Third lecture
Fungi

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Mold Morphology

- Molds are multinucleated, filamentous fungi composed of hyphae. A hypha is a branching tubular structure approximately 2-10 µm in diameter which is usually divided into cell-like units by cross walls called septa.
- The total mass of hyphae is termed a mycelium. The portion of the mycelium that anchors the mold and absorbs nutrients is called the vegetative mycelium , composed of vegetative hyphae; the portion that produces asexual reproductive spores is the aerial mycelium , composed of aerial hyphae Molds have typical eukaryotic structures and have a cell wall usually composed of chitin, sometimes cellulose, and occasionally both.
- Furthermore, molds are obligate aerobes and grow by elongation at apical tips of their hyphae and thus are able to penetrate the surfaces on which they begin growing.

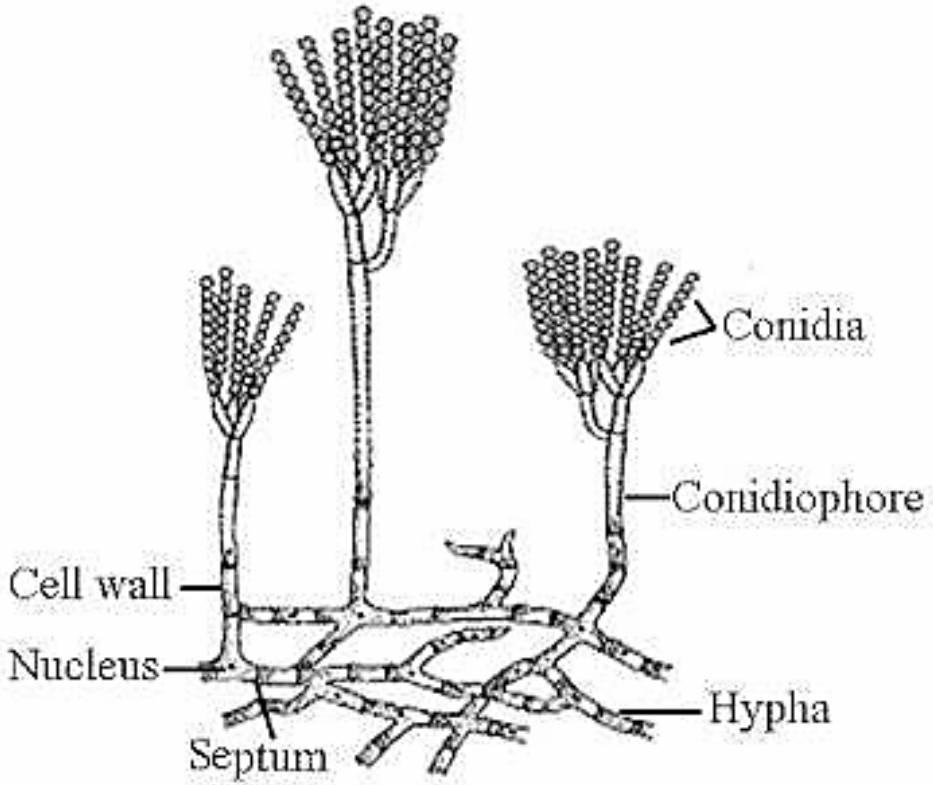
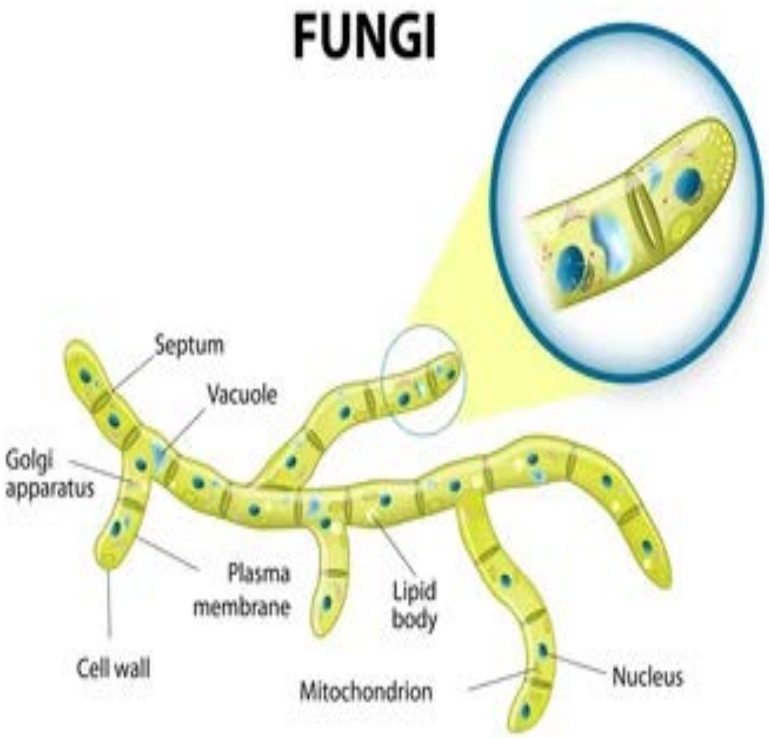


Fig: *Penicillium spp.* Mycellium showing hyphae and conidiophores bearing conidia.



filamentous fungi (composed of hyphae)

Taxonomy and classification of fungi (Mold)

- Kingdom Fungi

– Phylum Chytridiomycota , like *Batrachochytrium*

– Phylum Mucoromycota (formerly Zygomycota)Like:

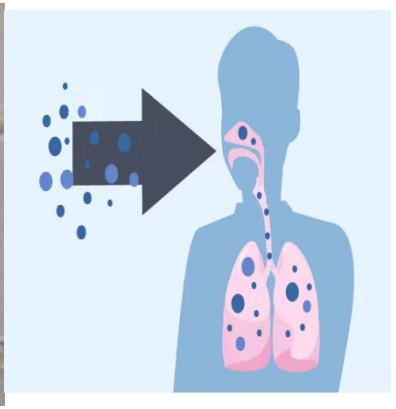
Mucor spp.

– Phylum Ascomycota, Like *Aspergillus*

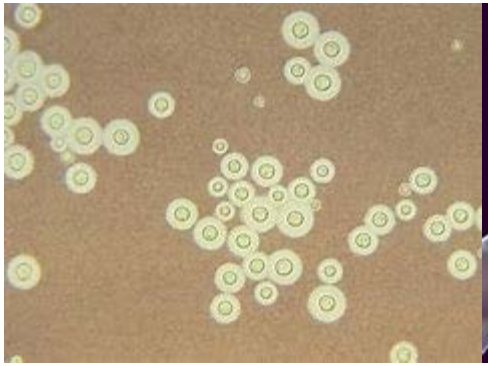
– Phylum Basidiomycota, Like *Cryptococcus*

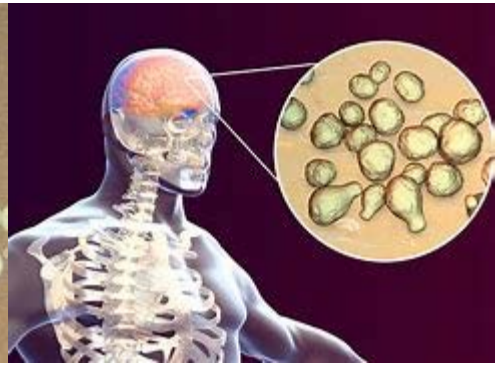
*contains species pathogenic to humans

Batrachochytrium



Mucor circinelloides





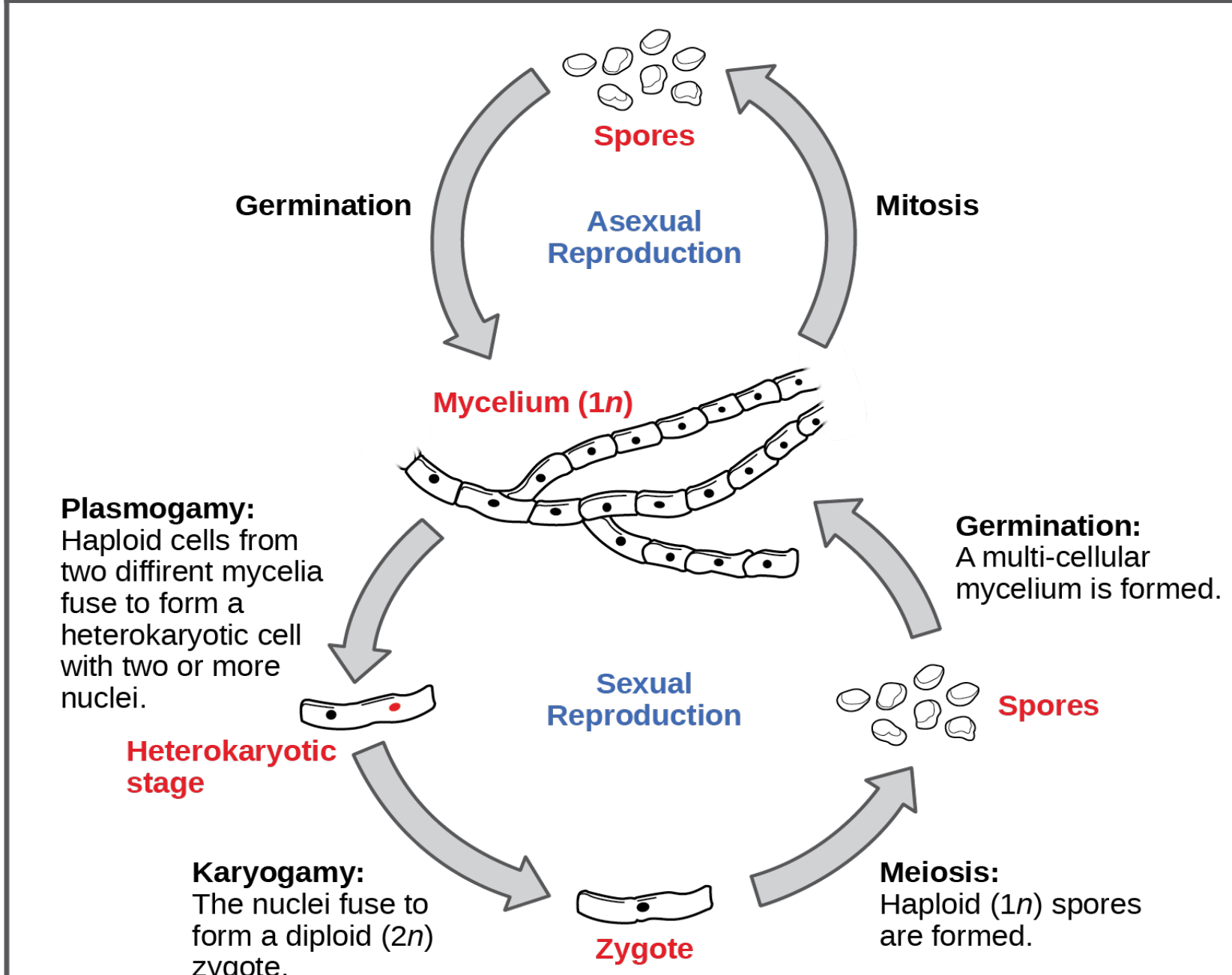
cryptococcus neoformans

Aspergillus Aspergillosis

Naming fungi

- A mold producing conidia by asexual reproduction is known as the anamorph state
- Many fungi produce spores as a result of sexual reproduction (involving meiosis)
- A mold producing spores by sexual reproduction is know as the teleomorph state
- Sexual reproduction and its accompanying structures have generally formed the main basis for the classification of the fungi

Fungi Life Cycle



Fungal terminology

- Databases (like NCBI) tend to use the teleomorph name Textbooks tend to use the anamorph name or the one most familiar to clinicians
- Proposes that for pathogenic fungi that have both an anamorph and a teleomorph name, the anamorph name be used if it is most familiar to clinicians.
- Includes *Aspergillus, Scedosporium, Scopulariopsis* and a few others
- The teleomorph name can be provided in a comment if desired .

- Example: *Aspergillus* in anamorph; *Eurotium* in teleomorph

Reproduction of Molds

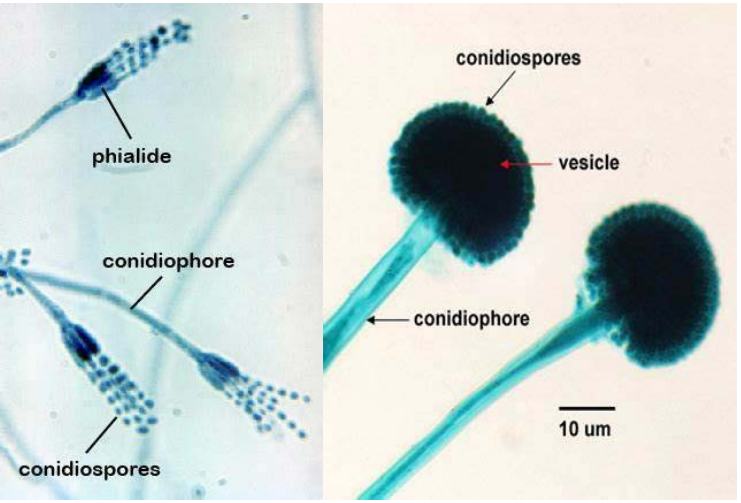
1. Molds reproduce primarily by means of asexual reproductive spores . These include the following:

a. conidiospores (conidia)
Spores borne externally on an aerial hypha called a conidiophore of the conidiospores of *Penicillium* and of *Aspergillus*.

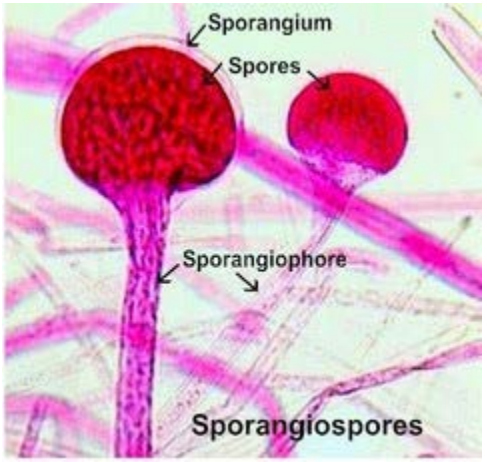
b. sporangiospores
Spores borne in a sac or sporangium on an aerial hypha called a sporangiophore of the sporangiospore of *Rhizopus*.

c. Arthrospores

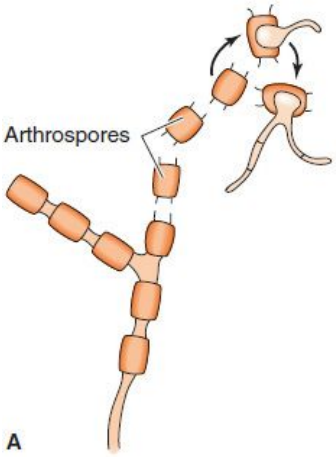
Arthrospores are derived from fragmentation of an existing hyphal cell. Liberated after fission of cells or lysis of separating cells spores produced by fragmentation of a vegetative hypha, like *Coccidioides* .

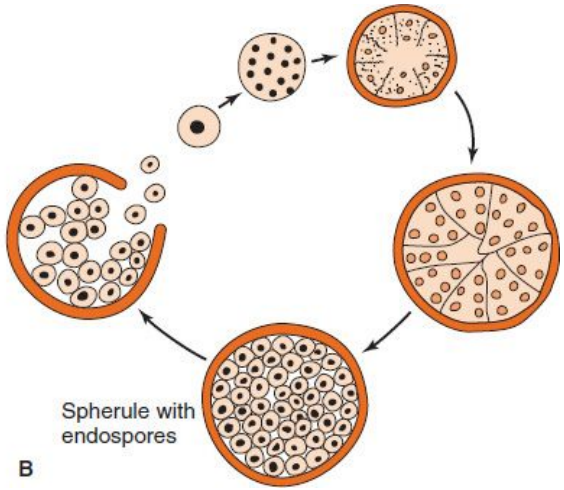


The conidiospores of *Penicillium* and of *Aspergillus*



sporangiospore of *Rhizopus*





arthrospores

Pathogenic Molds

1- Opportunistic Molds

- **Certain molds once considered as non-pathogenic have recently become a impartially common cause of opportunistic lung and wound infections in the weakened or immunosuppressed host. These include the common molds *Aspergillus* and *Rhizopus***
- **Although generally harmless in most healthy individuals, *Aspergillus* species do cause allergic bronchopulmonary aspergillosis (ABPA), chronic necrotizing *Aspergillus* pneumonia (or chronic necrotizing pulmonary aspergillosis (CNPA).**

- **Mucormycoses are infections caused by fungi belonging to the order of Mucorales.**
- ***Rhizopus* species are the most common causative organisms. The most common infection is a severe infection of the facial sinuses, which may extend into the brain. Other mycoses include pulmonary, cutaneous, and gastrointestinal.**

MOLD DISEASES

- MDs other than aspergillosis and mucormycosis are hyalohyphomycosis and phaeohyphomycosis. In the past, the term "zygomycosis" was commonly used; however, the term "mucormycosis" is mainly used concurrently because the genera in the order Mucorales cause most cases of human infection .
- Molds can be broadly divided into two morphologically distinct groups: those that produce septate hyphae and those that produce aseptate hyphae.
- Identification of aseptate hyphae in tissue is virtually pathognomonic of zygomycosis (mucormycosis). The discovery of septate hyphae in tissue is less diagnostic as septate hyphae may be caused by a vast number of species of molds.
- Septate molds are usually divided into those with pale or colorless (hyaline) hyphae (hyalohyphomycetes) and those with darkly pigmented hyphae (phaeohyphomycetes)

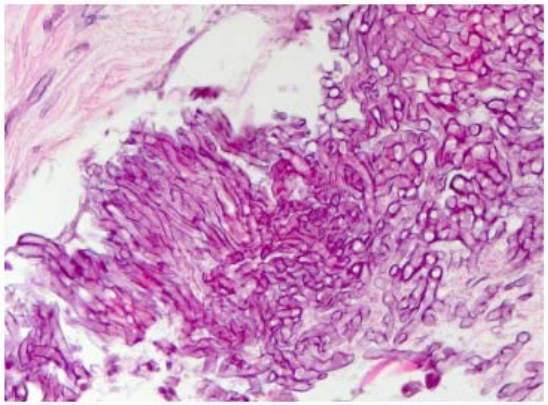
• Hyalohyphomycosis

Hyalohyphomycosis is caused by hyaline fungi (Hyphomycetes) that form septate hyphae in tissue. can cause infections, most of which are opportunistic, in humans.Most of the genera involved in hyalohyphomycosis are morphologically identical when observed in tissue sections and they trigger the same pathologic response. The most common agents involved in hyalohyphomycosis are *Aspergillus (fumigatus, niger, flavus)*, *Fusarium* spp., They are all widely distributed in nature, and can be found in any type of soil, wood, or decomposing plant material.They affect individuals of either sex and at any age, and immunosuppression is not a necessary condition for infection.

Hyalohyphomycosis

- *Aspergillus* sp.
- Fusarium sp.
- *Scedosporium* sp.
- Paecilomyces sp.

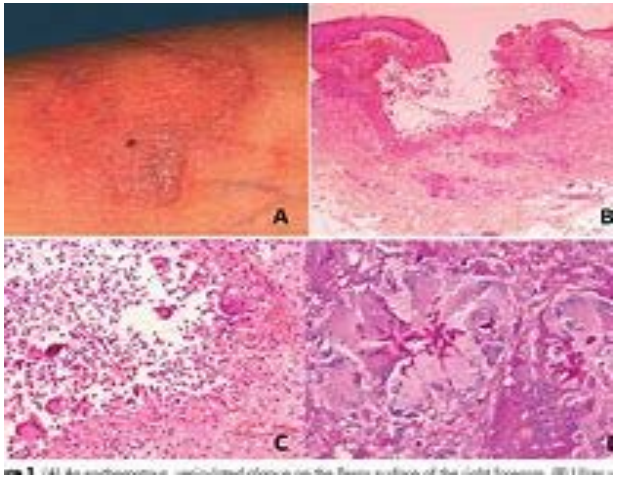
Superficial to systemic infections

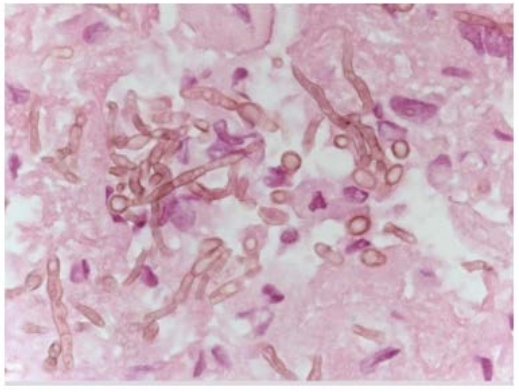


Aspergillus fumigatus

• Phaeohyphomycosis

- Phaeohyphomycosis is the result of infection with various species including *Alternaria*, *Exophiala*, *Cladophialophora*, and *Curvularia* .
- They cause a broad spectrum of diseases including skin and subcutaneous lesions, pneumonia, central nervous system disease, fungemia, and spread disease, particularly in immunocompromised patients.
- Dematiaceous fungi can frequently be distinguished in tissue specimens stained with conventional hematoxylin and eosin; they appear as septate, brownish hyphae or yeast-like cells, reflecting their high melanin content. Phaeohyphomycosis is distinguished from chromoblastomycosis and mycetoma by the absence of specific histopathologic findings such as sclerotic bodies or grains in tissue.





Cladophialophora bantiana