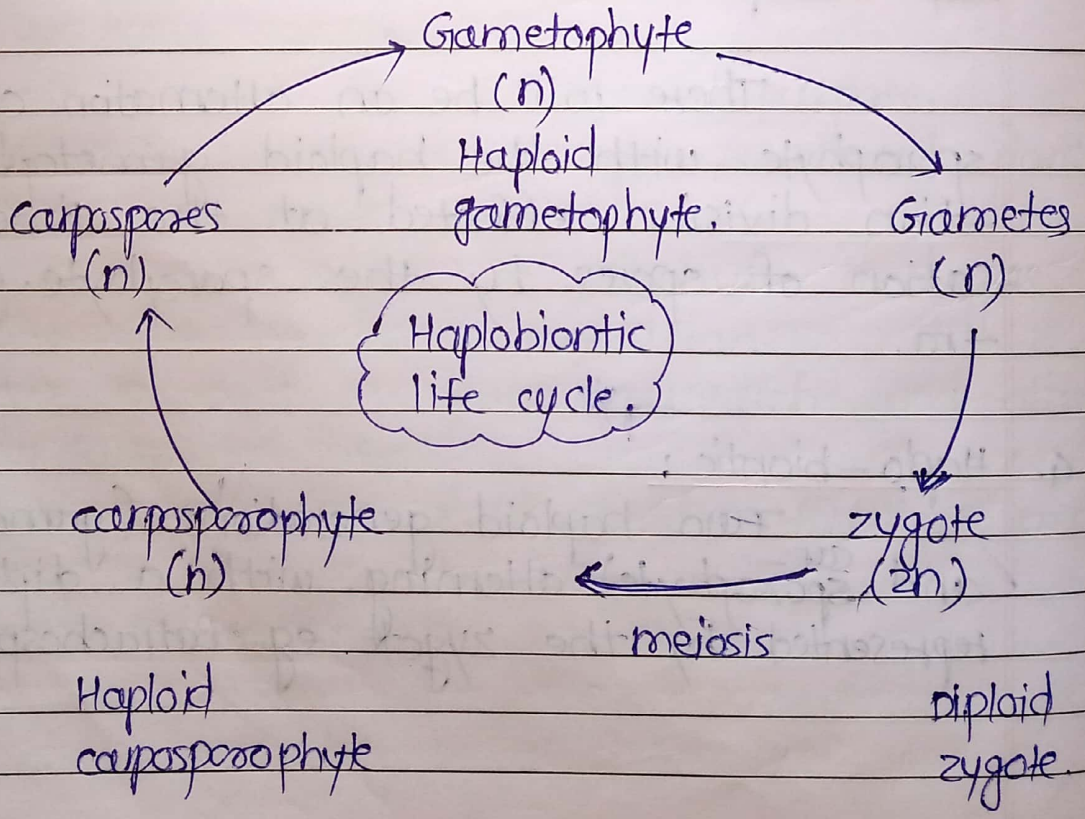
5. Diplo – bontic :

Two haploid phases (carposporophyte and tetrasporophyte) a haploid phase (gametophyte) alternating with each other. eg... Polysiphonia.

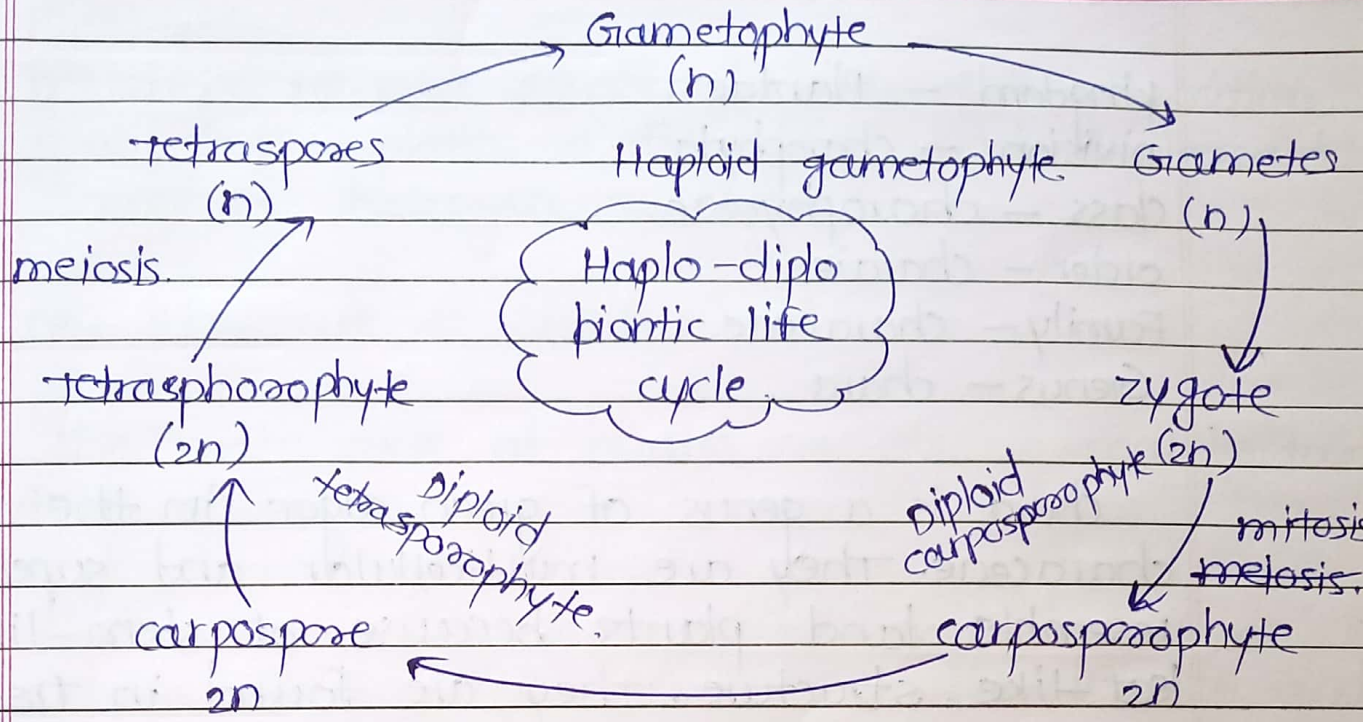
1. Haplontic life cycle.



2.



3.



chara.

kingdom – Plantae
division – charophyta
class – charophyceae
order – charales
Family – characeae
Genus – chara

chara is a genus of green algae in the family characeae. They are multicellular and superficially resemble land plants because of stem-like and leaf-like structure. They are found in fresh water, particularly in limestone areas throughout the northern temperate zone, where they grow submerged, attached to the muddy bottom.

They prefer less oxygenated and hard water and are not found in waters where mosquito larvae are present.

structure :

The branching system of chara species is complex with branches derived from apical cell, alternately. which cut off segments at the base to form nodel and internodel cells alterna-tely. The main axes bear whorls of branches in superficial resemblance to Equisetum. They are typically anchored to the litorial substrate by means of branching underground rhizoids. chara plants are rough to the touch beacause of deposited calcium salts on the cell wall. The

metabolic processes associated with this deposition give chara plants a distinctive and unpleasant smell of hydrogen sulphide.

cell structure of chara :

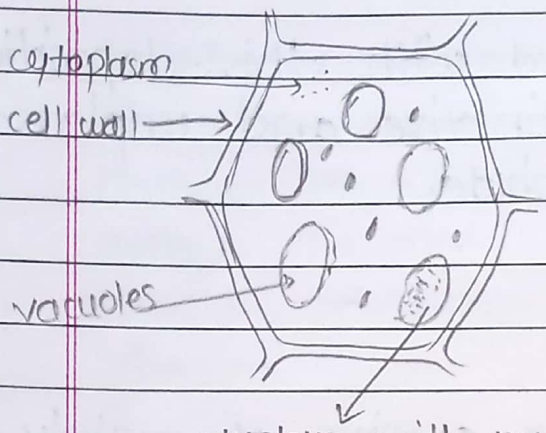
The main axis of chara consists of mainly two types of cells :

1. **Nodel cells :**

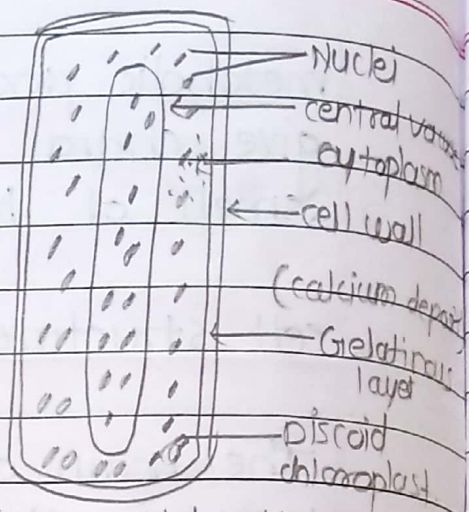
The nodel cells are smaller in size and isodiametric. The cells are dense cytoplasmic, uninucleate with small (few) ellipsoid -al chloroplasts. The central vacuole is not develo -ped instead many small vacuoles may be present. The cytoplasm can be differentiated in outer exoplasm and inner endoplasm.

2. **Inter nodel cells :**

The inter nodel cells are much elonga -ted. The cytoplasm is present around a large central vacuole. The cells are multinucleate and contain many discoid chloroplasts. The cytoplasm is also differentiated into inner enoplasm and outer exoplasm. The endoplasm shows streami -ng movements. The cell walls betⁿ nodel cells and inter nodel cells are porous to help in cytoplasmic continuity betⁿ cells.



a) Nodel cell



b) inter nodel cell

* Reproduction in chara:

Reproduction in chara takes place by two methods vegetative and sexual. Asexual reproduction is absent.

A) Vegetative reproduction:

Vegetative reproduction takes place by the following methods:

1. **Bulbils:**

The bulbils are spherical or oval tube like structure which develop on rhizoids c. aspera on lower nodes of main axis eg. C. baltica. The bulbils on detachment from plants germinate into new thallus.

2. **Amylum stars:**

In some species of chara eg. c. stelligna on the lower nodes of main axis develop

multicellular star shape aggregates of cells. These cells are full of amylum starch and hence are called Amylum stars. The amylum stars do detachment from plants develops into new chara thalli.

3. Amorphous bulbils:

The Amorphous bulbils are group, many cells, irregular in shape which develop on lower node main axis eg. C. delicatula or on rhizoids eg. C. Fragifera and C. baltica. The amorphous bulbils are perenating structures. When the main ~~axi~~ plant dies under unfavourable conditions; these bulbils servive and make chara plant on return of favourable conditions.

4. secondary protenema:

These are tubular or filamentous structure which develops from primary protone-ma or basal cells of the rhizoids. The secon-dary protonema like primary protonema form chara plants.

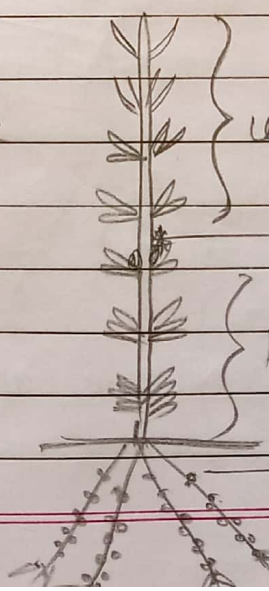


Fig.. Vegetative structure of chara.

B) sexual reproduction :

The sexual reproduction in chara is of highly advanced oogamous type. The sex organs are macroscopic and complex in organization. The male sex organs are called as antheridium or globule and the female oogonium or nucule. Most of chara species are homothallic i.e. the male and female sex organs are born on same node eg... C. zeylanica . Some species eg... C. Wallichii are heterothallic i.e. male and female sex organs are on different nodes.

The sex organs arise on the branches of limited growth or primary laterals, the nucule above the globule. The development of globule and nucule takes place simultaneously but species globule matures before nucule.

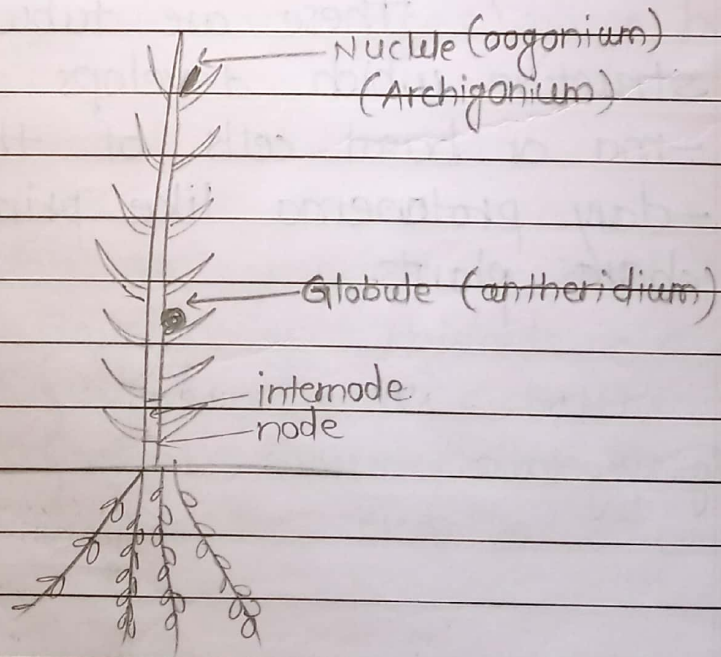


Fig.. Nucule and globule structure

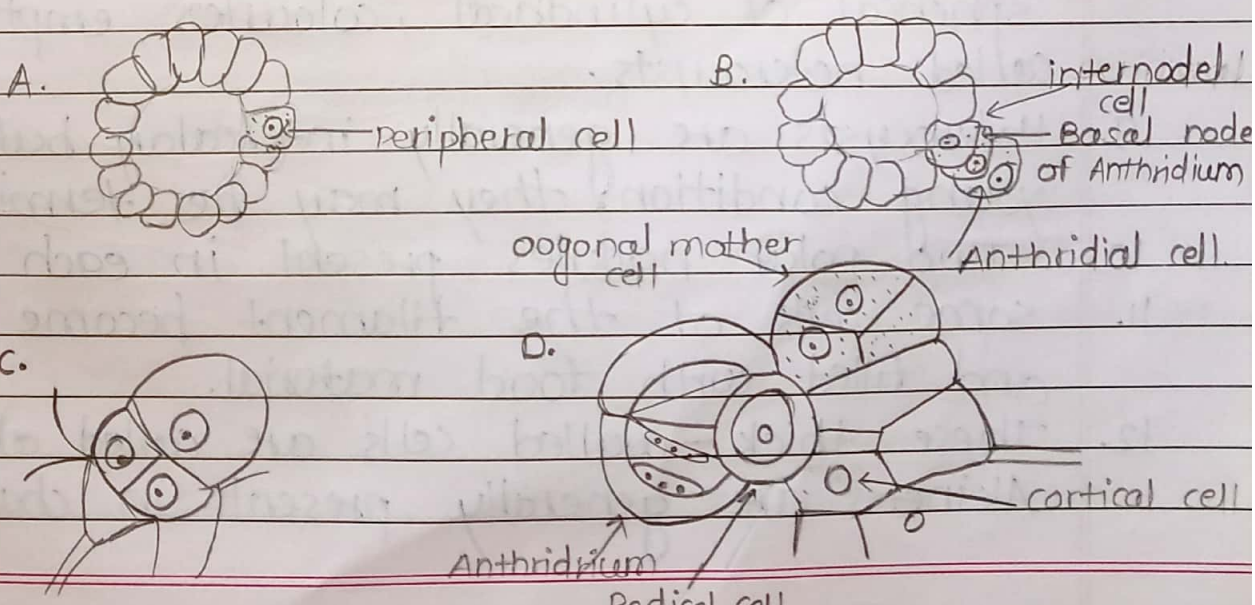
Globule:

The globule is large, ~~she sph~~ sperical, red or yellow structure.

Development and structure:

The early development of globule and nucule is similar. The peripheral cell of the lower node of the primary lateral divides periclinally to form and inner cell. The outer cell functions as anthiridial initial and lower cel again divides a periclinal division. out of these three cells formed, the lowermost functions as internodel cell the middle forms basal node, the upper most functions as the anthridial initial.

The middle basal node cell divisions to make 5 peripheral cells. out of these five peripheral cells, the upper one develops into oogonium, two lateral ones form unicellular bracteoles and two lower ones, one on either side of oogonium forms cortex or remains non-functional.



Nostoc

Data
Page

Classification :

Kingdom : Bacteria
phylum : cyanobacteria
Class : taxonomic note
order : Nostocales
Family : Nostocaceae
Genus : Nostoc.

1. Thalli are present in the form of colony.
2. Ball like colony is enveloped by a gelatinous sheat
3. Balls are greenish to blueish in colour.
4. Each colony contains thousands of straights or twisted filamentous or trichomes.
5. Each trichome is surrounded by its individual sheath and called the filament.
6. A trichome is contorted and consist of many cells arranged in a beaded manner.
7. Each cell is somewhat cylindrical or spherical i shape.
8. In filaments there are present some large, spherical or cylindrical, colourless empty cells called heterocysts.
9. Heterocysts are generally intercalary but in the young condition, they may be termind.
10. Two polar nodules present in each heterocys
11. some cells of the filament become enlarge and filled with food material.
12. These thick-walled cells are called akinetes. Akinetes are generally present in chain.

Date
Page

(B).

A. A single cell:

1. Each cell is surrounded by cellulose cell wall.
2. Protoplast shows the typical Myxophycean structure, ie. inner colourless centroplasm and outer pigmented chromoplasm. In the chromoplasm are present pigments, protenious cyanophycean granules and cynophycean starch granules while in the centroplasm is present in the incipient nucleus.

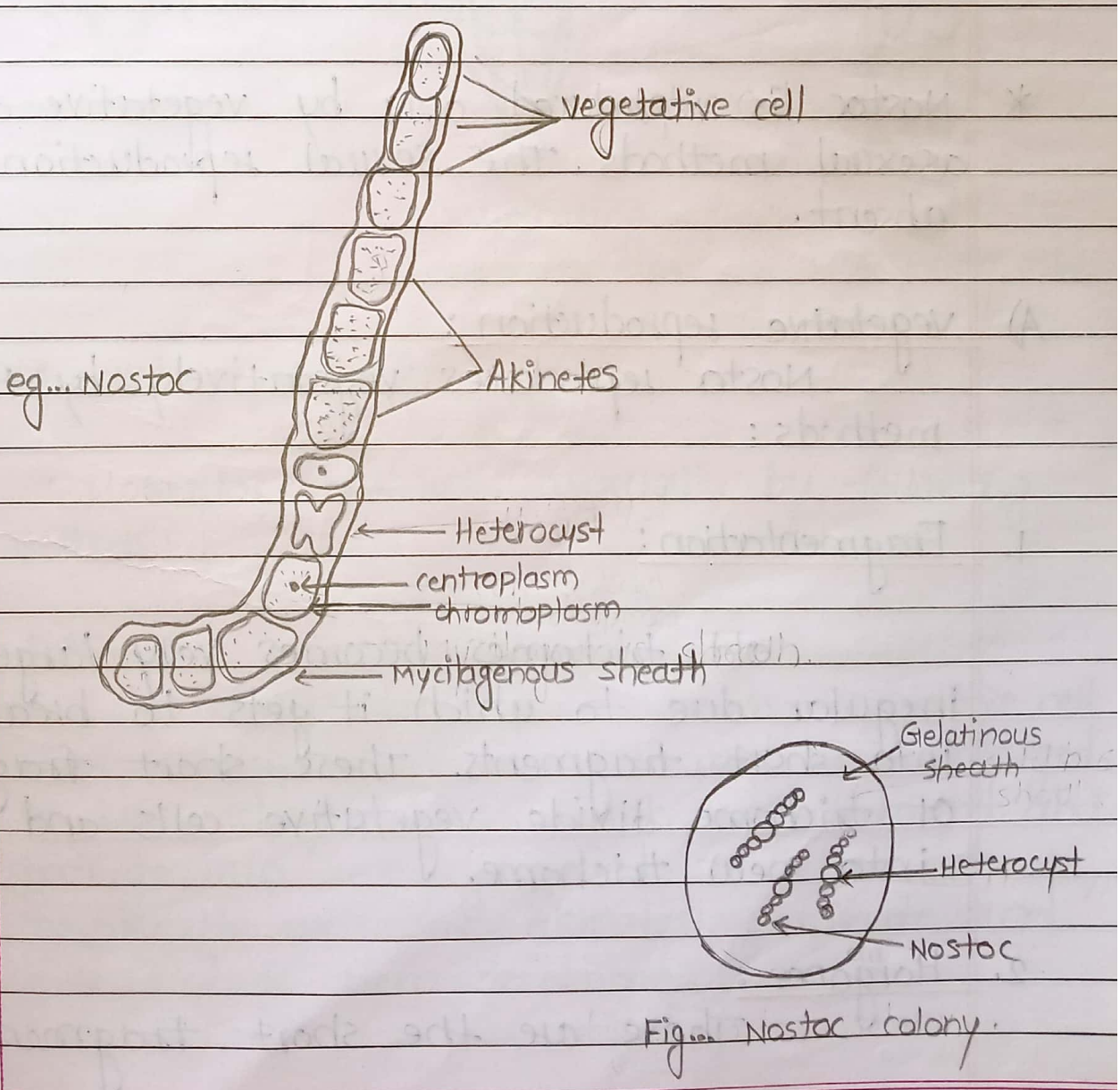


Fig... Nostoc colony.

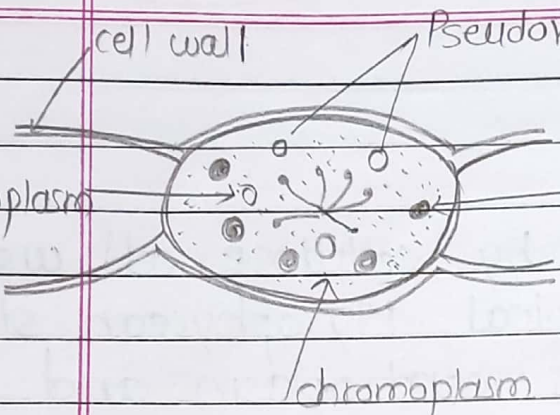


Fig. single vegetative cell

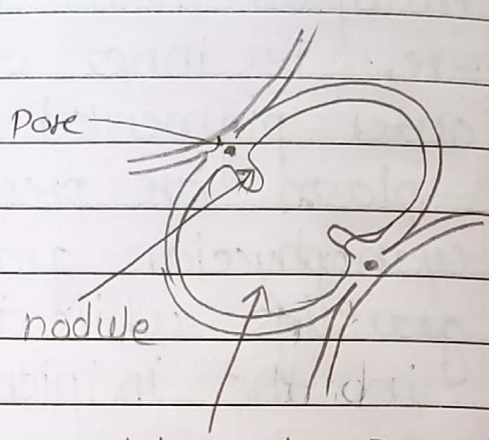


Fig. Hetrocyst

* Nostoc is reproduced only by vegetative and asexual methods. The sexual reproduction is absent.

A) Vegetative reproduction:

Nostoc reproduces vegetatively by following methods:

1. Fragmentation:

old trichomes becomes very large and irregular due to which it gets to break up into short fragments. These short fragments of trichome divide vegetative cells and develop into new trichome.

2. Hormones:

These are the short fragments of

trichomes. Hormogones are developed in the region of heterocyst. Then they come out of the trichome due to some movement. They divide vegetative cells and developed heterocyst and again set surrounded by mucilage sheath. In this way, new trichome is formed.

Hormogonium

Germinating Hormogonium

A young colony

B) Asexual reproduction :

Nostoc reproduce asexually by following methods :

1. Akinetes :

In unfavourable conditions, vegetative cell store enough food material and get enlarged in size. They secrete thick wall around and undergo into resting period. In return of favourable conditions, akinetes germinate and give rise to new trichome.

2. Heterocyst :

In some species of Nostoc, heterocyst cell divides transversly and form (2-4) celled hormogones. These hormogones come out by bursting the thick wall of heterocyst and germination occurs to give rise to new trichome.

3. Endospores :

In few species of Nostoc, heterocyst cell undergoes irregular cell division and forms thin walled spores which are called endospores. Endospores come out by bursting thick wall of heterocyst and germination occurs and new trichome is formed.

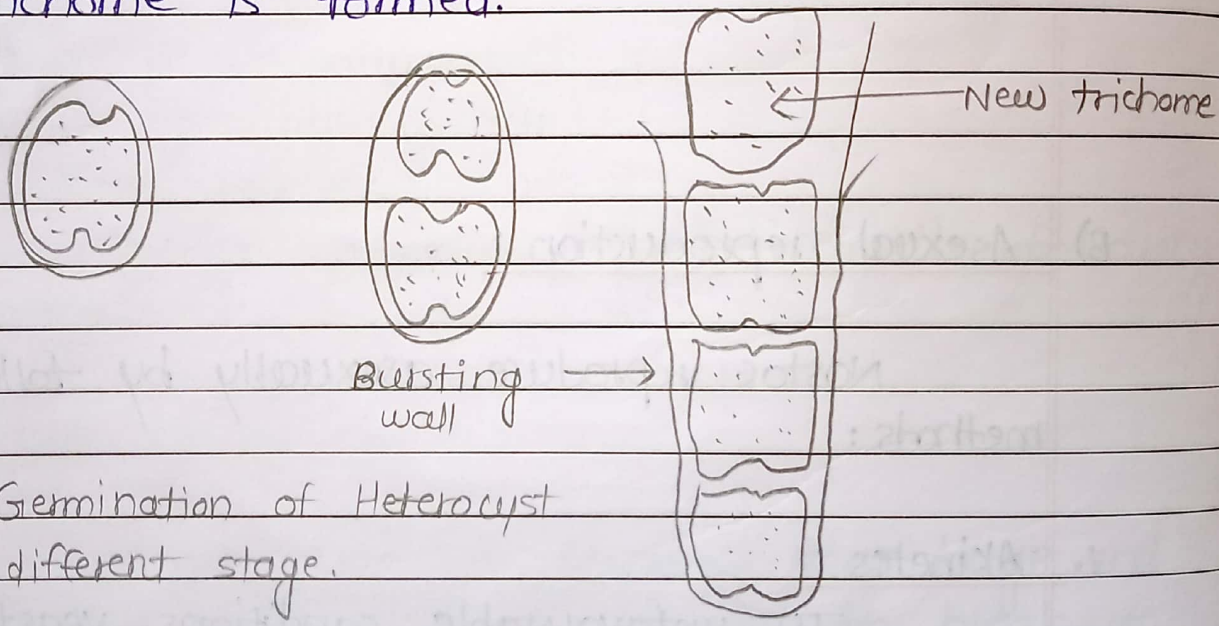


Fig.. Germination of Heterocyst different stage.

Botrydium

Date
Page

classification:

superphylum ⟶ Heterokonta
class ⟶ Xanthophyceae
order ⟶ Botrydiales
Family ⟶ Botrydiaceae
Genus ⟶ Botrydium.

The yellow-green alga, Botrydium has clusters of small, saclike, coenocytic vesicles. coenocytic or siphonous organisms do not have cross wall seperating individual cells, creating tube like thalli with many nuclei. The genus grow on on damp soil and has colourless rhizoids that attach underground. The vesicles can be large - as much as several mm in diameter - and therefore can sometimes be seen without the aid of microscope. A thin peripheral layer of cytoplasm contains the multiple nuclei and discoid plastids.

In culture, Botrydium cells often forms irregular clumps. When growing in natural conditions, Botrydium cells often develop colourless rhizoids that allow them to attach to substrate. These structures may not be present while the genus grow in liquid culture medium, since the rhizoids have no substrate to attach onto and are unnecessary under these conditions.

* special features :

1. Asexual reproduction by ~~bearing~~ zoospores bearing two unequal flagella.
2. Asexual reproduction also takes place by resting spores.
3. sexual reproduction isogamous or anisogamous.
4. Gametes biflagellate with unequal flagella.

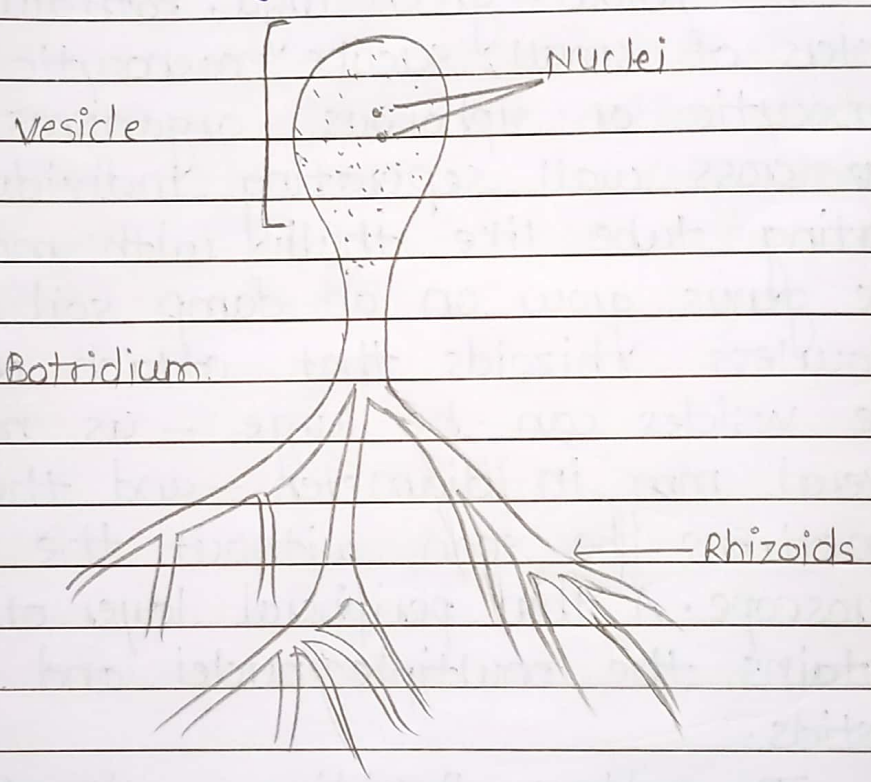


Fig: Botridium

When sufficient water is present, Botridium releases biflagellate zoospores or gametes with a single nucleus. When there is less water the parent cell instead produce aplanospores (nonmotile spores that sometimes develop flagella) or resistant cysts. Botridium reproduces sexually via isogametes or anisogametes. Like other yellow-green algae, Botridium can sometimes reproduce

asexually through fragmentation, bilateral division and the development of akinetes.

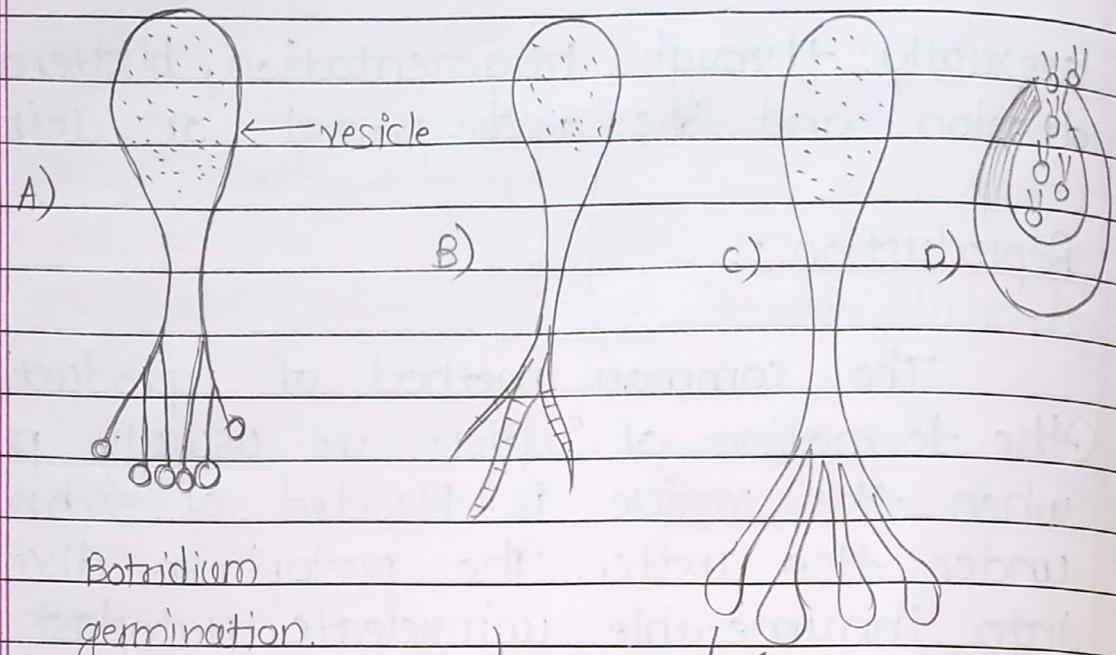
* Reproduction :

The common method of reproduction by the formation of which are usually produced when the vesicle is flooded or submerged under the water. The protoplasm divides into innumerable uninucleate protoplasts. These protoplasts bear become metamorphosed into pear-shaped zoospores which bear two anteriorly placed unequal flagella.

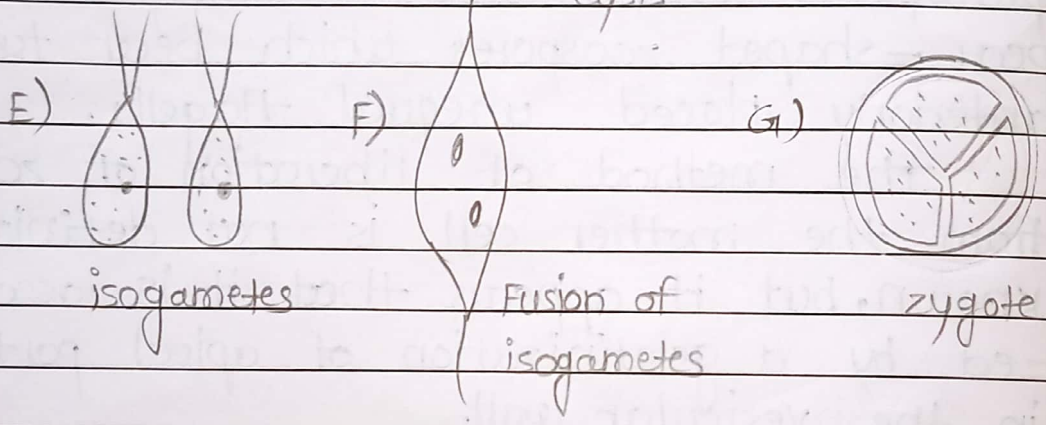
The method of liberation of zoospores from the mother cell is not definitely known, but it appears that it is accomplish-ed by a gelatinization of apical portion in the vesicular wall.

occasional formation of many biflagella-te isogametes or anisogametes which fuse in pairs being liberated from same veside to form zygote indicates that B. granulatum is homothallic. The zygote germinates immediately into new individual without undergoing any resting period when meiosis takes place. Formation of parthenospore has also been reported in some species.

Botridium



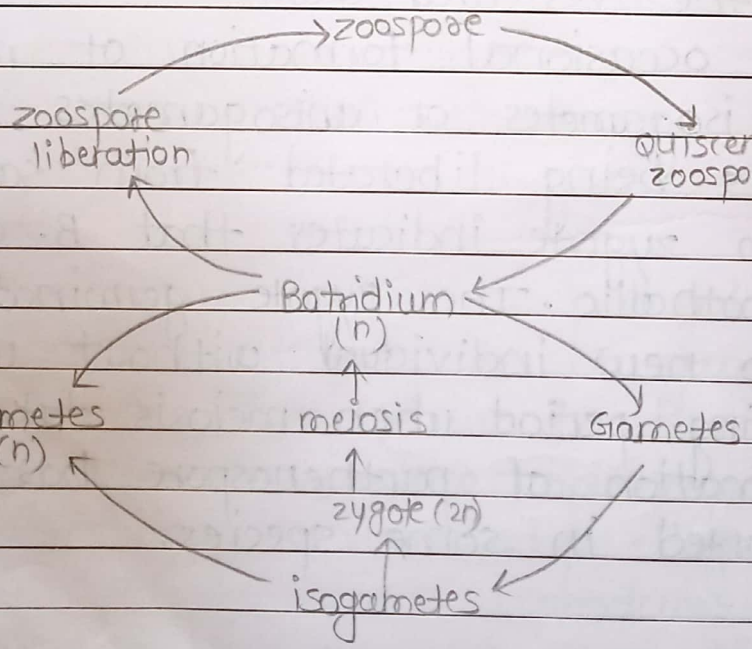
Botridium germination.



isogametes

Fusion of isogametes

zygote



Life cycle of Botridium

Batrachospermum

Date
Page

classification: (classificacao cientifica)

Dominio : Eukariota
subreino : Biliphyta
Filo : Rhodophyta
subfilo : Rhodophytina
classe : Florideophyceae
ordem : Batrachospermales
Familia : Batrachospermaceae
Genero : Batrachospermum.

* **occurance :**

1. This is one of the fresh water forms of Rhodophyceae. This algae is found in slow running stream, on the bank of lake & ponds.

2. It is more commonly found in well aerated weather in water. The plant are blue-green, dive green, ~~white~~, violet, reddish in colour.

3. The colour varies as a result of the differ-ence in light intensity.

4. species which grow in deep water are reddish or violet in colour. Whereas the species growing in shallow water are olive green in colour. The alga is also known as 'frog spawn'.

5. The plants are mucilagenous, moniliform or beaded in appearance to the naked eyes.

6. The plant may rich a length of 20 cm. Easily collected in slow running stream around Dehraduen specially in winter season.

* structure :

1. The thallus is filamentous, profusely branched and with mucilagenous feel. The filament consist of only one ~~axis~~ axial filament of main axis which has been produced by a single apical cell the cutting of segment parallel to the base. This way the central filament or main axis consist of uniseriate row of axial cell.

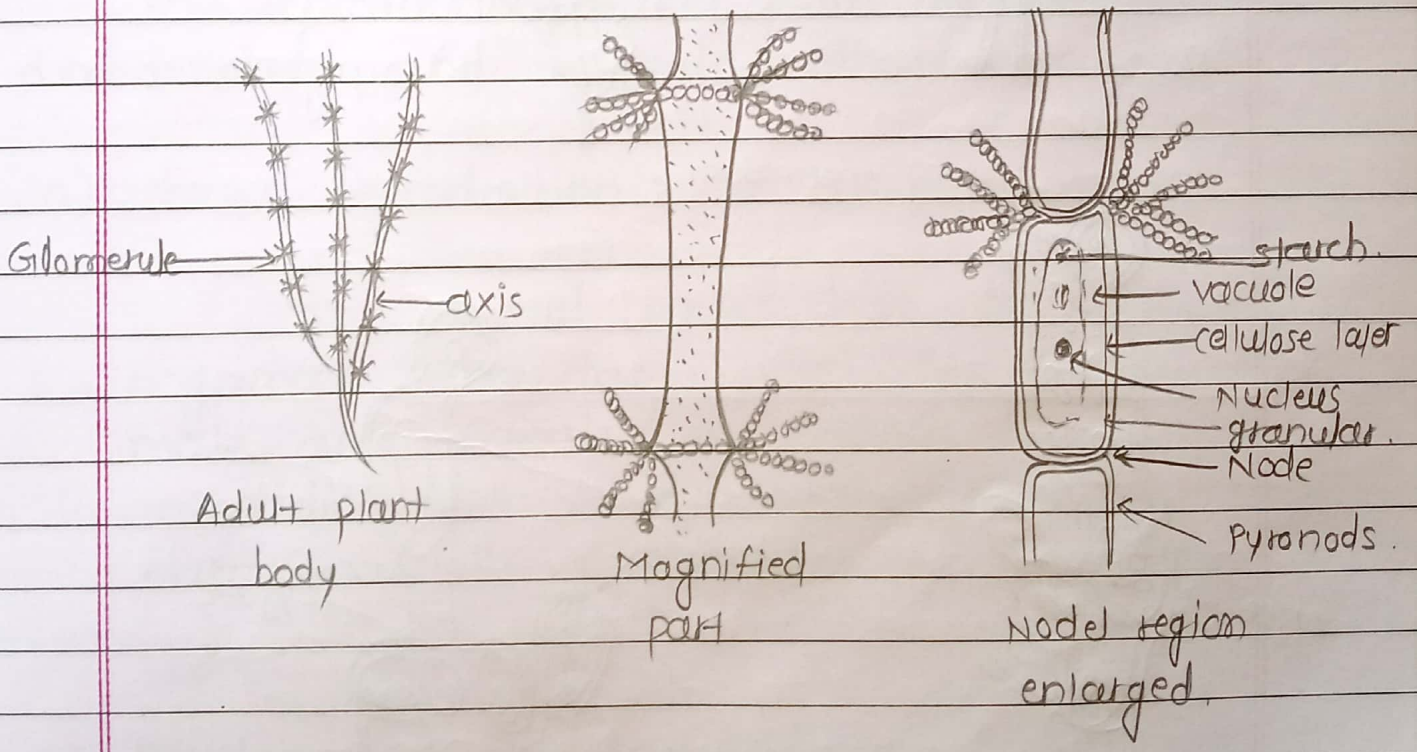
2. The main axis bears the lateral ~~and~~ at various points on its length. These laterals are very short in comparision to the main filament. they are called the branches or laterals.

3. At the nodal point, just beaneath the septum, usually four basal cells are formed each producing a ~~whole~~ whorl of the branches of the limited growth.

4. The laterals of the limited growth possess ~~uns~~ constricted a cell of moniliform appearan

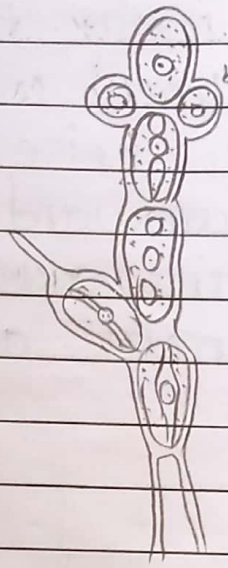
5. The ultimate cells of the branches of limited growth usually terminate in unicellular colourless hairs, the cluster of laterals at node are called the glomerules.

6. In addition to numerous branches of the limited growth, resemble the main filament in structure. The basal cell from which the branches of unlimited growth arise also produce filament growing downward, and ~~ensetting~~ ensheating the main axis they are called corticating filament and they form the pseudocortex.



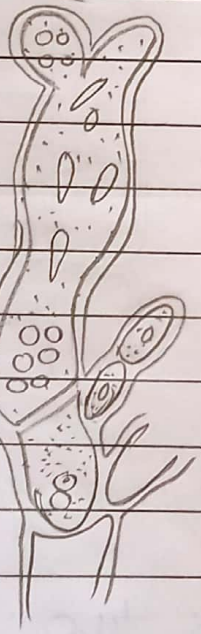
The cell wall of each cell is two layered. The outer layer consists of pectin and the inner one of the cellulose. The cells are uninucleate. Each cell contains many (more

than one) parietal chromatophores. The cells of Batrachospermum do not have pit connections which are common in the other members of florideae. Each chromatophore contains single pyrenoid.



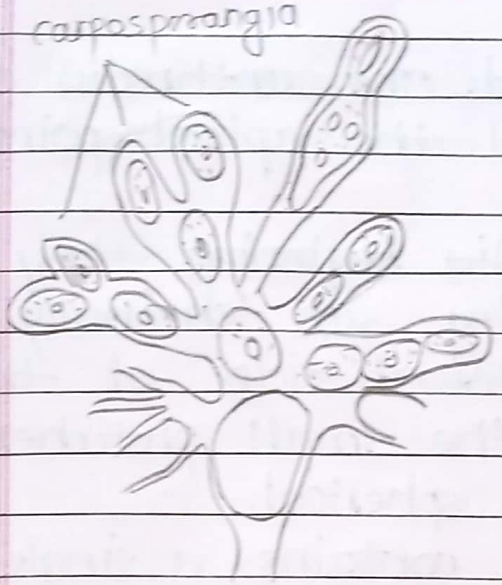
a) antridial branch

b) carpogonial branch

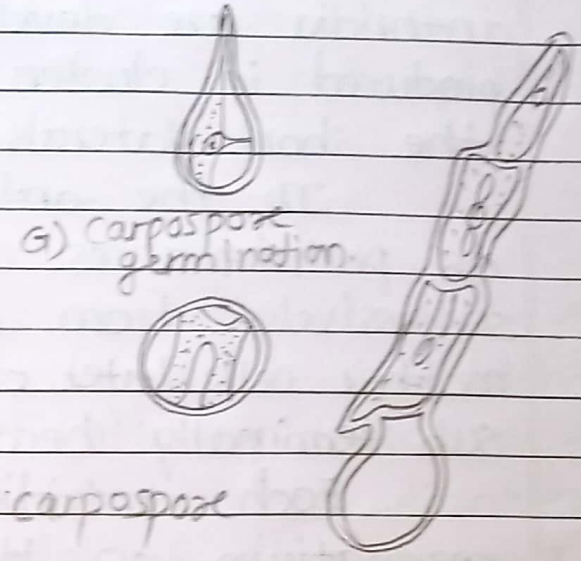


c) Fusion on trichogyne with spirogyra

D) Germination of zygote and formation of carposporangia.



F)



D) carpospore

The reproduction takes place by means of sexual and asexual methods.

a) sexual reproduction :

The sexual reproduction is advanced oogamous and takes place by means of male and female sex organs known as antheridia and carpogonia respectively. The plants may be monoecious or dioecious.

Development of antheridium :

The antheridium develops from an uninucleate, colourless antheridium mother cell. From each anthridium mother cell 1 to 4

anthridia are developed. The anthredia are produced in clusters at the apical points of the short laterals.

In the ~~anthredia~~ beginning they appear as protuberances arising sub terminally and successively from different sides of the mother cell. Later on, the small protuberances sub terminally become spherical.

Each antridium contains a single spermatium on its maturity. The non-motile, spermatium liberates through a slit formed in the wall of anthridium. The spermatia remain floating in the water.

In Batrachospermum, the nucleus divides into two as soon as it contacts the trichogyne. so at the time of the fertilization spermatium contains two nuclei and sometimes known as spermatium complex.

* Development of carpogonium:

The carpogonia develop on the terminal ends of the short laterals. the terminal cell of the lateral divides into four cells. the uppermost cell develops into the carpogonium.

The carpogonium consists of a swollen basal portion which contains an egg and known as carpogonium and an elongated receptive part, the trichogyne. The carpogonium is flask-like. In the majority of Florideae the cytoplasm

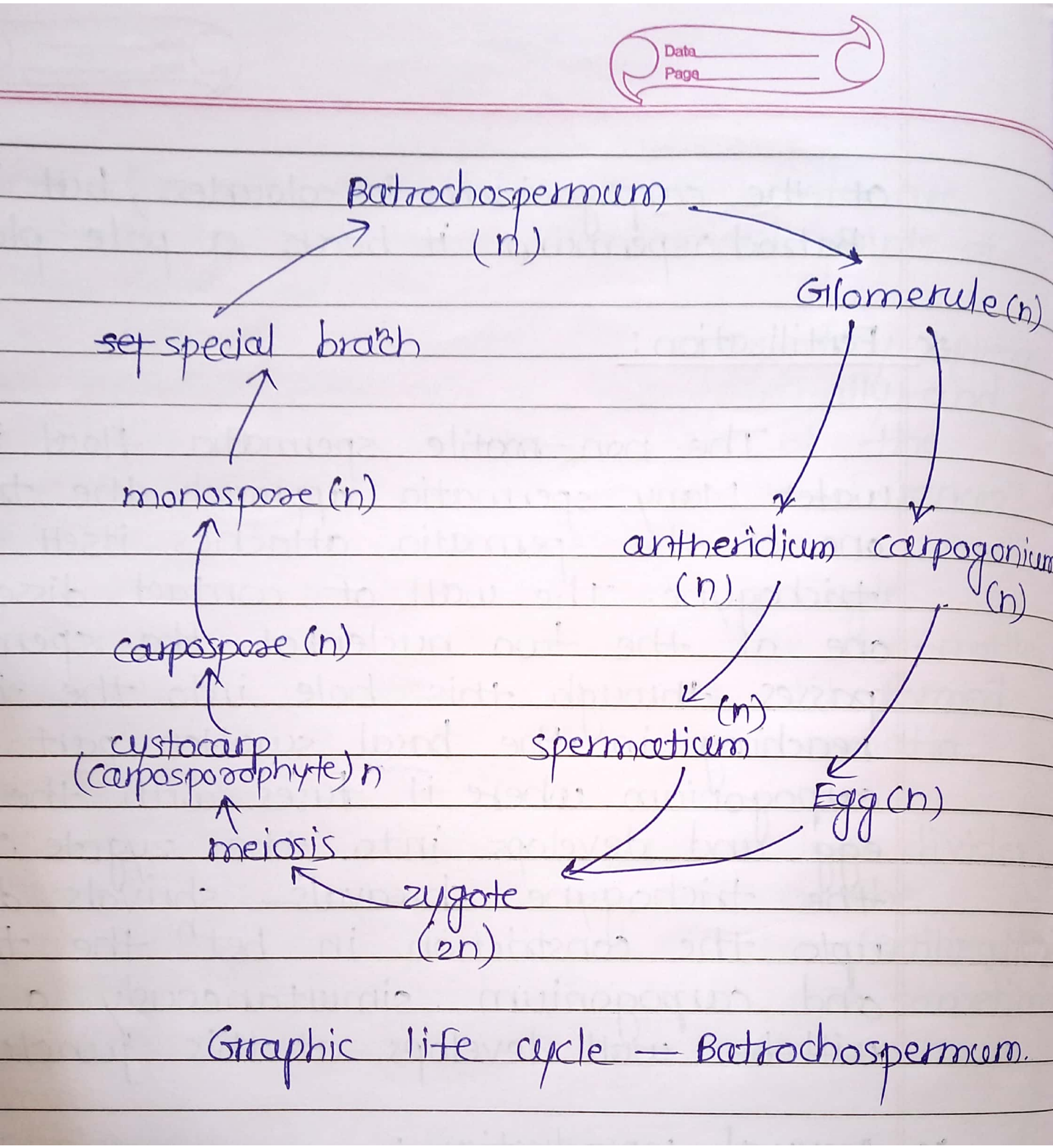
of the carpogonium is colourless, but in the Batrachospermum it bears a pale plastid.

* Fertilization:

The non-motile spermatia float in the water. Many spermatia approach the trichogyne. one of the spermatia attaches itself to the trichogyne. The wall of contact dissolves and one of the two nuclei of the spermatium passes through this hole into the trichogyne. reaching in the basal swollen part of the carpogonium where it fuses with the female egg and develops into the zygote. Thereafter the trichogyne ~~shreavals~~ shrivals down upto the constriction in betⁿ the trichogyne and carpogonium. simultaneously a cross ~~will be~~ wall develops at this juncture.

* Asexual reproduction:

In several species of Batrachospermum the short branches of the filaments of chantrasia stage produce monospores. these monospores again produce chantrasia stage, and again the apical cell of this stage produce new plants.



Graphic life cycle — Batrochospermum.