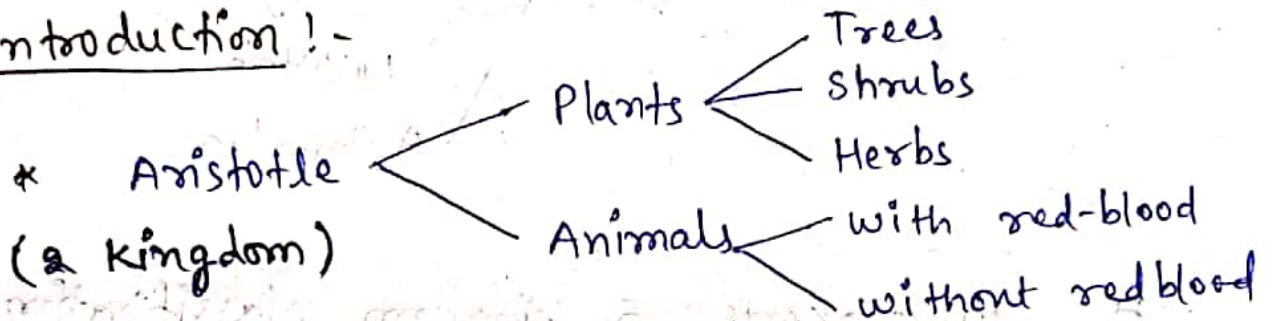


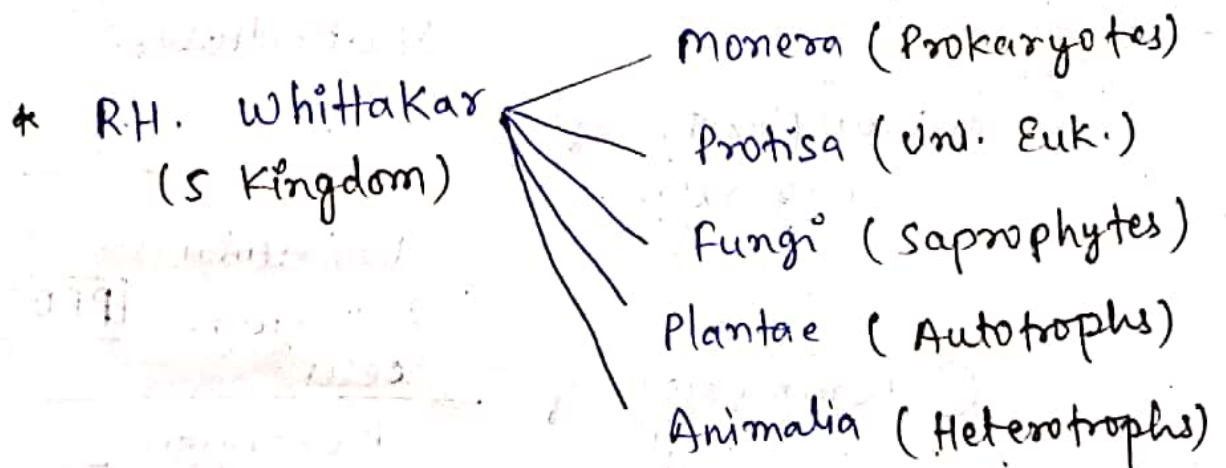
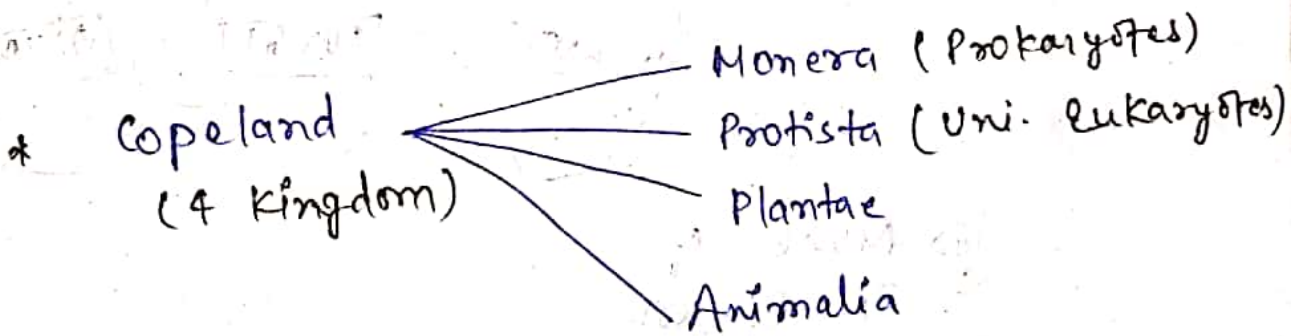
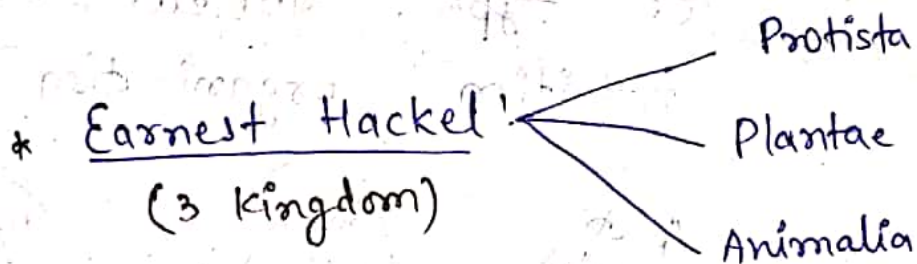
Ch-2 "Biological Classification"

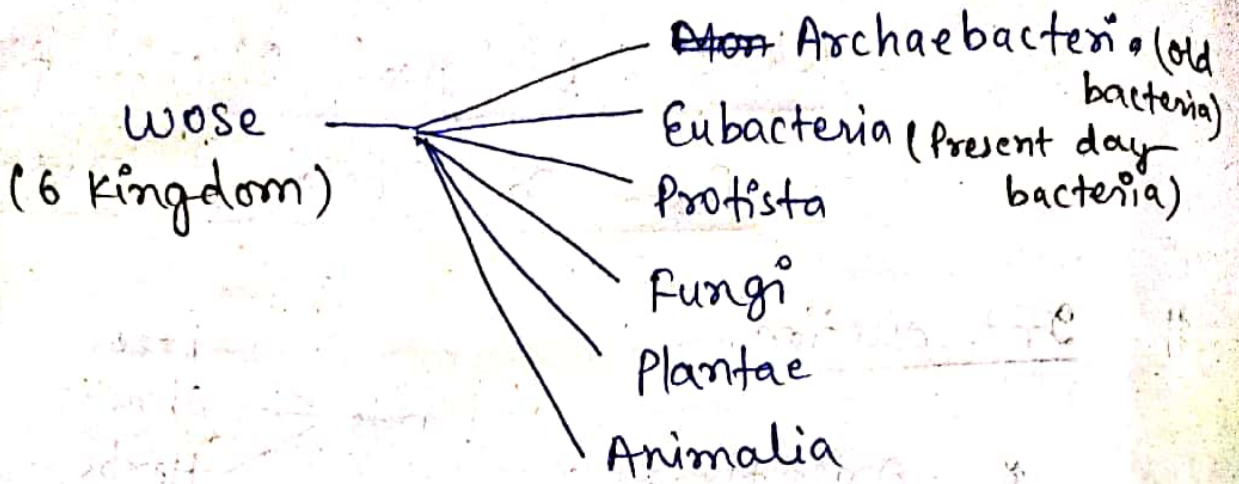
By - Dr. Neela Bakore

Introduction :-



* Linnaeus - 2 Kingdom Classification.

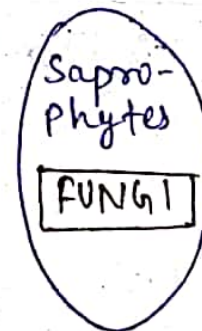




Whittaker's 5 Kingdom Classification!

Criteria!

cell type, Nucleus, cell wall, nutrition, organization.



③ Mode of Nutrition

② Complexity of organism.

Multicellular org.

① Complexity of the cell

Unicellular Eukaryotic cells.

PROTISTA

Prokaryotic cell

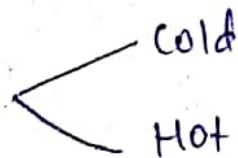
MONERA

	Monera	Protista	Fungi	Plantae	Animalia
cell	1	1	Multi	Multi	Multi
Nucleus	ab	✓	✓	✓	✓
Organelles	ab	✓	✓	✓	✓
cell walls	Peptidoglycan	Some have cell wall	All have cellulose Chitinic	cellulose	ab
Nutrition	Auto Hetero Sapro	Auto Hetero ↳ parasitic Sapro	Sapro	Auto	Hetero

Kingdom Monera:-

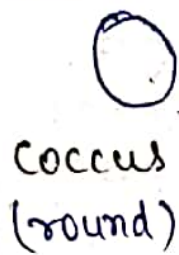
- Prokaryotic
- without any proper nucleus.
- No organelle.
- No membrane bound structures.

Habitat:-



- * ARCHAEBACTERIA:- ancient bacteria
- Survive in extreme condⁿ
- * EUBACTERIA:- modern day bacteria
- * CYNOBACTERIA:- (Blue-green algae)
- * MYCOPLASMA:- (PPLO:- Pleuro pneumonia like organism.
↳ smallest cell without cell wall.)

Shape!



Bacillus
(Rod
like)



vibrio
(comma
shaped)



Spirillum
(Spiral)



Mycelial
(thread
like)

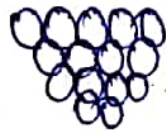
Note!-



diplococcus



Streptococcus (chain like)



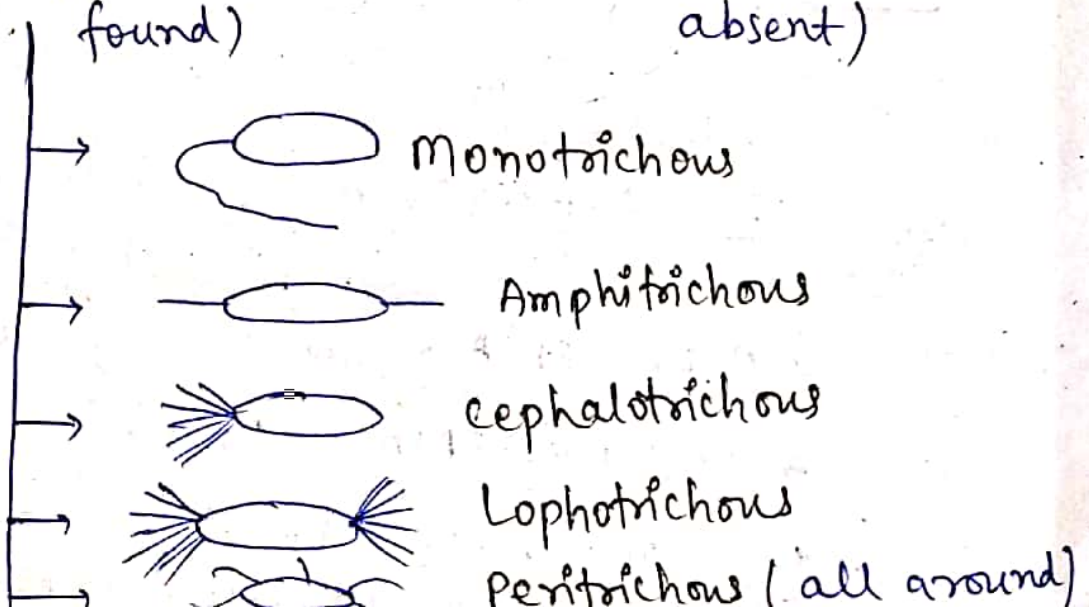
Staphylococcus (cluster like)

Flagella!

Bacteria

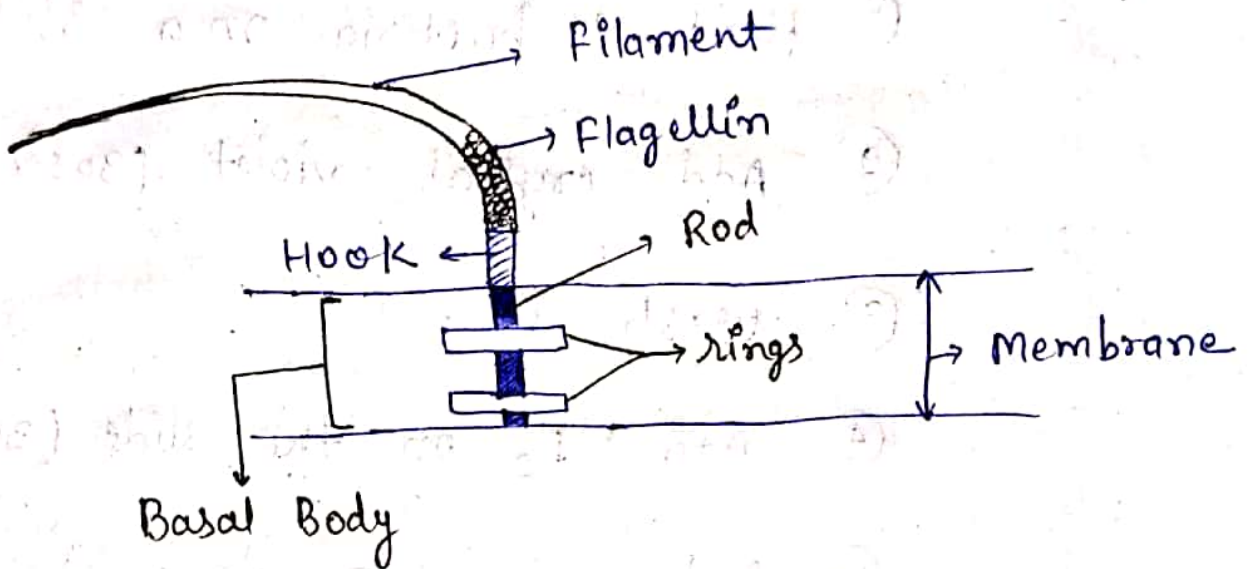
TRICHOUS
(Flagella are
found)

ATRICHIOUS
(Flagella are
absent)



Flagellum!

- Basal Body - rings {
 - 4 gram (-ve)
 - 2 gram (+ve)
- Hook
- Filament



Fig! - Flagellum parts.

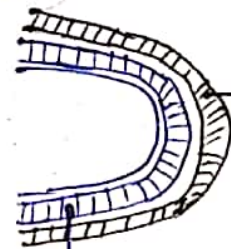
Gram (+ve) vs. Gram (-ve) Bacteria: -

Gram (+ve)



- cell wall (Thick)
(Peptidoglycan)
↳ with TEICHOIC ACID
- Retains gram stain.
- No extra layer present.

Gram (-ve)

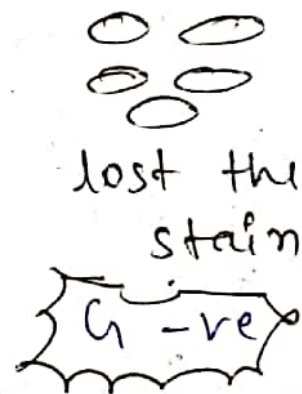
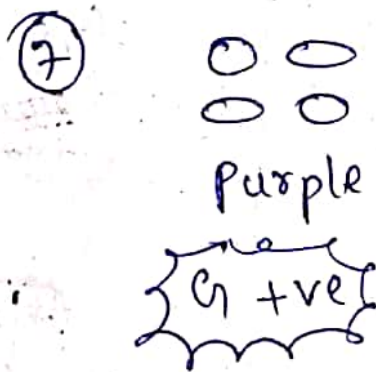


- ↳ lipoprotein + polysac.
- cell wall (Thin)
(Peptidoglycan)
↳ without TEICHOIC ACID.
- Doesnot retains stain.
- An extra layer of polysac. is present.

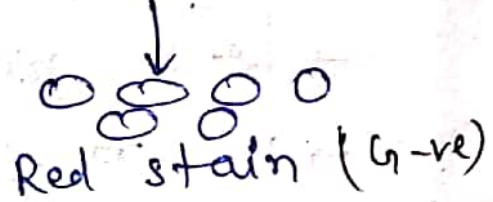
→ Staining process was discovered
by Hans Christian Gram

How to stain?

- ① Heat fix bacteria on a slide.
- ② Add crystal violet (30 sec to 1 min)
- ③ wash it.
- ④ Add I_2 on the slide (30 sec).
- ⑤ All bacteria purple.
- ⑥ wash it with 90% acetone or alcohol.



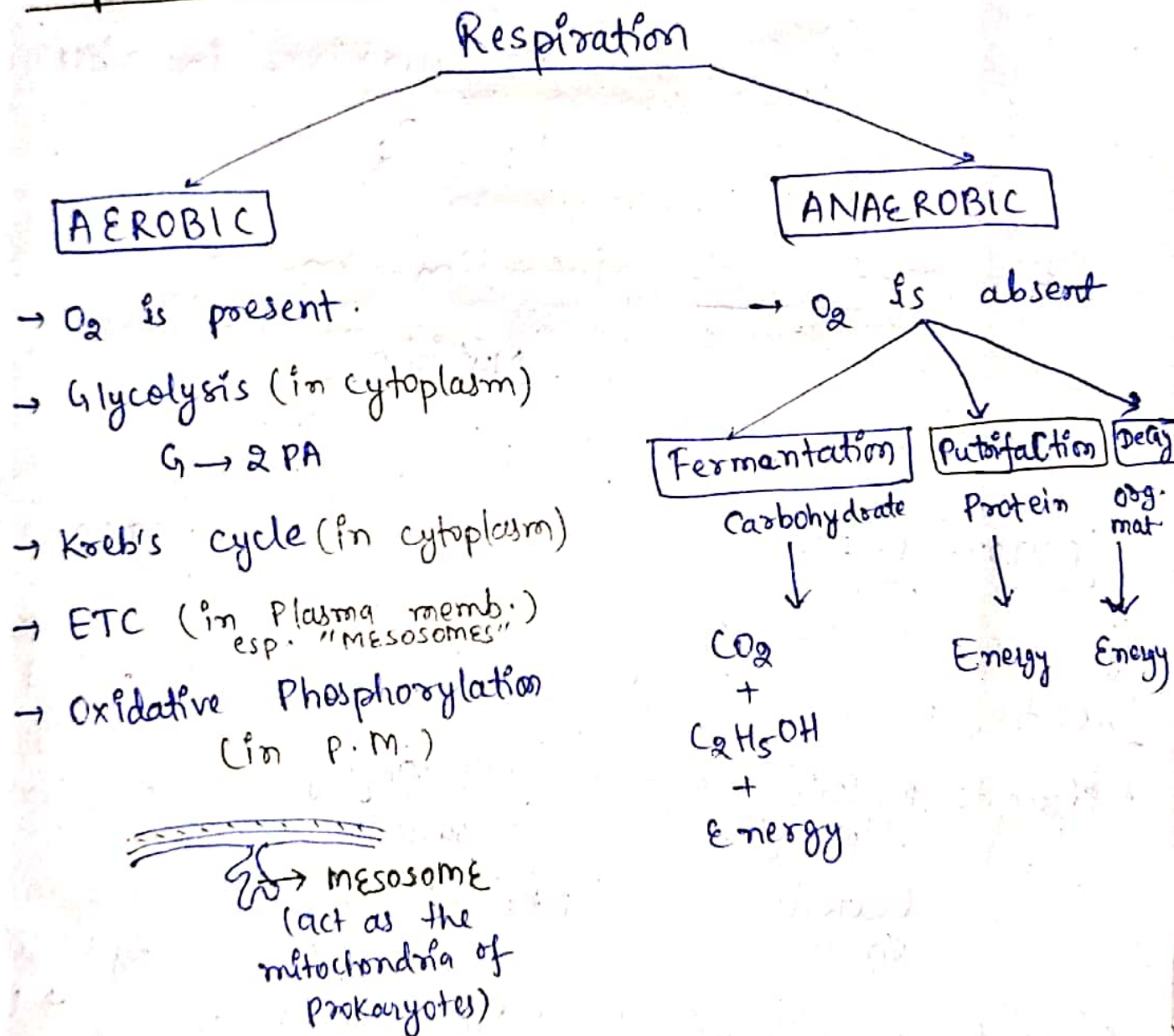
↓
Treat with
SAFRANIN



Note:-

→ Gram (-ve) does not retain stain bcoz, they have an extra layer of polysaccharides which is not sensitive to gram stain.

Respiration in Bacteria!:-



Note:-

(i) OBLIGATE AEROBS :- O_2 is must.

(ii) OBLIGATE ANAEROBS :- absence of O_2 is must.

(iii) FACULTATIVE AEROBS :-

→ They are anaerobic, but can survive in O₂ also.

(iv) FACULTATIVE ANAEROBS :-

→ They are aerobic but can survive in absence of O₂.

Mode of Nutrition in Bacteria :-

"Nutrition"

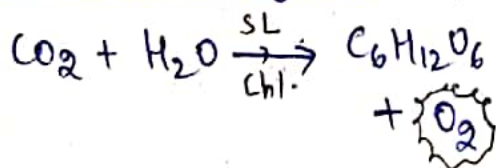
AUTOTROPHS

HETEROTROPHS

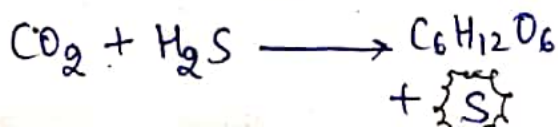
Phototrophs

- * Pigments - Bacteriochlorophyll
- Bacterio-
visidin

PS in Eukaryotes! (oxygenic)



PS in Prokaryotes! (Anoxygenic)



Chemoautotroph

- eg → Nitrifying Bacteria
- NH₃ → Nitrites
↓
Nitrites
- * Nitrosomonas
- * Nitrococcus

↳ Saprophytes

- dead decaying org. matter.
- eg → Clostridium

↳ Symbiotic

- eg → Rhizobium + Leguminous plants

↳ Parasitic

- bact → in the host
- eg → Vibrio cholerae

mode of Reproduction In Bacteria :-

Reproduction

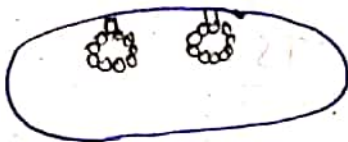
ASEXUAL / VEG.

SEXUAL

① Binary Fission



DNA Replicates



Cytokinesis



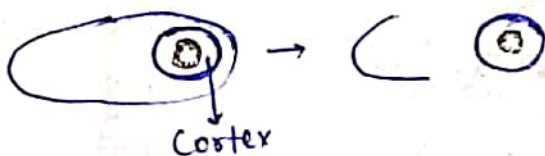
* **E. coli**

optimum condition

In 20 min
(2 daughter cells)

② Endospore Formation :-

→ In Unfavourable condⁿ



Cortex

③ Budding :-

→ v.v. Rare

* Exchange of genetic mat

① Transformation (By Griffith)

→ genetic material of 1 bact. transforms the genetic mat. of other bacteria.

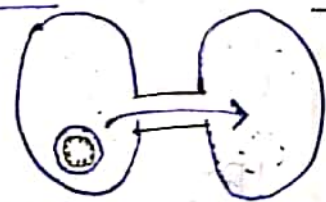
② Transduction (By Zinder & Lederberg)

→ Transfer of gen. mat. of 1 bact. into other via BACTERIOPHAGE (virus).

③ Conjugation :- (Lederberg & Tatum)

+ve

-ve



F-gene
(fertility gene)

Cyanobacteria / Blue-green Algae :-

They converted
reducing atmosphere \longrightarrow oxidising

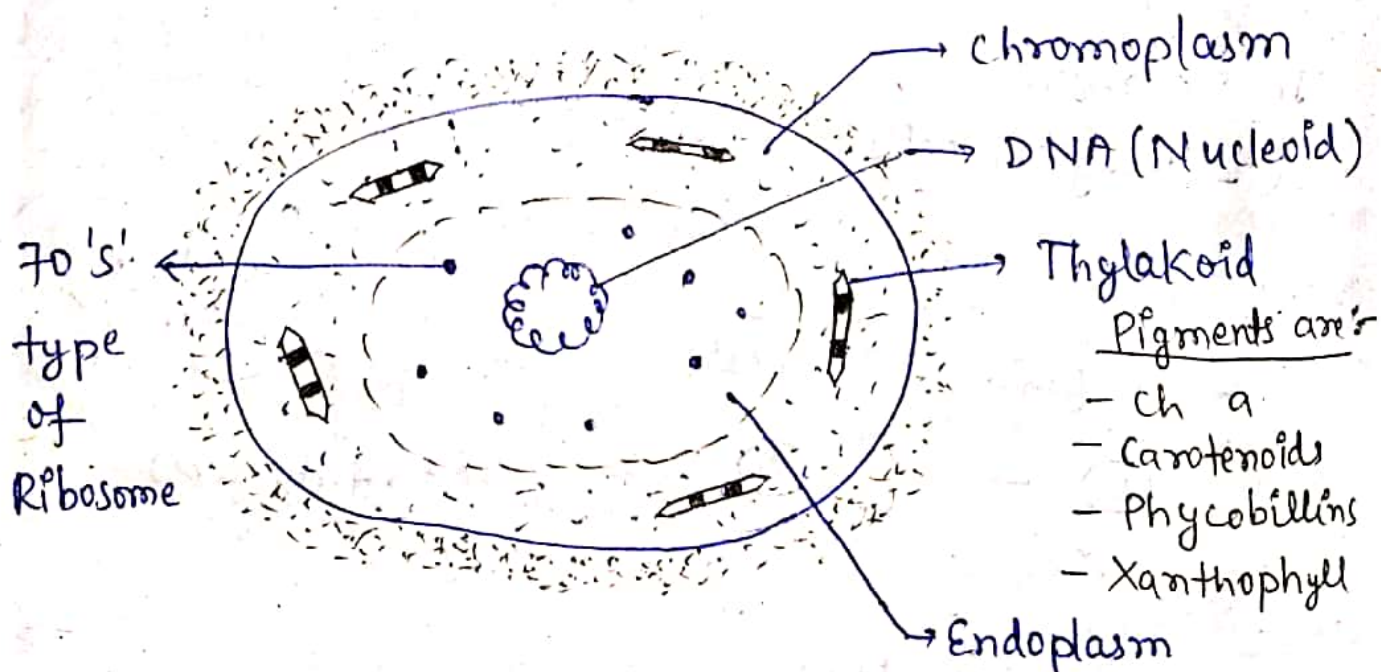
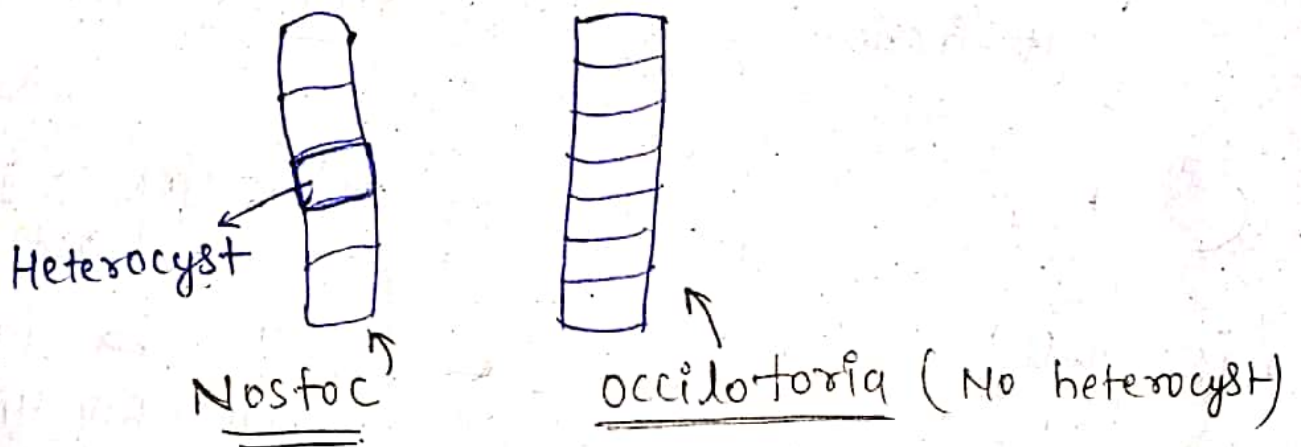
\rightarrow Unicellular, filamentous, colonial.

\rightarrow Some fix N_2

\hookrightarrow enzyme is NITROGENASE

\downarrow
works in anaerobic condition.

\hookrightarrow Special thick walled cells,
called HETEROCYSTS



Archaeobacteria :-

→ Ancient bacteria.

→ Survive in extreme - v. Hot (100°C)

- Highly acidic

- Highly Salty

→ They are prokaryotes

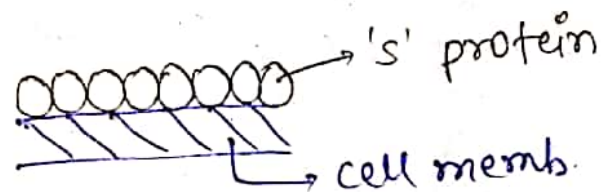
↳ do not have membrane bound structure.

↳ No nucleus, instead Nucleoid is present.

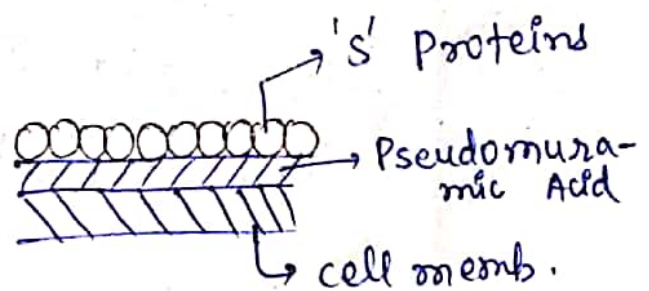
↳ cell memb.

* Branched lipids & Hydrocarbons.

↳ cell wall :-



OR



→ They are not affected by "LYSOZYME"

→ Repro - Binary Fission.

* Types of Archaeobacteria!

1. METHANOGENS!



→ Found in intestine of animals
and marshy areas.

2. THERMOACIDOPHILS!

→ Found at v. High temp. areas.

eg →

Thermus aquaticus

↳ Used in biotech.

→ Also found at high acidic condⁿ

3. HALOPHILS! (salt loving)

→ At high salinity areas.

→ Found in DEAD SEA.

Economic Importance of Bacteria - Useful activity!

①. Lactobacillus (LAB)

→ curd making

→ Cheese making

② Used in Biotechnology

Bacteria { Used as HOST
Used as VECTORS

③ Pest resistant plants

eg → BT cotton (by *Bacillus thuringiensis*)

④ Fibre setting

Jute → Bast fibre (phloem)

* Clostridium

⑤ Curing of leaves

→ Tobacco, tea, coffee beans

⑥ Cellulose digestion

eg → Ruminococcus
↳ produces cellulase enzyme

⑦ E. coli

→ Helps in absorption & synthesis of vit. B.

⑧ Sewage treatment

eg → Pseudomonas species
Clostridium species.

⑥ Used as Biofertilizers

$N_2 \rightarrow$ Nitrates

eg \rightarrow Nitrosomonas
Nitrococcus

* Harmful effects/activities :- \rightarrow

① Disease Causing bact.

\rightarrow Vibrio cholerae

\rightarrow Mycobacterium tuberculosis

\rightarrow Neisseria gonorrhoea

\rightarrow Treponema pallidum (syphilis)

② Act as Denitrifying bacteria

③ Food poisoning :-

eg \rightarrow Clostridium species

Mycoplasma, viruses, viroids, Prions, Lichens

1. Mycoplasma :-

\rightarrow Smallest living organism

\rightarrow Do not have cell wall

\rightarrow Most of them are PATHOGENS
and are also known as PPLD.

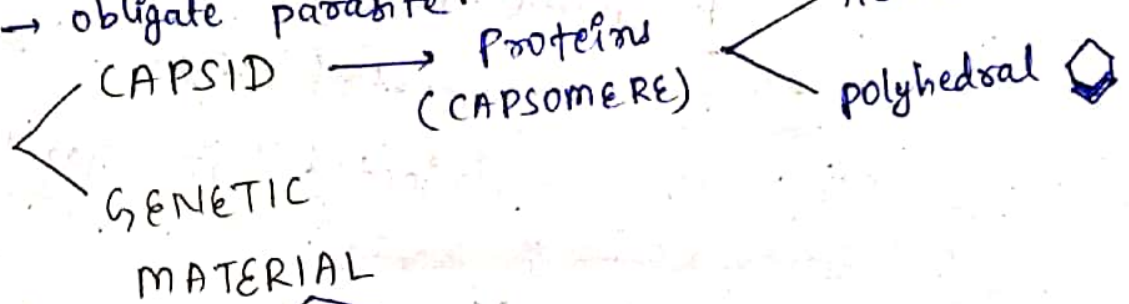
\rightarrow PPLD \rightarrow Pleuro pneumonia
like organisms.

Note 1.

- ① Smallest living org. → bacteria
- ② Smallest living organism without cell wall → Mycoplasma

2. Viruses :-

- Non-cellular organism.
- obligate parasite.



RNA

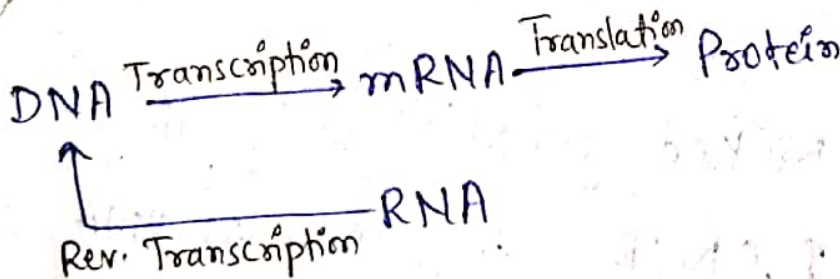
→ RNA containing viruses are called "RETROVIRUS"

DNA

→ Animal viruses have DNA :-

↳ ss DNA

↳ ds DNA



→ Plant viruses have RNA (ss)

~~→ Animal viruses may have~~

~~↳ ss DNA~~

~~↳ ds DNA~~

→ Virus means "venom".

→ Virus term was given by PASTEUR.

→ IVANOWSKY identified some microbes from Tobacco mosaic infected plants.

* Smaller than bact.

→ BEIJERNECK

→ isolated from TMV & injected in healthy plants.

→ STANLY

→ Crystallized virus.

→ Viruses are obligate parasites.

(Can survive only in host & reproduce there)

3. Viroids:-

→ Naked genetic material.

→ DICNER isolated ss-RNA, circular.

4. Prions:-

→ These are proteins which are infectious.

5. Lichens:-

→ Permanent Symbiotic association of Algae & Fungus.

[* Algae → Phycobiont → Synt. Food
* Fungus → Mycobiont → absorbs H_2O , & provides shelter.

→ Used as a Pollution Indicator (SO_2)

Kingdom Protista:- (By Haeckel)

→ Unicellular Eukaryotes

→ Pre-aquatic

PROTISTA

↓
Photosynthetic Protists (Autotrophs)

1. CRYSOPHYTA
* Golden Algae
eg → Diatoms

2. PYROPHYTA
↳ Fire Algae
eg → Dinoflagellates.

3. EUGLENOPHYTA
eg → Euglena

↓
Protozoan Protists (Heterotrophs)

1. SARCODINA
→ Amoeboid protist
eg → Amoeba, Entamoeba,
Locomotive str. → Pseudopodia

2. LILITA
eg → Paramecium

3. ZOOFLAGELLATA
eg → Trypanosoma

4. SPOROZOANS
→ endoparasites
eg → Plasmodium

↓
Saprophytic Protist (dead & decaying)

↓
eg → Slime
moulds
eg → Plasmodium

Algae -

→ Common term for Photosynthetic forms like :-

Monera → Blue-green Algae.

Protista → Golden algae.

Plantae → Green, Red, Brown algae.

* Characteristics of Algae :-

1. Aquatic

2. Autotrophs

3. Chlorophyll

4. Unicellular sex organs and sex organs are non-jacketed.

5. Shows gametophytic phase as well as sporophytic phase.

6. Gametophytic phase is predominant.

Chlorophyll :-

Ch a → In all algae

Ch a, b → green algae / Euglena.

Ch a, c → Brown algae.

{ phycoerythrin
phycocyanin
Ch-a } → Red Algae

Photosynthetic Protists :- (Plant like protists)

1. CRYSOPHYTA :-

→ commonly known as "GOLDEN ALGAE"

eg → Diatoms.

Diatoms :-

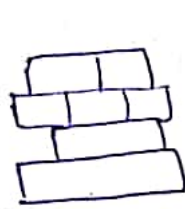
→ Microscopic

→ Aquatic $\left\{ \begin{array}{l} \text{Freshwater} \\ \text{Marine} \end{array} \right.$

→ Photosynthetic Organelle

→ cell wall made of → Silica

↓
Indestructible



→ Diatomaceous
earth (मिट्टी)
(deposits due to death)

* Used for making insulating bricks

* Used in filtration of oil

* Used as fine abrasive.

→ Due to silica deposition on their upper layer, they have ornamental appearance, called

JEWELS OF PLANT KINGDOM.

Structure of Diatoms

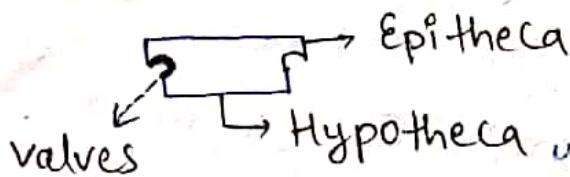
Pinnate
"SOAP BOX"

* Bilateral symm.

centric
"circular"

* Radially sym.

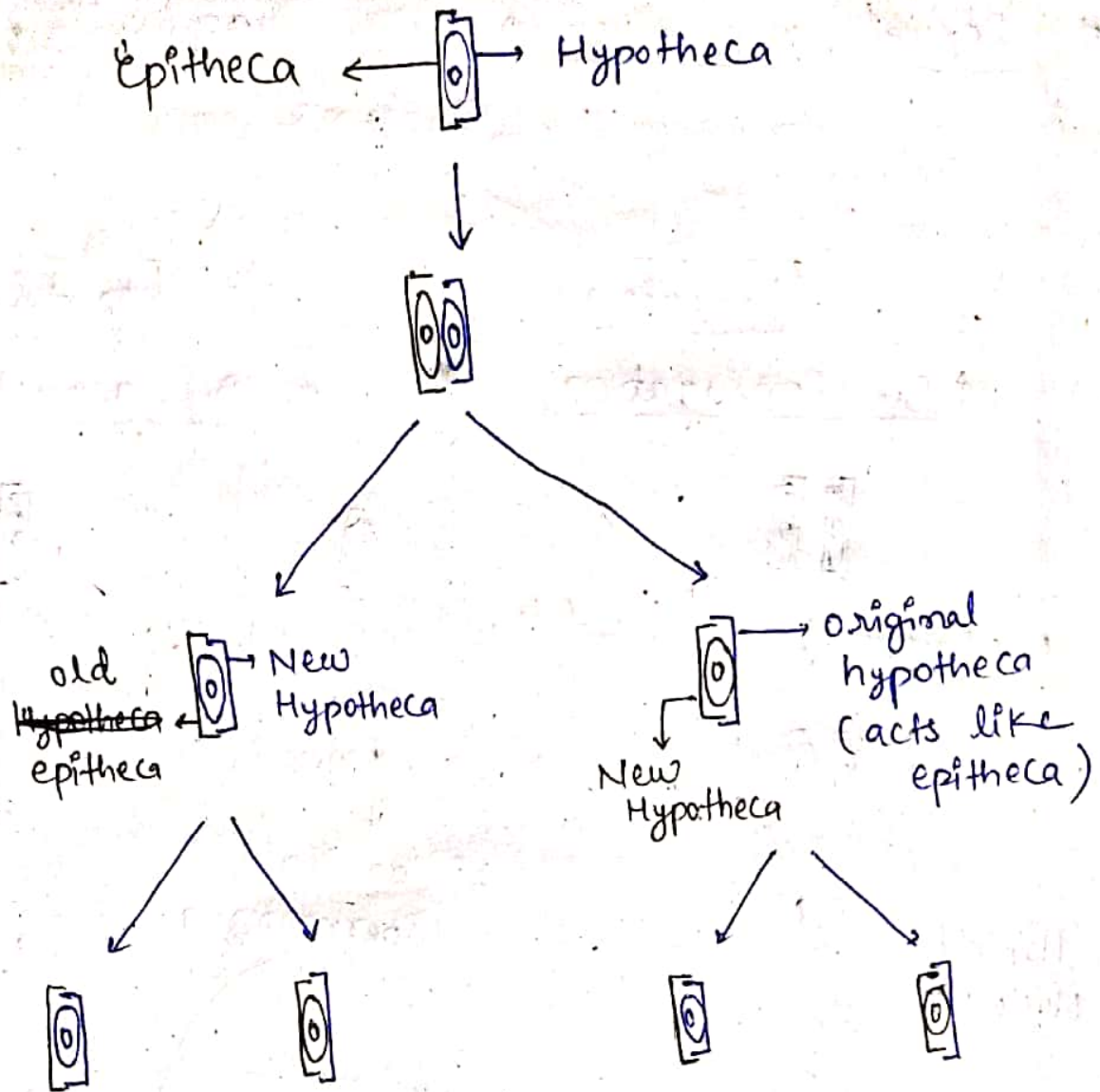
Fig →



- No flagella.
- Float due to oil, volutin granules
- $2n$
- veg. as well as Sexual reproduction

Vegetative reproduction in Diatoms :-

- Diatoms reproduce vegetatively as well as sexually.
- vegetative reproduction
 - Mitosis occurs
 - Takes place during night.



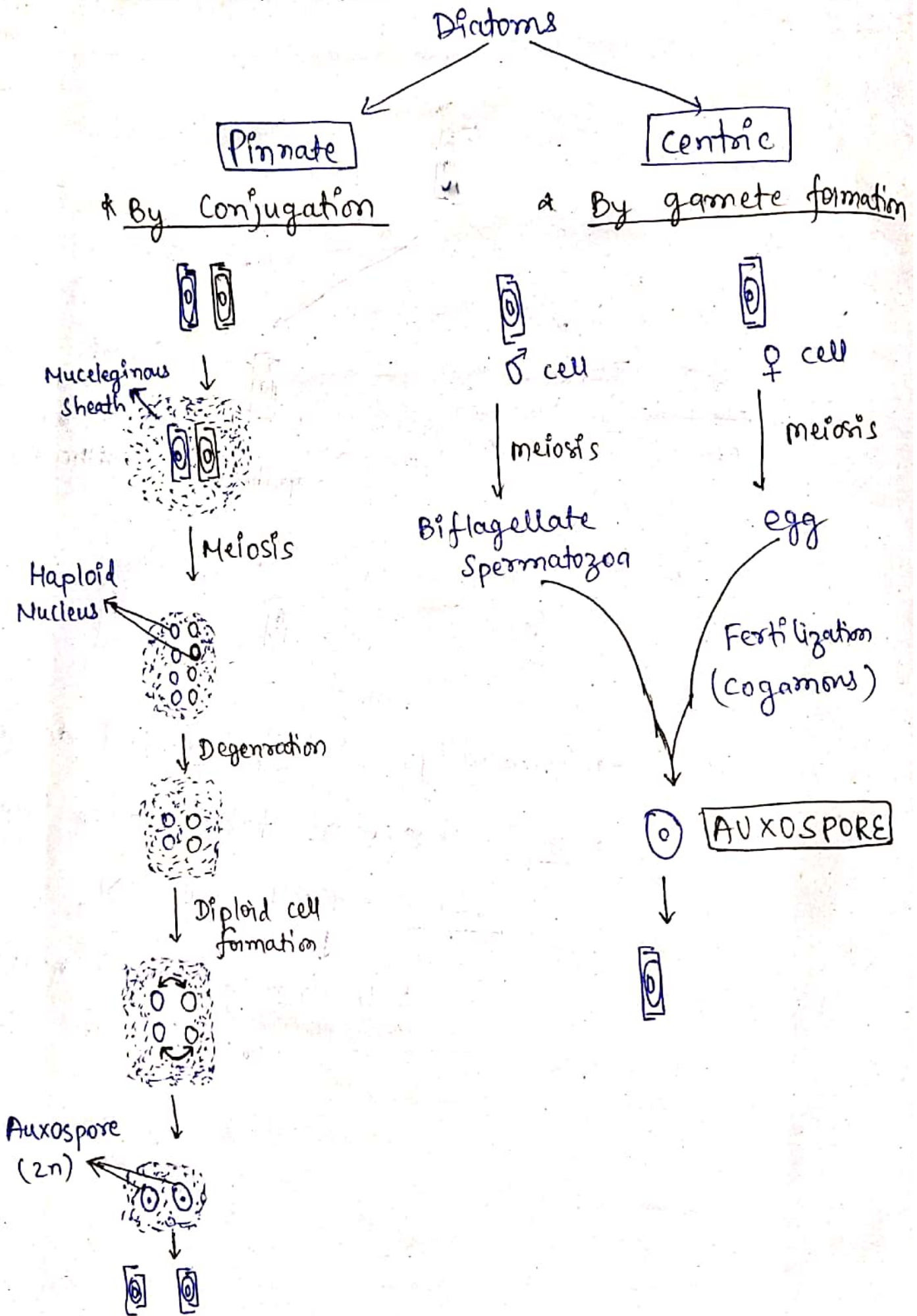
→ Gradually, the size of cell decreases.

→ Size correction takes place by

SEXUAL REPRODUCTION.

- ↓
- * mixing of genetic materials.
- * size correction.

Sexual reproduction in Diatoms!



2. PYROPHYTA :-

- Fire Algae
- Unicellular, autotrophs.
- Biflagellates
- eg → DINOFLAGELLATE

- mostly marine.
- cellulosic cell wall.

Imp ex.

→ GONYAULAX → no. Tes.

↓
↳ Causes Red Tides

* Bio luminescence / Phosphorescence

↓
Glowing

Protein → Luciferin

"Fire Algae"

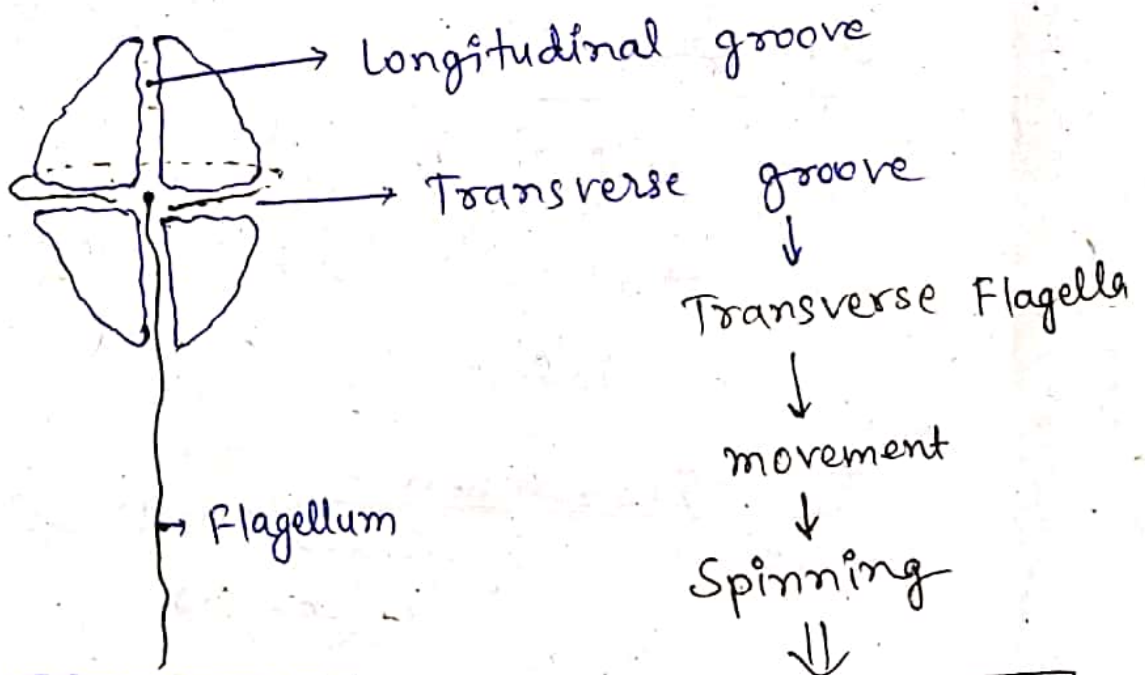


Fig: Dinoflagellates

"WHORLING WHIPS"

* Reproduction! -

Asexual → mainly

Sexual repro. → observed in some pyrophyta.

① Ceratium l.

→ zygotic meiosis

$n+n \rightarrow 2n \xrightarrow{\text{meiosis}} n, n, n, n.$

② Noctiluca! -

→ gametic meiosis

$2n \rightarrow n$ gametes

$n+n \rightarrow 2n \rightarrow$ organism

* Nutrition! -

→ mainly autotrophic.

→ But in some cases symbiotic relation is observed.

Ex! Zooxanthellae!

* Symbiosis with other protists or vertebrates.

→ Some are parasitic.

Ex! Banidium.

3. EUGLENOPHYTA:-

eg → Euglena

→ Fresh water

→ Few plants like character.

(Ch - chloroplast)

→ Connecting link b/w plants & animals.

→ 1 to 2 Flagella.

Botanist → Euglenophyta
Zoologist → Protozoa → Mastigophora



"PHYTO-MASTIGOPHORA"

Structure:-

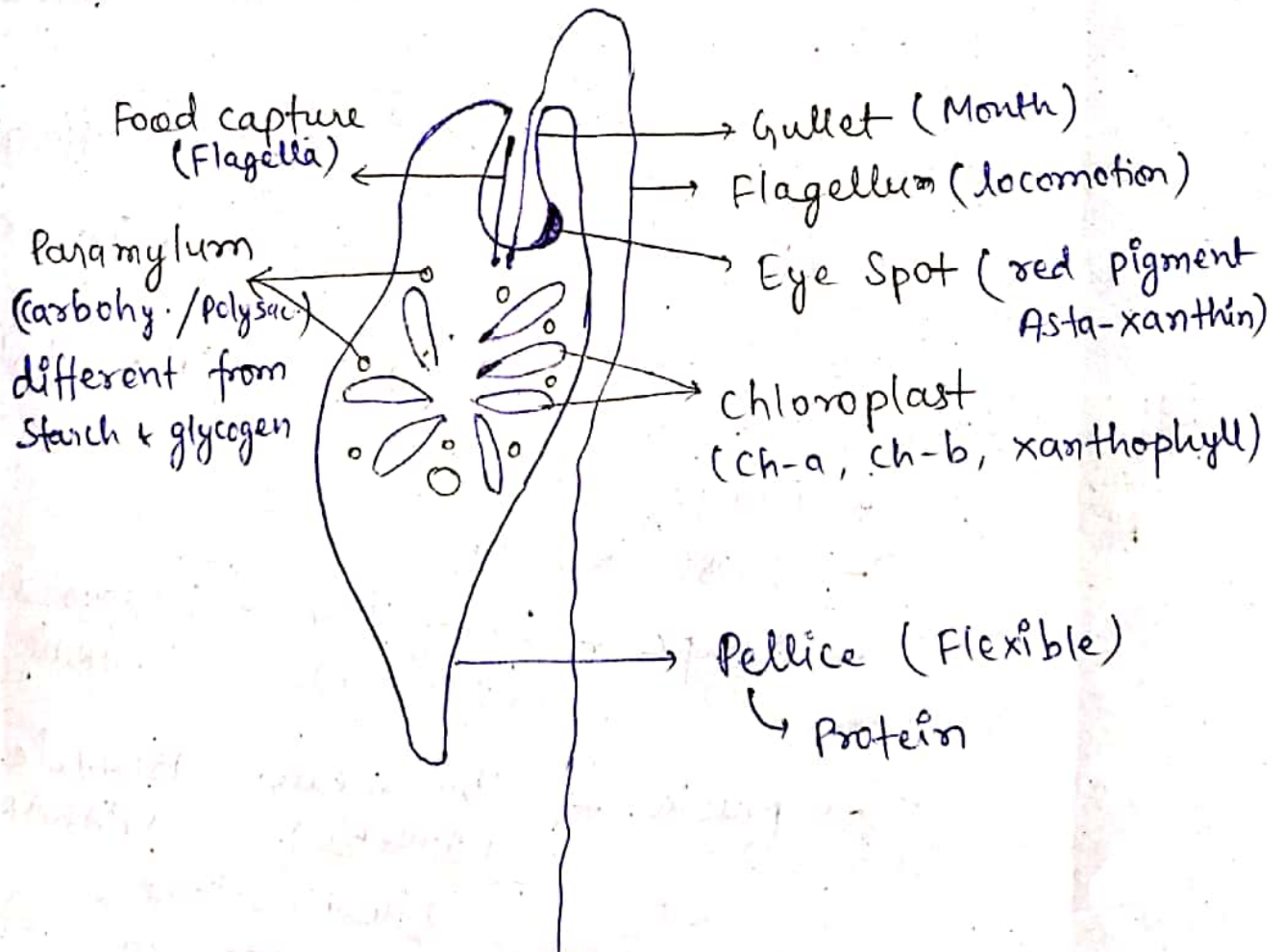
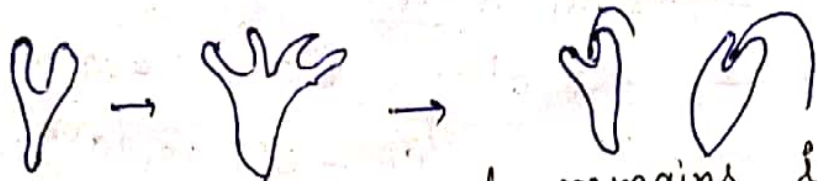


Fig:- Structure of Euglena

Reproduction in Euglena!

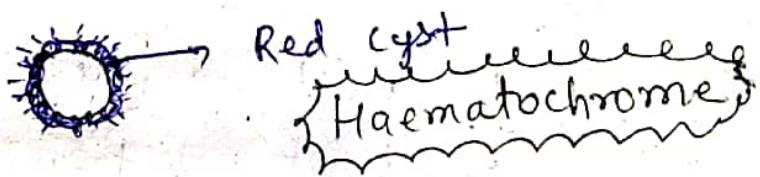
→ Longitudinal Binary Fission



→ Nuclear memb. remains intact.

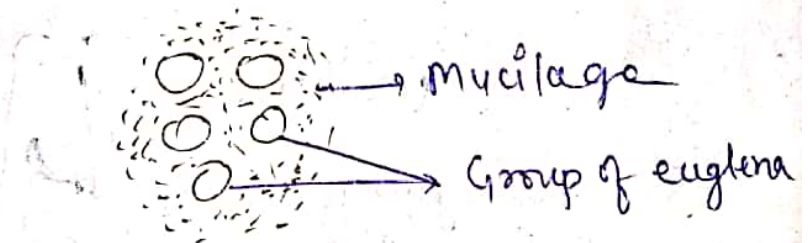
→ In adverse conditions,

① CYST FORMATION.



② Palmella stage:

→ many euglenoids come close,
4 surrounded by Mucilage.



Protozoan Protists! - (Animal like Protists)

→ Animal like.

→ Most diverse.

→ Shape - irregular, slipper like
(AMOEBA) (PARMOECIUM)

→ Nuclei - Uninucleate, Binucleate,
(AMOEBA) (PARAMOECIUM)

Multinucleate
(PELOMYXA)

→ Nutrition - parasitic, holozoic, symbiotic, saprophytic

→ Locomotive structures :

(i) Flagella → ZOOFLAGELLATA

(ii) CILIA → CILIATA

(iii) Pseudopodia → SARCODINA

(iv) NO structure → SPOROZOA

(i) * ZOOFLAGELLATA :-

→ Flagella are present (1 to many).

→ Endoparasites / pathogenic.

→ Only asexual repro. by longitudinal Binary fission.

eg:-

① Trypanosoma gambiense :-

→ Uniflagellata, endoparasite.

→ Digeneric → (life cycle in 2 hosts).

one host → man

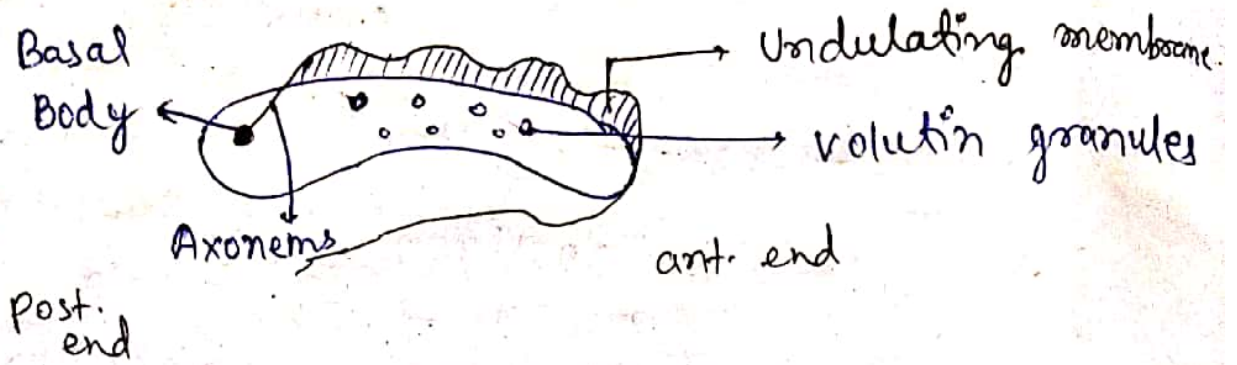
second host → Tse-Tse Fly

→ Found in salivary gland of Tse-Tse fly → goes to human blood

↓
Lymph
← CSF (cerebrospinal fluid)

→ Disease "African Sleeping sickness"

Structure of Trypanosoma gambiense



2nd example:-

② Leishmania Donovanii:-

→ By Leishman & Donovanii

→ Flagellata, digenetic

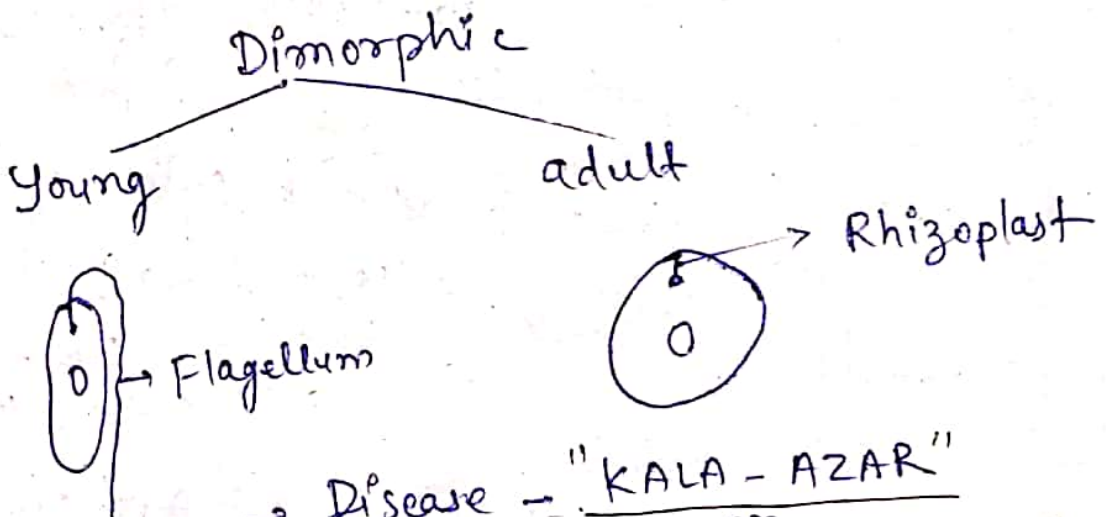
dimorphic

↓
2 Forms

↳ life cycle in 2 hosts :-

- ① Man - Blood capillaries
- ② Sandfly
liver, spleen,
& Bone Marrow

(Blood sucking)
→ Sand Fly → Salivary gland
(Phelobotamus argentipes)



→ Disease - "KALA-AZAR"
"DUM-DUM FEVER"

→ In Kala-azar, enlargement of visceral organs like spleen & liver takes place.

3rd example!

③ Trichonympha :-

→ Multiflagellata.

→ Symbionts in intestine of

TERMITES.

cellulose $\xrightarrow[\text{secreted by Trichonympha}]{\text{cellulase}}$ Simple Sugar

4th example!

④ Giardia intestinalis :-

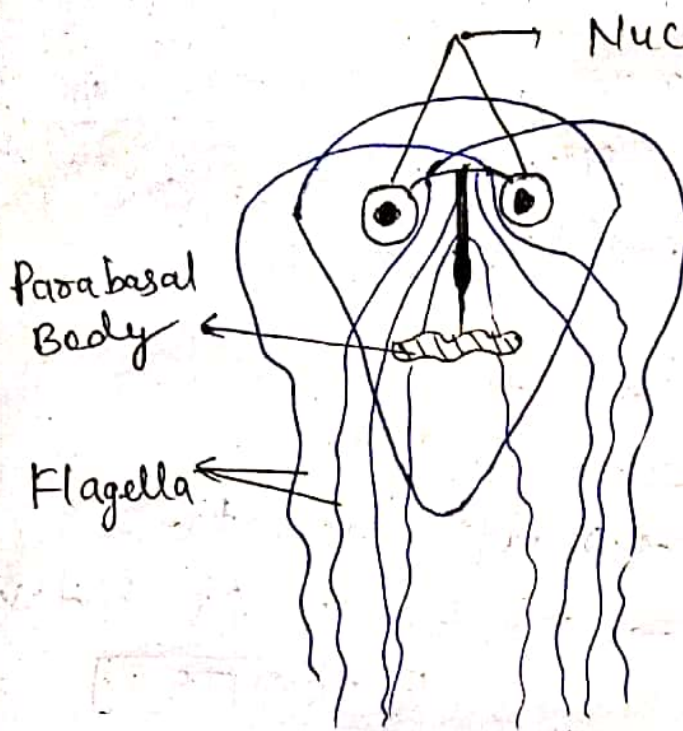
→ "Grand Old man of Intestine"

→ Discovered by Leeuwenhooke in his own faeces.

→ 1st pathogenic protist.

→ Binucleate, an adhesive disc, axostyle, parabasal body, 4 pairs of backwardly directed flagella.

→ Monogenetic → life cycle in man.



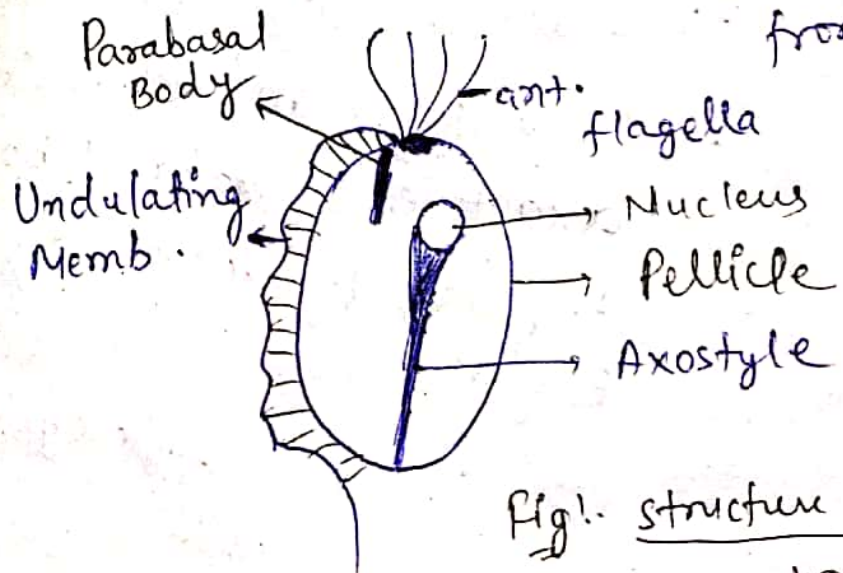
- Infection by direct or contaminated food + water.
- Repro - Longi. Binary Fission
- Disease - "Giardiasis"

Fig!- Structure of Giardia intestinalis

5th example :-

⑤ Trichomonas vaginalis :-

- In vagina of human ♀.
- Male act as carriers.
- 4 ant. flagella & 1 backwardly flagella.
- Disease - "LEUCORRHOEA"
↓
white, smelly discharge from vagina.



Fig!- Structure of Trichomonas vaginalis.

(ii) ** SARCODINA :-

→ free living or parasitic.

→ Fresh water, marine, muddy areas.

→ Uninucleate or multinucleate.
↓
(Amoeba) ↓ (Pelomyxa)

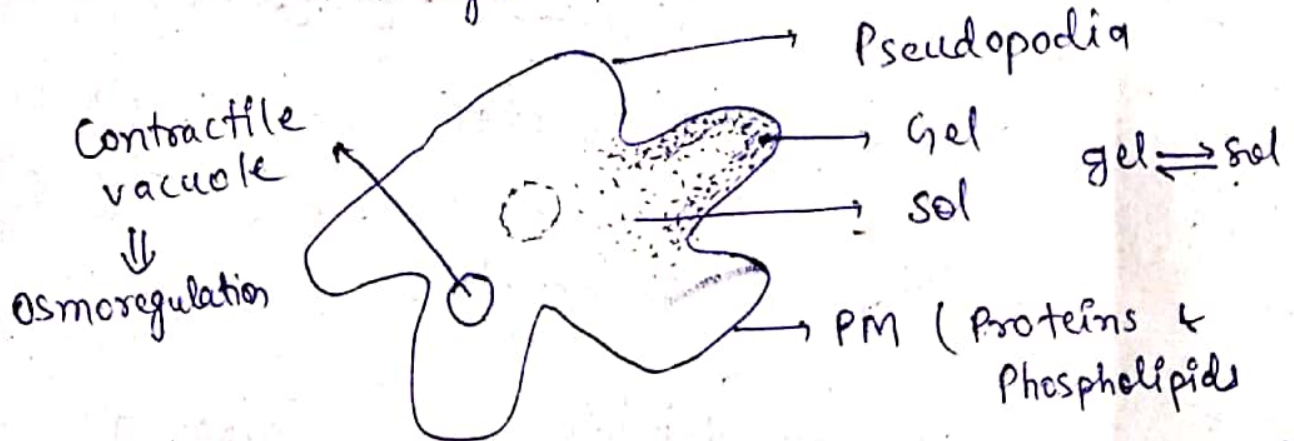
→ Locomotion by Pseudopodia.

→ Asexual or sexual reproduction
↓
(Binary or Multiple fission) ↓ (Syngamy)
eg. Pelomyxa

Examples :-

① AMOEBA PROTEUS :-

→ Irregular, Uninucleate, fresh water.



→ only Asexual repro (in Favourable condⁿ)

- Binary
- Multiple Fission
↓
Sporeulation.

→ Encystment (in Unfavourable condⁿ)



Example 2:-

② AULOCANTHA:-

→ Max no. of chromosomes.

$$2n = 1600.$$

Example 3:-

③ Pelomyxa:-

→ Giant Amoeba.

→ Multinucleate (100-1000 nuclei/cell)

→ Sexual repro → Syngamy.

Example 4:-

④ ENTAMOEBIA HISTOLYTICA:-

→ discovered by Lambley

→ Monogenetic - lifecycle only in Intestine of man.

→ Dimorphic

Minuta

Magma

(TROPHOZOITE)



Pathogenic

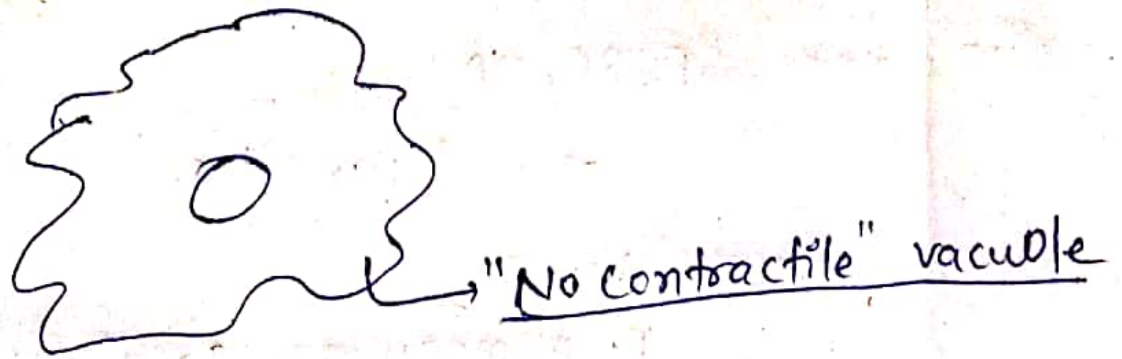
→ Feeds on RBCs.

→ Disease caused AMOEBIASIS.

↓
• Abdominal pain

• Cramps

• Acidic stool, • dysentery



→ Infection!

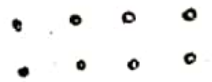
Infectious stage

Tetra Nuclear Cyst



1 mitotic divⁿ

↓
Minuta



Pathogenic Stage

↓
Magma (Trophozoite)

Secretes → Histolytic

↓
damages intestine linings

Example 5:-

⑤ E. GINGIVALIS :-

→ Mouth Amoeba.

→ Found in Tarter of teeth.

→ Aggravates Pyorrhoea.

↓
"Gingivitis"

(iii) *** SPOROZOA! -

→ Endoparasites.

Examples!

PLASMODIUM! (Malarial parasite)

→ discovered by Loverson in RBCs of humans.

Types!

P. vivax → Benign Tertian Malaria

P. ovale → Mild " "

P. falciparum → Malignant Tertian malaria
↳ cerebral ter. mal.

P. Malariae → Quartan Malaria

→ Digentic
 Pri. host → ♀ Anopheles Mosquito
 Sec. host → Man

Life cycle! 3 phases

① Shizogony (Multiple fission in Humans)
 Liver (Man) - Hepatic shizogony
 RBC (Man) - Erythrolytic shizogony

② Gamogony → Starts in humans & completed in ♀ Anopheles.

③ Sporogony → in ♀ anopheles only.

Symptoms!

- ① chill cold stage
- ② Hot stage / Fever — due to HAEMOZOIN
↓
"Pyrogen"
↳ Fever causing Substance
- ③ sweating

Infective stage → Sporozoite.

Treatment!:-

- * Symptom targeted :- Anti-pyretic drug like chloroquin.
- * Pathogen targeted :- Quinine

~~(iv)~~ *

(iv) **** CILIATA!

→ locomotion by cilia.

eg!:- Paramoecium!

→ Free living.

→ Balantidium (Pathogenic, endoparasite)

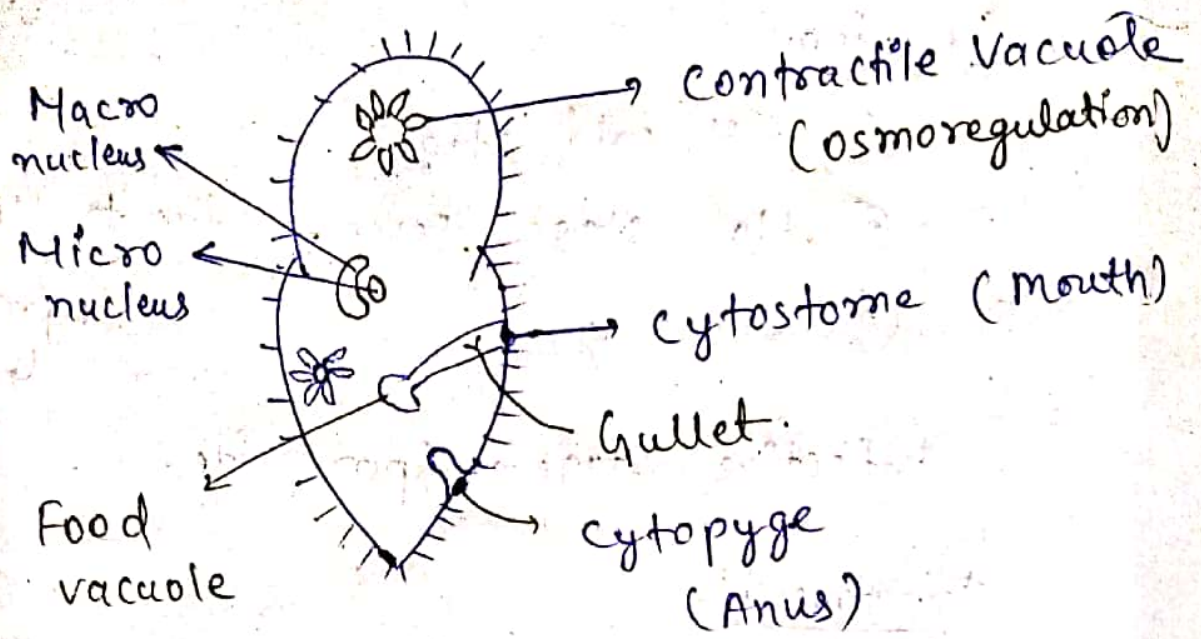
Types!:-

P. Caudatum (1 macro, 1 micro nucleus)

P. Aurelia (1 macro, 2 micro nucleus)

P. multinucleatum (1 macro, many micro nucleus).

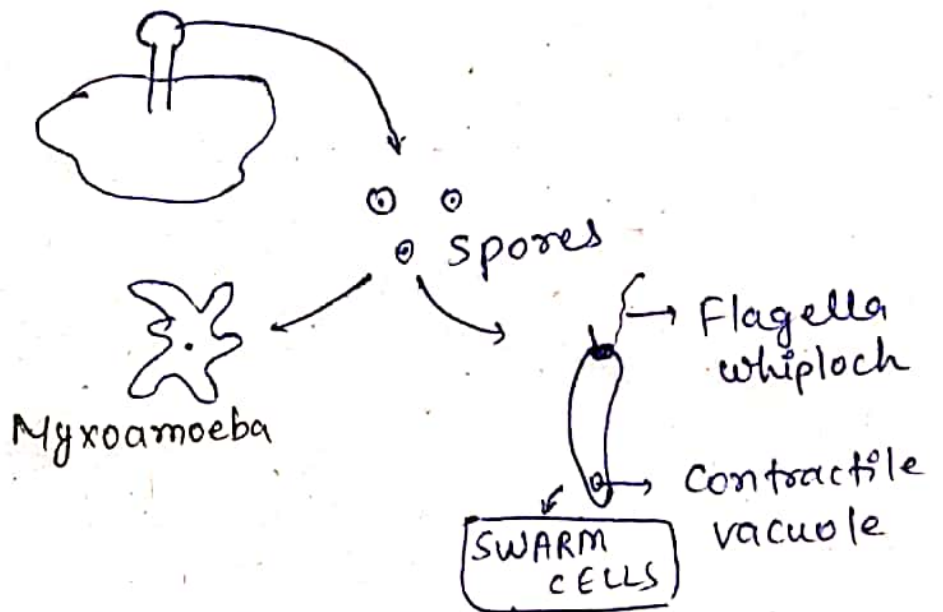
→ Repro $\left\{ \begin{array}{l} \text{Asexual - Trans. Binary Fission} \\ \text{Sexual - Conjugation} \end{array} \right.$



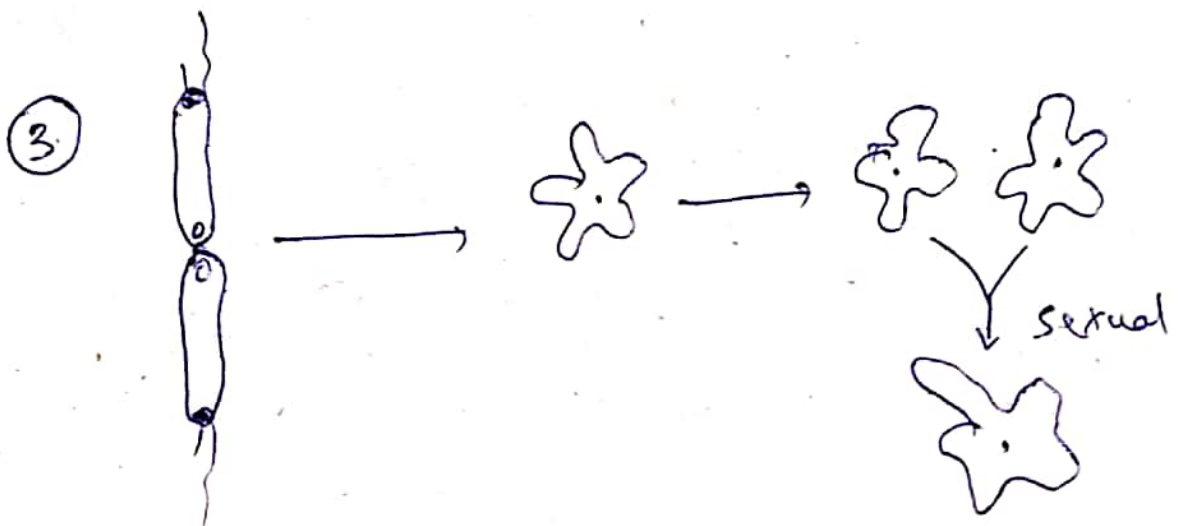
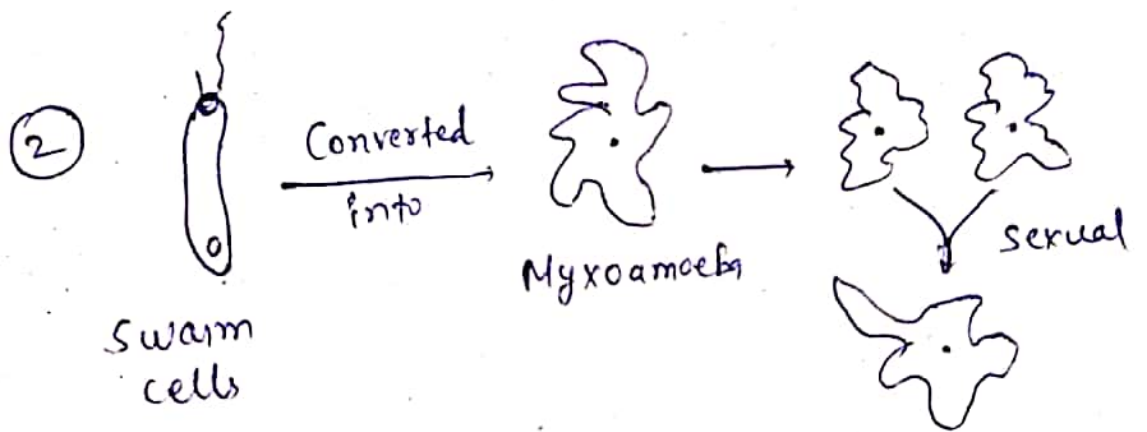
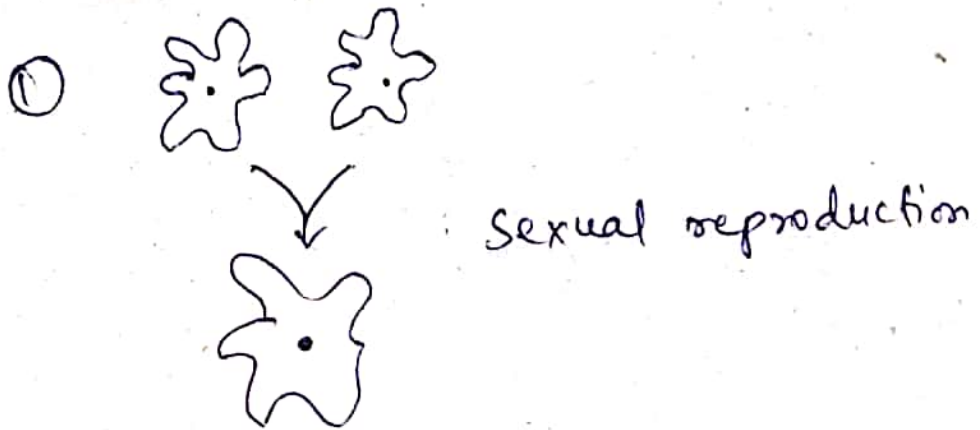
Saprophytic Protists :-

* Slime Moulds :-

- Saprophytic (decomposers)
- grow on dead & decomposing substance.
- Found in dark & damp places.
- No cell wall.
- vegetative reproduction
 - Fragmentation
 - Sclerotia Formation
- Asexual reproduction by spore formation.

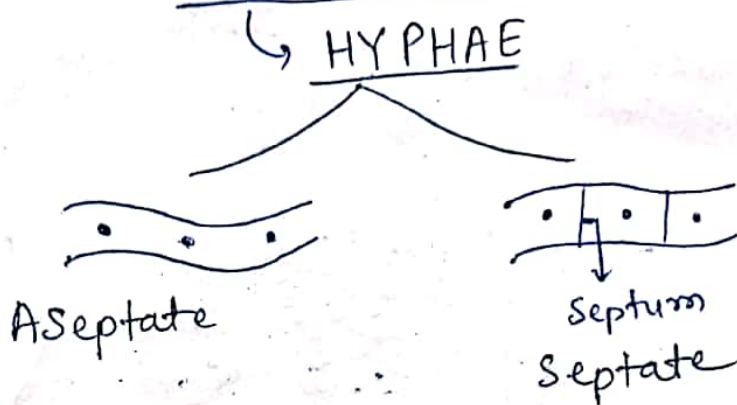


→ 3 types they can reproduce



Kingdom Fungi :-

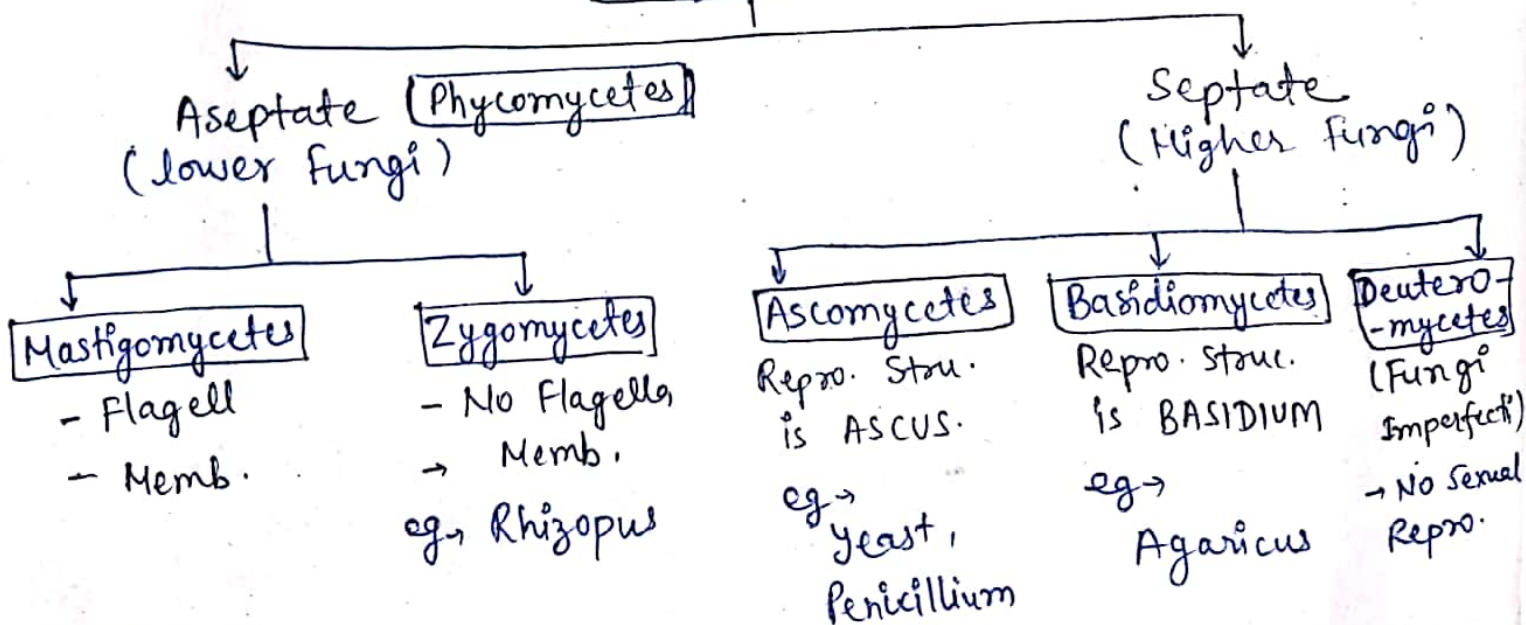
- Multicellular eukaryotes.
- Exception - yeast (unicellular)
- Body! - Thread like structure



- No pigments.
- saprophytic → extracellular
- Parasitic & symbiotic "

→ cell wall! -
Chitin — N-acetyl glucosamine
(Homopolysaccharides)

Fungi (Eumycetes)



Zygomycetes :-

- Conjugation Fungi.
- No motile cell.
- Aseptate.
- Coenocytic (multinuclear)

eg:-

RHIZOPUS STOLONIFER :-

(Bread Mould)

- Commercial production of Fumaric Acid.
- In few steps of production of Cortisone.

Vegetative structure :



Stoloniferous Hyphae.

Rhizoidal Hyphae.

sec - diastatic substance
↓
digest food.

Asexual reproduction in Rhizopus :

- It is by spore formation.
- various stages are involved

P.T.O

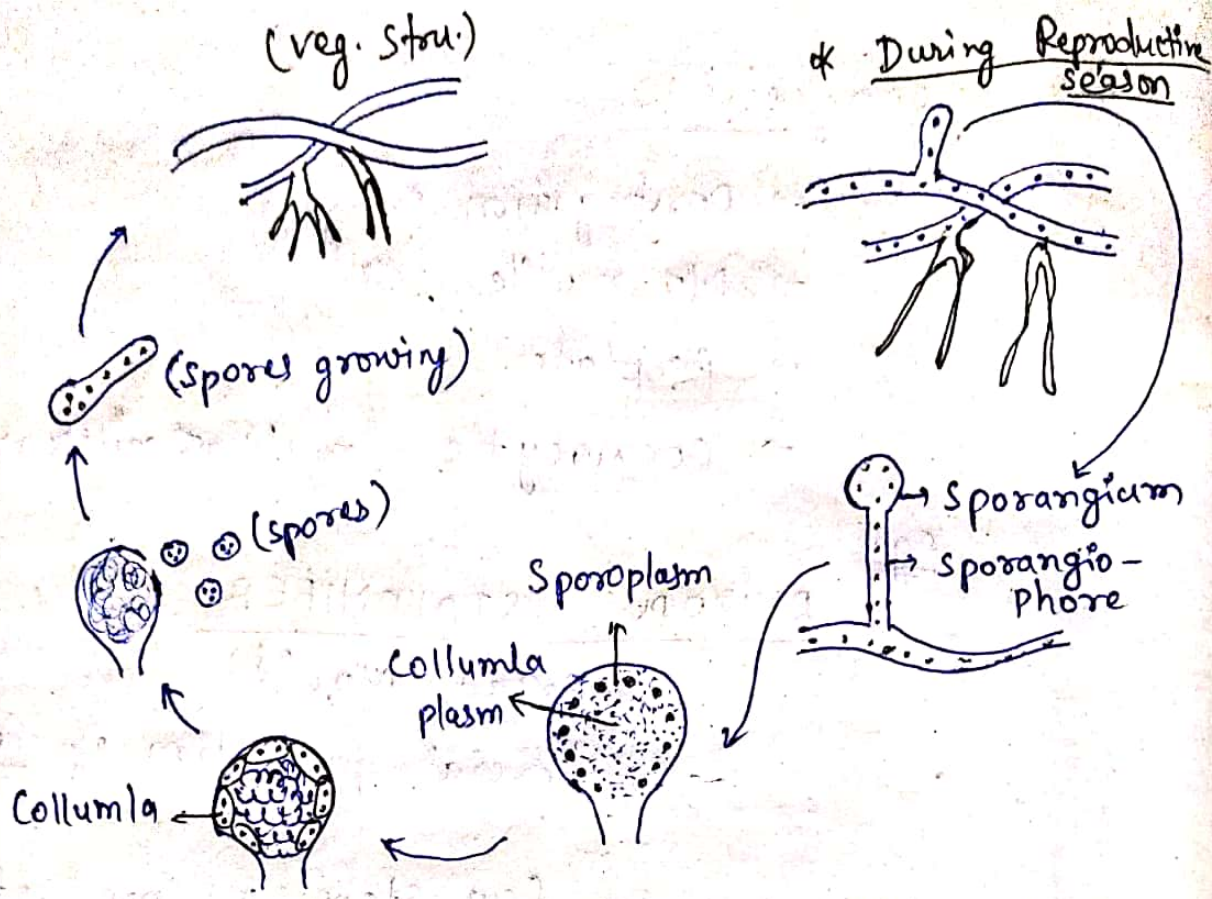
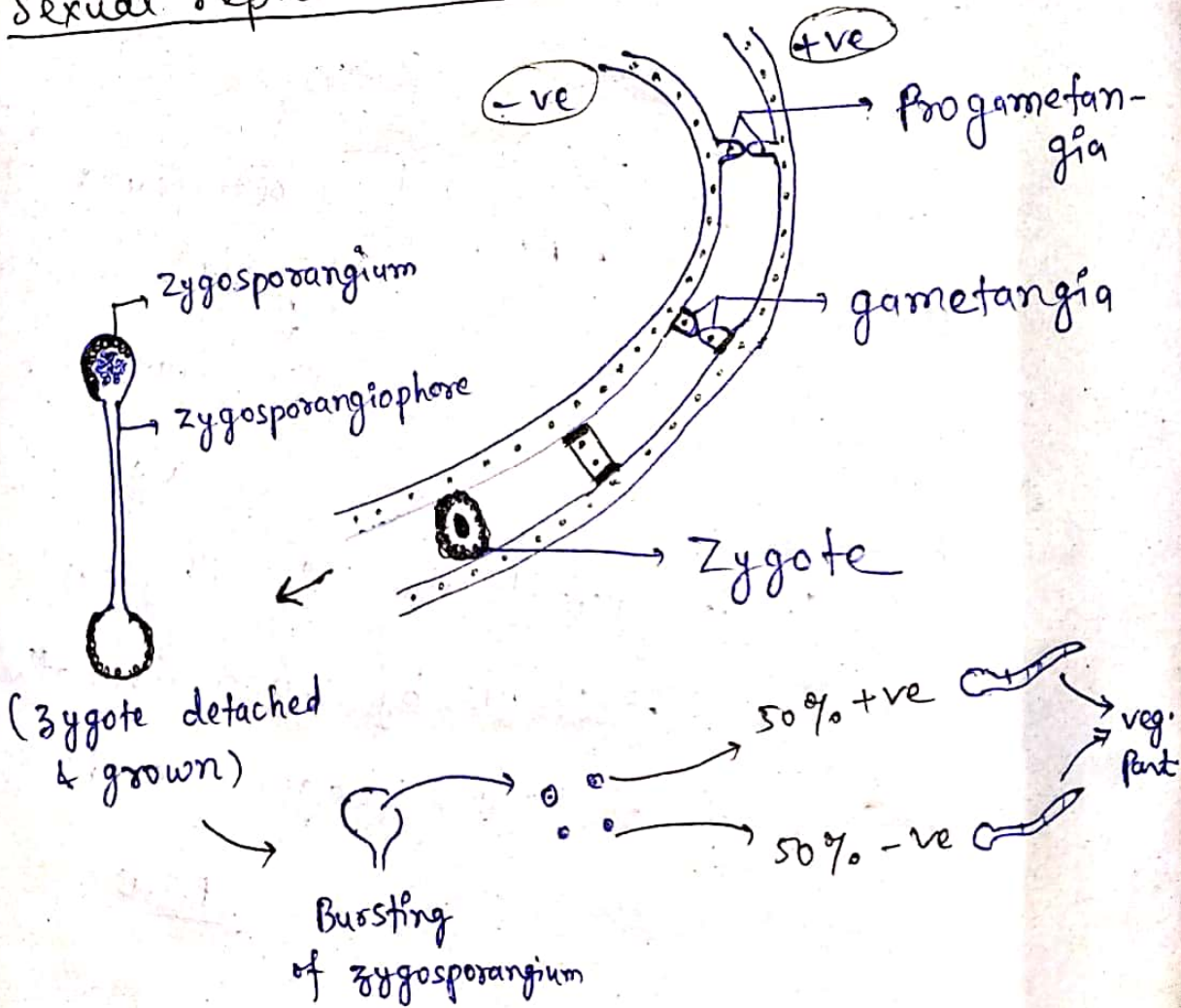


Fig:- Asexual repro. in Rhizopus

Sexual reproduction in Rhizopus :-



Mucor

→ Sporangiothores are single.



→ No differentiation of Hypae.

→ grows on dung
(coprophilous)
dung dung

Rhizopus

→ Sporangiothores are in clusture.



→ differentiation of Hypae.

→ grows on bread.

ASCOMYCETES :-

→ Unicellular - yeast

→ Multicellular - Penicillium

** Yeast

→ cell wall → chitin, phosphoric Acid, & glycogen.

→ Big central vacuole.

→ saprophytic mode of nutrition.

↳ secretes → Zymase (enzyme complex)

digest complex sugar

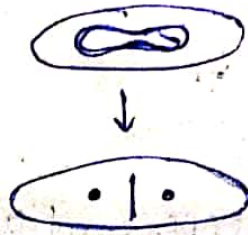
↓
into simple sugars.

* Asexual repro. in yeast!

Budding



Fission



Note!

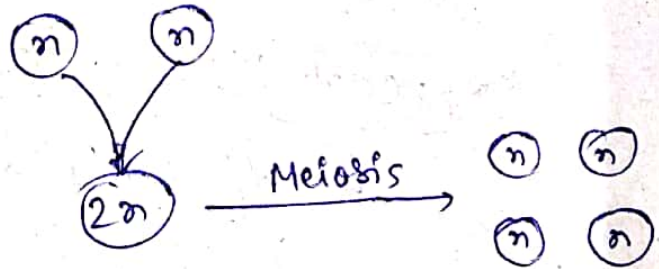
HALOBIAL YEAST

↳ yeast that shows asexual repro. by budding as well as fission.

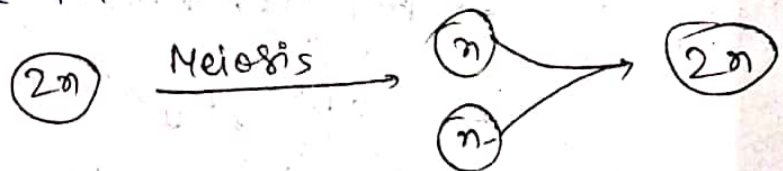
* Sexual repro. in yeast!

Plasmogamy, Karyogamy, Meiosis

① Hologamy → In haploid yeast.



② Gamete formation →



* Life-cycles of yeast!

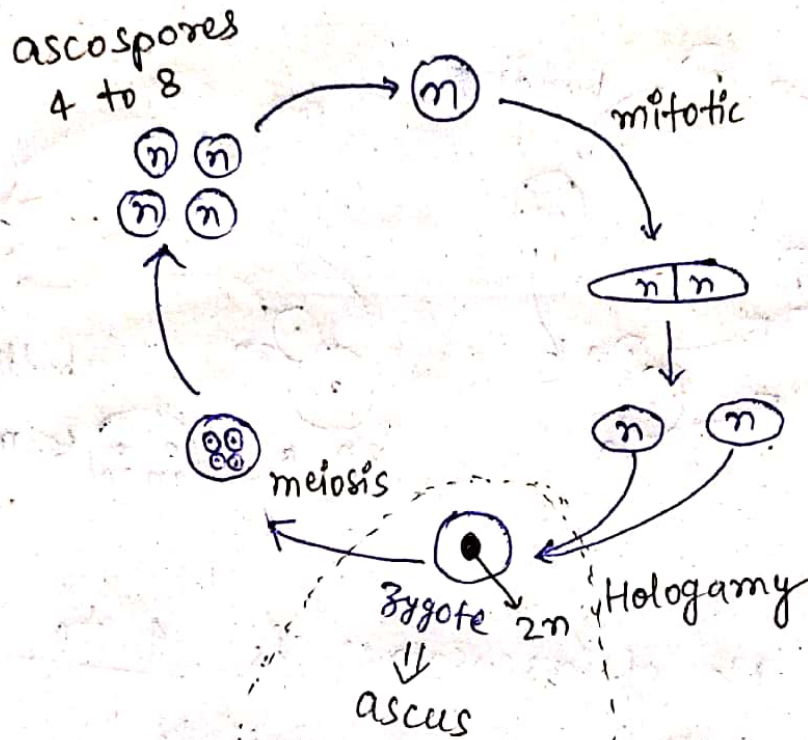
(i) Haplontic → (Most stages are Haploid, only one stage diploid)

(ii) Diplontic → (Most stages are Diploid, only 1 stage Haploid)

(iii) Haplo-diplontic.

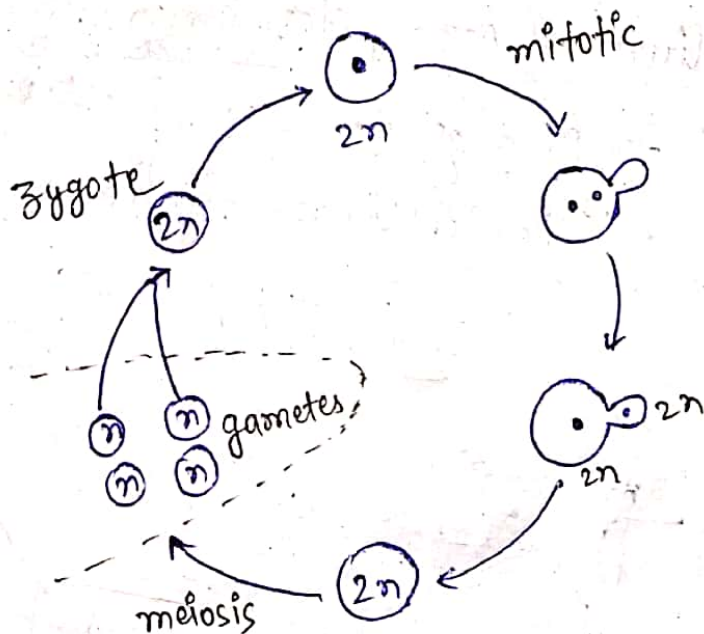
1. Haplontic lifecycle :-

→ Seen in *Schizosaccharomyces octosporus* (n)



2. Diplontic life cycle :-

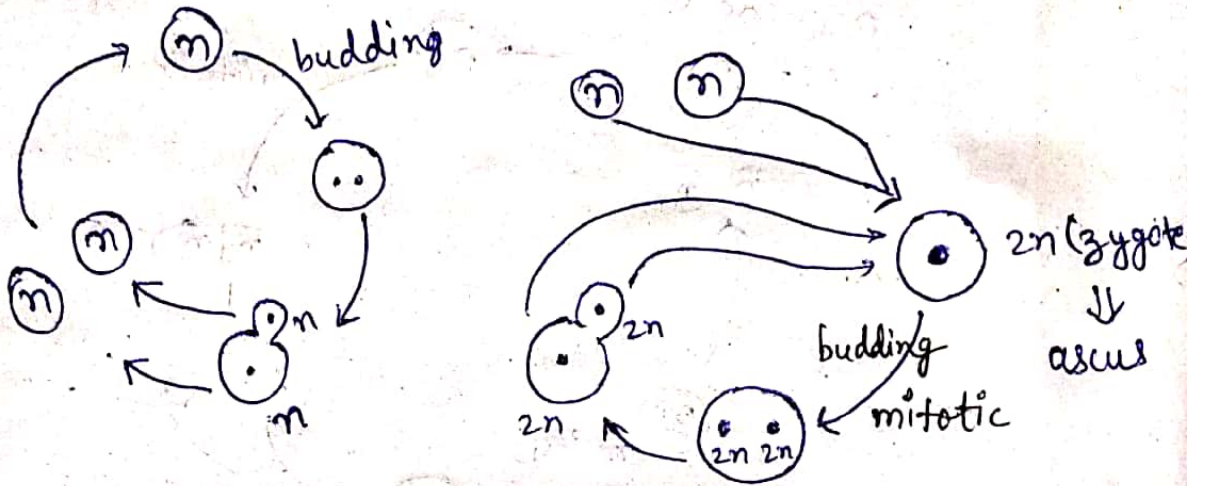
→ Seen in *Saccharomyces ludwigii* ($2n$)



3. Haplo-diplontic life-cycle!

→ seen in *Saccharomyces*

Cervisiae ($n/2n$)



Note!

No. of ascospores is 4 to 8.

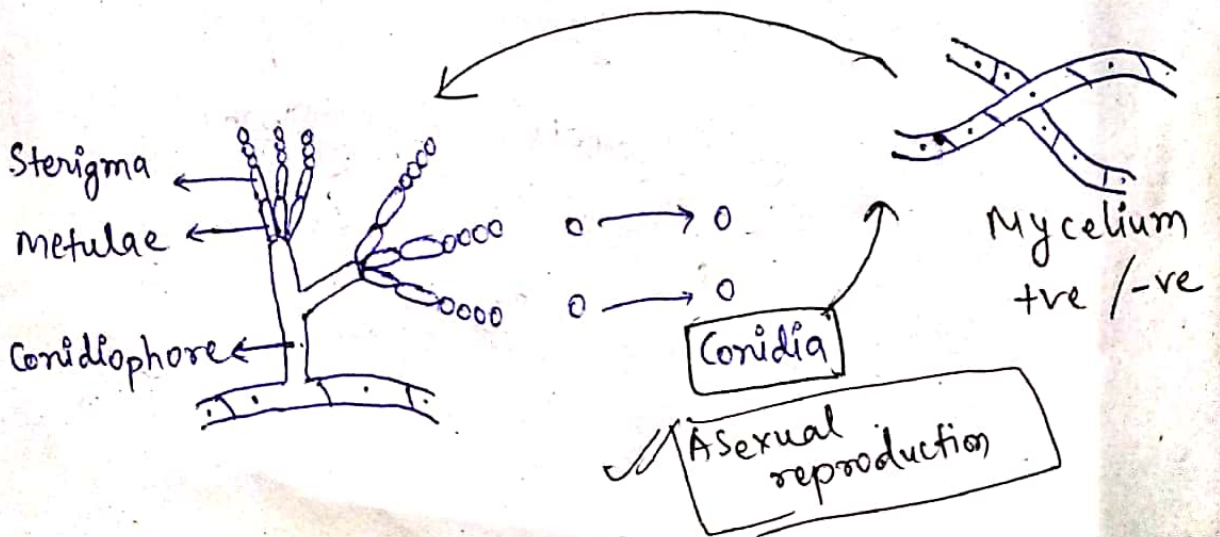
(4) → if only meiosis

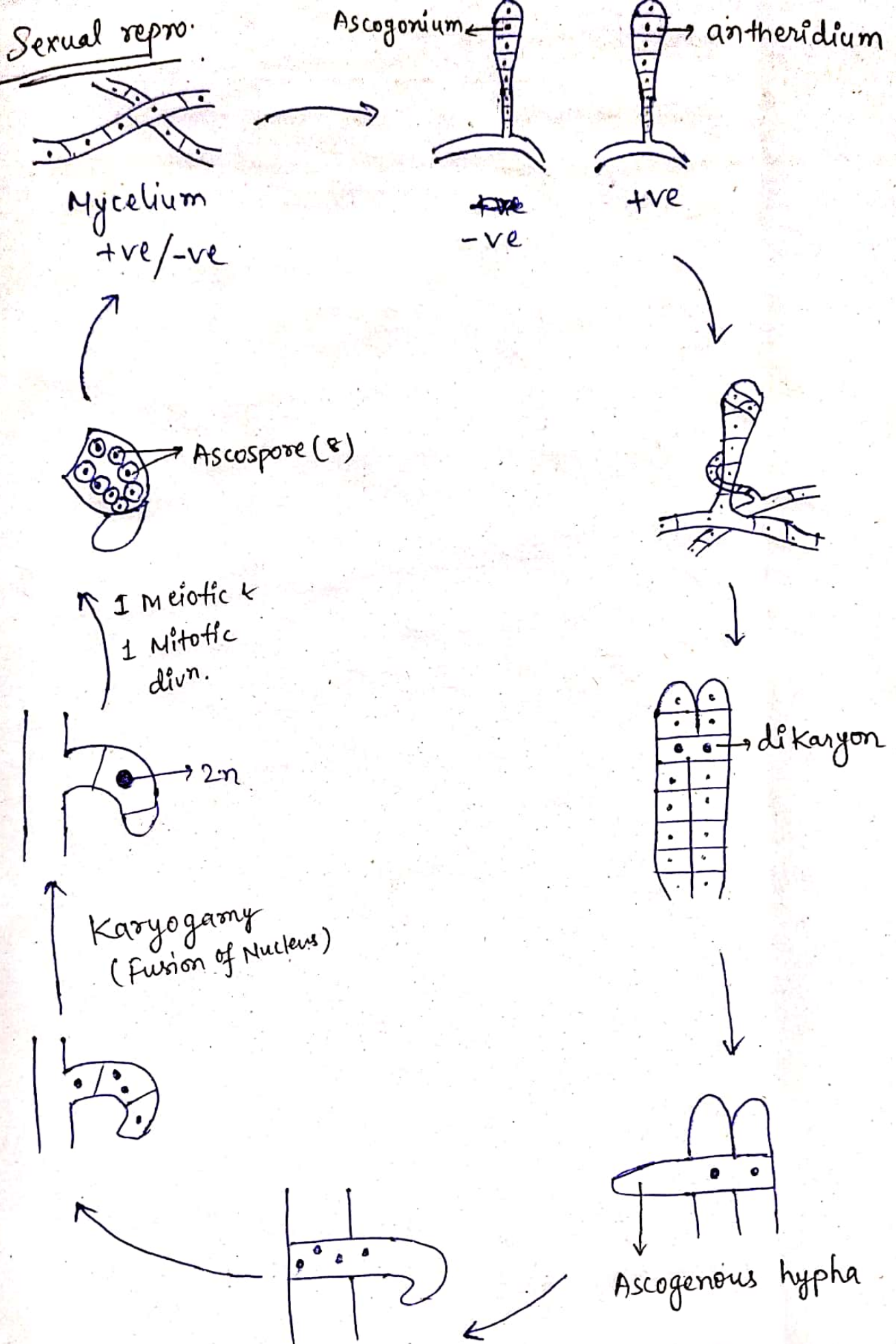
(8) → if meiosis is followed by mitosis

Penicillium (Ascomycetes group):-

→ Belongs to Ascomycetes.

→ *Penicillium notatum*.





Note:

Asexual repro → by Conidia formation
 Sexual repro → by Ascospore formation.