

Biological classification

Defination :-

- Classifying the organisms into different groups based on similarities and non-disimilarities and placing these groups in hierarchy of categories is called Biological classification.

Classification :-

- 2 Kingdom Classification → Aristotle
 - Plants
 - Animals
- 2 Kingdom Classification → Linnaeus
 - Plantae
 - Animalia
- 3 Kingdom Classification → Ernst Haeckel
 - Protista
 - Plantae
 - Animalia
- 4 Kingdom Classification → Copeland
 - Monera
 - Protista
 - Plantae
 - Animalia
- 5 Kingdom Classification → R. H Whittaker
 - Monera
 - Protista
 - Fungi
 - Plantae
 - Animalia
- 6 Kingdom Classification → Carl wase
 - Archaeobacteria
 - Eubacteria
 - Protista
 - Fungi
 - Plantae
 - Animalia

2 Kingdom Classification :-

- Aristotle
 - Plants
 - Trees
 - Shrubs
 - Herbs
 - Animals
 - Enaima
 - Anaima
- Aristotle used simple morphological characters to classify plants into trees, shrubs & herbs.
- Aristotle classified animals based on presence or absence of blood group.
 - Animals with blood group are Enaima.
 - Animals without blood group are Anaima.

2 Kingdom Classification:-

Q Based on what features Linnaeus gave 2 Kingdom Classification

Ans Cell wall
Locomotion
mode of nutrition
Response to External stimuli
Contractile system
organisms

Q What are placed under plantae by Linnaeus?

Ans Bacteria, fungi, algae, Bryophyte, pteridophytes, gymnosperms, Angiosperms.

Q What are placed under Animalia by Linnaeus?

Ans Protzoa, Invertebrates, Vertebrates

Q What are the drawbacks of Linnaeus 2 Kingdom classification.

Ans i He couldn't differentiate between unicellular and multicellular organisms.

ii Not separated prokaryotes from Eukaryotes.

iii Couldn't differentiate between photosynthetic and non-photosynthetic.

3 Kingdom Classification:-

Given by Ernst Haeckel

Q Name the unicellular organisms placed under protista by Ernst Haeckel

Ans Protzoa, Algae, Bacteria, Slime moulds

4 Kingdom Classification:-

Q In 2 Kingdom & 4 Kingdom, the fungi was placed under?

Ans Plantae

Q In 3 Kingdom, the fungi was placed under?

Ans Protista

5 Kingdom classification:-

It was given by R.H Whittaker

Q Based on what features, R.H Whittaker given 5 K classification

Ans. Cell structure

Thallus organisation

mode of nutrition

Reproduction

monera :- All prokaryotes

Protista :- only unicellular Eukaryotes

Fungi :- Both uni & multicellular fungi

Plantae :- All multicellular plants

Animalia :- All multicellular animals.

Phylogenetic or Evolutionary relationship.

Q2 Drawbacks observed by R.H. Whittaker, from Earliest classification?

- Ans: Due to presence of cell wall all the widely ranged organisms like bacteria, blue green algae, fungi, mosses, ferns, gymnosperms, angiosperms are grouped under plantae.
- i unicellular (Chlamydomonas) grouped with multicellular (Spirogyra) under Algae.
 - ii Prokaryotes are grouped with Eukaryotes
 - iii Autotrophs (Green Plants - Cellulose) grouped with heterotrophs (Fungi - chitin)

Q3 Changes done by the R.H. Whittaker?

- Ans. Separated fungi as separate Kingdom i.e., Kingdom - Fungi.
- He separated Chlamydomonas & Chlorocella from plantae, Paramecium & Amoeba from Animalia & placed all the above 4 under Protista.

6 Kingdom Classification:-

• Given by Carl Woese

Q1 Based on what features Monera was divided into Archaeobacteria & Eubacteria?

- Ans Based on the absence of peptidoglycan in cell wall & Presence of branched chain lipids in Archaeobacteria

Q2 Carl Woese clustered 6 Kingdom into 3 domains, based on

Ans Archaeobacteria, Eubacteria, Protista, Fungi, Plantae, Animalia

Clustered ↓

Archae, Bacteria, Eukaryotes

3 domains

6 K Based on presence of 16S ribosomal RNA genes.

• Carl Woese believed that all three domains are originated from common ancestor Progenote.

Introduction:-

- Since the dawn of civilisation, many attempts have been done to classify the living organisms.
- Without using scientific criteria, based on need of organisms like food, shelter and clothing the classification was done instinctively.

1 Aristotle:-

- He was the earliest to attempt more scientific basis of classification

2 Linnaeus:-

- His 2 Kingdom classification was based on gross morphology
- Classification was easily done and was easy to understand, but large number of organisms did not fall into either plant or animal category.
- Therefore, 2K classification used for a long time was found inadequate.
- Therefore, 2K is inappropriate
- Besides, gross morphology a need was also felt for including other characters like
 - i. Cell structure
 - ii. Nature of wall
 - iii. Mode of nutrition
 - iv. Habitat
 - v. Methods of reproduction
 - vi. Evolutionary relationship
- ∴ Systems of classification for living organisms have undergone several changes over the period of time

Note:-

- Plant and animal kingdoms are constant under all different systems.
- Number and nature of other kingdoms have been understood differently by different scientists over the time

3 R. H Whittaker:-

- According to 5K Chlamydomonas & Chlorella kept under the protista but we study in algae

2.1 Kingdom Monera:-

- 1 Monera
 - Archaeobacteria
 - Eubacteria

- 2 Protista
 - Chytridiophytes
 - Dinoflagellates
 - Euglenoids
 - slime moulds
 - protozoans
- 3 Fungi
 - Chycomycetes
 - ascomycetes
 - zygomycetes
 - Ascomycetes
 - Basidiomycetes
 - Deuteromycetes
- 4 Plantae
- 5 Animalia

1 Kingdom Monera:-

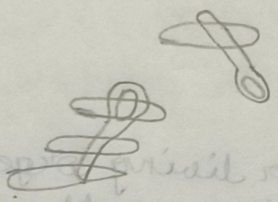
- Bacteria are the sole members of kingdom monera.
- Bacteria are most abundant
 - in soil
 - Extreme habitats (hot spring, desert, snow, deep ocean)
 - live as parasites

• Based on the shapes, the bacteria are divided into four categories

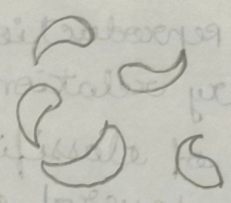
- spherical (coccus)
- Rod (Bacillus) → produce spore
- Comma (Vibrium)
- Spiral (Spirillum) → has flagella



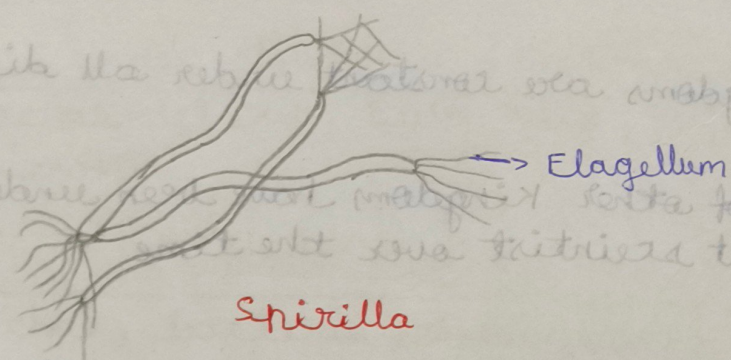
Cocci



Bacilli



Vibrio



Spirilla

- Bacteria structure is simple and very complex behaviour.
- Bacteria show extensive metabolic diversity.
- Some bacteria are autotrophic
 - Photosynthetic autotroph
 - chemosynthetic autotrophic
- These autotrophs prepare food from inorganic substances.
- majority are heterotrophs (Depend on others)
 - They depend on dead organic matter

Archaeobacteria (Ancient bacteria)

- These are the ancient bacteria
- live in harsh habitats
- archaeobacteria are of 3 types
 - Halophiles
 - Thermoacidophiles
 - methanogens
- cell wall of bacteria is different from another bacteria. *This bacteria can survive in extreme conditions*
- Halophiles (Extreme salty areas)
- Thermoacidophiles (hot springs)
- methanogens (marshy areas) can
 - ↳ Present in the gut of ruminants
 - Eg:- Cows & buffaloes
 - ↳ Produce methane gas (Biogas from the dung)

Eubacteria

- It is a true bacteria. There are ^{in 1000's} rigid
- characterised by the presence of cell wall
 - ↳ If motile (Flagella present)
- Cyanobacteria:- Blue green algae
 - ↳ Photosynthetic autotrophic bacteria
 - ↳ has chlorophyll - a similar to green plants
 - ↳ live in fresh water / marine water / terrestrial algae
 - ↳ Unicellular, colonial, filamentous.
 - ↳ Colonial cyanobacteria
 - ↳ Surrounded by the gelatinous sheath
 - ↳ Produce blooms in water polluted bodies.
 - ↳ Filamentous cyanobacteria
 - ↳ can fix N_2 in the specialized cells called heterocyst

Chemosynthetic autotrophic bacteria

- ~~These are abundant & decomposers~~
- They oxidise inorganic substances like nitrites, nitrates and ammonia and release energy used for ATP production
- They have a great role in recycling nutrients like nitrogen, phosphorous, Iron and sulphur

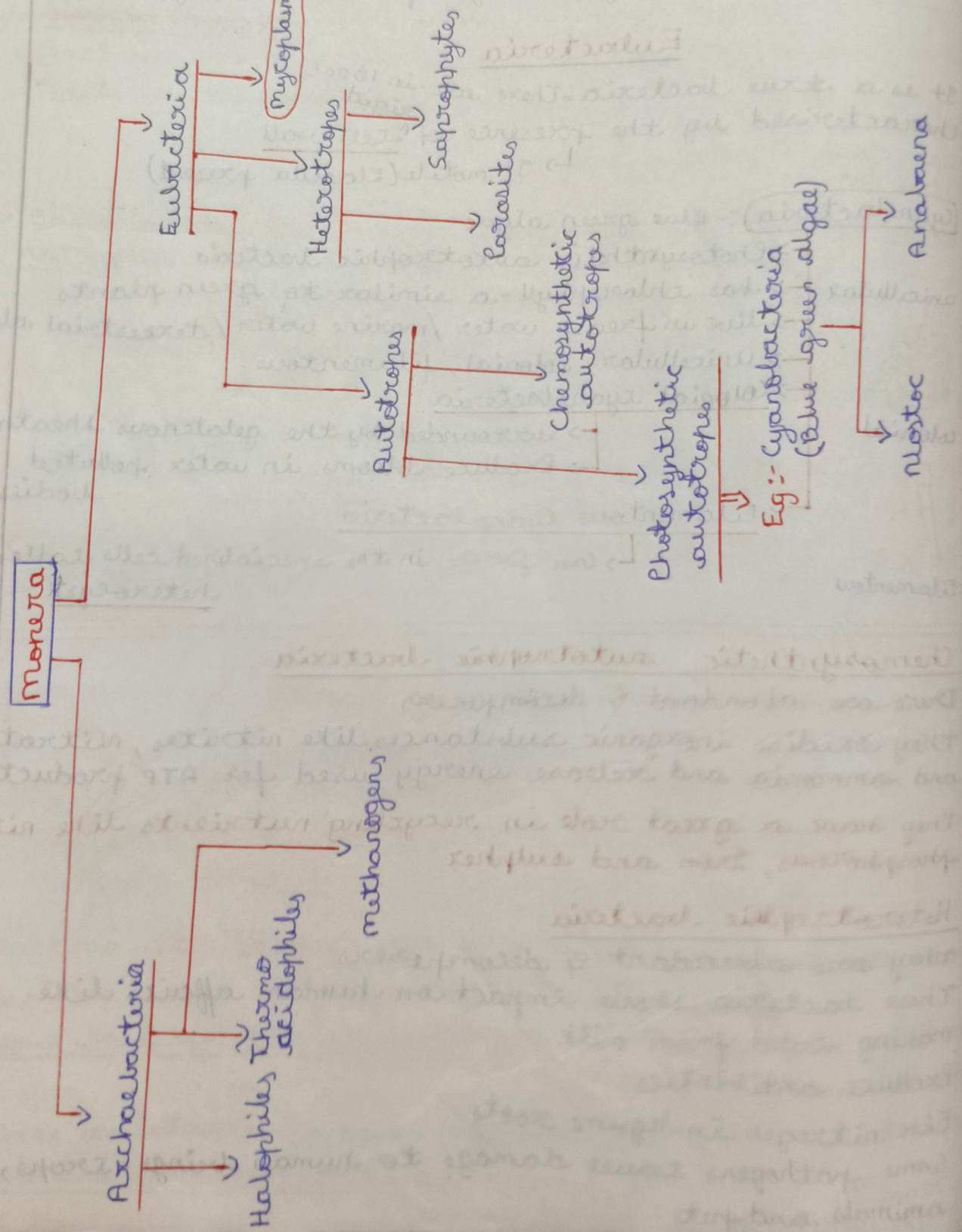
Heterotrophic bacteria

- They are abundant & decomposers
- These bacteria show impact on human affairs like
 - a making curd from milk
 - b Produce antibiotics
 - c Fix nitrogen in legume roots
- Some pathogens cause damage to human beings, crops, farm animals and pets.

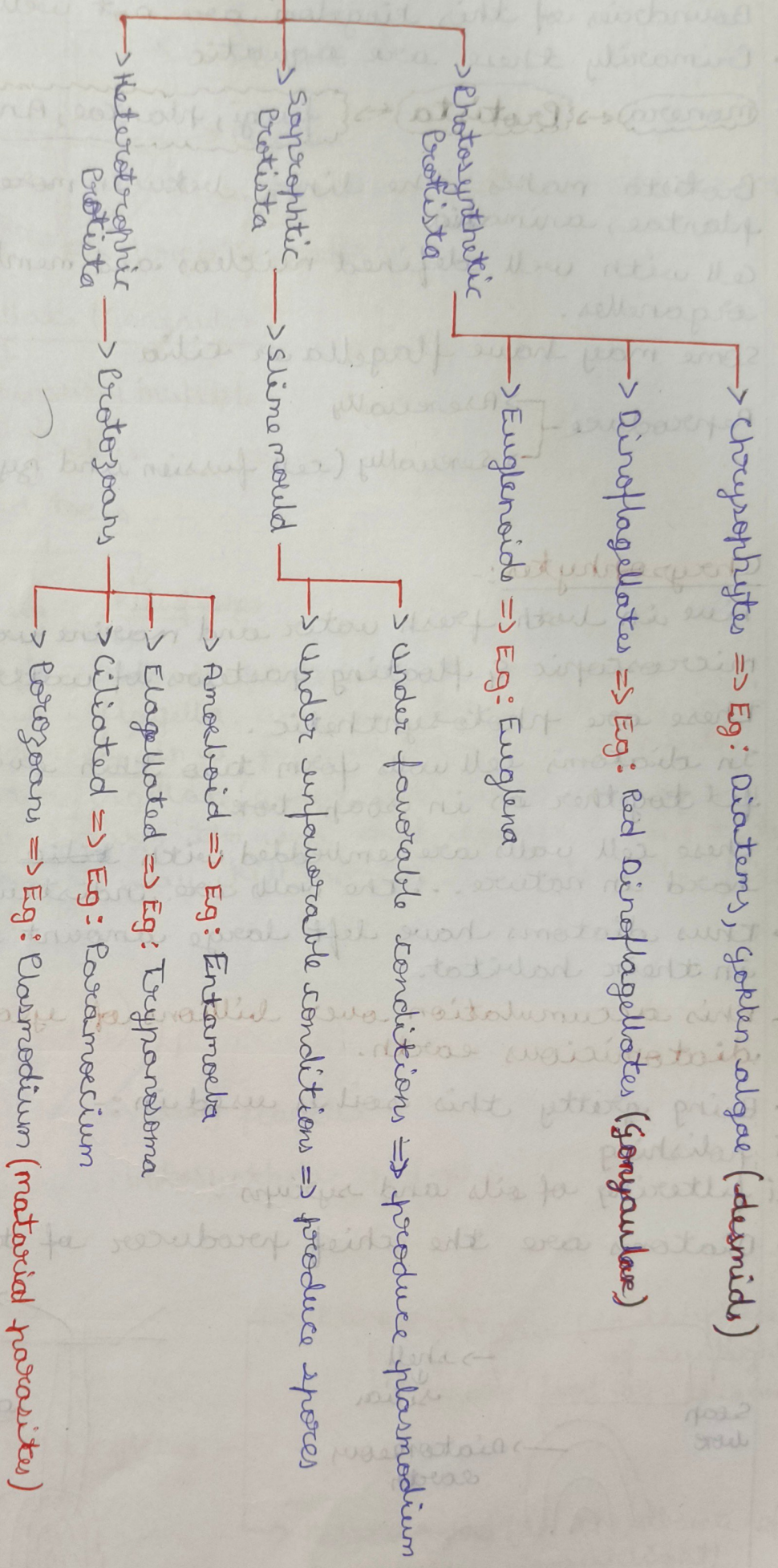
- The diseases caused are Colera, Typhoid, Tetanus & Citrus Canker.
- These bacteria can reproduce by:-
 - by fission
 - during unfavorable conditions they produce spores
 - sort of sexual reproduction (primitive type of DNA transfer from one bacteria to another.)

mycoplasma :-

- Lacks cell wall
- It is the smallest living organism can survive without oxygen.
- Pathogenic for both plants and animals



Protista

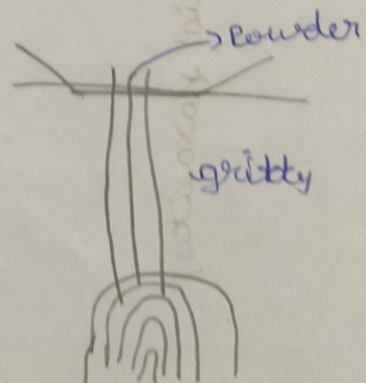
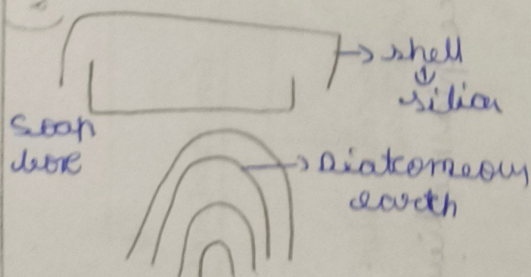


Protista:-

- Some biologists treat as photosynthetic protist.
- Some biologists treat as plantae.
- Included single celled eukaryotes.
- Boundaries of this kingdom are not well defined.
- Primarily these are aquatic
- Monera ↔ Protista ↔ Fungi, plantae, Animalia
- Protista makes the link between ~~more~~ as monera, ~~fu~~ plantae, animalia
- Cell with well defined nucleus and membrane bounded organelles.
- Some may have flagella or cilia
- Reproduce
 - Asexually
 - Sexually (cell fusion and zygote formation)

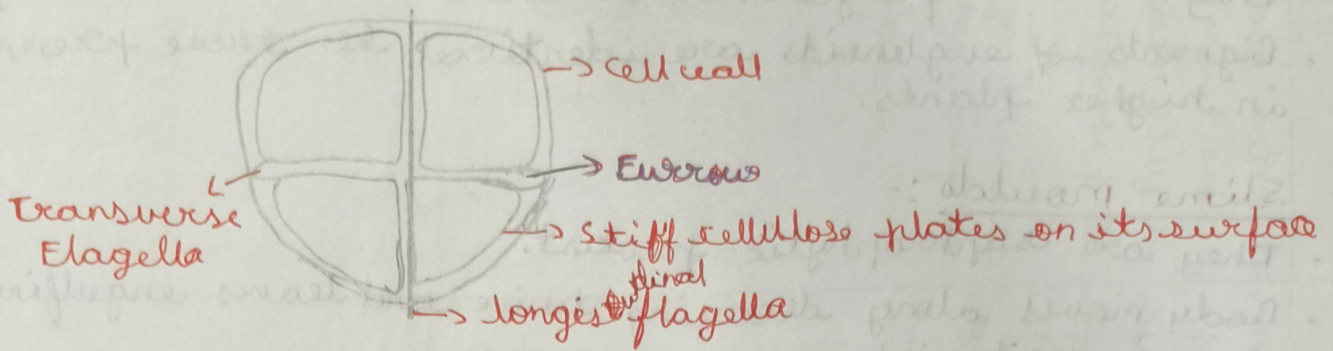
Chrysophytes:-

- Live in both fresh water and marine water.
- microscopic & floating pastew of water current (Ela)
- These are photosynthetic.
- In diatoms cell walls form two thin overlapping shells fit together as in soap box.
- These cell walls are embedded with silica which is hard in nature. ∴ The walls are indistructable.
- Thus diatoms have left large amount of cell wall dyp in their habitat.
- This accumulation over billions of years is called diatomaceous earth.
- Being gritty this soil is used in:-
 - i polishing
 - ii filtering of oils and syrups
- Diatoms are the chief producer of the oceans.



Dinoflagellates:-

- mostly marine and photosynthetic
- Appear yellow, green, brown, blue or red depending on pigment present on the cell.



Red dinoflagellate (Gonyaulax)

continuously multiple

release

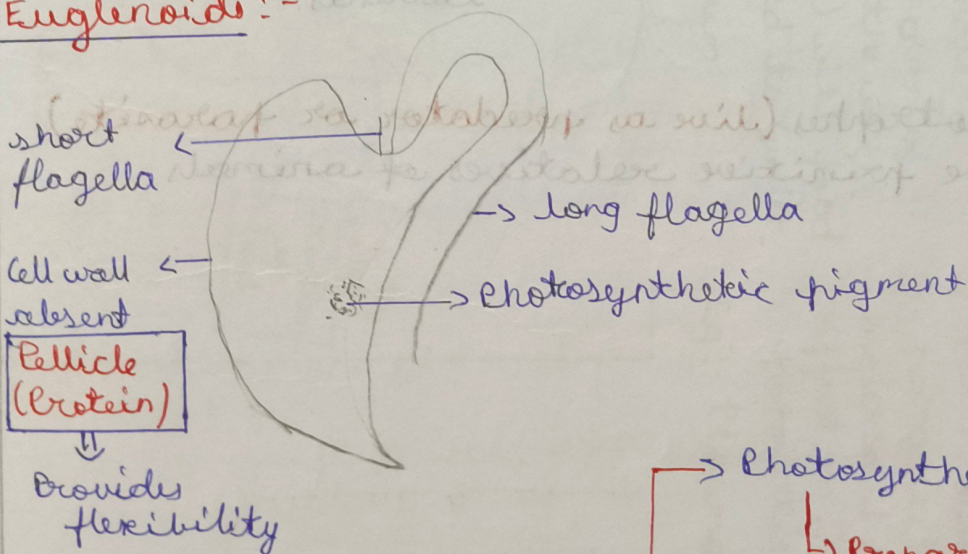
Red toxin

makes sea
red (red tides)

kill fishes

- Cell wall has stiff cellulose plates on its surface
- most of them have 2 flagella. one lies longitudinally and other lies transversely in a furrow between the plates
- Very often red dinoflagellate (*Gonyaulax*) undergo rapid multiplication and makes the sea red colour. (red tides).
- The released toxin may kill marine animals like fish

Euglenoids:-



Euglena

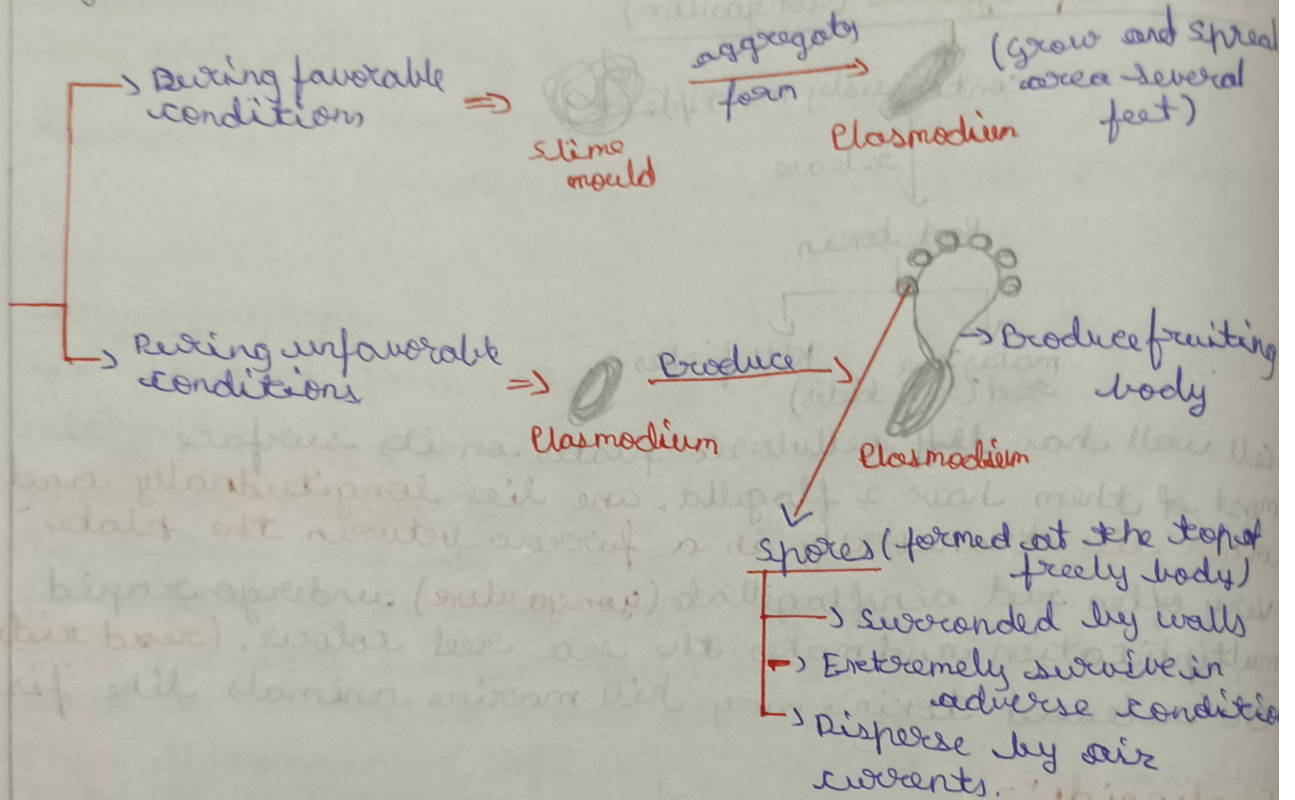
→ Photosynthetic (In the presence of sunlight)
↳ prepare food by its own

→ Heterotrophes (In the absence of sunlight)
↳ products on other organisms

- They live in fresh water, mostly found in the stagnant water.
- Cell wall is absent, instead they have pellicle (Protein) makes body flexible.
- They have 2 flagella one is short and other is long.
- Pigments of euglenoids are identical to those present in higher plants.

Slime moulds :-

- They are saprophytic protist.
- Body moves along decaying twigs and leaves engulfing organic material



Protozoans :-

- All are heterotrophes (live as predator or parasite).
- Believed to be primitive relatives of animals.

Amoeboid

- live in fresh water, salt water, moist soil.
- move and catch prey by pseudopodia (false feet) as in amoeba.
- marine form has silica shells on their surface

Eg:- Entamoeba

Euglenated

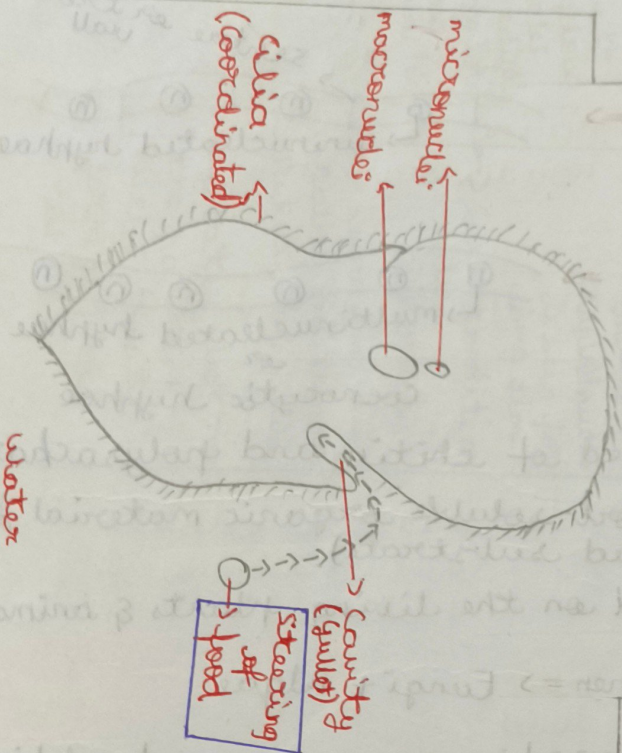
- might be free living or parasitic
- Has flagella
- Parasites cause disease like sleeping sickness

Eg:- Trypanosoma

Ciliated

- Aquatic or actively moving organisms due to 1000's of cilia
- Cavity (gullet) opens to the outside of the cell surface.
- The co-ordinated movement of rows of cilia causes the water laden (moving) with food to be steered to gullet.

Eg:- Paramecium



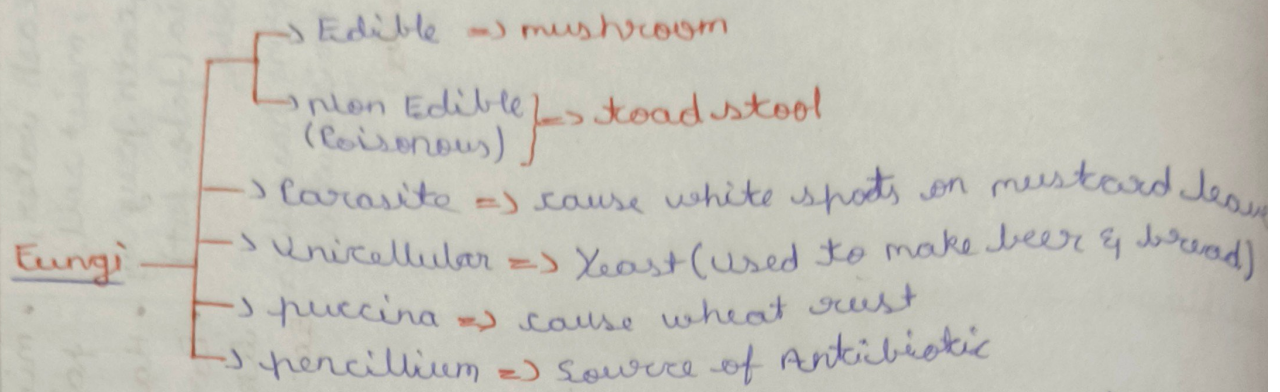
Sporozoans

- Includes diverse organisms as if infectious phase like stage in their lifecycle
- most notorious plasmodium (malaria parasite) causes malaria has straggling effect on human population.

Eg:- Plasmodium

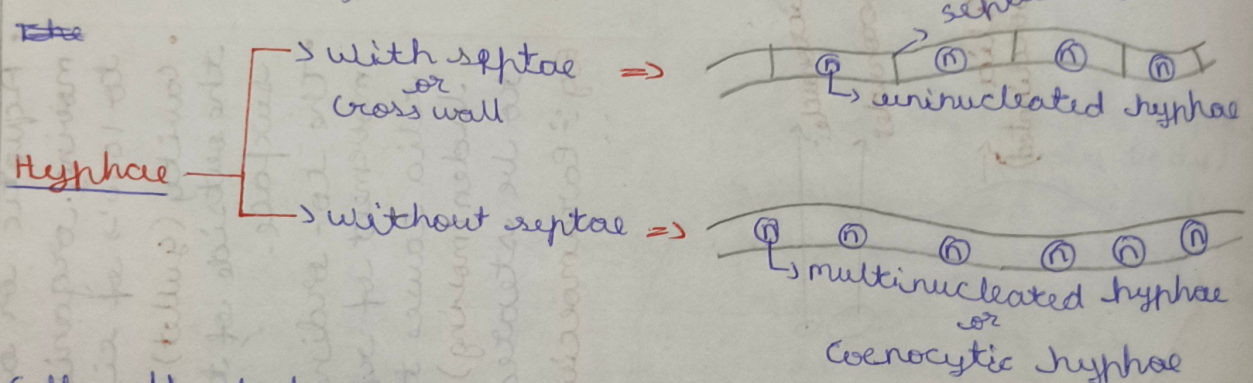
Kingdom Fungi

- Fungi is the unique kingdom of heterotrophic nutrition.
- show great diversity in morphology and habitat.
- mostly found on the moist bread and rotten fruits.



- It is cosmopolitan occur in air, water, soil & all animal and plant
- Favorable habitat ⇒ grow in warm and humid places.
- Except yeast (unicellular) all other fungi are filamentous.
- → long, slender, thread like structure is called hypha
- → network of hyphae is called mycelium

Fungi
(Filamentous body)



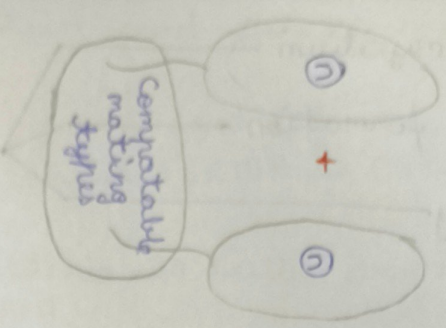
- Cell wall of fungi is composed of chitin and polysaccharide
- Fungi
 - Saprophytic (absorb soluble organic material from dead substrate).
 - Parasitic (depend on the living plants & animals)
 - Symbiotic
 - Lichen ⇒ Fungi + Algae
 - Mycorrhiza ⇒ Fungi + Roots of higher plants.
- Reproduction
 - Vegetative (takes place by fragmentation, fission & budding)
 - Asexual (occurs by conidia, sporangiospore, zoospore)
 - Sexual (occurs by ascospores, Basidiospores)

3 Steps of Sexual Reproduction in Eungi

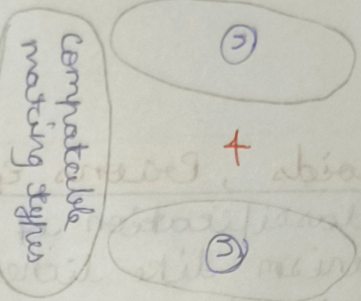
Plasmogamy

Fusion of protoplasm between 2 motile or non motile gametes

motile gametes

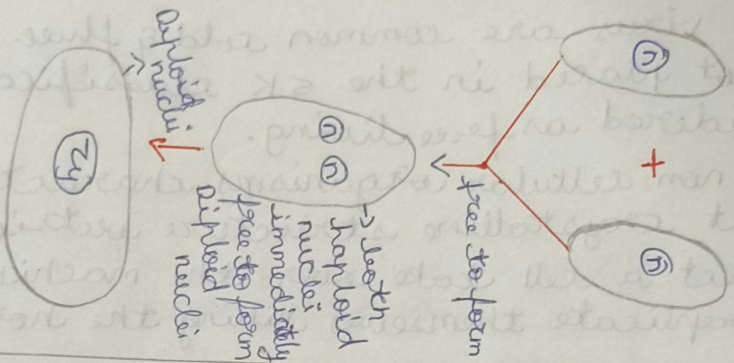


non motile gametes

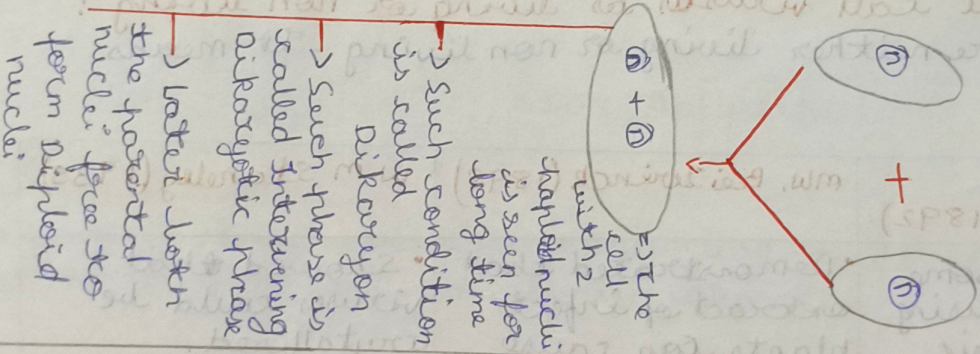


Karyogamy

Fusion of 2 nuclei in other than Ascomycetes & Basidiomycetes

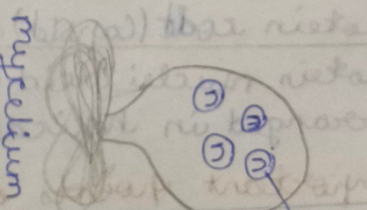
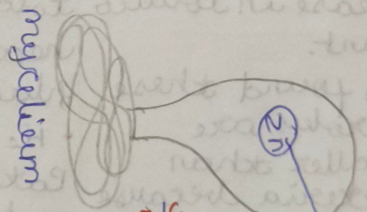


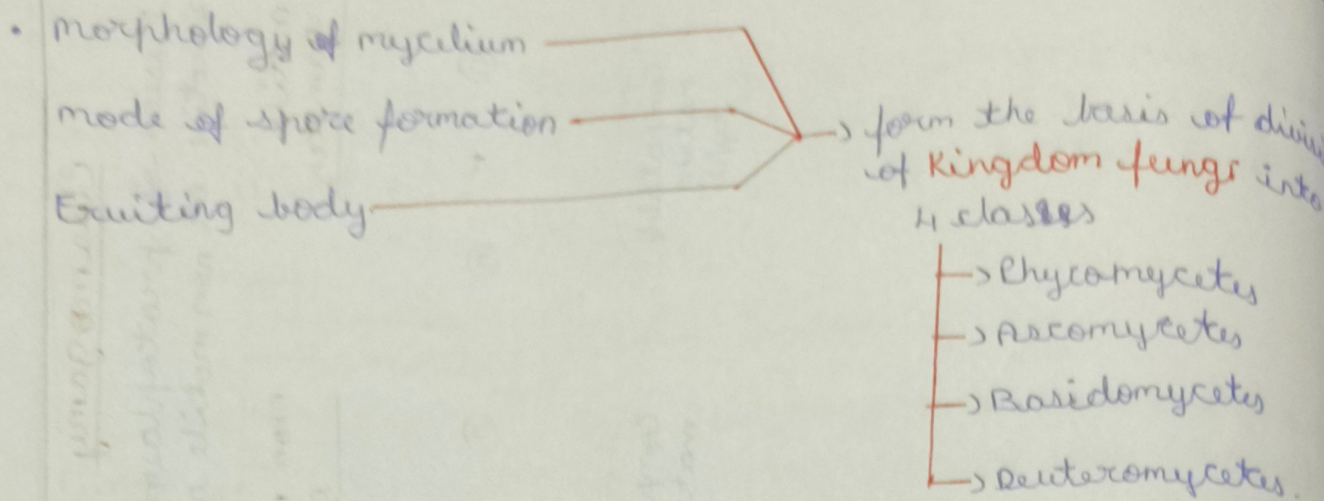
In ascomycetes and Basidiomycetes



Meiosis

diploid nuclei → fruiting body → undergo meiosis





Viruses, Viroids, Prions & Lichens

- In the 5K classification of Whittaker there is no mention of dual organism like lichen and acellular organisms like viruses, viroids & prions.
- All effects of virus are common cold & flu.
- Viruses need not be placed in the 5K classification as they are not considered as free living.
- Viruses are non-cellular organisms characterised by having inert crystalline structure outside the cell.
- once they infect a cell take over the machinery of the host cell to replicate themselves killing the host.

1. Would you call viruses as living or non living?

Ans. Viruses are neither living or non living. It means in between.

Primiti Ivanovsky (1892)	M.W. Beijerinck (1898)	W.M. Stanley (1935)
- Discovered some microbes causing tobacco mosaic disease in tobacco plant. - He found these microbes are smaller than bacteria because they passed from bacterial proof filters.	- Demonstrated that extract of infected plants can cause tobacco infection in healthy tobacco plant. - He named the pathogen as virus and called the fluid as <u>Contagium Vivum fluidum</u> (Infectious living fluid).	- Showed that viruses could be crystallised. - These crystals consist largely of proteins.

- Protein coat (capsid) is made up of capsomeres.
- Protein nucleic acid (RNA)
- Arranged in helical or polyhedral geometric forms.

Important points of viruses

- Virus has protein coat + genetic material (Either RNA or DNA)

- Virus is a nucleic protein and genetic material is infectious.
- Virus has ssRNA which infect plants.
- Virus has either ssRNA or dsRNA or dsDNA which infect animals.
- Virus which infects bacteria is called bacteriophage which has double stranded DNA.

- Viruses are inert crystalline outside the host cell
- Viruses are obligate parasites

Viral diseases

In man

- Mumps, small pox, Hepes, AIDS, Influenza

Symptoms in plants

- mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

Phycomycetes

Habitat:-

- Found in aquatic habitats, decaying wood in moist & damp places.
- obligate parasites on plants.

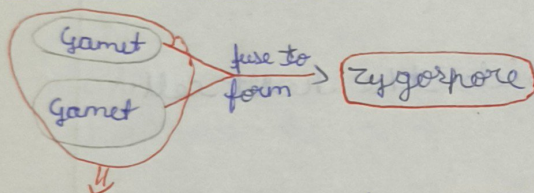
Mycelium:-

- Aseptate or coenocytal

Asexual reproduction:-

- is by
- zoospores (motile)
 - Aplanospores (non motile)
- Produced endogenously in sporangium.

Sexual Reproduction:-



Both gametes might be

- 1) Isogamous (Both gametes are morphological similar)
- 2) Anisogamous (" " " " dissimilar)
- 3) Oogamous (♀
 - large
 - non motile
 - ♂
 - small
 - motile)

Important Points:-



Examples:-

Albugo (Parasitic fungi / mustard)

Rhizopus (Bread mould)

Mucor

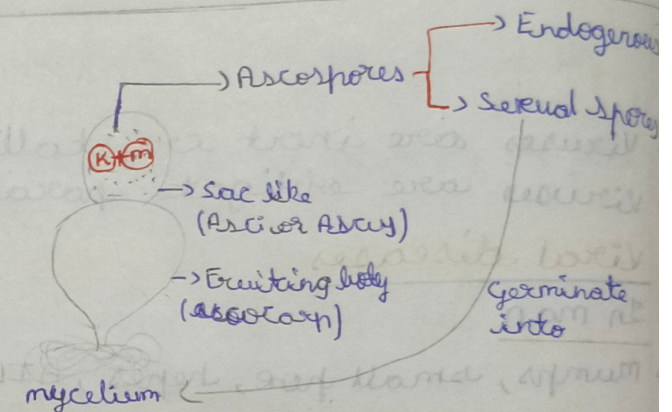
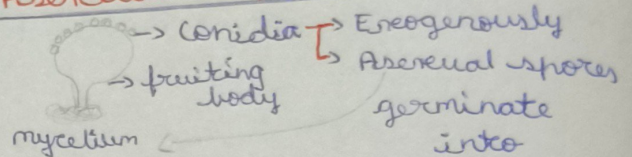
Habitat:-

- Saprophytic, decomposers, parasitic and coprophilous (living on dung)

Mycelium:-

- Septate and branched

Asexual reproduction:-



Important Points:-

- Karyogamy & meiosis takes place in ascus or ascus

Examples:-

Claviceps

Aspergillus

Neurospora (used in biochemical & genetic work)

Morrels }
Truffles } → Both are edible and delicacies

Penicillium

Yeast (Saccharomyces) → Unicellular

Basidiomycetes / Club fungi

common form $\left\{ \begin{array}{l} \rightarrow \text{mushroom} \\ \rightarrow \text{Bracket fungi} \\ \rightarrow \text{puff balls} \end{array} \right.$

Habitat:-

- Grow in soils, logs, tree stumps.
- In living plant body as parasites $\left\{ \begin{array}{l} \rightarrow \text{Smut} \\ \rightarrow \text{Rust} \end{array} \right.$

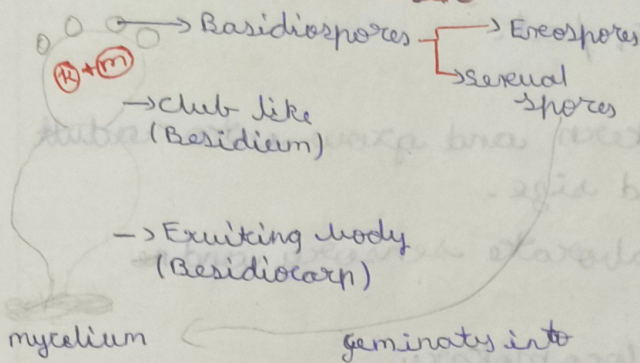
mycelium:-

- Septate & branched

Note:-

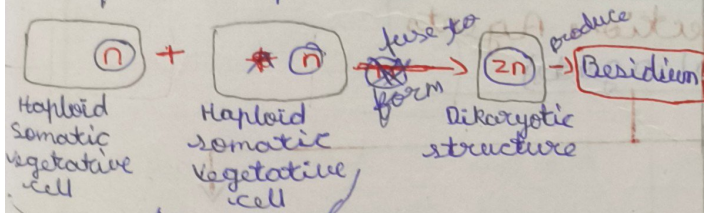
- Asexual spores are not found
- Vegetative reproduction occurs by fragmentation.

Sex organs are absent



Important Points:-

- Plasmogamy takes place by the fusion of two



These both cells belong to different strains or genotypes

- Karyogamy & meiosis occur in Basidium

Examples:-

Agaricus (mushroom)

Ustilago (smut)

Puccinia (Rust fungus)

Deuteromycetes / Imperfect fungi

Habitat:-

- Some are saprophytes or parasites.
- majority are decomposers of litter help in mineral recycling

mycelium:-

- Septate & branched

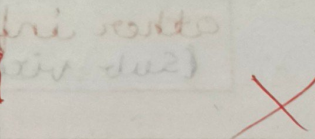
Note:-

- Asexual spores are conidia
- only asexual and vegetative phases are known.

Note:-

- No sexual reproduction
- Sexual members move to Ascomycetes & Basidiomycetes

Important Points:-



Examples:-

Colletotrichum

Alternaria

Trichoderma

Kingdom Plantae

- Includes all eukaryotic, chlorophyll containing organisms.
- Some plants are heterotrophs
 - Insectivorous Eg:- Venus fly trap, bladderwort
 - Parasite Eg:- Cuscuta
- 2 phases of plant lifecycle
 - Diploid sporophytic
 - Haploid gametophytic
- i Both stages alternate with each other.
- ii length (duration), free living or dependent on other, differ from group to groups in the plants.
- iii This phenomenon is called alternation of generation.

Kingdom Animalia

- Heterotrophic Eukaryotic organisms.
- Multicellular and lacks cell wall.
- Animals either directly or indirectly depend on plants for food.
- Digest the food in internal cavity and store the reserve food as glycogen & fat.
- Holozoic nutrition.
- Follow definite growth pattern and grow into adult that have definite shape and size.
- The Higher forms show elaborate sensory and neuromotor mechanism.
- Most of the animals are locomotory.
- The sexual reproduction is by copulation of males and females followed by embryological development.

Other Infectious Agents (Sub viral agents)

Virooids

- Discovered by T.O Diener
- Smaller than virus
- has free RNA (with low molecular weight) & lack protein coat.
- disease ⇒ potato spindle tuber

Prions

- Discovered by Alper et al
- Similar in size to virus
- has abnormally folded protein.

Neurological disorders

- In cattle
 - ↓
 - BSE (Bovine spongiform Encephalopathy)
 - mad cow disease
- In human
 - ↓
 - CJD (Creutzfeldt Jacob disease)

Lichens (symbiont)

Algae

- Is called phycobiont.
- Is autotrophic.
- Prepare food for fungi.

Fungi

- Is called mycobiont.
- Is heterotrophic.
- Provide shelter and absorb minerals, nutrients & water for algae.