

# **Fungi: General Account, Nutrition and Reproduction**

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# The Fungus

- **Fungi are cosmopolitan in distribution, they can grow in any place where life is possible**
- **Eukaryotic organism**
- **Achlorophyllous**
- **Typically surrounded by cell walls with many other complex organic molecules**
- **Cell wall containing chitin or cellulose or both together**
- **Mostly Spore bearing through Asexual and Sexual reproduction**

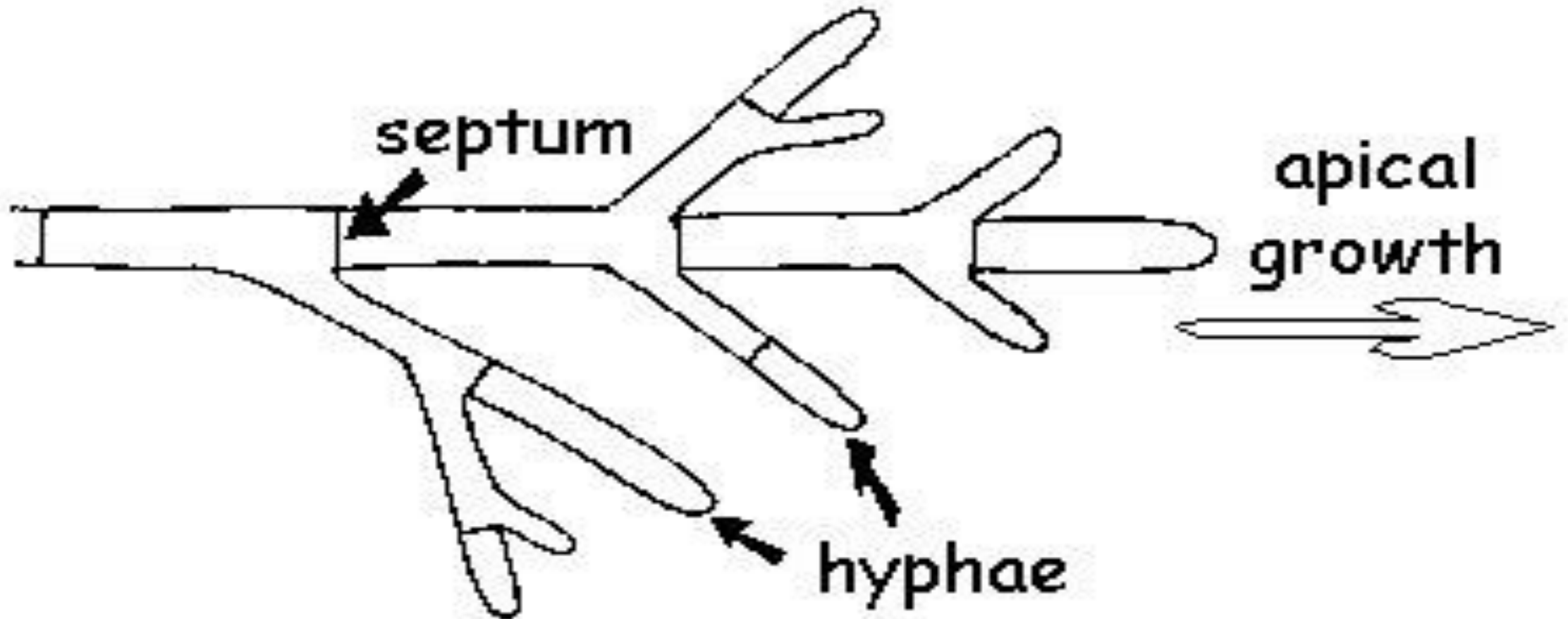
# Habitat of Fungi

- ❖ Most of the fungi are terrestrial which grow in soil, on dead and decaying organic material
- ❖ Some grow on both plants and animals
- ❖ They can grow on foods like jam, bread, fruits etc.
- ❖ Some members are also found in water known as aquatic fungi

# What Do Fungi Look Like?

- ❖ **Unicellular (Yeasts)**
- ❖ **Unicellular and primitively branched (Chytrids)**
- ❖ **Mycelial (filamentous forms)**
  - **Holocarpic – no differentiation**
  - **Eucarpic– differentiated in vegetative and reproductive parts**
- ❖ **Dimorphism (Two morphological forms)**

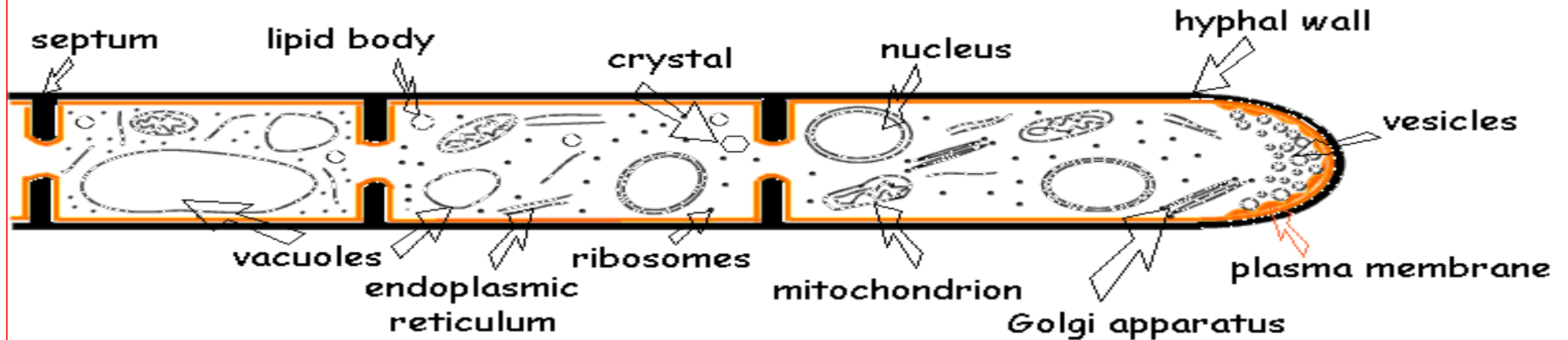
# Thallus Organization of A Typical filamentous Fungi



- ❖ **HYPHA** is a tube consisting of a rigid wall and containing protoplasm and tapered at its tip showing apical growth
  - Coenocytic or nonseptate
  - Septate with simple solid septum or perforated septum
- ❖ **SEPTA (cross-walls)**
  - To isolate old or damaged regions of a hypha
  - To isolate reproductive structures
  - At regular intervals along the lengths of hyphae and possess one or more pores

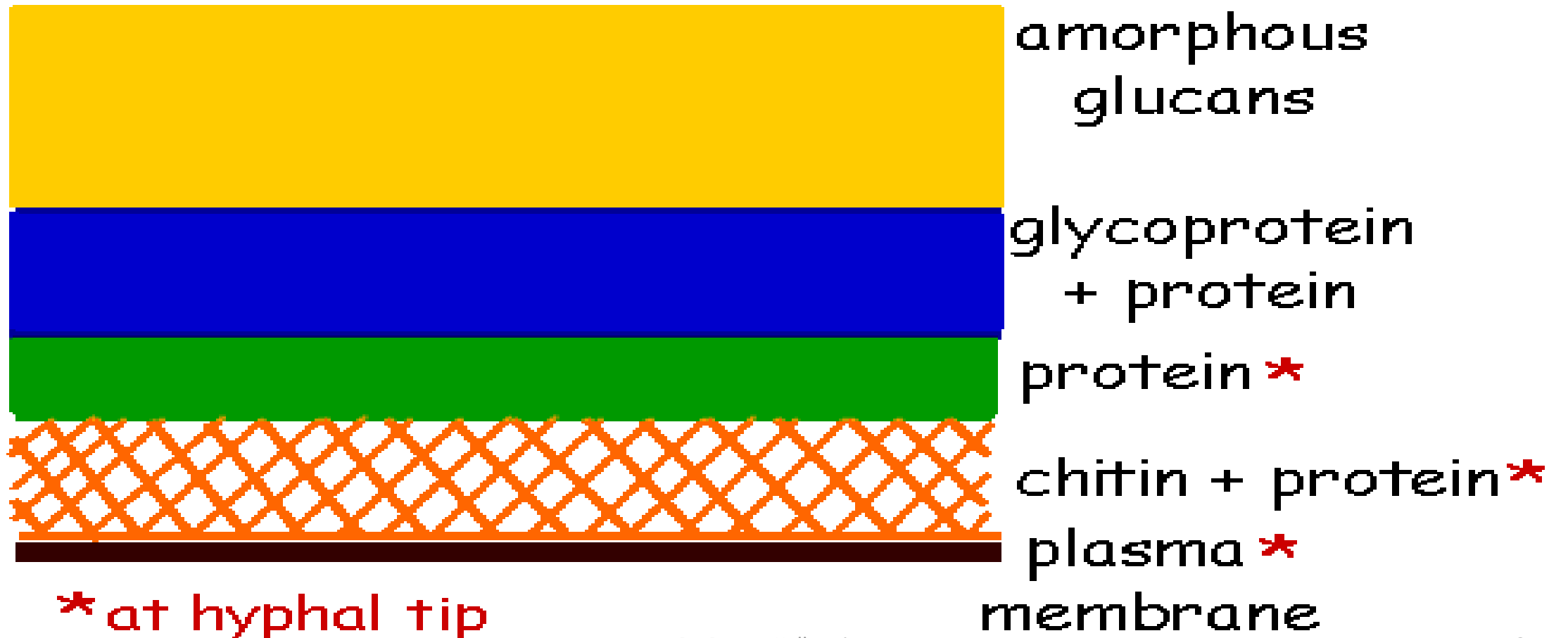
- ❖ **The cells generally contain colourless protoplasm due to absence of chlorophyll, nucleus, mitochondria, endoplasmic reticulum, ribosomes, vesicle and microbodies**
- ❖ **The reserve food material of the fungi is glycogen, fats or lipid globules**

# Diagrammatic Structure





# Fungal Cell Wall



# Chemical Composition of Cell Wall

## ❖ Polymeric fibrils

- ❖ chitin

- ❖ cellulose (in the Oomycota)

## ❖ Amorphous matrix components

- glucans

- proteins

- lipids

- heteropolymers (mixed polymers) of mannose, galactose, fucose and xylose

❖ The types and amounts of these various components vary amongst different groups of fungi and may even vary during the life cycle of a single species

# Functions of Fungal Cell Wall

- **PROTECTS** the underlying protoplasm
- **Determines and MAINTAINS THE SHAPE** of the fungal cell or hypha
- Acts as an **INTERFACE** between the fungus and its environment
- Acts as a **BINDING SITE** for some enzymes
- Possesses **ANTIGENIC** properties to allow interactions with other organisms

# Fungal Nutrition

- ❖ They are chlorophyll deficient organisms, hence cannot manufacture carbohydrates
- ❖ So all fungi are CHEMOHETEROTROPHIC (chemo-organotrophic) and they need pre-existing organic sources in their environment
- ❖ They are dependent on degradation of dead or living organic matter for their energy requirements

- ❖ **SMALL MOLECULES** (simple sugars, amino acids) and soluble compounds can be absorbed directly across the fungal wall and plasma membrane
- ❖ **LARGER, MORE COMPLEX MOLECULES** (polymers such as polysaccharides and proteins) must be first broken down into smaller molecules, which can then be absorbed
  - ✓ This degradation takes place outside the fungal cell or hypha and is achieved by **EXTRACELLULAR ENZYMES** which are either released through or are bound to the fungal wall

**On the basis of mode of nutrition they are classified into four groups**

- **Saprophytes**
- **Parasites**
- **Symbionts**
- **Predaceous**

# Saprophytic Fungi

- ❖ Saprophytic fungi obtain their nutrition from dead organic matter may be both animal or plant origin
- ❖ Some species bear special structures for absorption of nutrition called RHIZOIDS
- ❖ These fungi mainly produce exo-enzymes for release of simple organic matter
- ❖ They may grow on the surface of organic matter or grow inside the organic matter

**Ex. Mucor, Rhizopus, Aspergillus etc..**

# Parasitic fungi

- ❖ These fungi take food from other living plants and animals
- ❖ The living organisms on which fungi grow are called HOST
- ❖ The growing fungi are harmful to the host as they develop DISEASE conditions in their host
- ❖ Such relationship is known as PARASITISM
- ❖ Some Parasitic fungi possess specialized structures called HAUSTORIA for absorption of nutrition from host

**Ex. Erysiphae, Phytophthora, Albugo**



# **The parasitic fungi are of three types –**

**1. Obligate Parasites-** Essentially require living host, not able to live on dead organic matter

**Ex. Puccinia, Albugo**

**2. Facultative Saprophytes-** These are parasites but can live on dead organic matter when specific host is not available

**Ex. Taphrina**

**3. Facultative Parasites-** These are usually saprophytes but under certain conditions they parasitized living host

**Ex. Fusarium, Phythium**

# Symbiotic Fungi

❖ These fungi grow on or with living organisms but both of them are mutually benefitted

## Ex. Lichen and Mycorrhiza

✓ Lichens are symbiotic association of algae and fungi

✓ Mycorrhiza are symbiotic association of fungi and roots of higher plants

# Predacious Fungi

- ❖ These are animal capturing fungi
- ❖ These fungi usually inhabit in the soil
- ❖ The fungi possess special hyphal traps called SNARES which capture small animals like Amoeba and Nematodes
- ❖ Some of them also produce sticky secretions for capturing their prey

**Ex. Arthrobotrys, Dactylaria**

# Fungal Reproduction

**Fungi show three modes of reproduction**

- ❖ **Vegetative**
- ❖ **Asexual**
- ❖ **Sexual**

# 1. Vegetative Reproduction

**Helps to increase the number of individuals in population**

❖ **Fragmentation**

❖ **Fission**

❖ **Budding**

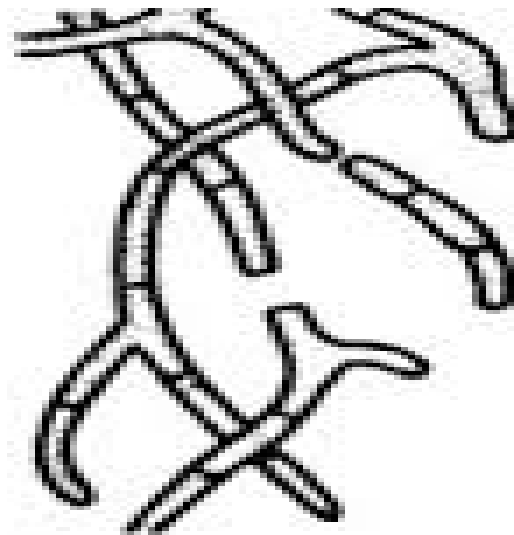
❖ **Sclerotia**

❖ **Rhizomorph**

# Fragmentation

❖ Mycelial fragmentation occurs when a fungal mycelium separates into pieces with each component growing into a separate mycelium

**Ex. Rhizopus, Alternaria,  
Fusarium**



# Fission

- ❖ Reproduction by simple cell division
- ❖ One cell undergoes nuclear division and splits into two daughter cells

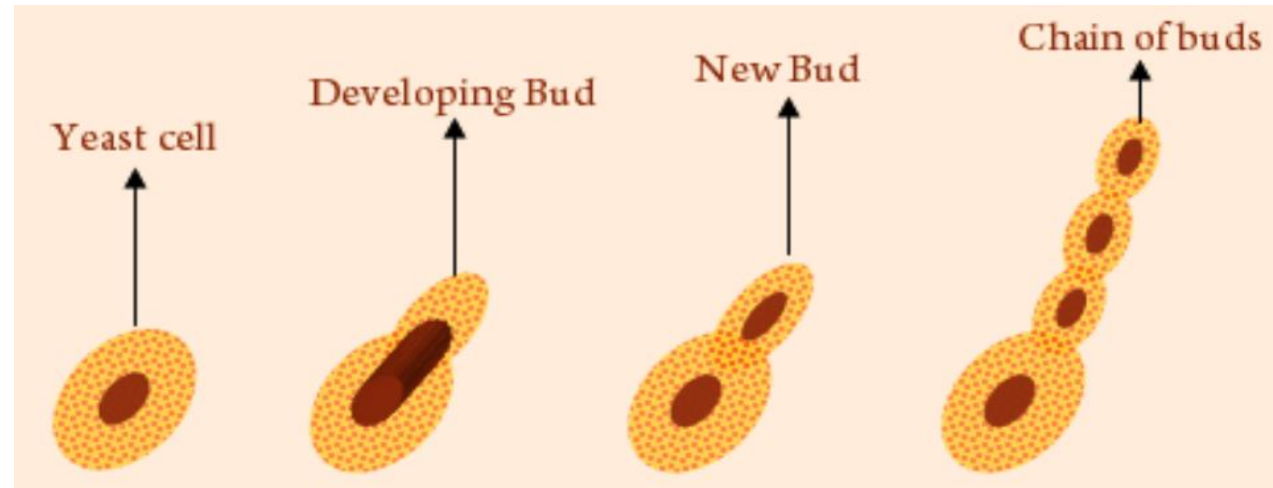
**Ex. Saccharomyces, Schizosaccharomyces**



# Budding

❖ A bud is develop on the surface of either the yeast cell or the hypha, with the cytoplasm of the bud being continuous with that of the parent cell

**Ex. Saccharomyces, Schizosaccharomyces**

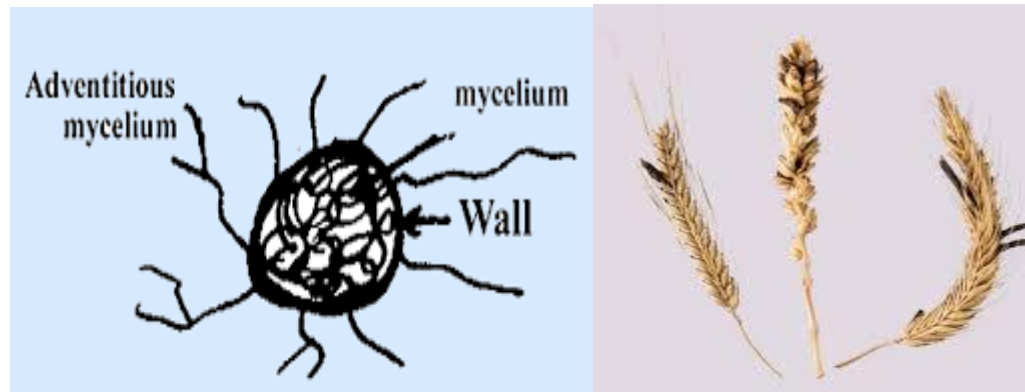




# Sclerotia

- ❖ Sclerotium are mycelial aggregates develops under unfavorable conditions
- ❖ It may survive for long periods of time
- ❖ These are commonly produced by plant pathogenic fungi

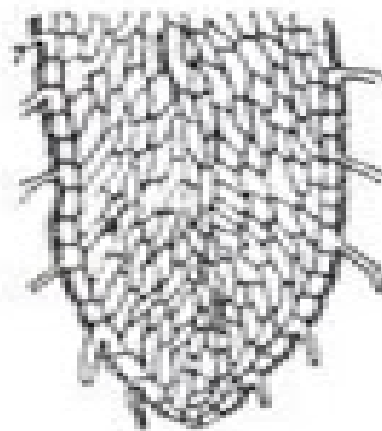
**Ex. Rhizoctonia,  
Botrytis**



# Rhizomorph

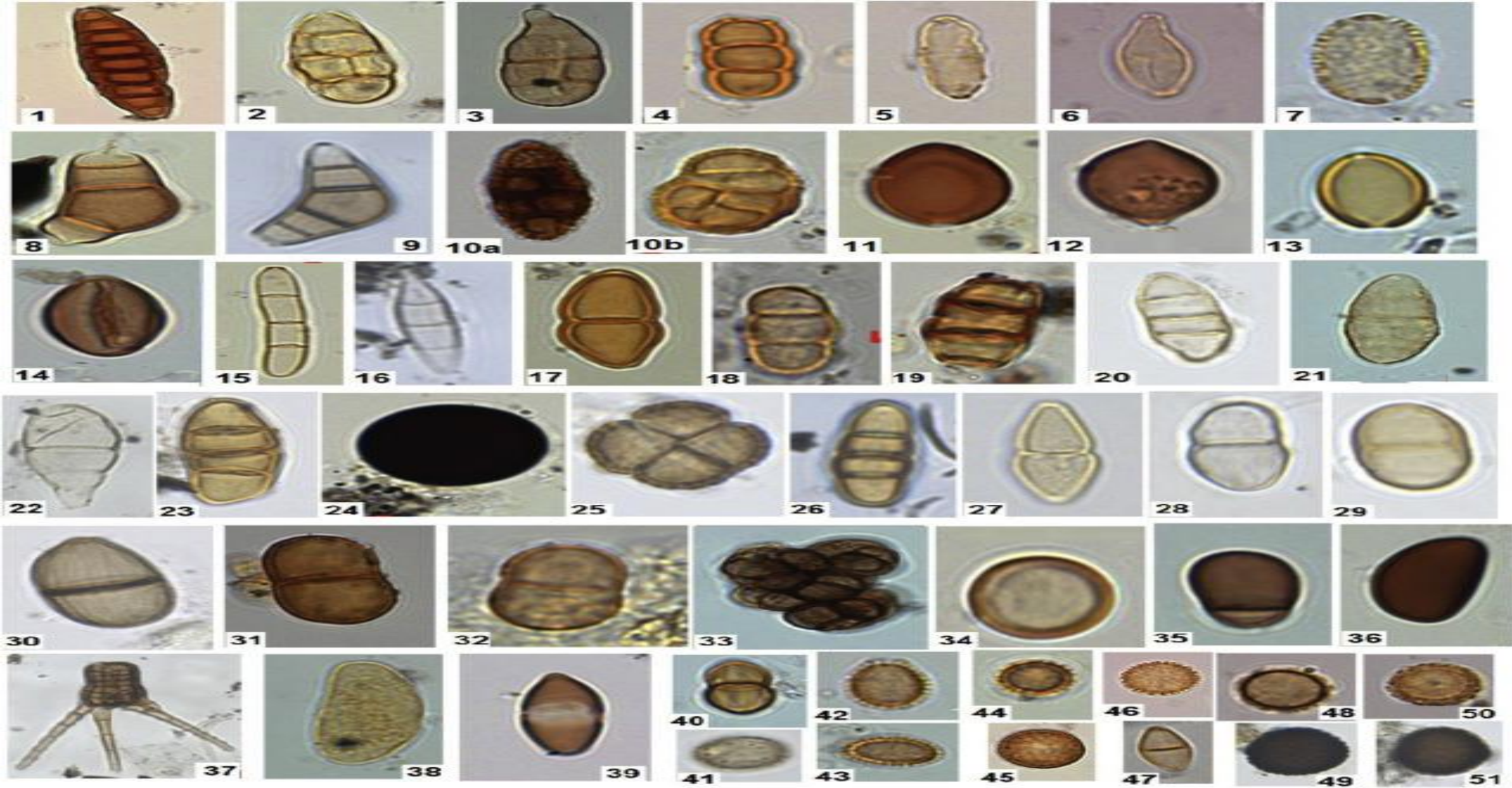
- ❖ These are root mycelial aggregates
- ❖ These can also overcome unfavorable conditions and survive for long time in soil
- ❖ These have more pathogenic potential than normal hyphae

**Ex. Armillaria,  
Polyporus**



## 2. Asexual Reproduction

- ❖ By different types of spores represent microscopic propagules
- ❖ These are produced after mitosis, also called MITOSPORES
- ❖ They vary in size, shape and colour
- ❖ They may be unicellular or multicellular
- ❖ Some spores possess a textured or ornamented surface
- ❖ They also vary in the methods by which they are formed, released and dispersed
- ❖ They possess a relatively low water content and exhibit a low rate of metabolic activity their primary role is DORMANT SURVIVAL



# Types of Asexual Spores

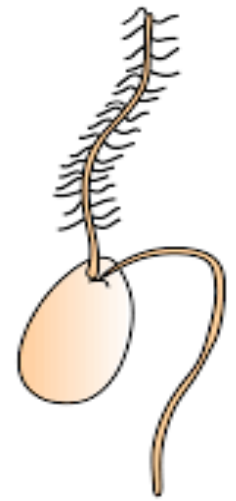
**On the basis of their ORIGIN and FUNCTION, they are classified as.....**

- ❖ **Zoospores**
- ❖ **Sporangiospores**
- ❖ **Oidia**
- ❖ **Chlamydospores**
- ❖ **Conidia (Conidiospores)**

# Zoospores

- ❖ Motile asexual spores
- ❖ Presence of Flagella for swimming
- ❖ These zoospores differ in number and types of flagella

**Ex. Members of Chytridiomycota, Hyphochytriomycota and Oomycota**

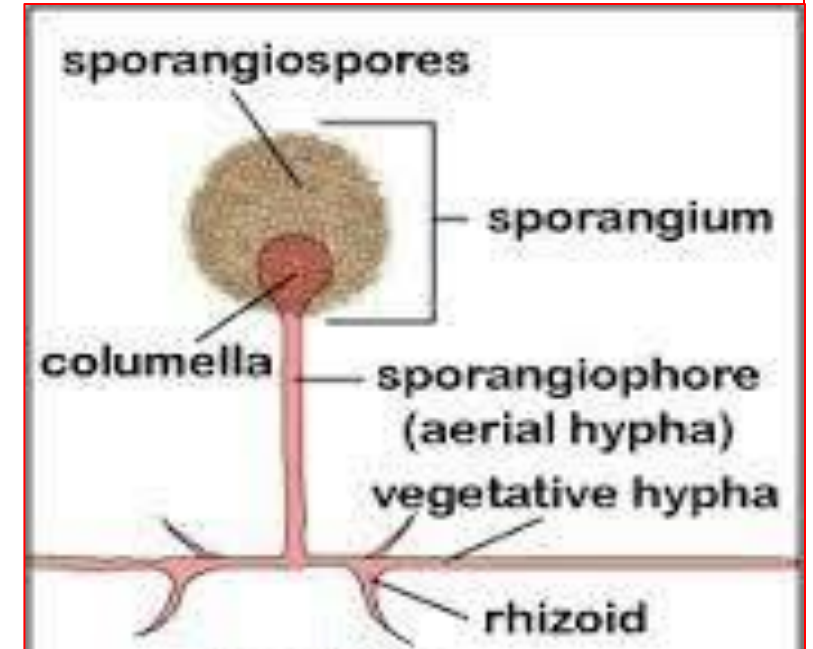




# Sporangiospores

- ❖ Sporangia are swollen bodies of reproductive branches
- ❖ The spores are non-motile produced inside the sporangia
- ❖ These spores are produced in large numbers and dispersed by wind

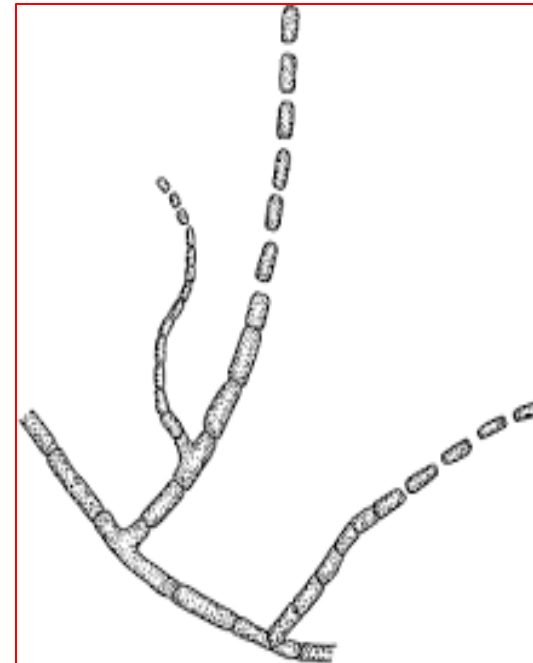
**Ex. Rhizopus and Mucor**



# Oidia

❖ An oidium is an asexually produced fungal spore that developed through hyphal breaks up into component cells/ small pieces

**Ex. Mucor, Ascobolus, Coprinus**

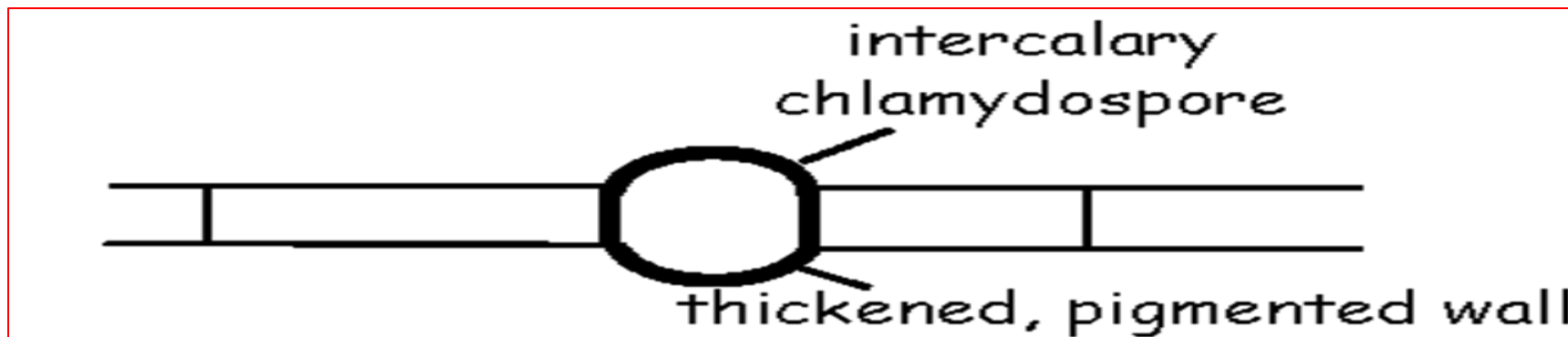




# Chlamydospores

- ❖ A type of resting (survival) spore
- ❖ It is enlargement of any hyphal cell which rounds up and develops a thickened, pigmented wall and contain dense cytoplasm and nutrient storage compounds
- ❖ Usually develop under conditions of stress and are unfavorable for normal growth

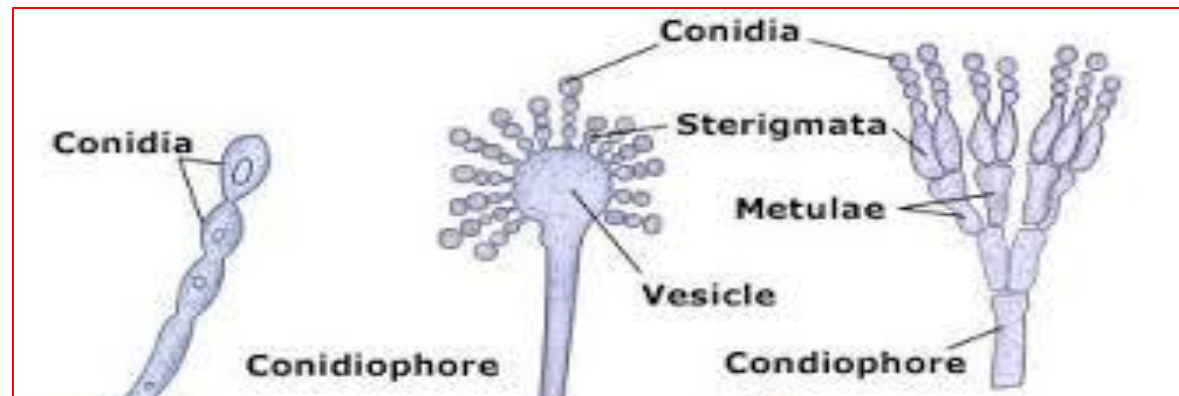
**Ex. Fusarium**



# Conidia

- ❖ Conidia are exogenous, non-motile spores
- ❖ These are produced singly or in chains with different shapes and sizes
- ❖ They produce on the tip of special hyphal branches called **CONIDIOPHORES**

**Ex. Aspergillus and Penicillium**



# 3. Sexual Reproduction

- ❖ It is the process of union between two compatible nuclei
- ❖ The nuclei in some members are contributed by two well-organized GAMETES
- ❖ Sexual reproduction is an important source of genetic variability and allows the fungus to adapt to new environments

# The whole process of sexual reproduction consists of three phases

## (i) Plasmogamy:

❖ It involves the union of two protoplasts

## (ii) Karyogamy:

❖ It involves the fusion of two haploid nuclei brought together during plasmogamy, resulted in the formation of **DIPLOID NUCLEUS** or a short lived **ZYGOTE**

## (iii) Meiosis:

❖ It follows karyogamy and reduce the number of chromosome from diploid zygote nucleus to original **HAPLOID** number in the daughter nuclei

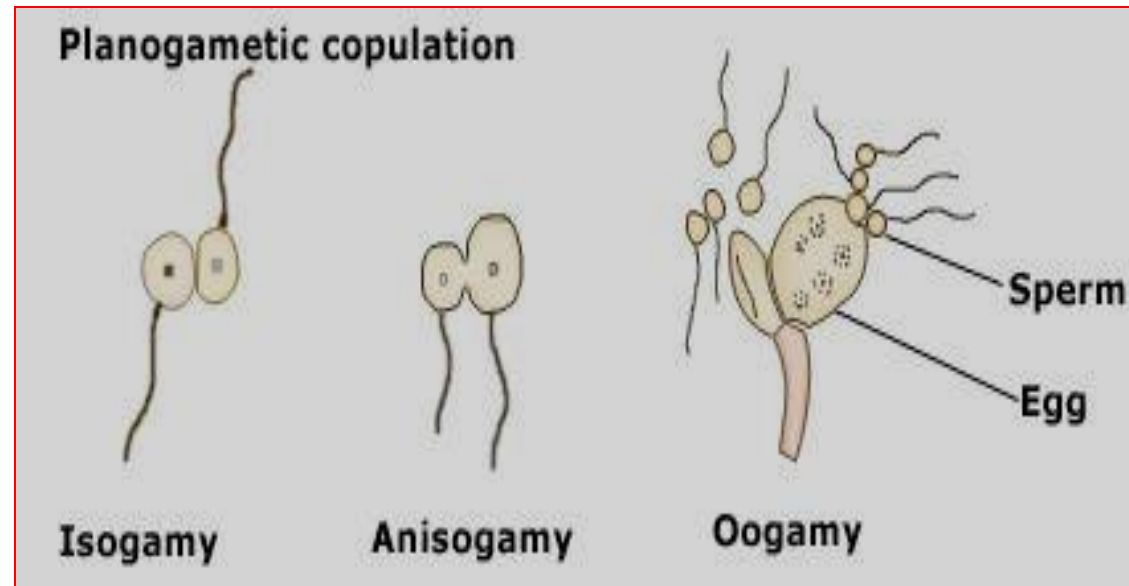
# **Different methods of Plasmogamy**

- 1. Planogametic copulation**
- 2. Gametangial contact**
- 3. Gametangial copulation**
- 4. Spermatization**
- 5. Somatogamy**

# 1. Planogametic Copulation

- By the fusion of two naked gametes, one or both of them are motile
- The motile gametes are known as planogametes

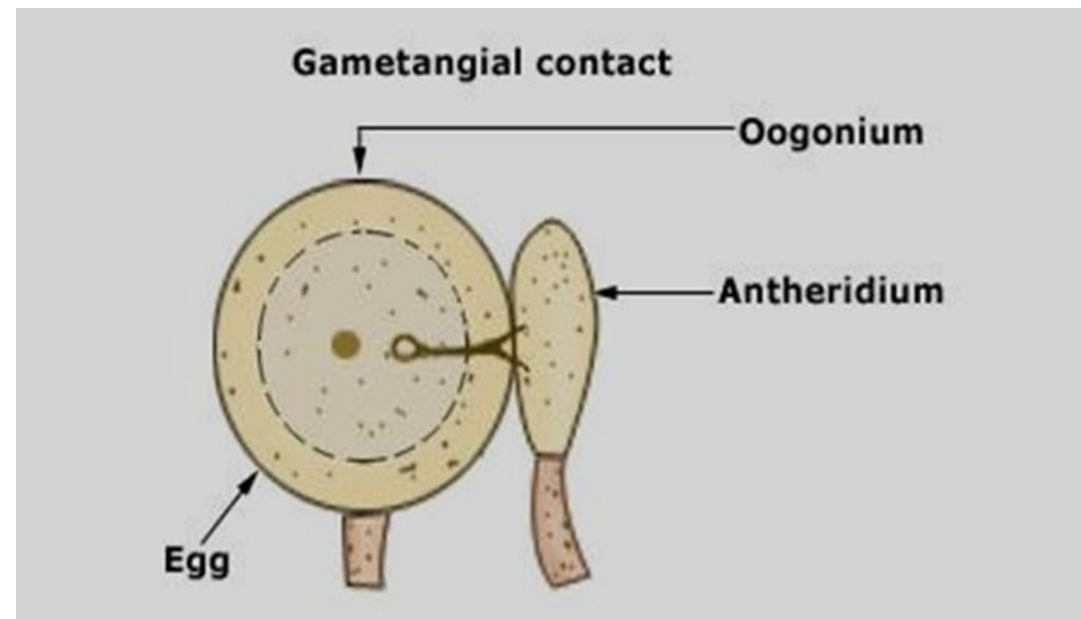
**Ex. Members of primitive fungi, Synchytrium and Plasmodiophora**



## 2. Gametangial Contact

Gamete bearing structures called gametangia come closer to each other and develop a fertilization tube through which the male gamete migrates into the female gametangium

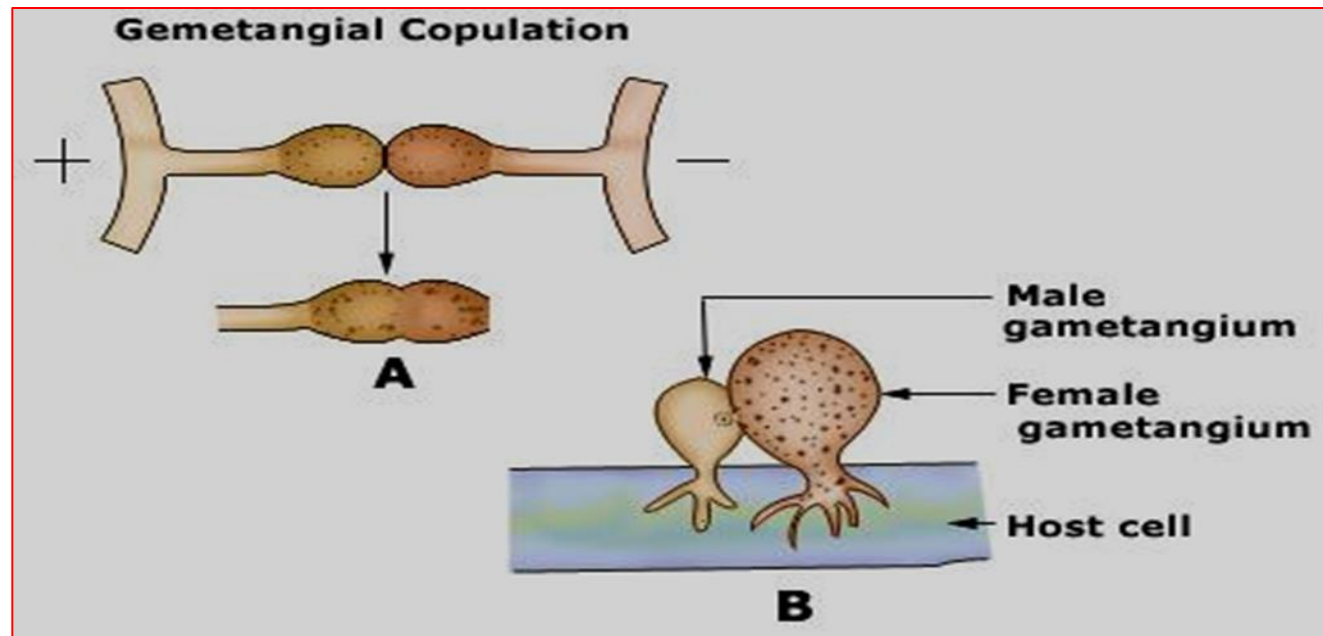
**Ex. Pythium, Ascobolus**



### 3. Gametangial Copulation

❖ Two entire compatible gametangia fuse with each other, lose their identity and develop into a zygospore

**Ex. Mucor, Rhizopus, Entomophthora**

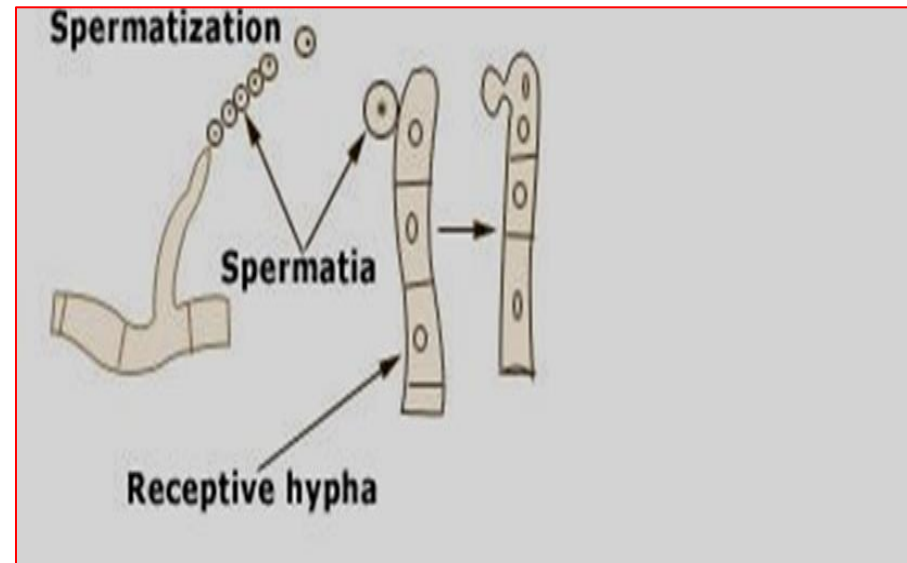




## 4. Spermatisation

- ❖ Tiny unicellular spore like structures called spermatia are developed and get transferred to female gametangia through various agencies
- ❖ The spermatia are carried to the receptive hyphae (trichogynes) of female gametangia, to which they become attached and further pass into it

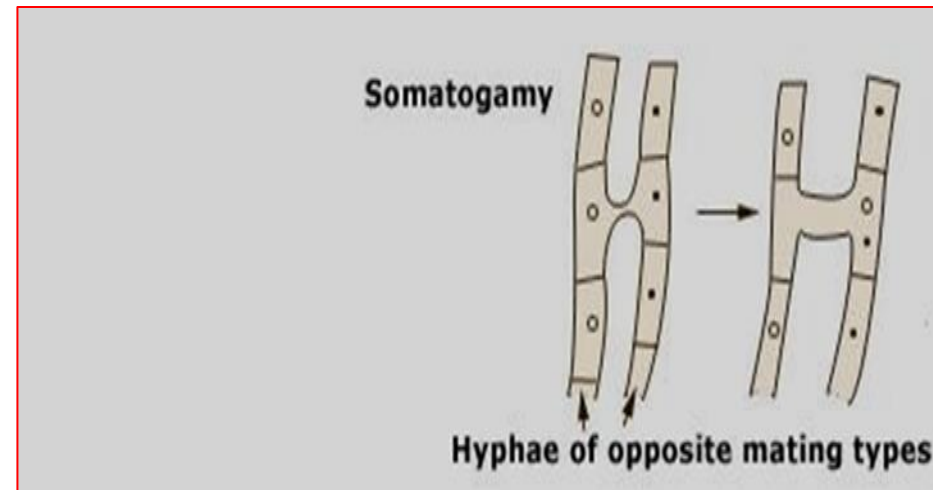
**Ex. Rust and Smut fungi**



## 5. Somatogamy

- ❖ The sex organs are not produced
- ❖ The somatic cells take part in sexual fusion, two cells of different hyphae of opposite mating type exchange their nuclei through a fertilization tube

**Ex. Morchella, Polyporus, Agaricus**



❖ **The sexual spores produced after meiosis, also called MEIOSPORES**

❖ **Sexual reproduction in fungi resulted in the formation of these structures**

➤ **Zygospore**

➤ **Oospore**

➤ **Ascocarp containing Ascospores**

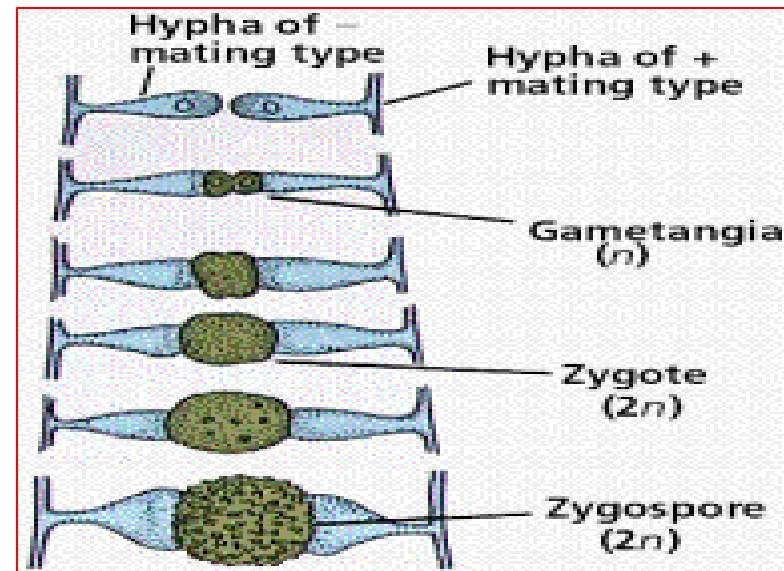
➤ **Basidiocarp containing Basidiospores**

# Sexual Spores of Fungi

## Zygospore

- ❖ It is a thick-walled spore of fungi that is formed by union of two similar sexual cells
- ❖ It usually serves as a resting spore, and produces the sporophytic phase

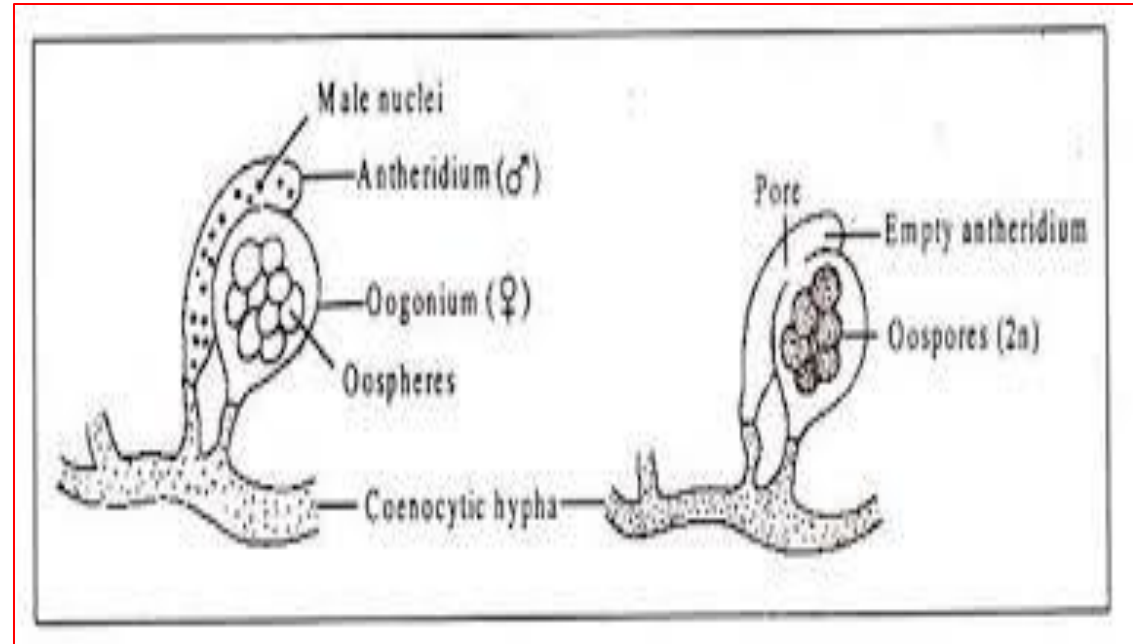
**Ex. Rhizopus**



# Oospore

- ❖ An oospore is a thick-walled sexual spore that develops from a fertilized oosphere
- ❖ It is evolved either through the fusion of two species or the chemically-induced stimulation of mycelia

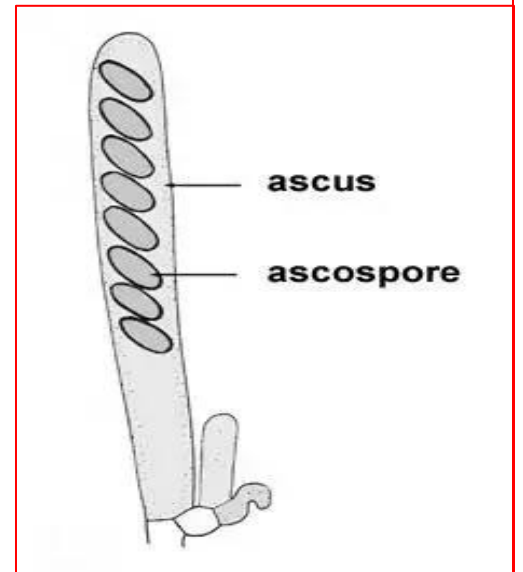
**Ex. Pythium, Phytophthora**



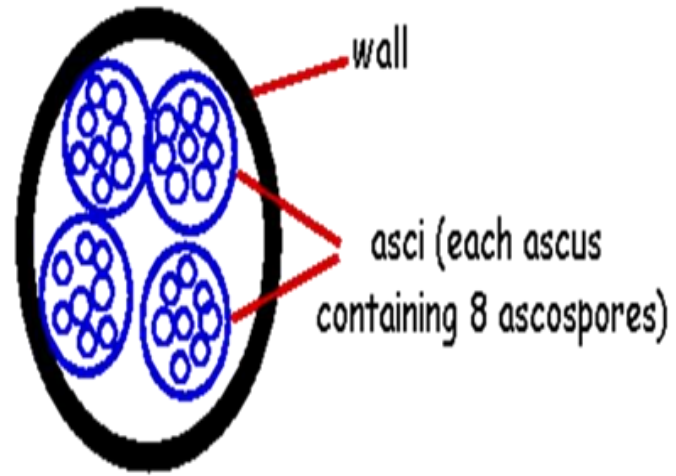
# Ascospores in Ascus and Ascocarp

- ❖ Ascus is a saclike structure produced by the members of Ascomycota (sac fungi)
- ❖ They contain sexually produced spores (ascospores), usually four or eight in number
- ❖ Asci may arise within a fruiting structure (ASCOCARP) structure of varying types

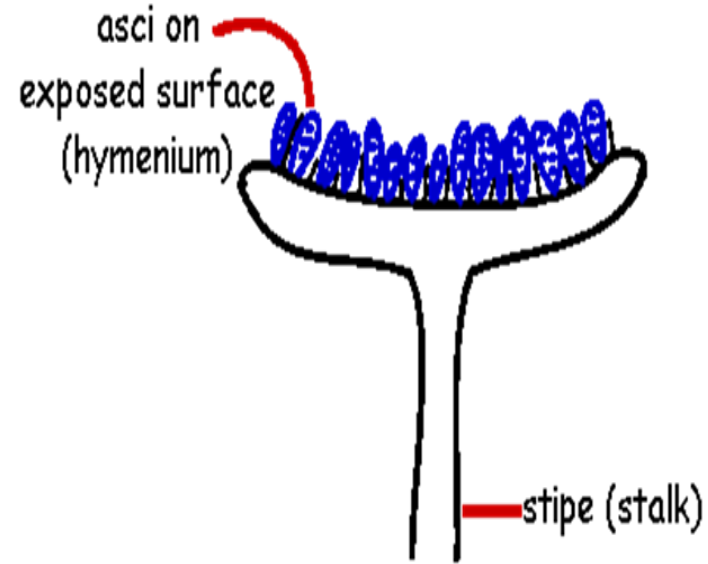
**Ex. Penicillium, Aspergillus, Neurospora, Morel, Peziza**



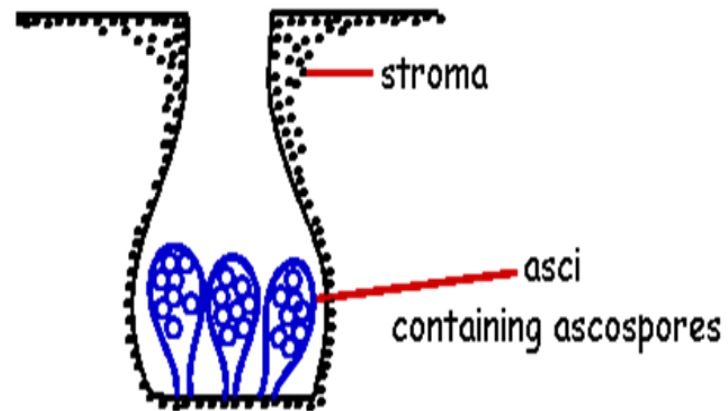
# Types of Ascocarps



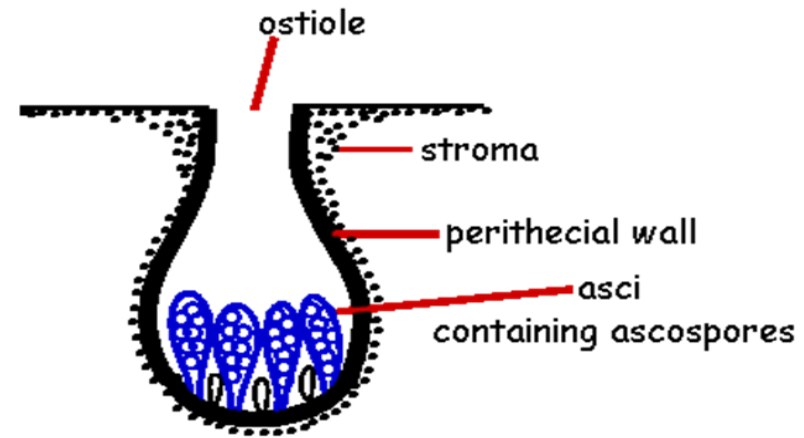
**Clestothecium**



**Apothecium**



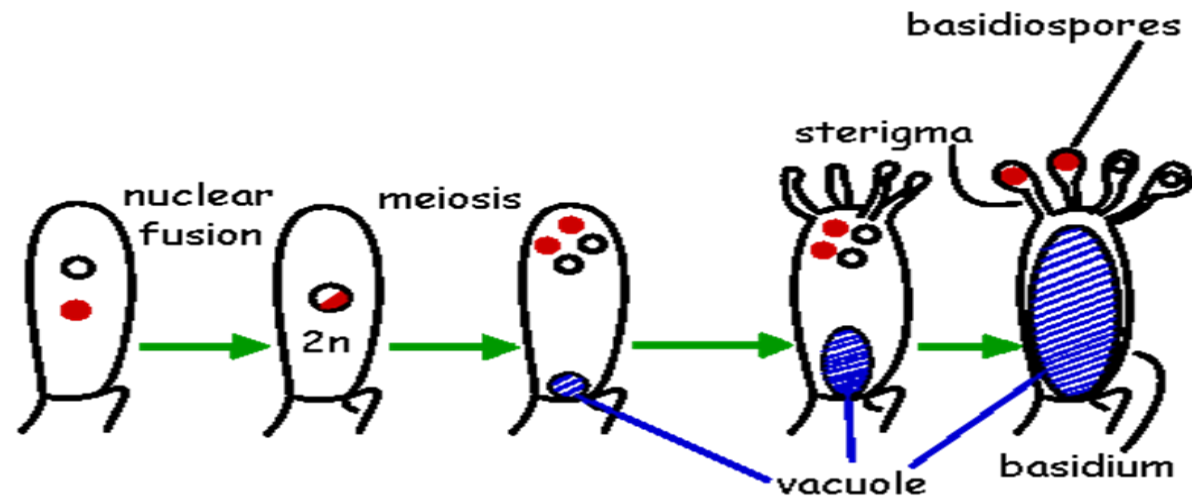
**Perithecium**



# Basidiospores by Basidia on Basidiocarp

- ❖ A basidiospore is a reproductive spore produced by Basidiomycete fungi, includes mushrooms, shelf fungi, rusts, and smuts
- ❖ Basidiospores typically contain one haploid nucleus that is the product of meiosis,
- ❖ They are produced by specialized fungal cells called basidia

## Ex. Mushrooms





# Types of Basidiocarps (aerial structures which bear basidia)



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