

Mycology I

Lecture 20

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Introduction

- **Mycology** (*myco* = “fungus”, *logy*= Study)
- About 75,000 species are formally described, but up to 6 million may exist.
- Fungi are the most widely distributed organism on the globe.
- **Examples of the common Fungi**

- Yeast
- Mushrooms
- Molds
- Truffles



- Fungi are important **sources** of antibiotics (e.g., penicillin. *Penicillium chrysogenum*) and immunosuppressant drugs.

Mycology terms

❖ Mycology

✓ Study of fungi

❖ Mycologists

✓ Scientists who study fungi

❖ Mycotoxicology

✓ Study of fungal toxins and their effects

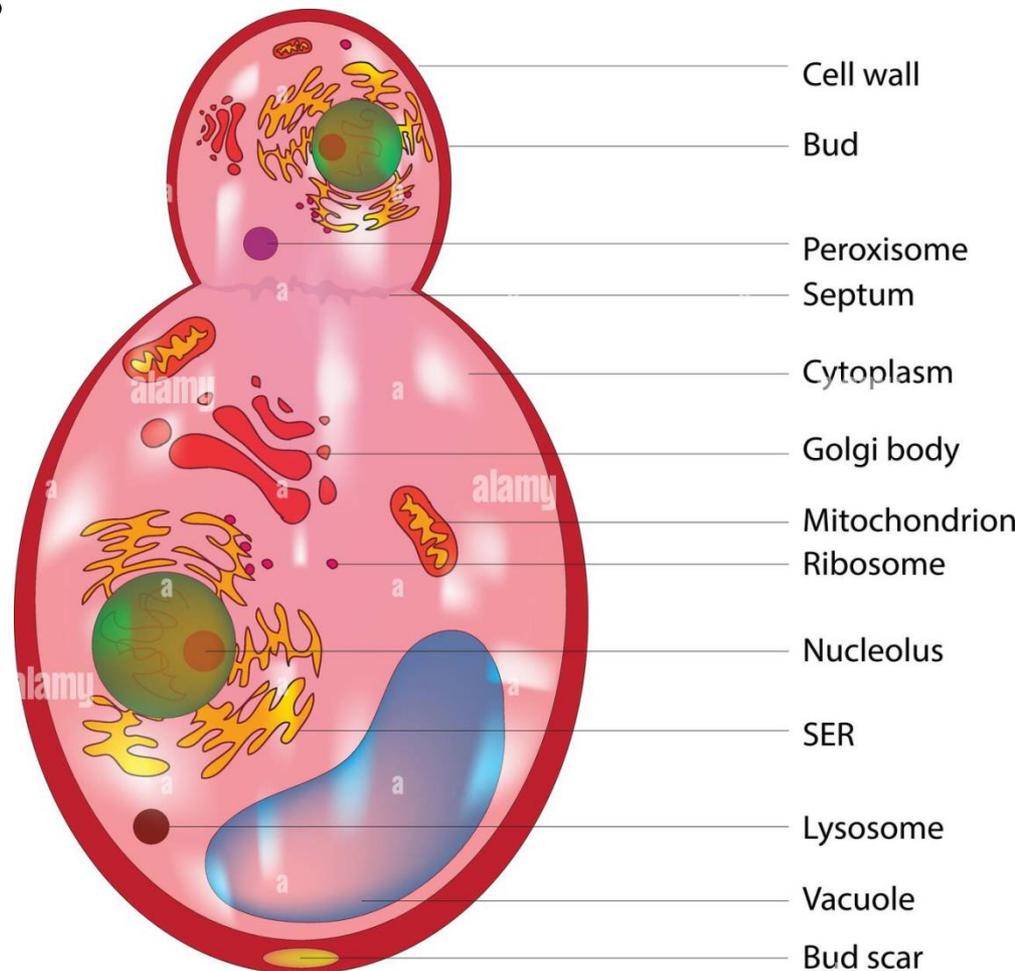
❖ Mycoses

✓ Diseases caused by fungi

General features of Fungi

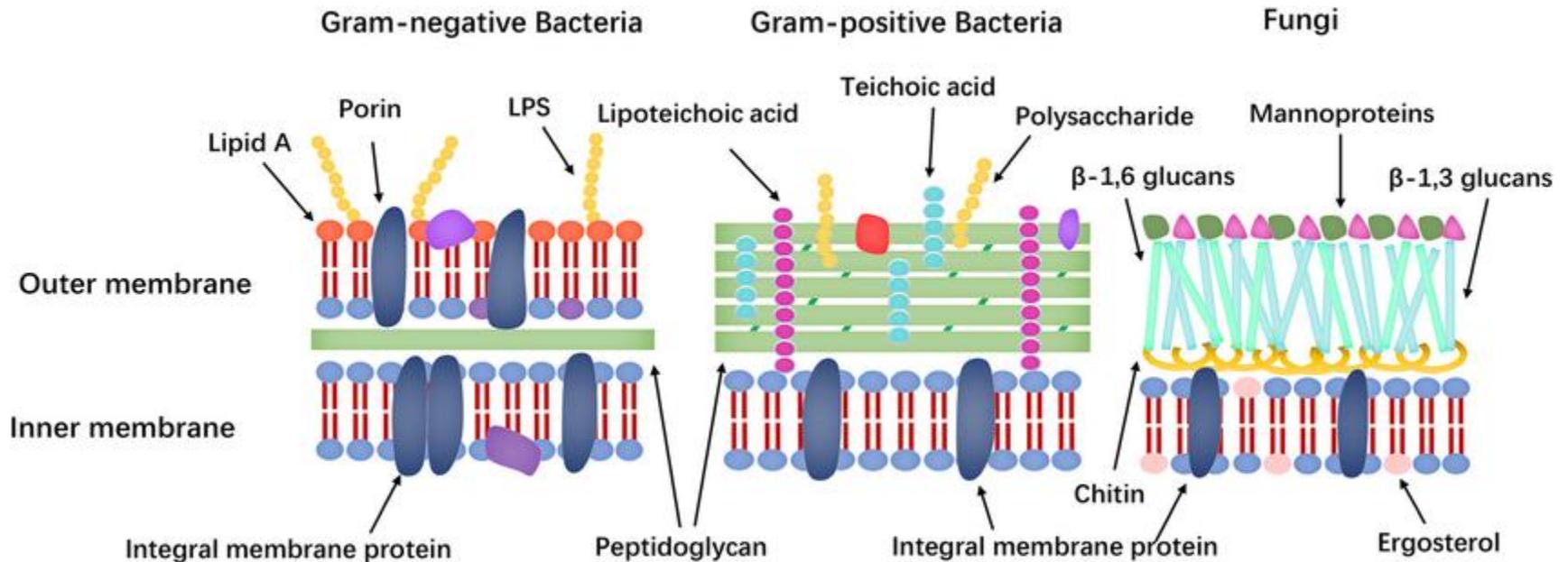
1. Eukaryotic (True nucleus, Nuclear membrane)

- Membrane bound organelles

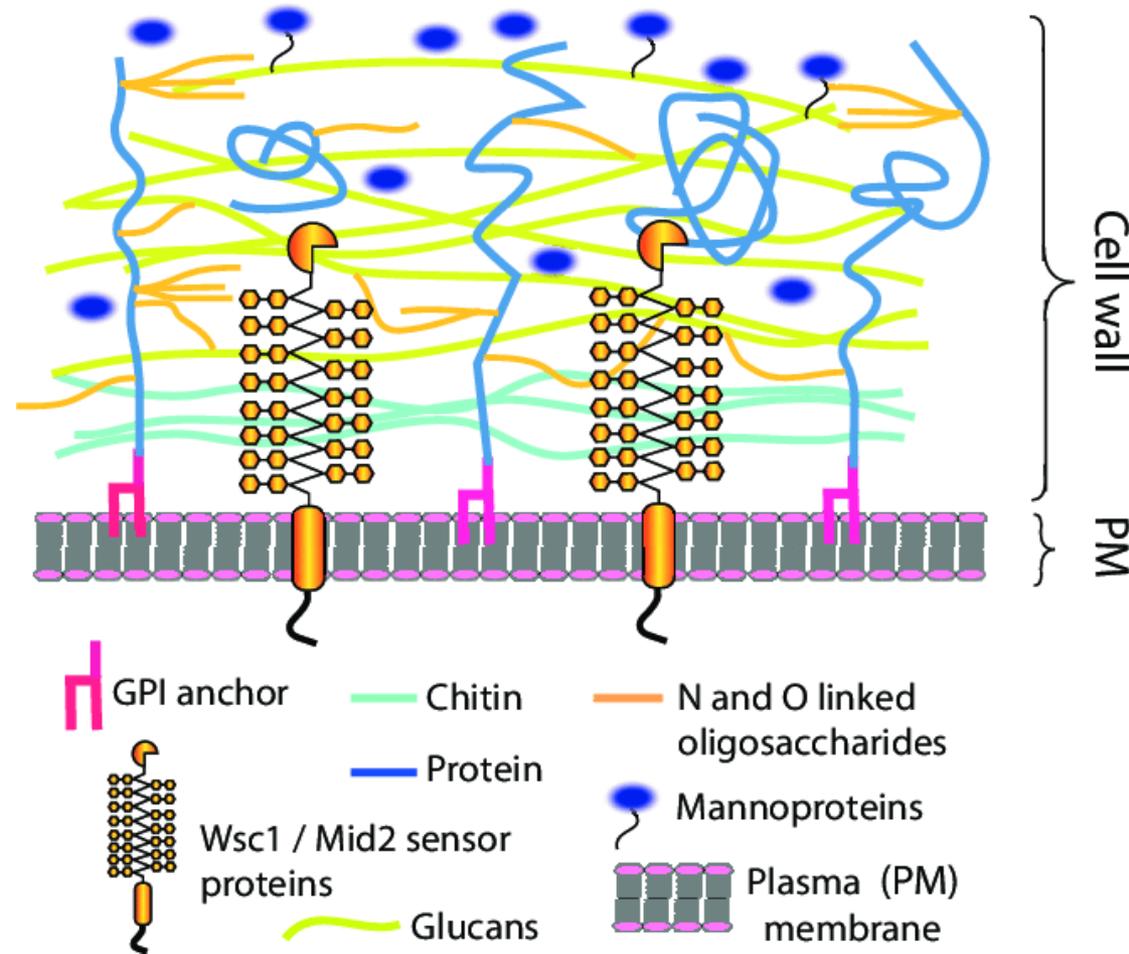


General features of Fungi

2. Rigid Cell wall (Chitin)+ Mannan+ Glucan



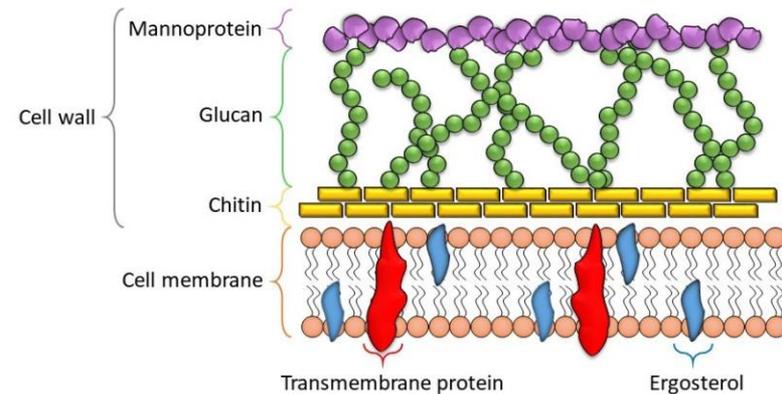
- **Chitin** is a polysaccharide found in fungal cell walls, similar to its role in arthropod exoskeletons.
- It is a long-chain polymer of **N-acetylglucosamine** that helps maintain cell shape and integrity, often embedded with other components like glucans.



General features of Fungi

3. Cytoplasmic membrane (**Ergosterol**)

4. Chemo -Organo –Heterotrophic (Lacking the chlorophyll),
Saprophytes, *Secrete extracellular Enz.*



Extracellular Enzymes

- Fungi secrete extracellular enzymes to break down complex organic matter (like cellulose, lignin, chitin, and proteins) into smaller, absorbable molecules for nutrition and ecosystem nutrient cycling.
- **Carbohydrases**: Cellulases, pectinases, chitinases , β -glucosidase).
- **Ligninolytic Enzymes**: Lignin peroxidases, manganese peroxidases, laccases (for breaking down lignin).
- **Proteases**: (for protein degradation).
- **Lipases**: (for lipid breakdown).
- **Phosphatases**: Acid phosphatases (for phosphate acquisition).

General features of Fungi

5. No obligate anaerobes (Aerobically)

- Most fungi are **obligate aerobes** (requiring oxygen for survival).
- Some are **facultative anaerobes** (able to grow with or without oxygen),
- It was once believed that no fungi were obligate anaerobes.

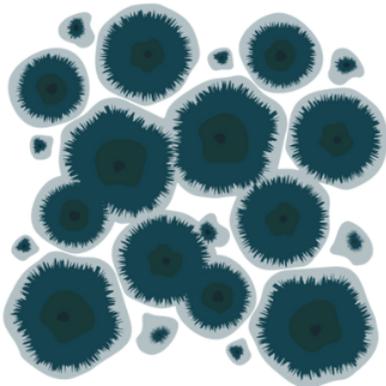
General features of Fungi

6. Some fungi grow as **Multicellular called Hyphae** plural, **Hypha** singular **(Molds)**

(Branching growth), others are **single-celled (yeasts)**

Molds

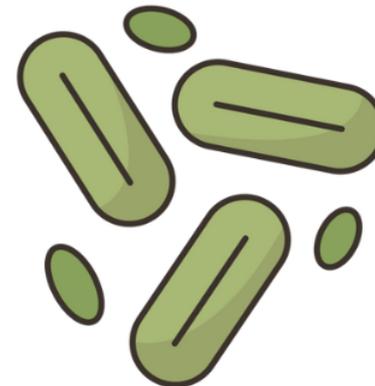
Molds are multicellular fungi that form visible structures



Vs

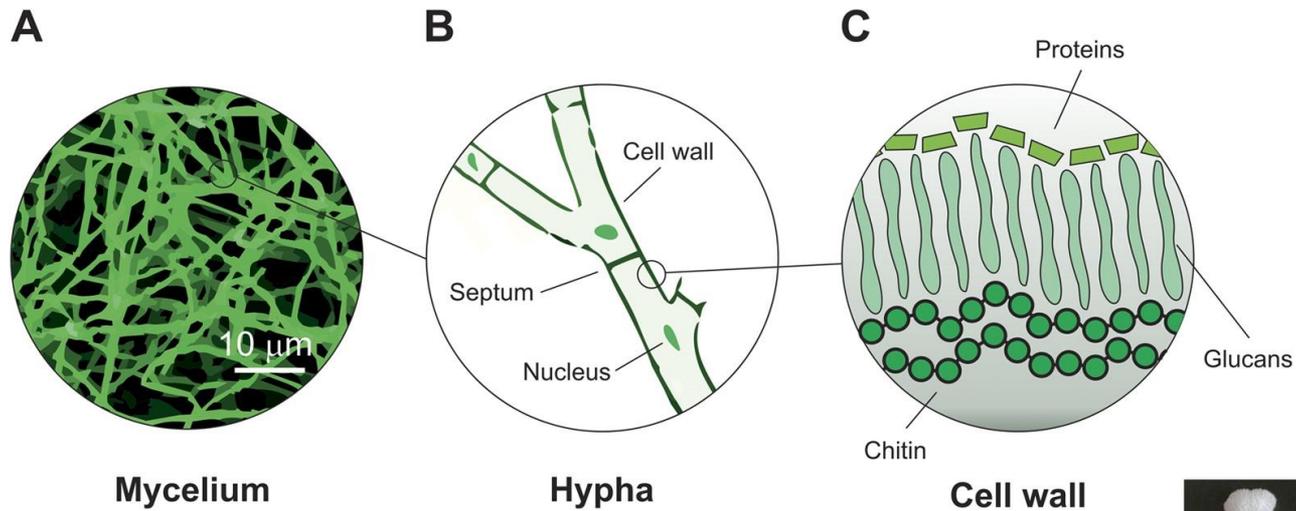
Yeasts

Yeasts are unicellular fungi that do not form visible structures

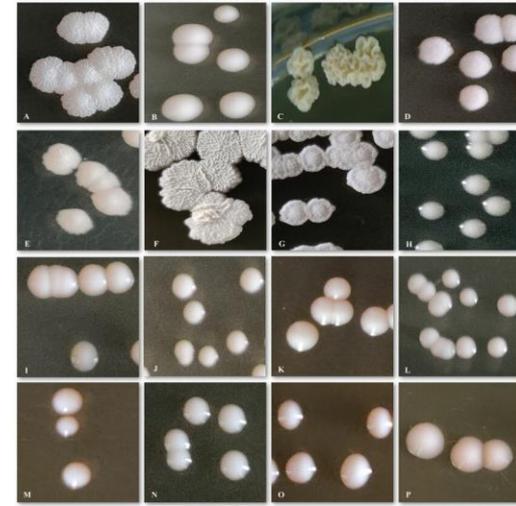


General features of Fungi

7. A mass of interwoven hyphae is called a **mycelium**



8. Unicellular (Yeast) Produce colonies



General features of Fungi

9. Some fungi have fluorescent (Microsporium)



Tinea capitis caused by *Microsporium canis*, with blue-greenish

10. Store food as glycogen like animal cells

Fungal Anti-agents

- **Polyenes**

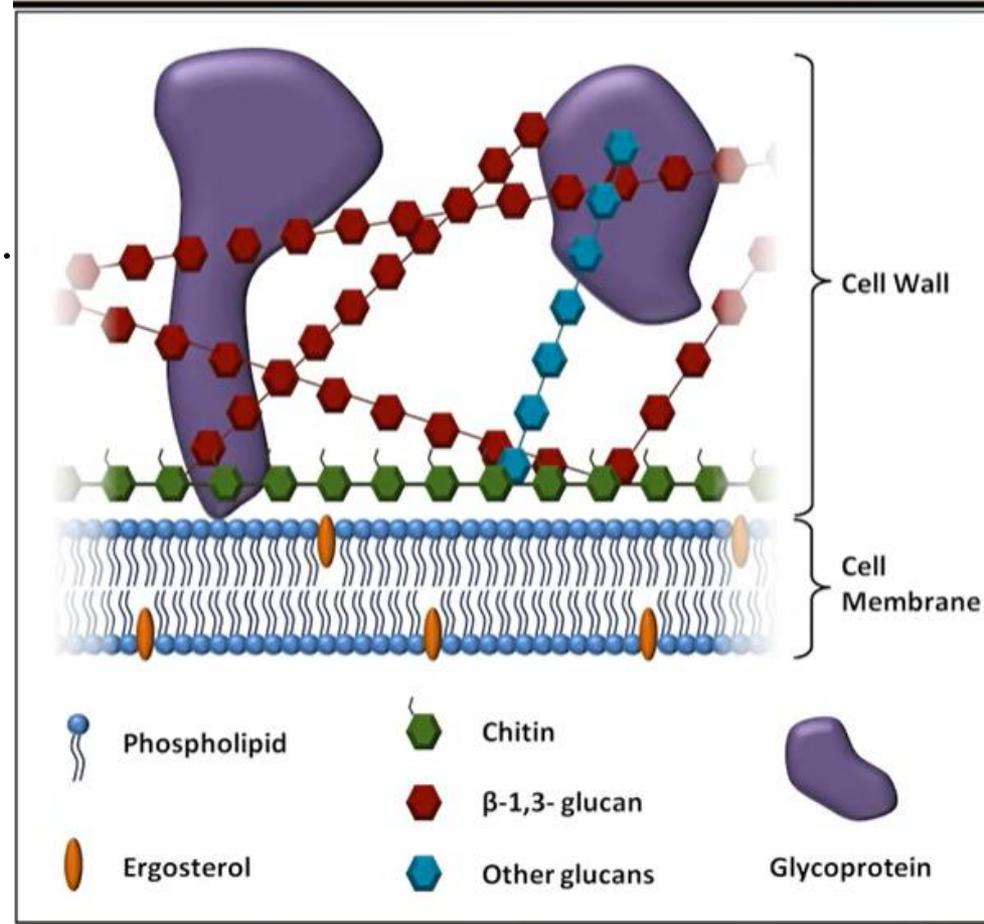
- Cell membrane inhibitors
- Derived from *Streptomyces* bacteria
- Binds to ergosterol and causes pores to develop in cell membrane.
- Inhibit Enzyme **14 alpha demethylase**.

- **Azole**

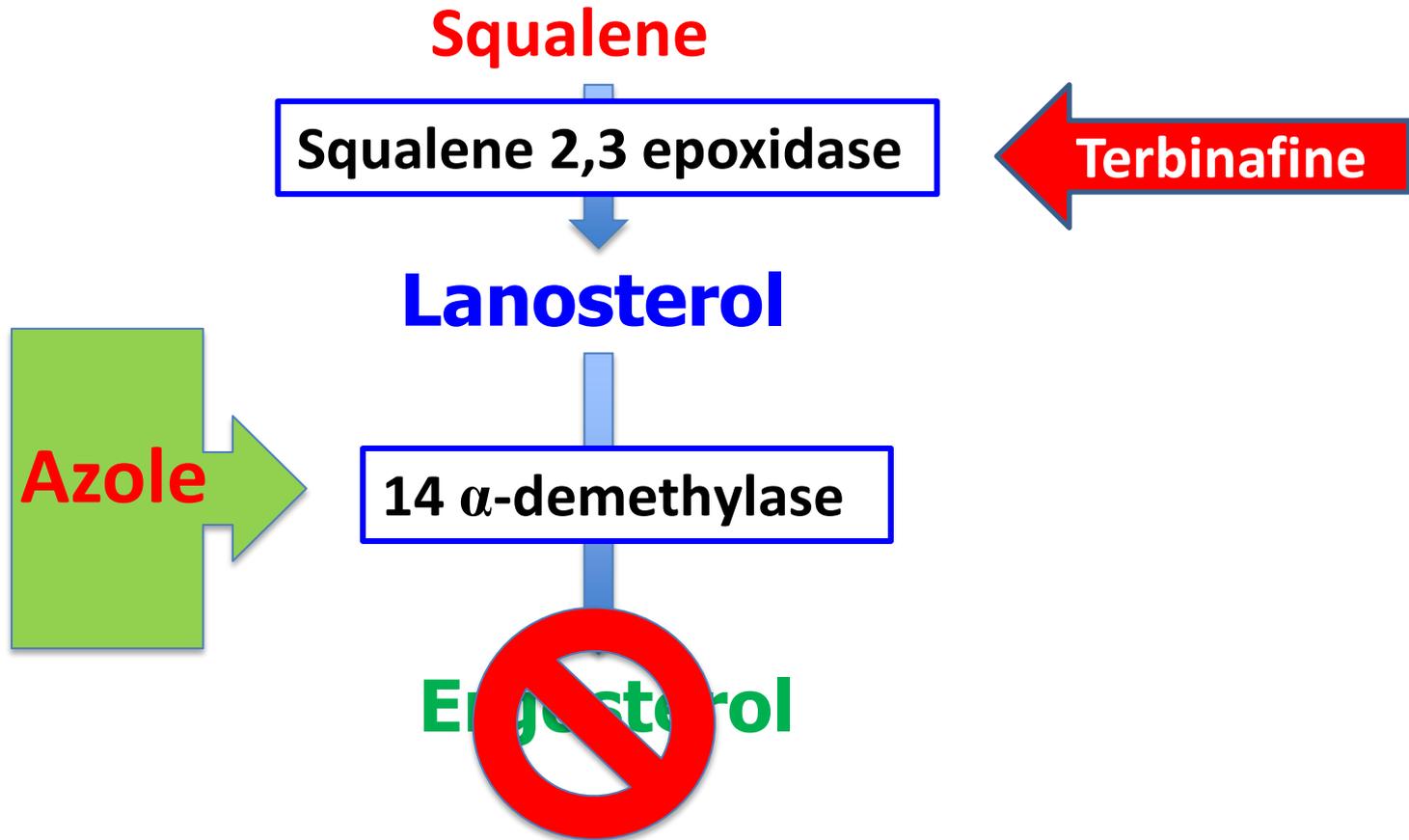
- Cell membrane inhibitors
- Inhibit Enzyme **14 alpha demethylase**.
Led to inhibit ergosterol synthesis

- **Echinocandins**

- Cell wall inhibitors
- Inhibit Enzyme **β 1,3 D- glucan synthase**

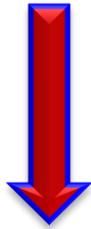


Prevent ergosterol formation - Azoles

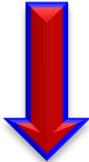


Prevent ergosterol formation- Polyenes

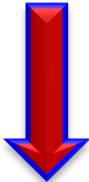
Amphotericin B/ Nystatin



Binds to ergosterol

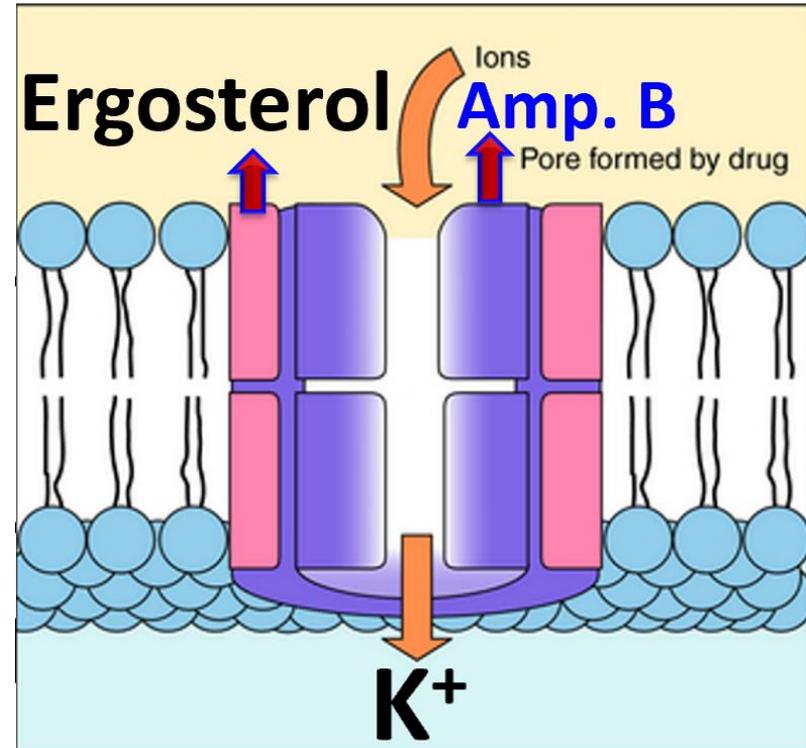


Pores formation



Ions leakage (K^+)

Cell death



Fungicidal



Local

Nystatin



Inhibition of nucleic acid

- Flucytosine

- Enters fungal cells via **cytosine permease**. enzymes absent in mammalian cells.

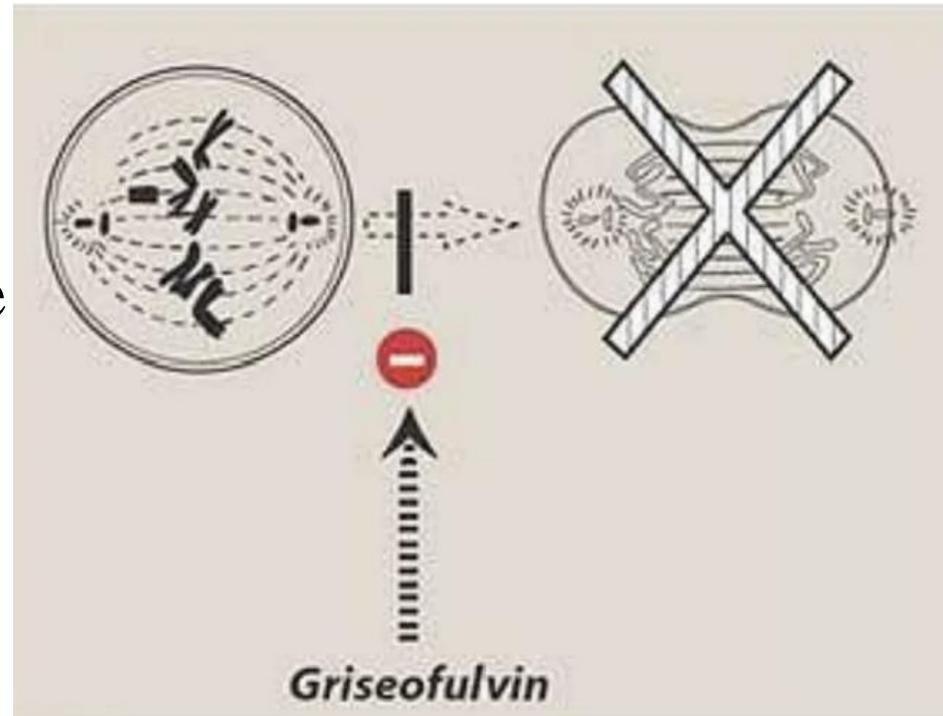
- **Fungal cytosine deaminase** converts flucytosine to 5-fluorouracil (5-FU).

- 5-FU disrupts **RNA Synthesis**. or

- Converted to **fluorodeoxyuridylic acid**, which inhibits **thymidylate synthase** (**DNA synthesis**).

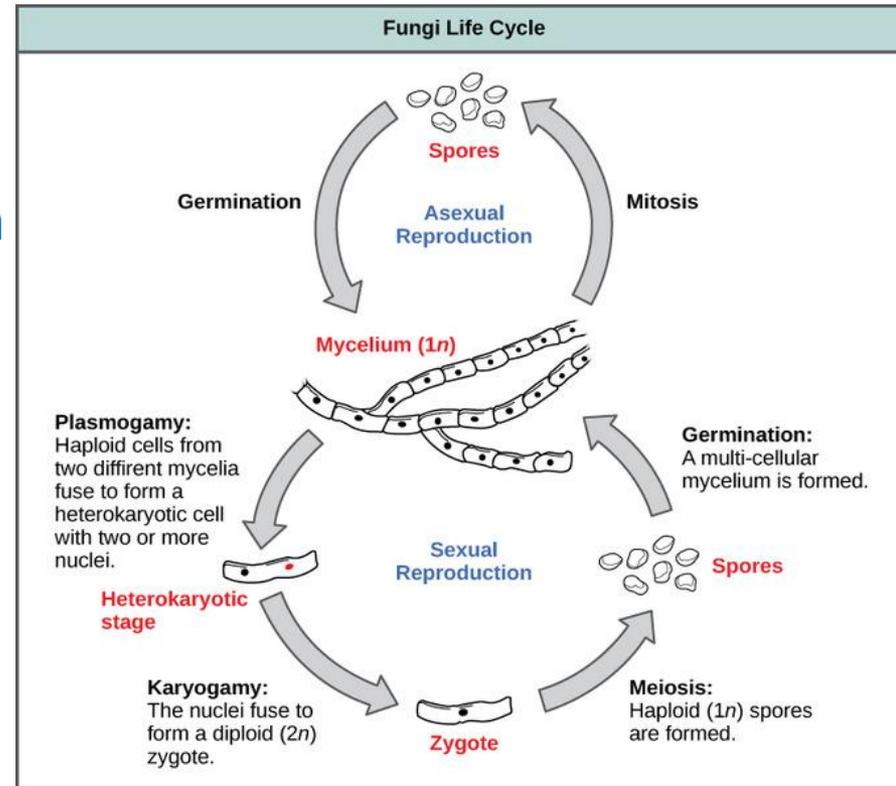
Inhibition of Cell division (Griseofulvin)

- Inhibit mitosis
- Hepatotoxicity
- Disrupting mitotic spindle formation (**microtubule**), arresting cell division (mitosis), and inhibiting fungal growth.
- Acting as a **fungistatic** agent.



Reproduction

- Fungi reproduce:
 - ✓ Sexually by meiosis (fusion)
 - ✓ Asexually by mitosis. No fusion



- Perfect fungi reproduce both sexually and asexually, while imperfect fungi reproduce only asexually (by mitosis)
- In both sexual and asexual reproduction, fungi produce spores that disperse from the parent organism by either floating on the wind or hitching a ride on an animal.

Sexually by meiosis (fusion)

- **Two mating types are produced.**
- **Homothallic:** When both mating types are present in the same mycelium.
- **Heterothallic:** Mycelia require two different, but compatible, mycelia to reproduce sexually.
- **Three stages:**
 - ✓ **Plasmogamy:** fusion of protoplasm, leading to a **dikaryotic stage** where two haploid nuclei coexist in a single cell.
 - ✓ **Karyogamy:** fusion of nucleus.
 - ✓ **Meiosis:** reductional nuclear division, takes place in the gametangia (**singular, gametangium**) organs, in which gametes of different mating types are generated.
- At this stage, spores are disseminated into the environment.

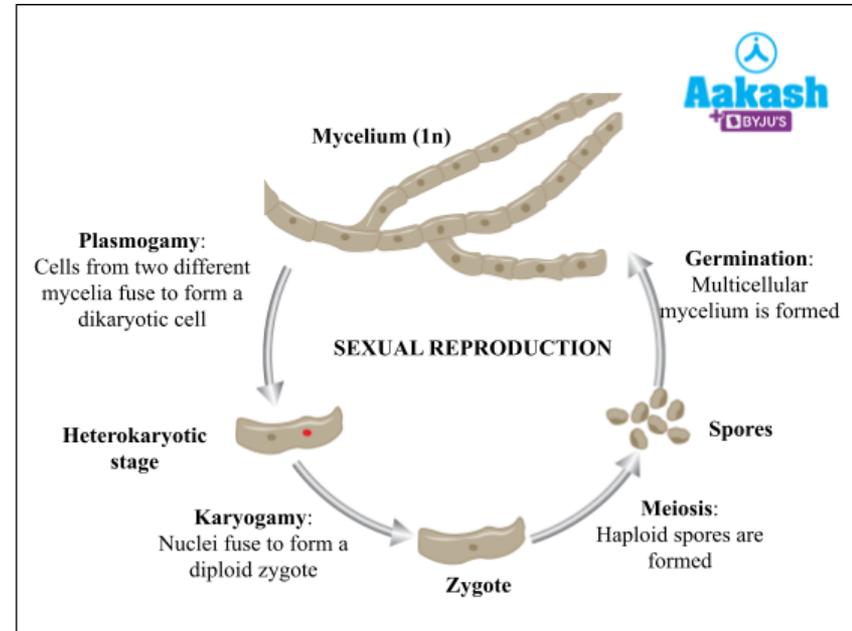


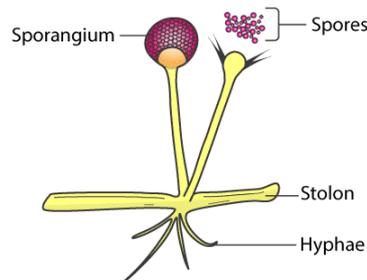
Fig: Sexual reproduction in fungi

1. Zygosporangia
2. Ascospores
3. Basidiospores (mushrooms).

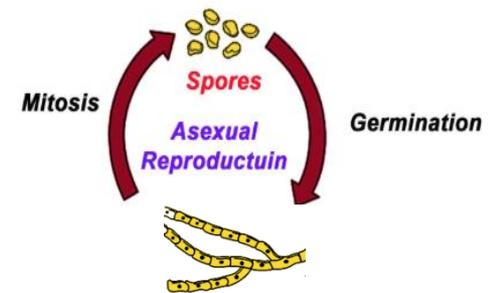
Asexually by mitosis. No fusion

- **Asexual reproduction in fungi:**
 - ❖ **Binary fission**, a mature cell elongates and its nucleus divides into two daughter nuclei.
 - ❖ **Budding** (yeast).
 - ❖ **Fragmentation or disjoining of hyphae.**
 - ❖ **Asexual spore formation**(conidia, sporangiospores)
- Identical division to the parent cell, creating genetically identical offspring.
- Mitosis allows for rapid propagation and colonization of new environments.

STRUCTURE OF KINGDOM FUNGI

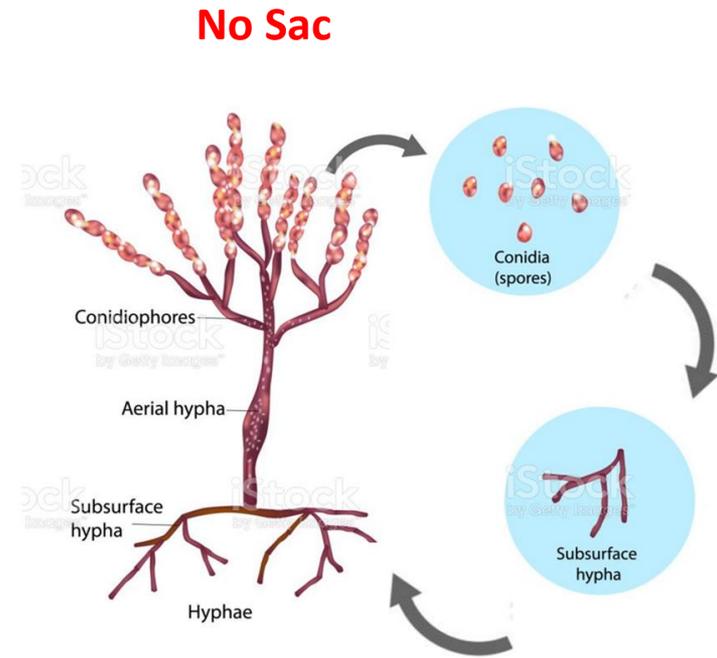


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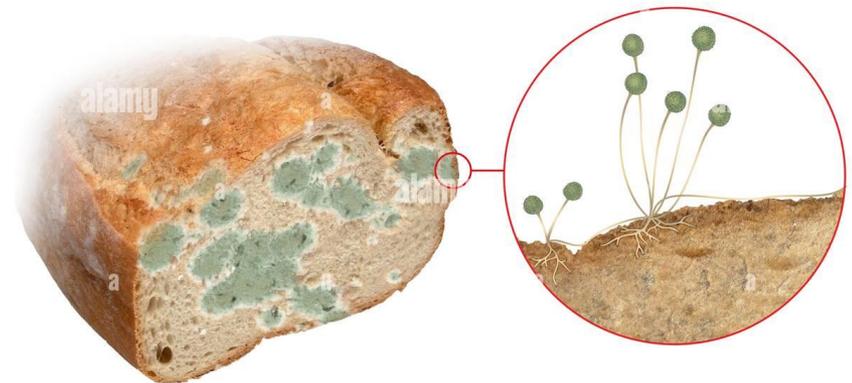


Molds

- Molds reproduction by **conidia** (spores) (Asexual)
- **Conidia** (It is an asexual spore produced on a conidiophore for certain fungi).
- Molds composed of long, tangled, branching filaments that form visible colonies.
- Each individual filament is called a **hypha** (plural: hyphae).
- As hyphae grow and branch, they form a mass known as a **mycelium** (plural: mycelia).
- Most hyphae in the mycelium remain embedded in soil or the nutrient medium and are not visible.
- Some hyphae grow **upward** as aerial hyphae, which bear reproductive structures such as mushrooms and produce spores.

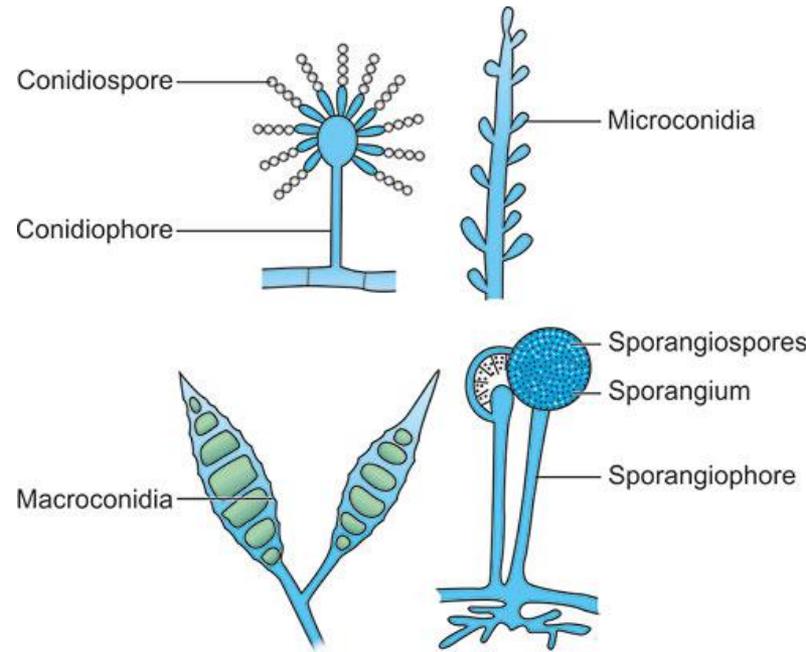


Reproduction



Reproduction

- **Conidia:** Are asexual, non-motile fungal spores (mitospores) produced via mitosis for dispersal, varying in size (**macro/micro**) and shape.
- **Macroconidia:** Larger, often multi-celled spores multi septate conidia, spindle or sickle-shaped.
- **Microconidia:** Smaller, simpler, usually single-celled (e.g., oval/spherical)

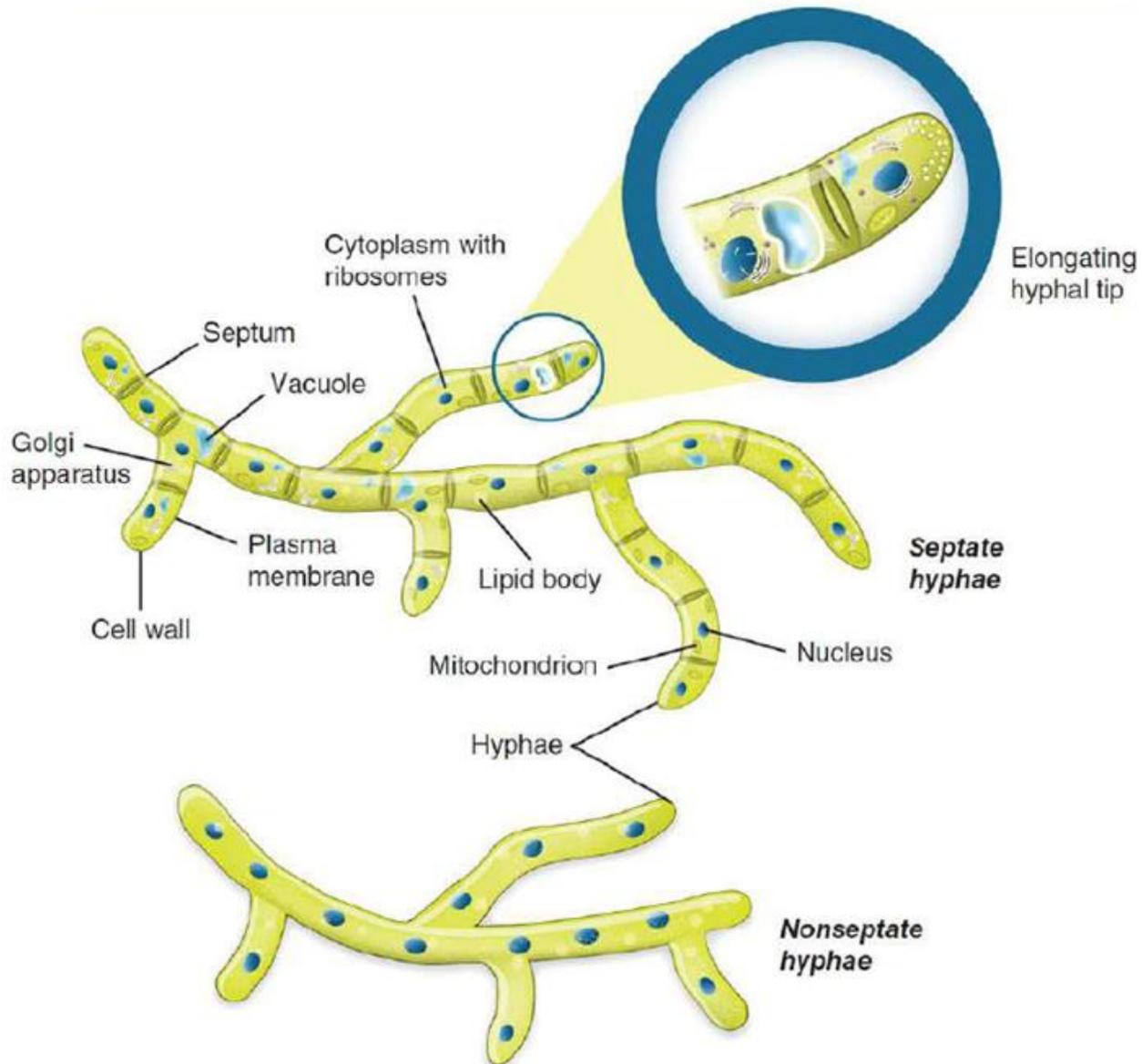


Reproduction

- Many fungal hyphae contain septa (cross walls) that divide the hypha into connected, cell-like compartments.
- Each septum has a pore, allowing cytoplasm to flow and mix between adjacent compartments.
- **Some molds lack septa entirely**; these are nonseptate hyphae.
- Nonseptate hyphae are **Coenocytic**, meaning they contain many nuclei within one continuous cytoplasm.
- This filamentous, multinucleated structure is unique to fungi and not found in other organisms.

B

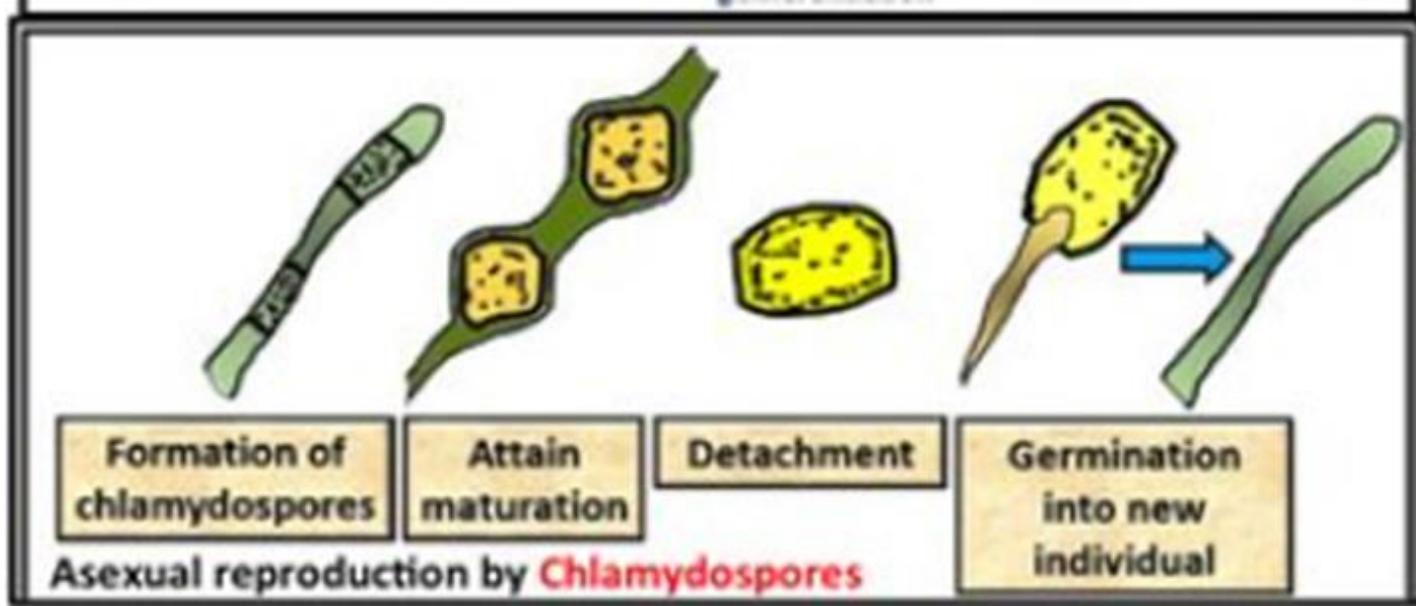
Molds have hyphae that are either septate or nonseptate. Septa compartmentalize hyphae into separate cells, although the septa have a pore through which cytoplasm and nuclei can move.



Reproduction

❖ Chlamydospore

- Is a thick-walled, asexual resting spore produced by fungi (like *Candida albicans*, *Histoplasma capsulatum*) and some algae for survival in harsh conditions.
- These enlarged vegetative cells develop a dense cytoplasm and a protective coat to withstand heat, dryness, or nutrient deprivation.



Candida albicans

