

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**

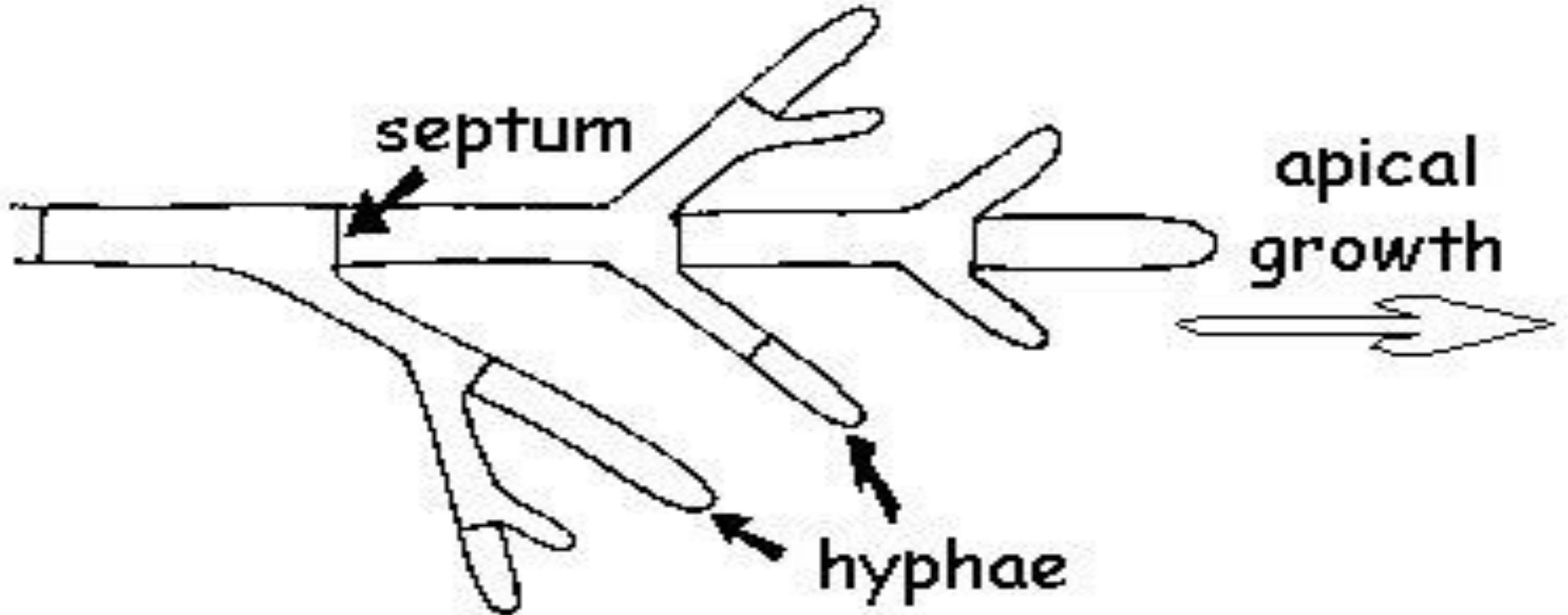
Habitat of Fungi

- ❖ **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)**

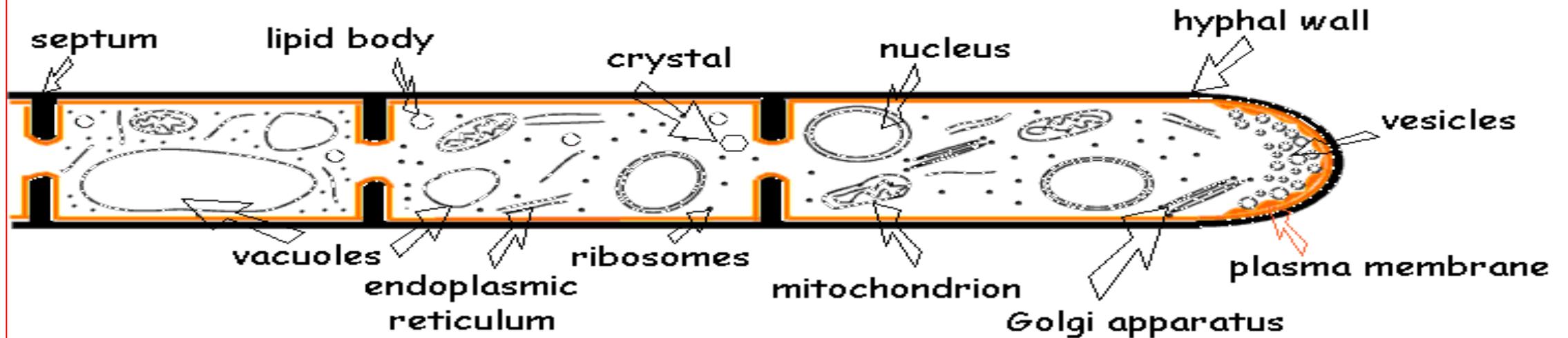
Thallus Organization of A Typical filamentous Fungi



- ❖ **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**

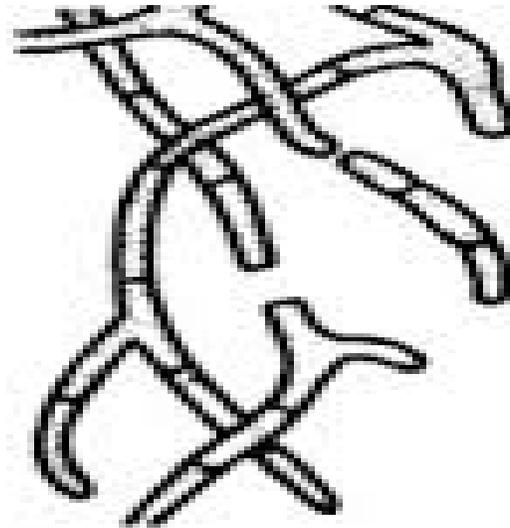
❖ **Sclerotia**

❖ **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

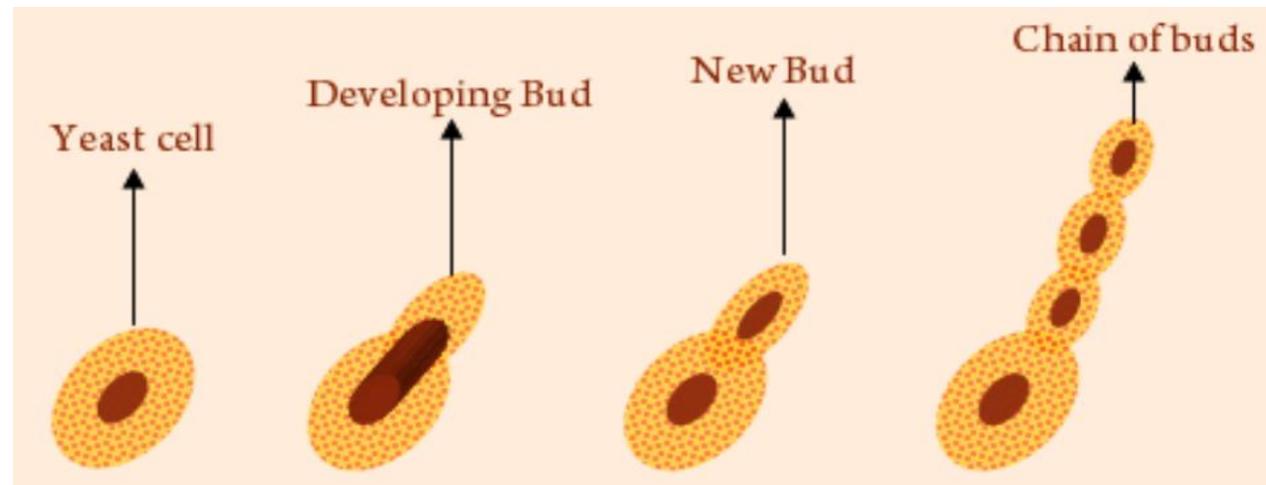
Ex. Saccharomyces, Schizosaccharomyces



Budding

❖ A bud is developed 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

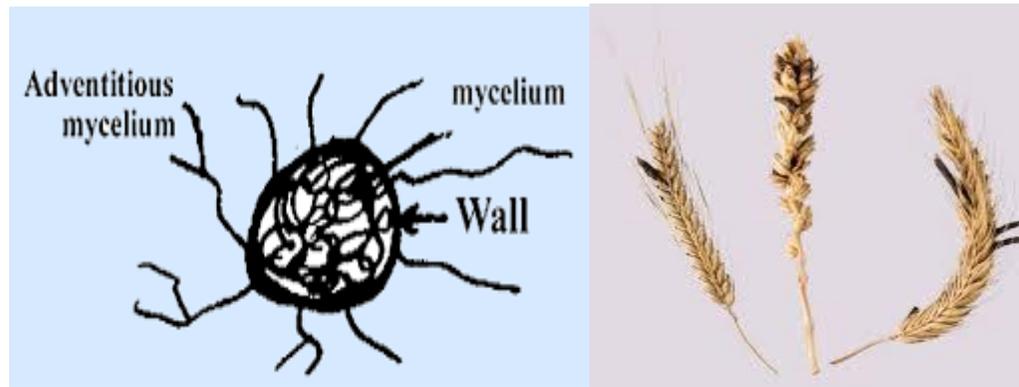
Ex. Saccharomyces, Schizosaccharomyces



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

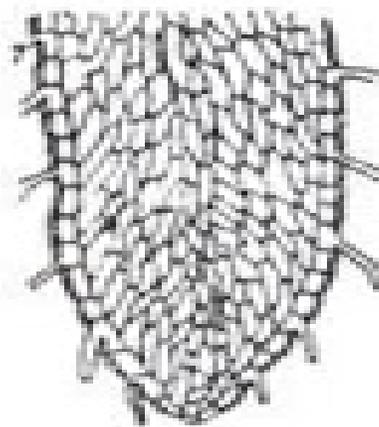
**Ex. Rhizoctonia,
Botrytis**



Rhizomorph

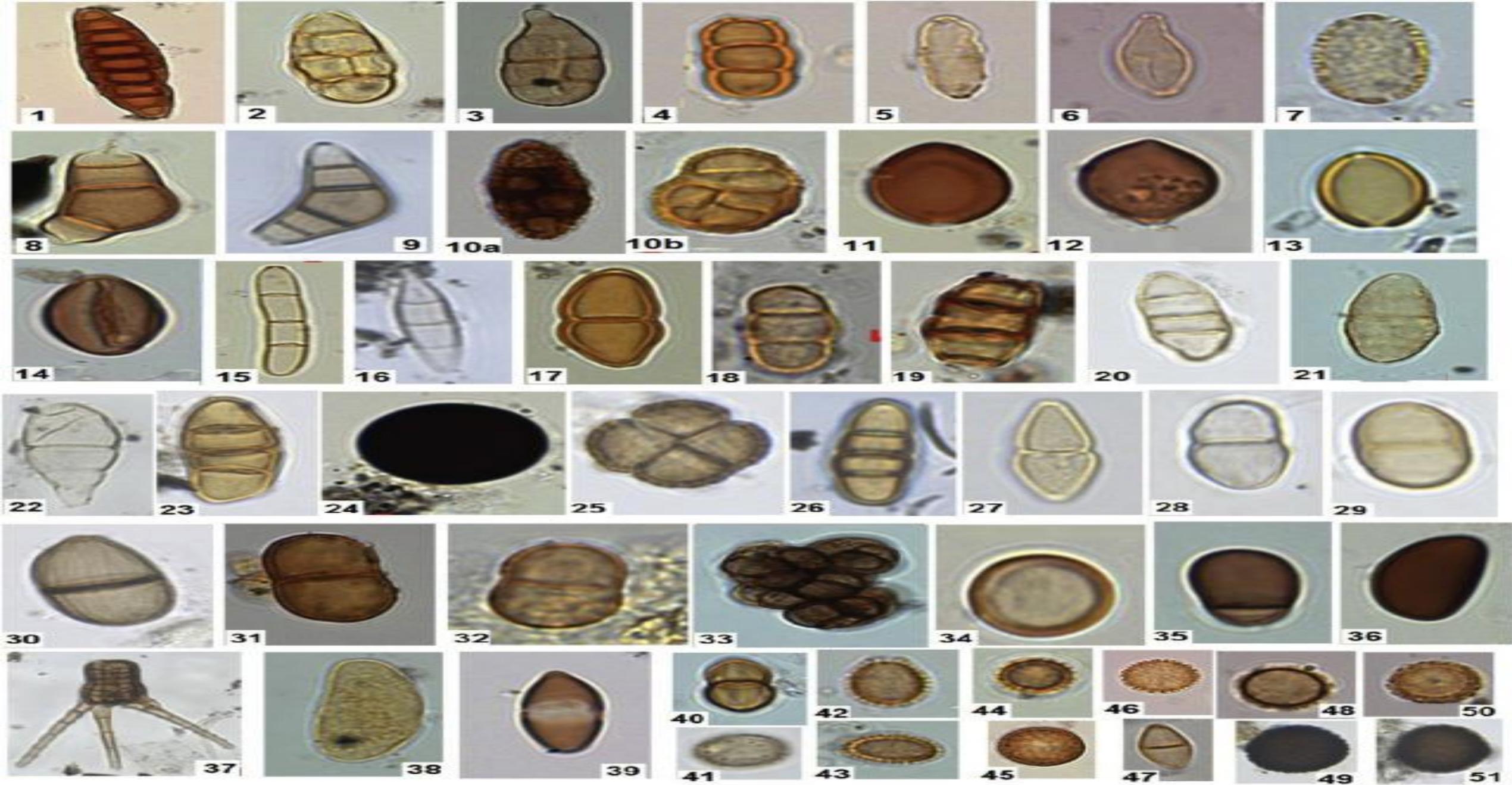
- ❖ These are root mycelial aggregates
- ❖ These can also overcome unfavorable conditions and survive for long time in soil
- ❖ These have more pathogenic potential than normal hyphae

**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

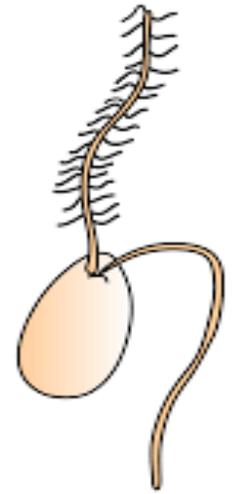
On the basis of their **ORIGIN** and **FUNCTION**, they are classified as.....

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

Zoospores

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

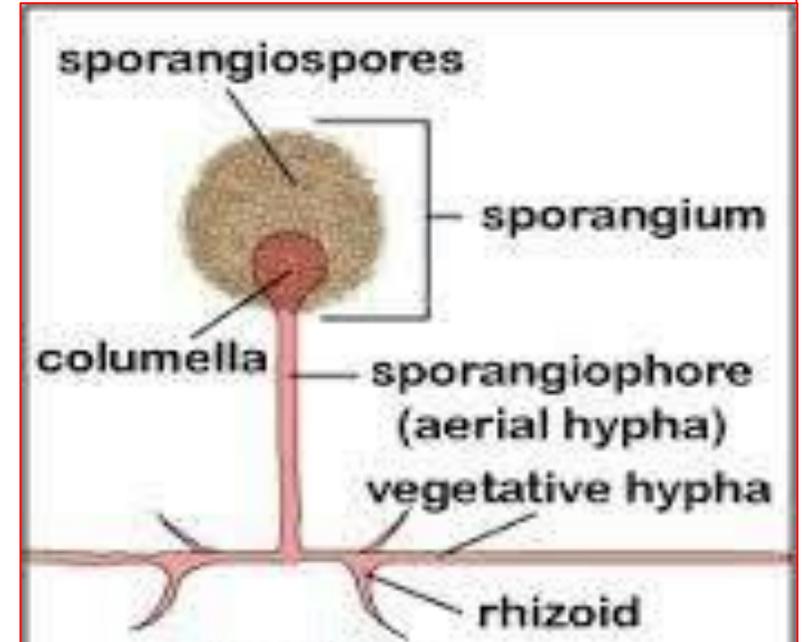
Ex. Members of Chytridiomycota, Hyphochytriomycota and Oomycota



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

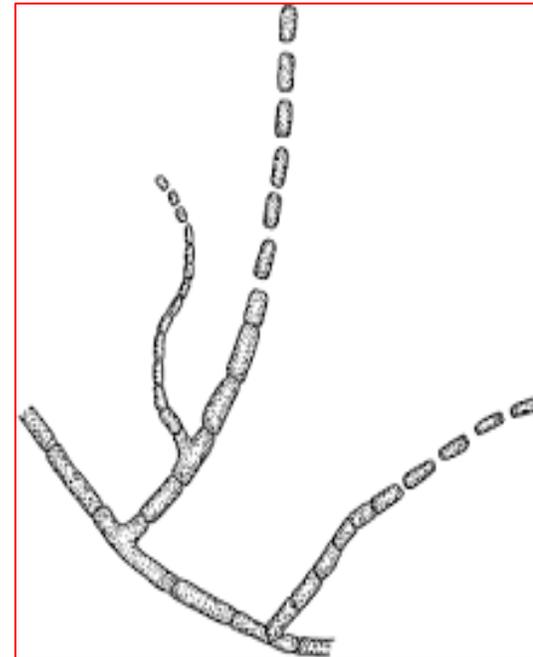
Ex. Rhizopus and Mucor



Oidia

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

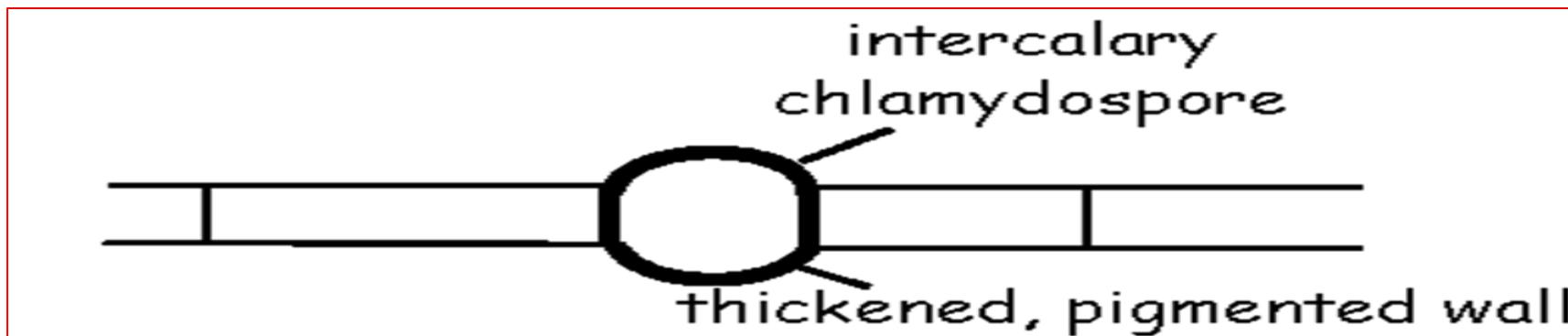
Ex. Mucor, Ascobolus, Coprinus



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

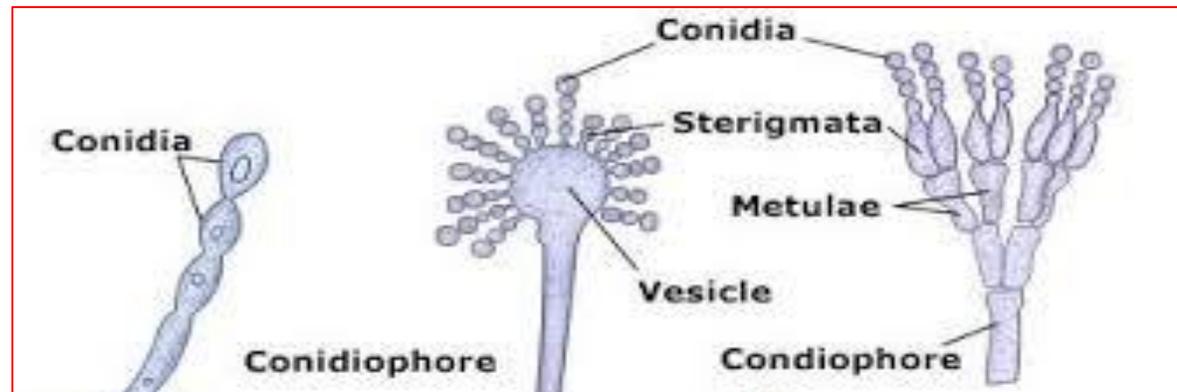
Ex. Fusarium



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

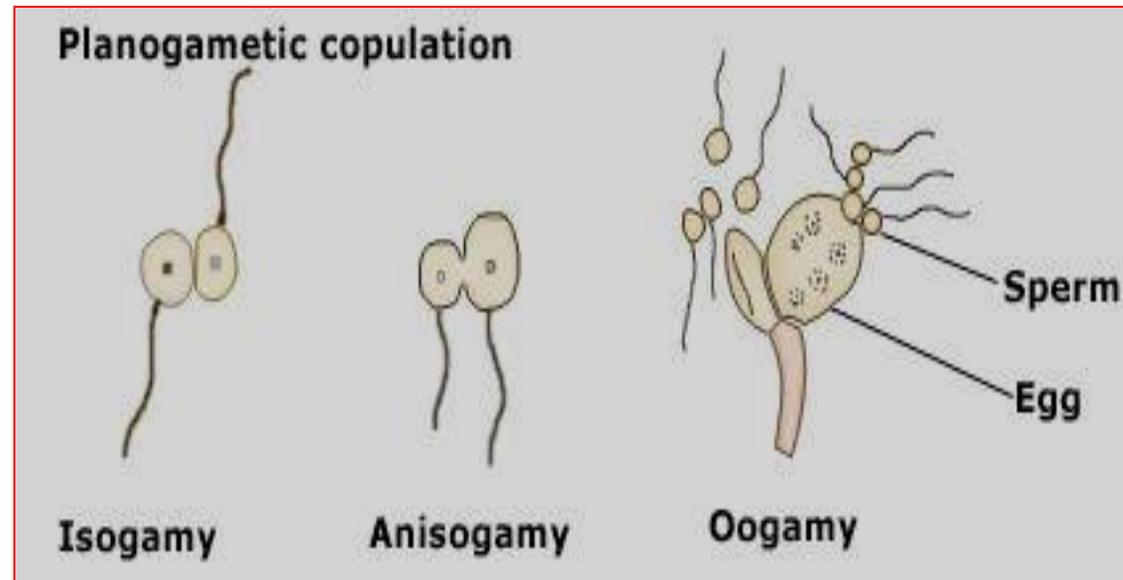
Different methods of Plasmogamy

- 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

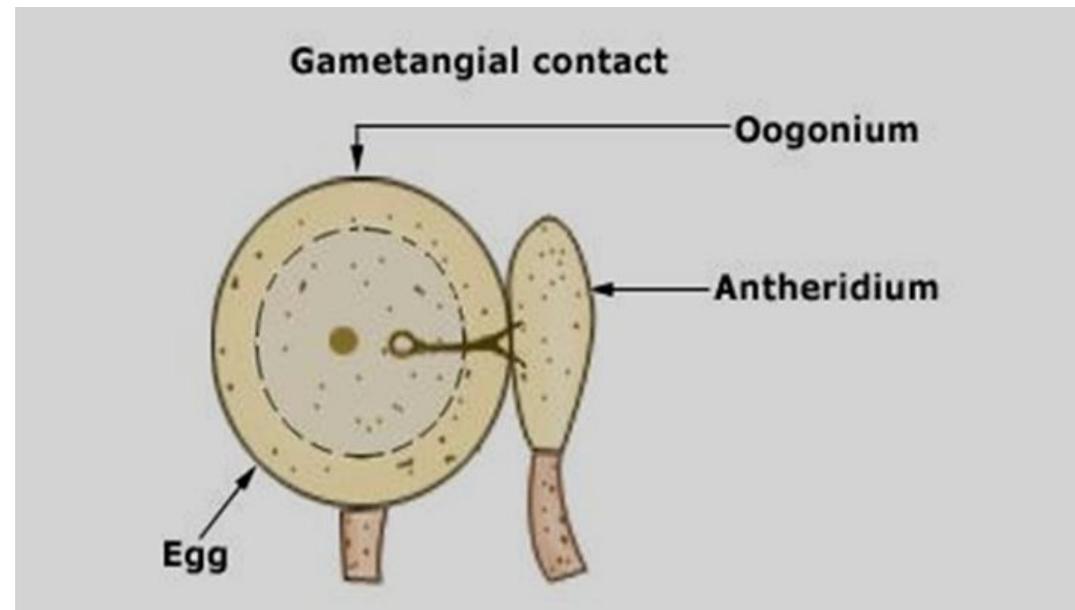
Ex. Members of primitive fungi, Synchytrium and Plasmodiophora



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

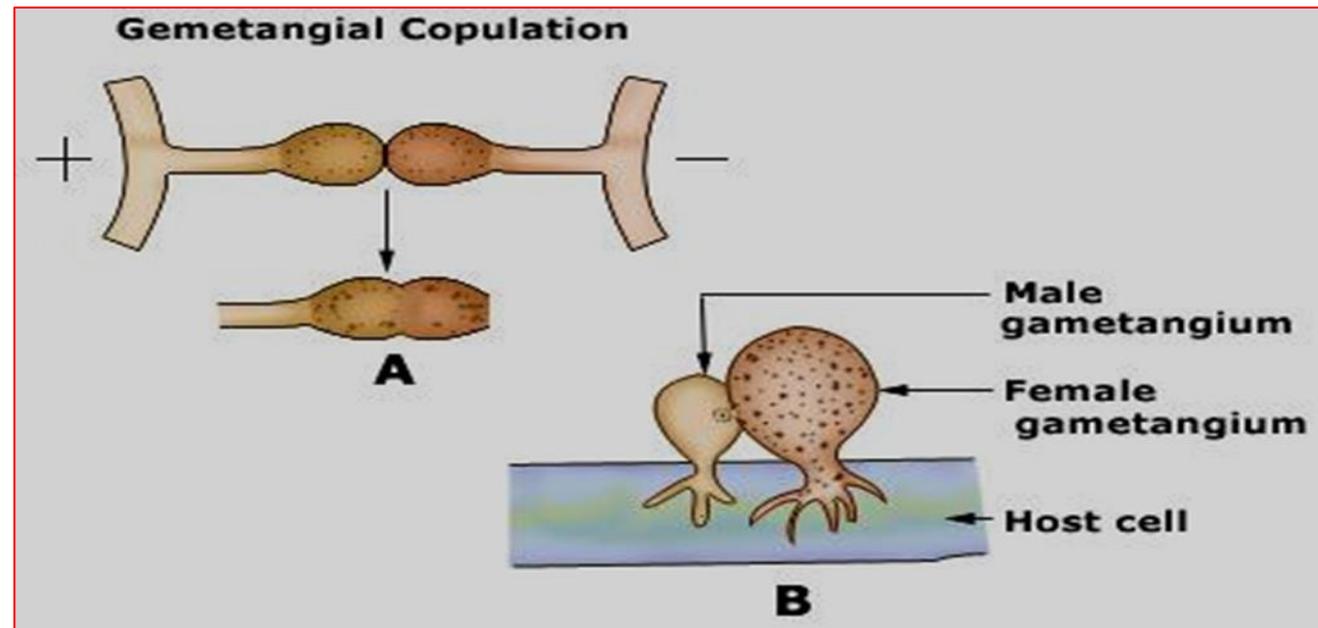
Ex. Pythium, Ascobolus



3. Gametangial Copulation

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

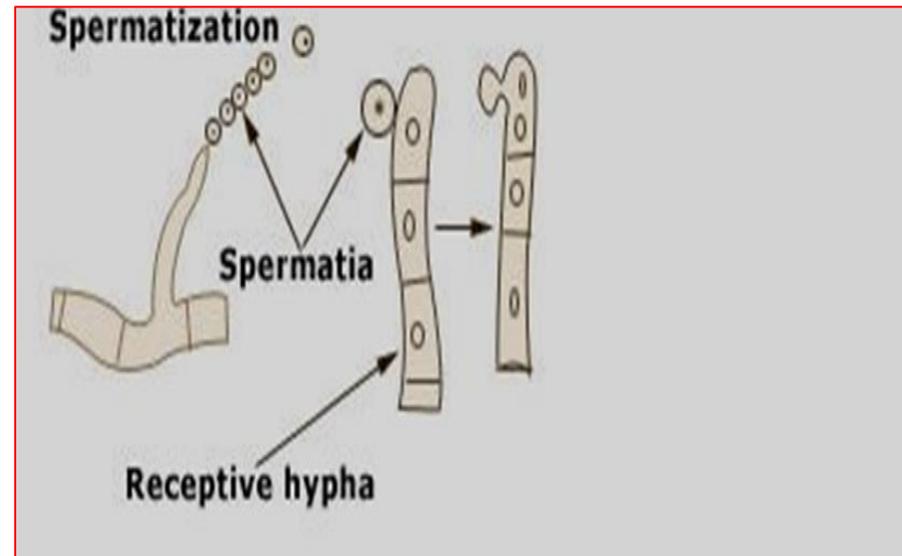
Ex. Mucor, Rhizopus, Entomophthora



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

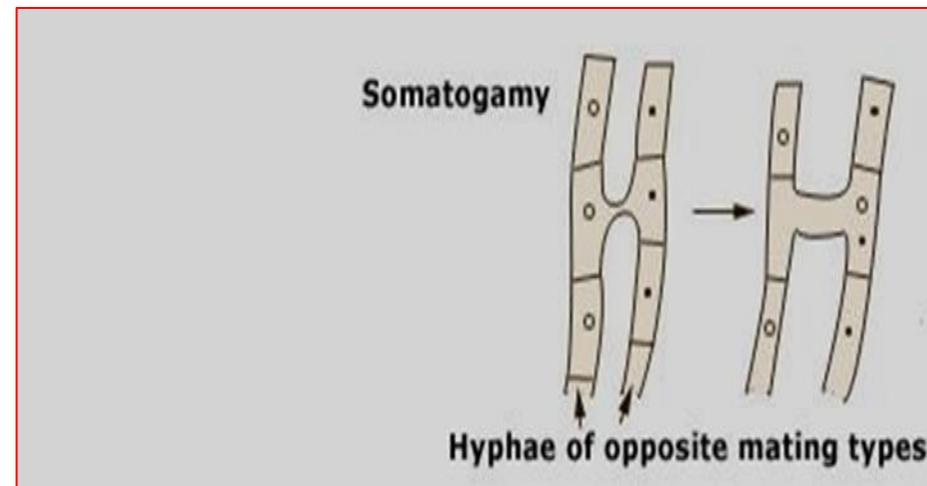
Ex. Rust and Smut fungi



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**

➤ **Zygospor**

➤ **Oospore**

➤ **Ascocarp containing Ascospores**

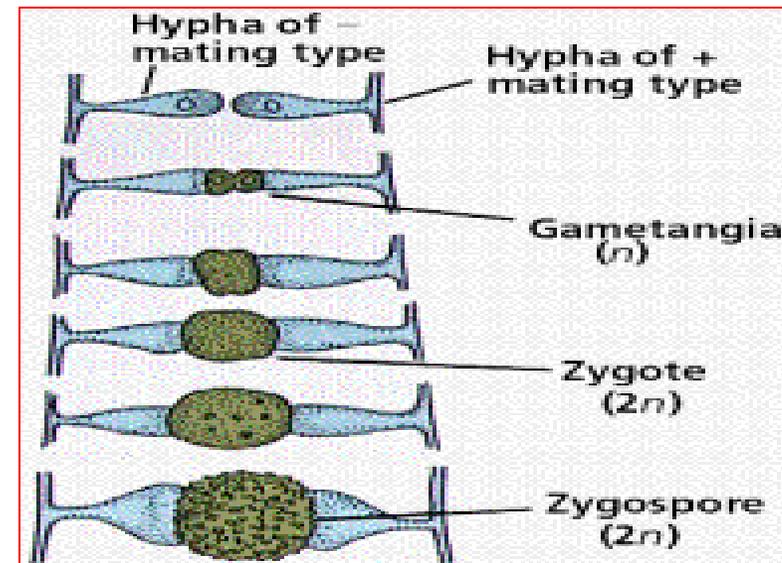
➤ **Basidiocarp containing Basidiospores**

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

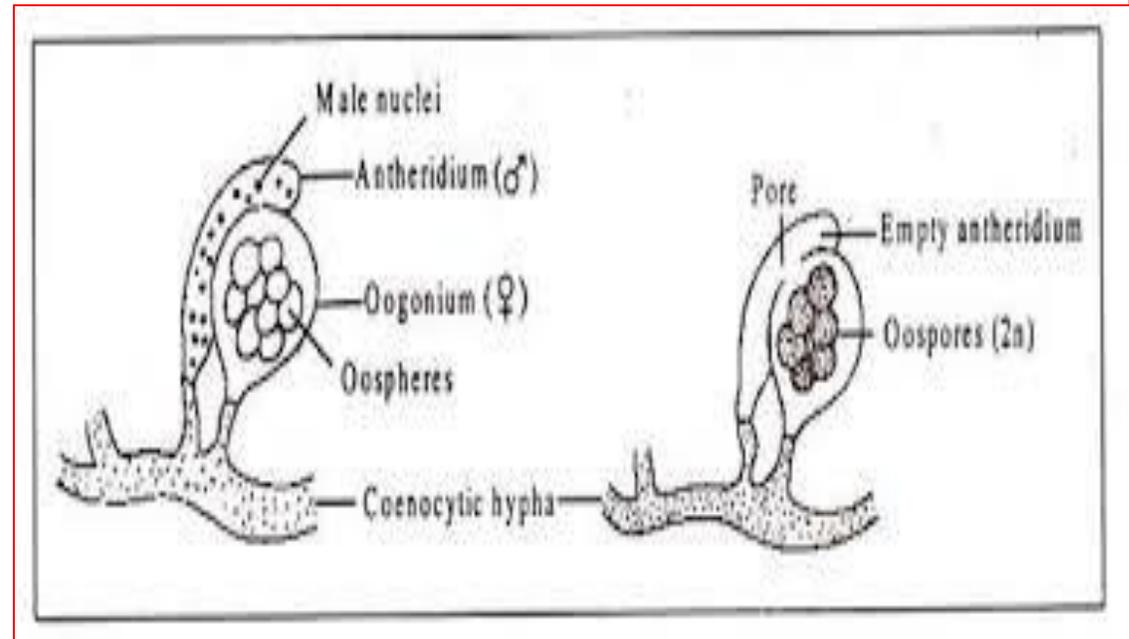
Ex. Rhizopus



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

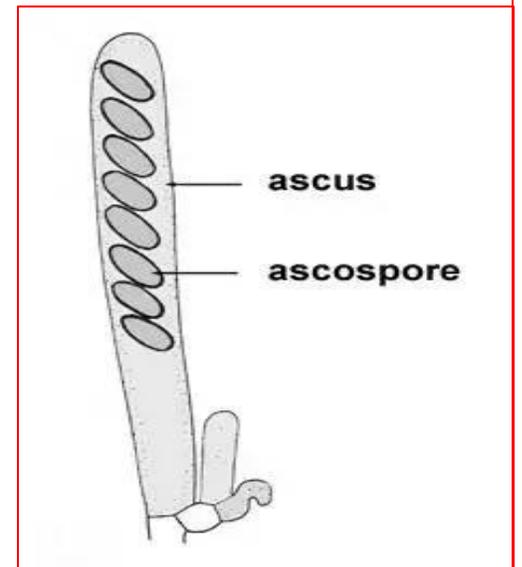
Ex. Pythium, Phytophthora



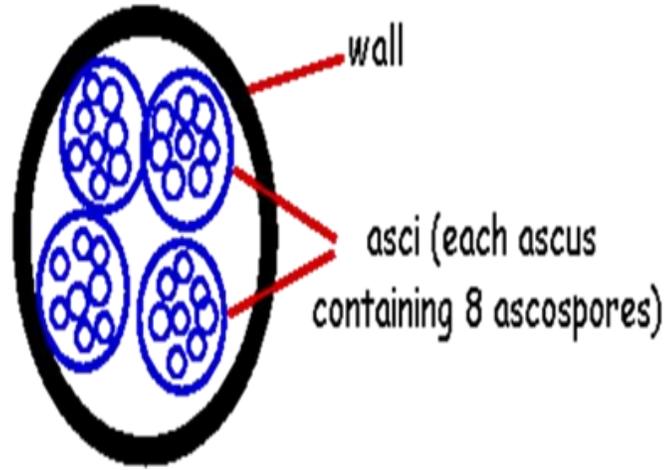
Ascospores in Ascus and Ascocarp

- ❖ 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

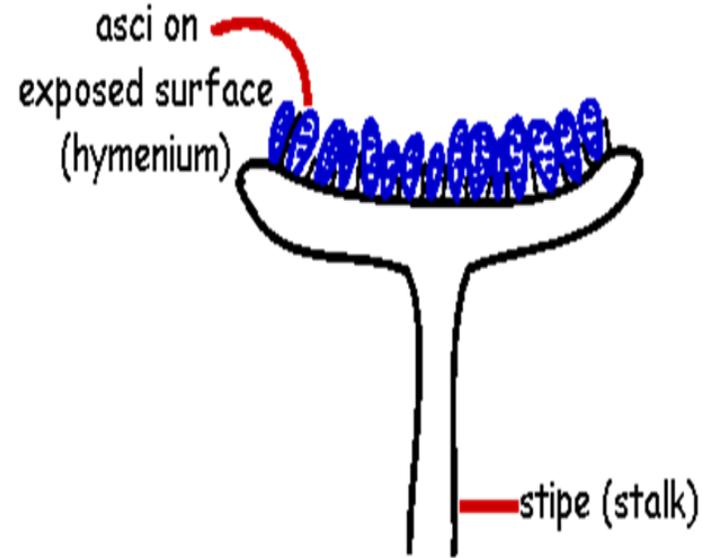
Ex. Penicillium, Aspergillus, Neurospora, Morel, Peziza



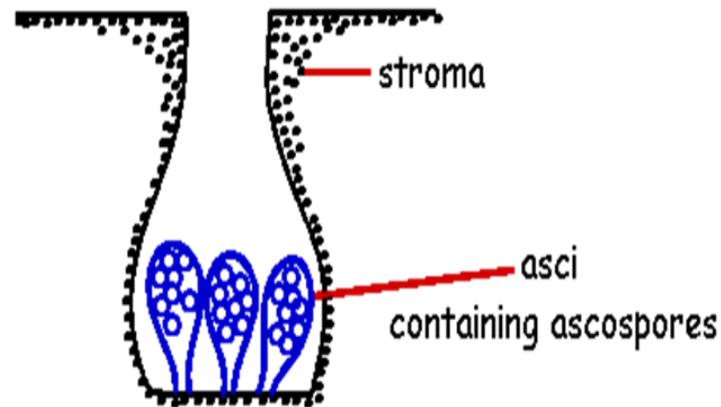
Types of Ascocarps



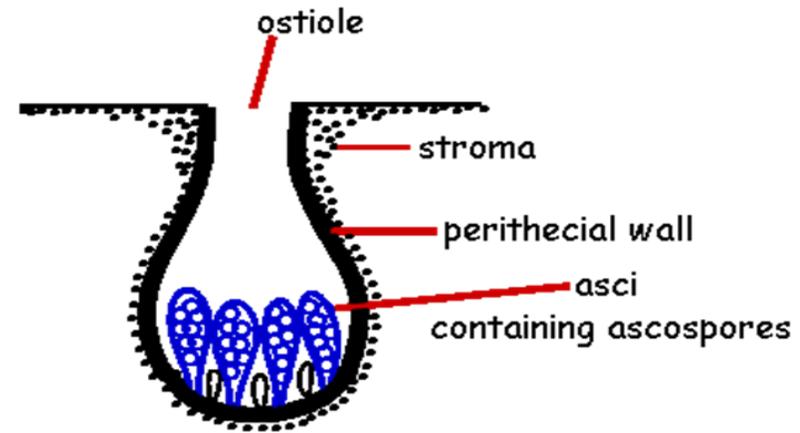
Clestothecium



Apothecium



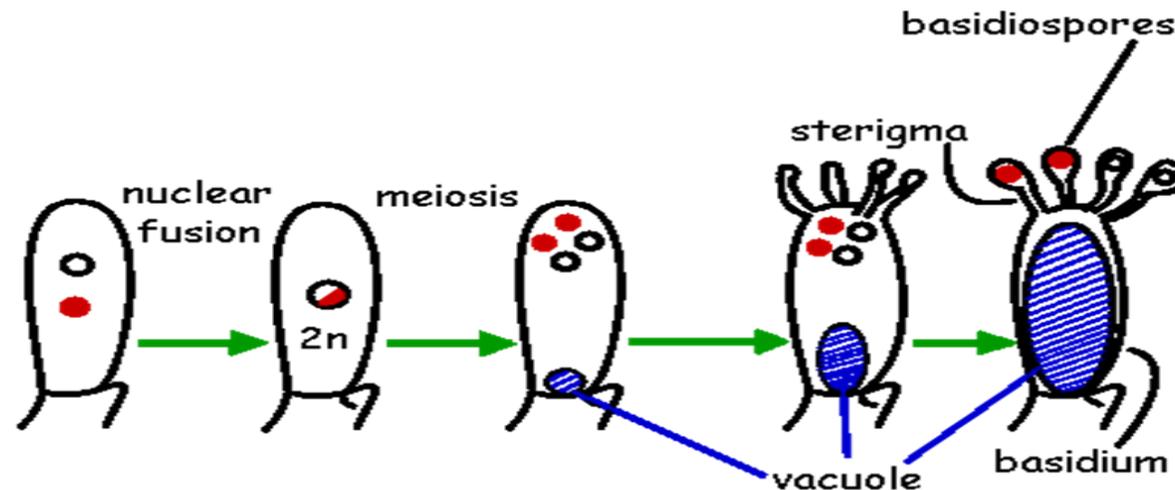
Perithecium



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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Thank You.....