

Kingdom: Fungi

➤ General characters:-

- 1-True fungi are eukaryotic organisms, lacking plastids; hence their mode of living is heterotrophic, either saprobic, mutualistic or parasitic.
- 2-Nutrition is by absorption (osmotrophic) never phagotrophic.
- 3-Lacking amoeboid pseudopodial phase.

4– Cell wall contains chitin and β -glucans.

5–Thallus is unicellular or filamentous, multicellular or coenocytic. Hyphae are haploid.

6–Mostly non-flagellate; flagella when present are of the whiplash type.

7– Reproducing sexually or asexually, the diploid phase is generally short-lived.

Division: Zygomycota

Class: Zygomycetes

Order: Mucorales

Family: Mucoraceae

▶ General characters:-

1- Habitat: soil inhabitants, on dung and on moist fresh organic matter.

2- Live either as



Saprophytic species



Parasitic species

❖ **Saprophytic species** play an important role in the early colonization of soil.

Such as: *M. rouxii* is used industrially to break down starch to sugar before fermentation.

***since **yeasts** which ferment sugars to alcohols **lack the amylolytic enzymes necessary for initial breakdown of starch into sugars.**

❖ **Parasitic species** are facultative parasites on plants and animals.

▶ For Example:

1– *Rhizopus stolonifer* causes rot disease of sweet potatoes, apples, strawberries and tomatoes.

2– *Mucor* and *Rhizopus* species cause a human disease called mucomycosis in patients suffering from diabetes, leukemia, and cancer.

3– **Mycelium** is coarse and coenocytic, except at the bases of the reproductive structures.


4– **Cell wall** contains chitin microfibrils, in addition to other polysaccharides, proteins and minerals.

5– **Sexual reproduction** occurs by zygospore formation as result of conjugation .

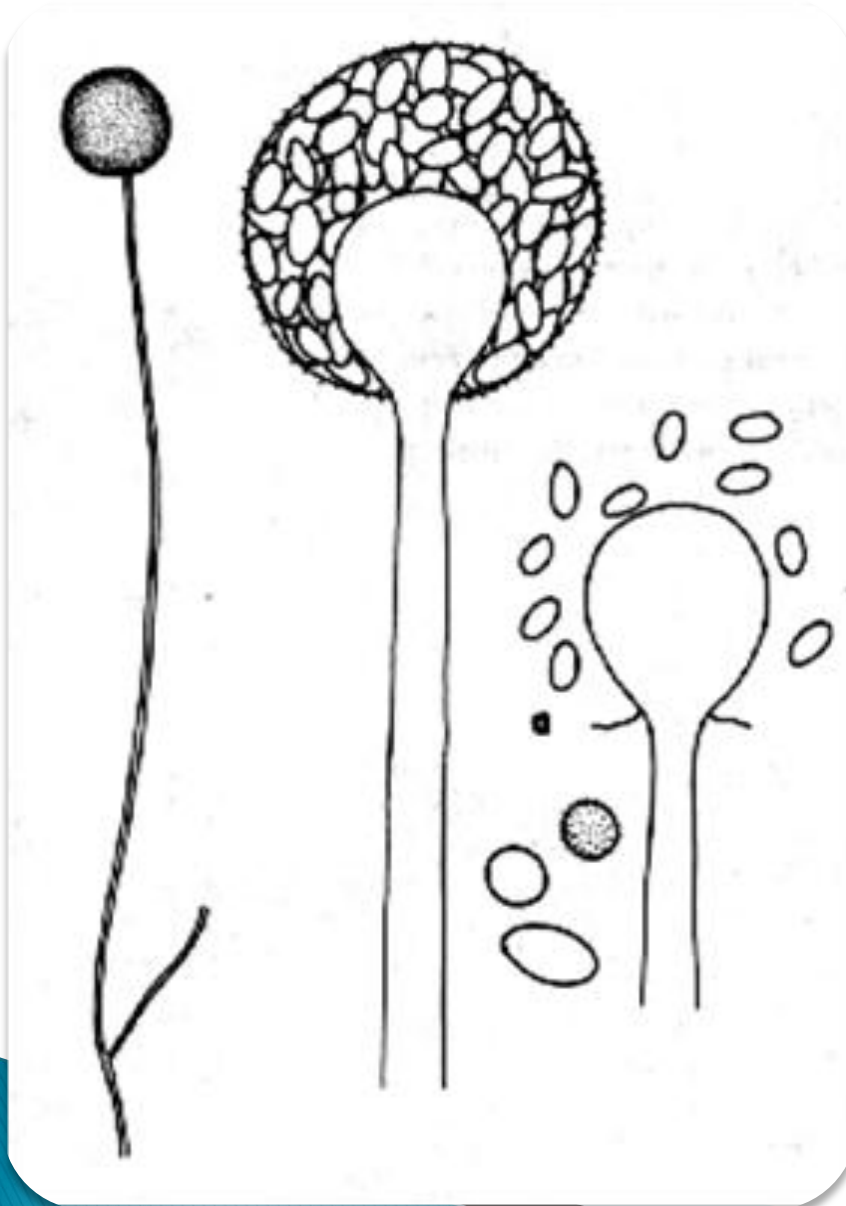
6– **Asexual reproduction** is by non-motile aplanospores (sporangiospores) formed within columellate sporangia .

Asexual reproduction

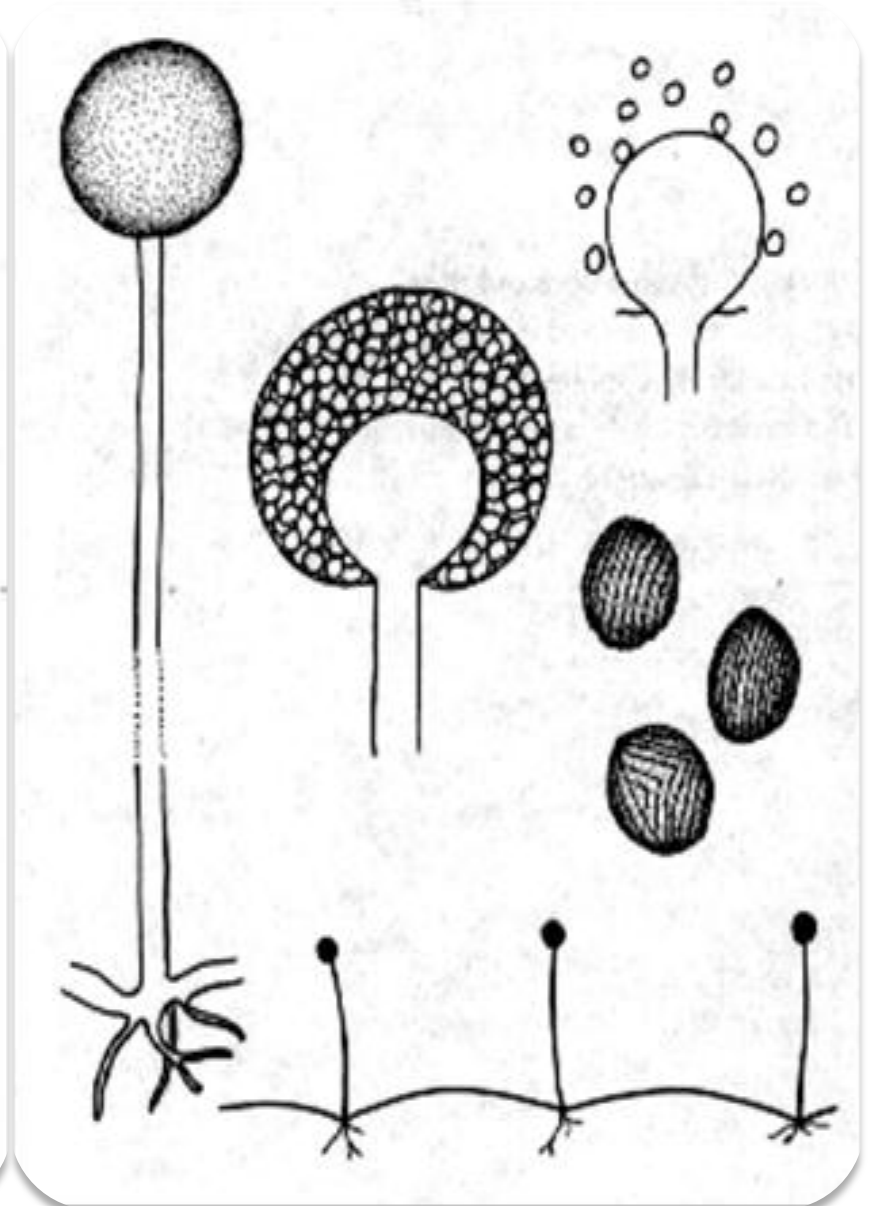
- ▶ It occurs by aplanospores from globose or pear-shaped sporangia that being formed as follow:
 - Sporangiohores are phototropic and develop as aerial hyphae whose tip enlarges to form the sporangium initial.
 - Sporangium initial is filled with cytoplasm containing numerous nuclei that continue to divide.
 - A dome-shaped septum is laid down and the columella formed beneath.

- Cytoplasmic cleavage occurs and spores are differentiated.
 - Sporangial wall often darkens and may develop a spiny surface.
 - Spores are released generally by breakdown or dissolution of the sporangial wall.
 - Spore germinates and gives rise into a coarse, coenocytic and branched mycelium.
 - Thick-walled mycelial segments or chlamydospores may be cut off by septa.
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Mucor



Rhizopus




Sexual Reproduction

▶ It occurs by means of conjugation, resulting in the formation of zygospores.

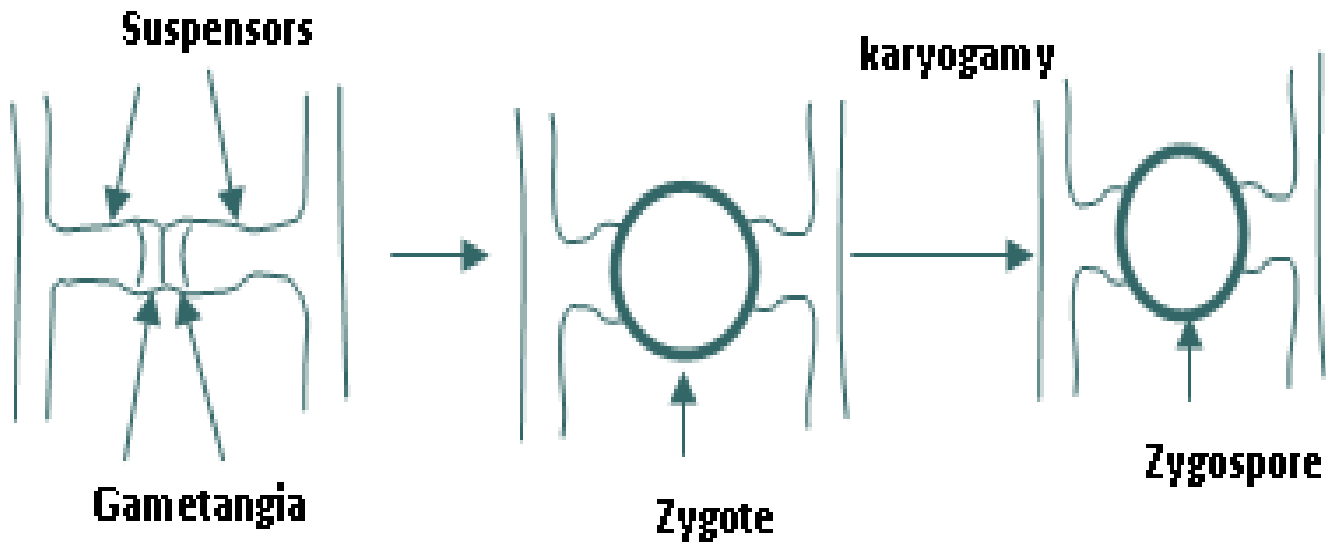
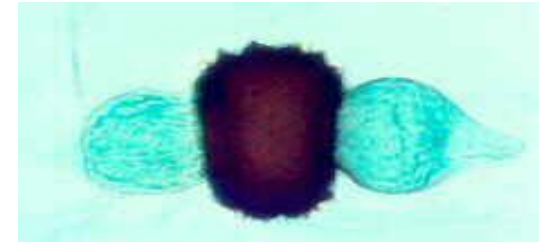
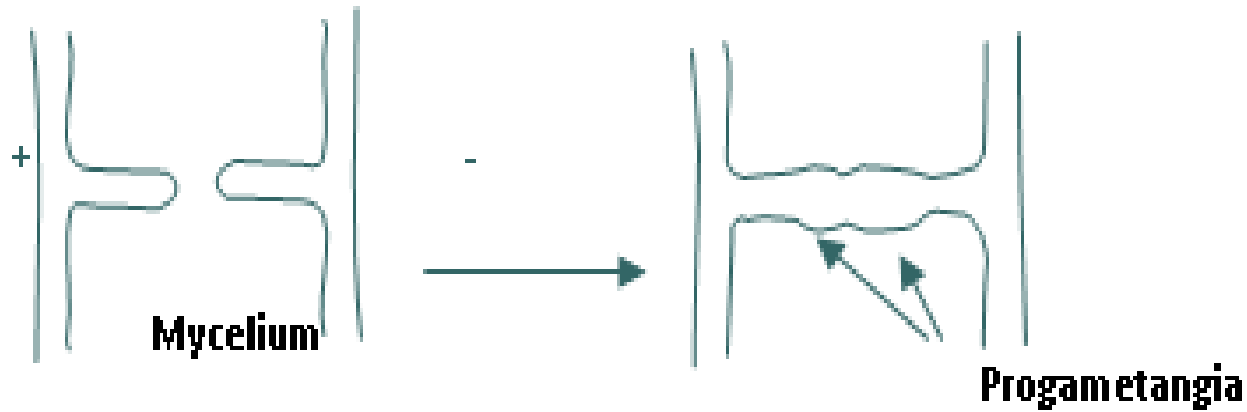
****In homothallic species,** zygospores being formed from a single strain.

****In heterothallic species,** zygospores are formed from compatible strains. Because there is no distinct sex organs compatible strains are labeled as (+) or (-).

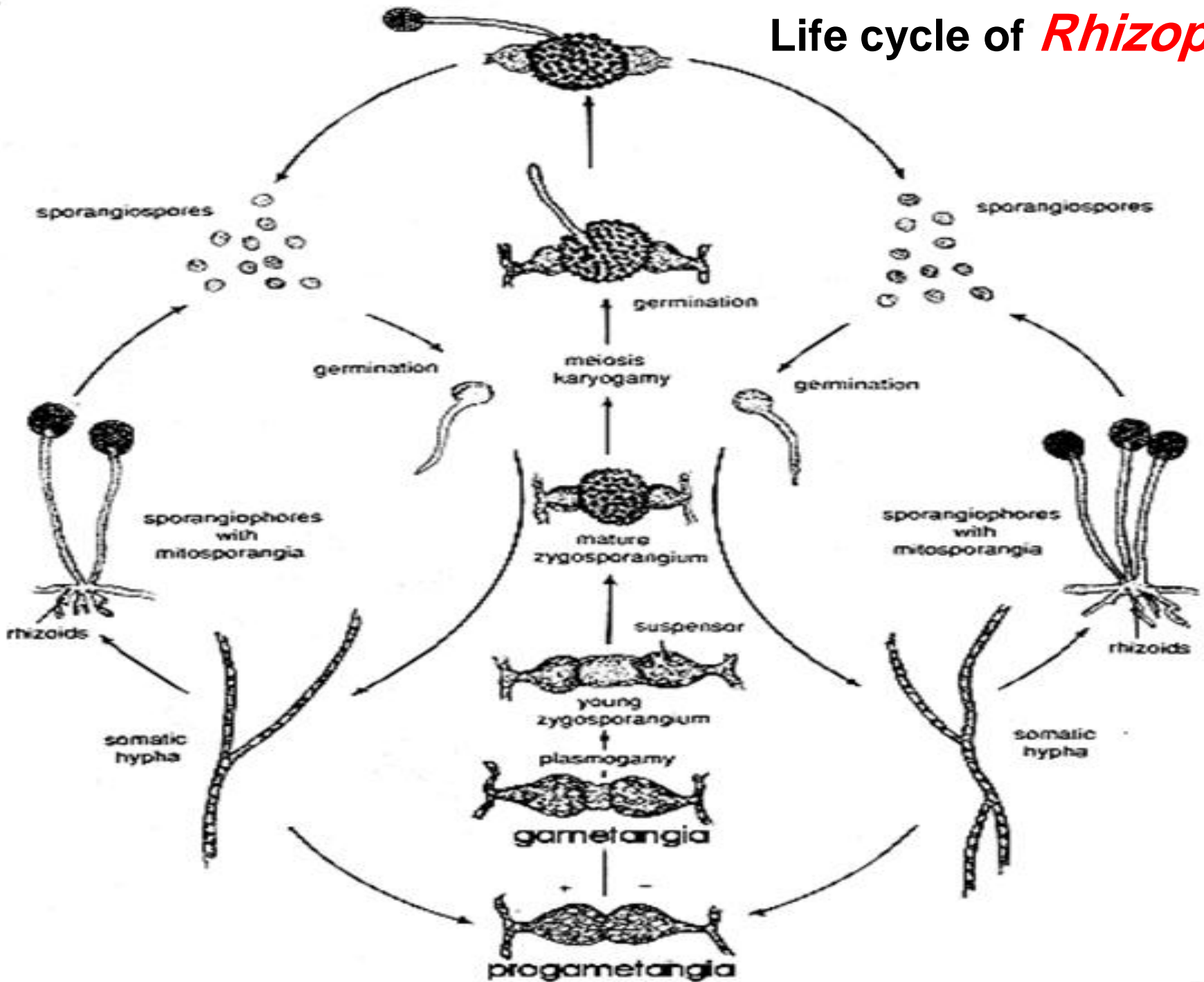
- ▶ **Compatible strains** are stimulated for aerial zygothore formation.
- ▶ Zygothores are club-shaped and **yellow** in colour due to their content of **β -carotene**.
- ▶ When compatible zygothores come in contact they develop into progametangia.
- ▶ The tip of each progametangium is cut off by a septum to separate a distal multinucleate gametangium from the subterminal suspensor.

- ▶ **The separating wall disintegrates and contents are fused.**
 - ▶ **The fusion cell, or zygospore, swells and develops a dark warty outer layer.**
 - ▶ **After a resting period the zygospore may germinate by developing an unbranched sporangiophore carrying the germ sporangium.**
 - ▶ **In some cases, zygospore germinates into a vegetative mycelium.**
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Conjugation and production of zygospore



Life cycle of *Rhizopus*.



Division: Ascomycota (Sac fungi)

- It is the largest group of fungi.
- They occur in a wide variety of habitats: in soil, dung, in marine and fresh water.
- They live as saprophytes, as animal and plant pathogens, or as lichen forming. Familiar examples are:

A– morels, truffles, cup fungi, and the majority of lichens (ascolichens) such as *Cladonia*.

B– Many **plant–pathogenic fungi** e.g. apple scab, ergot and the powdery mildews.

C– *Sordaria fimicola*, *Neurospora crassa* and several species of **yeasts** are used in many genetics and cell biology experiments.

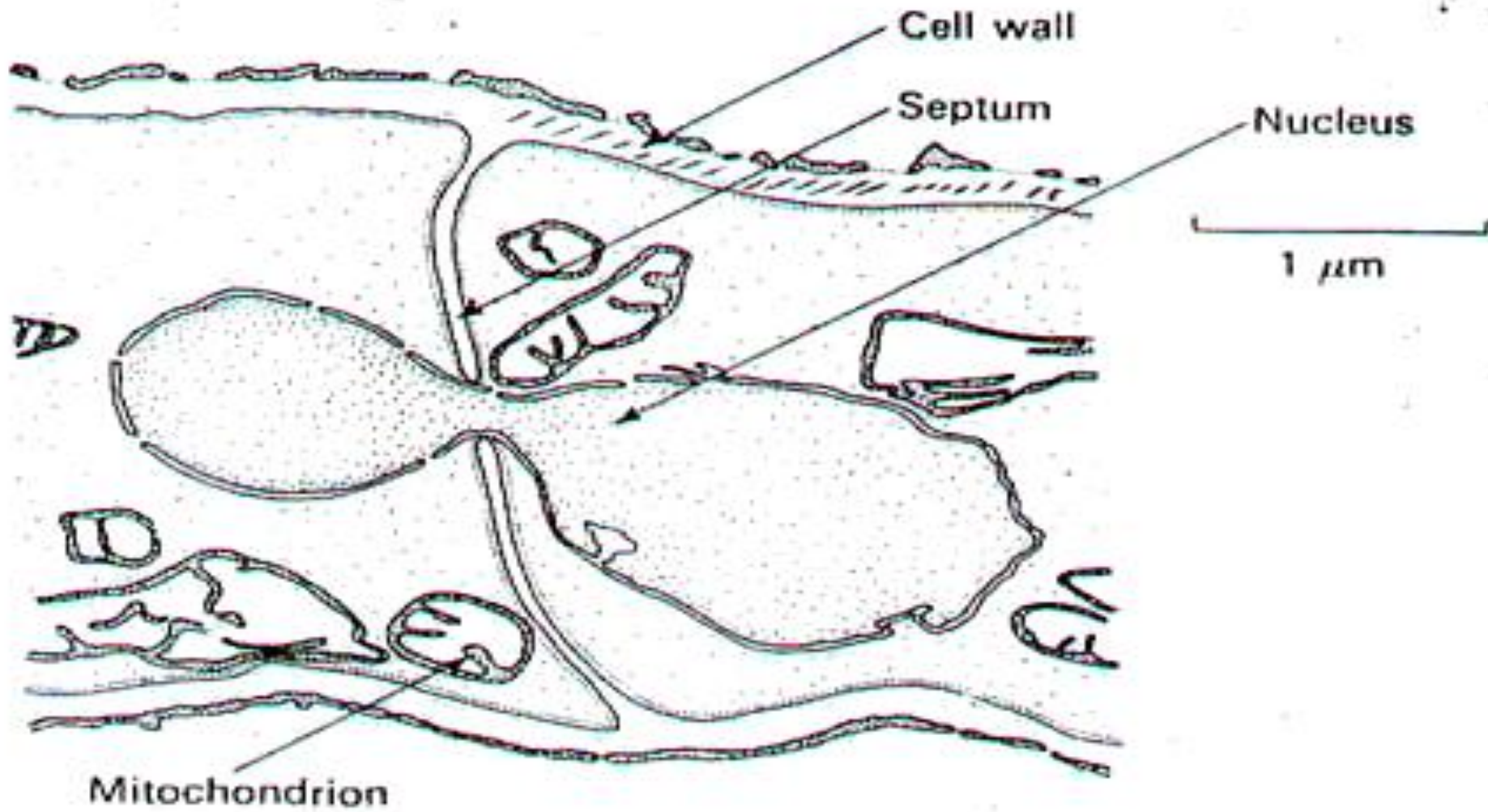
D– *Penicillium* species are used in production of cheeses and antibiotics.

❖ General characteristics:

1- Thallus is either of single cells (as in yeasts) or septate filaments; each segment often contains several nuclei. The septum is perforated by a pore that allows cytoplasmic continuity between segments. The pore is also wide enough to allow mitochondria and nuclei to pass through.

2- The cell wall contains chitin, amino-sugars and proteins including enzymes.

Perforated septum



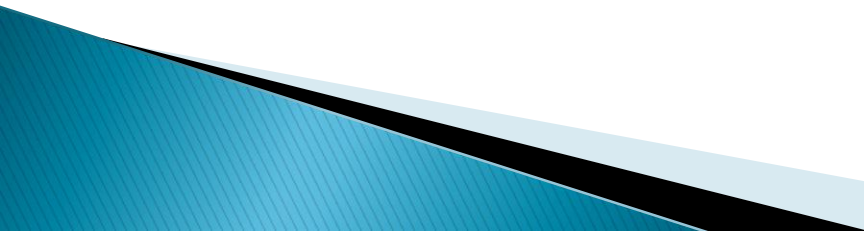
Reproduction

1 – Asexual Reproduction:–

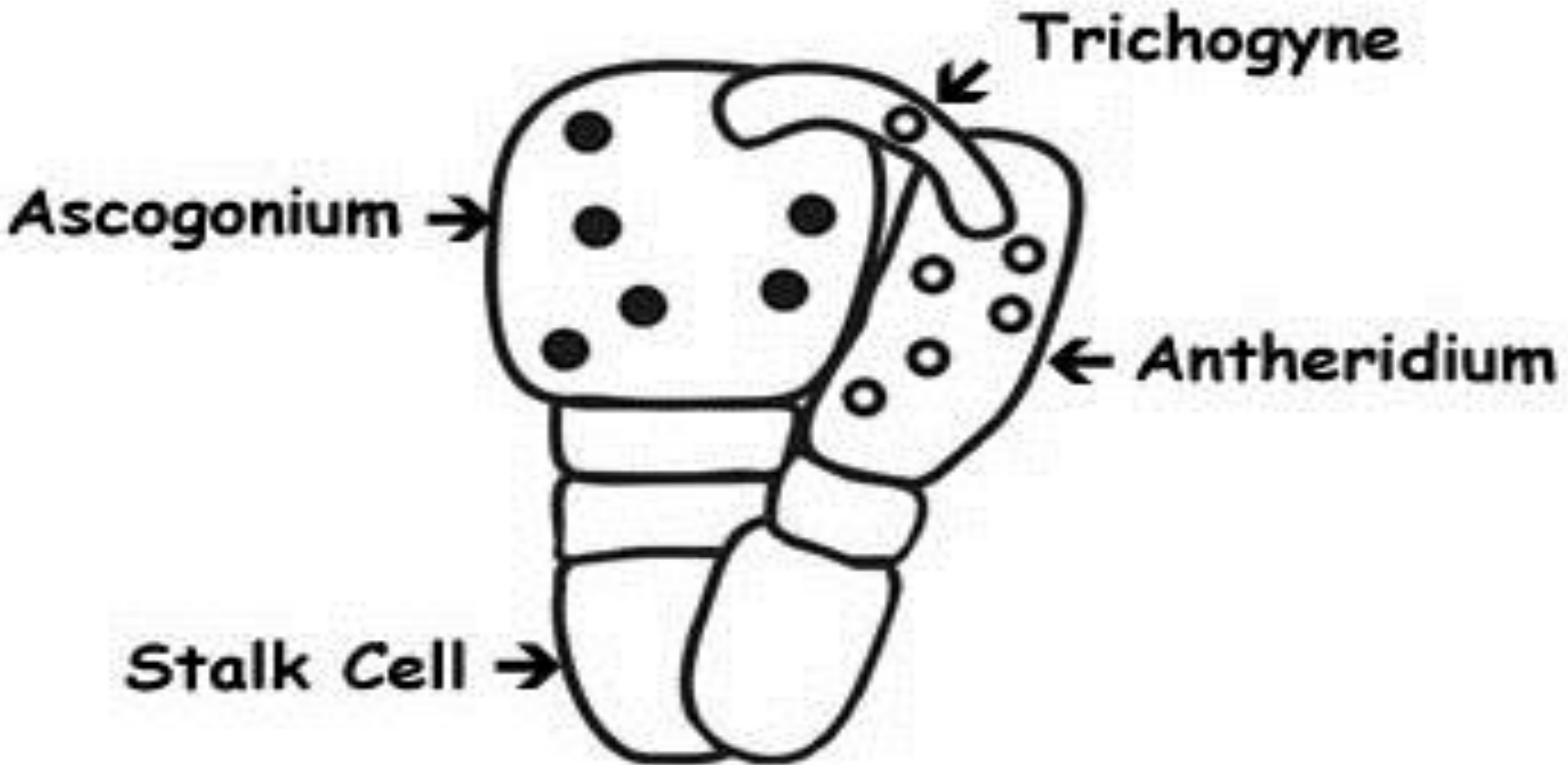
- ▶ It occurs by conidia (mitospores) which have one nucleus and born on the ends of specialized hyphae.
- ▶ The "conidiophores". Conidia vary considerably in shape, size and colour.

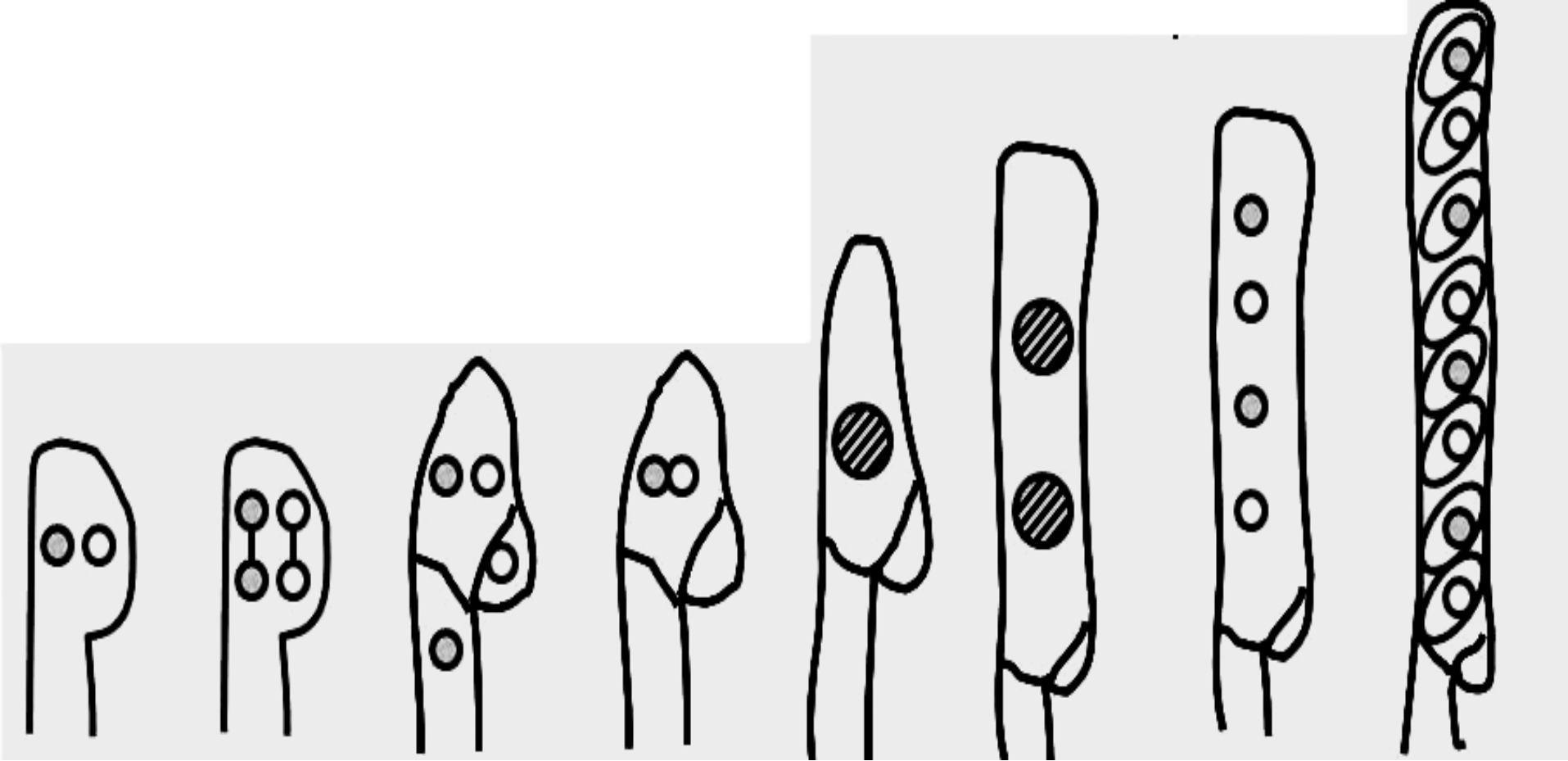
2– Sexual Reproduction:–

- The thallus may be homothallic or heterothallic.
- A **female** gametangium called **ascogonium** fuses with the **male** gametangium called **antheridium**.
- Ascogenous hyphae develop from the ascogonium, each hypha contains both male and female nuclei.
- Within the ascogenous hyphae mitosis occurs and the terminal cell differentiates into the ascus mother cell (ascus initial).

- In the ascus initial the two nuclei fuse and the diploid nucleus undergoes meiosis to form four haploid daughter nuclei. These nuclei undergo a mitotic division so that eight haploid nuclei result.
 - Meanwhile, ascus is elongating and the cytoplasm is cleaved out around each nucleus to form an ascospore.
 - The eight ascospores normally present in an ascus will include four of one mating type and four of the other type.
 - In many cases the asci are surrounded by packing tissues in the form of paraphyses.
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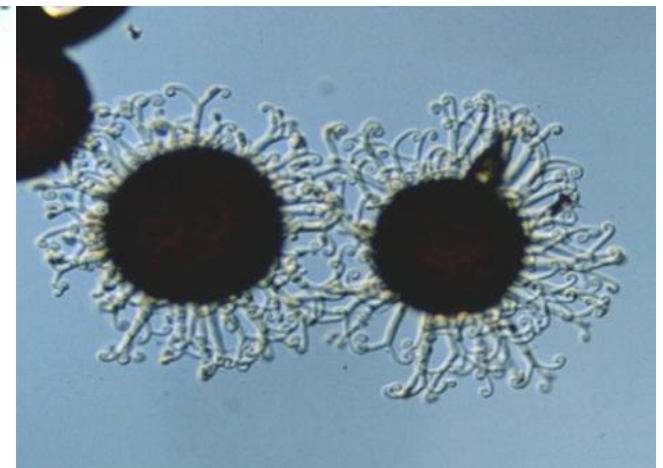
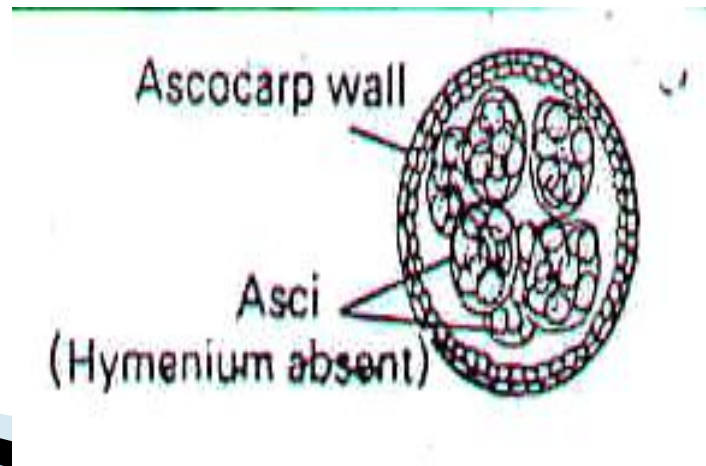
Ascogonium and antheridium.



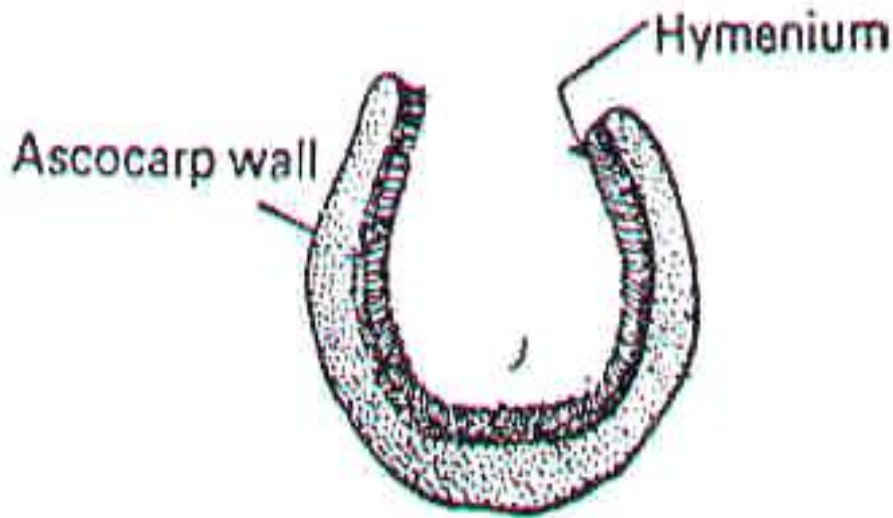


Ascus development commenced from ascus mother cell.
a. binucleate tip; b. mitosis; c. septum to delimit cells; d.
karyogamy (ascus mother cell); e. meiosis I; f. meiosis II; g. mitotic
division and formation of ascospore wall.

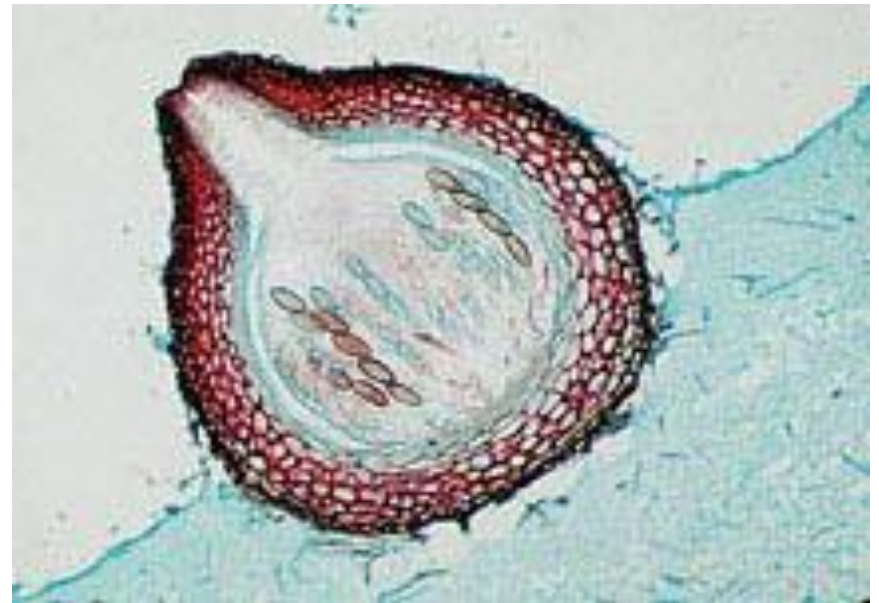
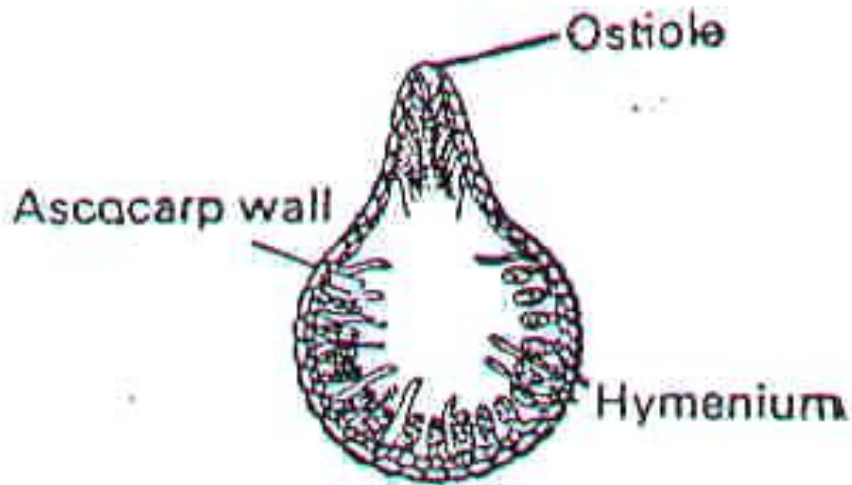
- ▶ Asci generally aggregate in structures called fruit bodies or ascocarps (ascomata).
- ▶ Ascomata may arise singly or are often clustered together. However, in yeast and related fungi the asci are not enclosed by hyphae.
- ▶ The form of ascoma varies. It may be a
1 – **Cleistothecium** in which the asci are enclosed in a globose fructification with no opening to the outside e.g. *Erysiphe*.



2- **Apothecium** where the asci are borne in open saucer-shaped ascocarps and at maturity the tips of the asci are freely exposed e.g. members of the order Pezizales.



3- **Peritheciium** which is a flask-shaped fruiting body opening by a pore or ostiole; e.g. members of Xylariales and Hypocerales.



▶ Hymenium and Hamathecium

▶ **Hymenium** is the fertile tissue of ascocarp.

▶ **Hamathecium** is the sterile cells associated with hymenium; it may be:

1– **Paraphyses** – hyphae growing amongst the asci

2– **Periphyses** – hyphae in the ostiolar canal of an ascocarp

3– **Pseudoparaphyses**–originate above the asci of ascostroma; grow down among the developing asci.