

Eukaryotic microbiology

- Protozoa
- Parasitic helminths (worms)
- Fungi
- Algae

Kingdom Fungi

- 100,000 species divided into 2 groups:
 - macroscopic fungi (mushrooms)
 - **microscopic fungi** (molds, yeasts)
- majority are unicellular or colonial, a few have cellular specialization

Fungi Cell wall: Mostly complex polysaccharides (chitin).. is a long-chain polymer of N-acetyl glucosamine, few amount glucan , mannan .

Cell membrane: lipid-phosphate & protein
Their Plasma membranes containing Ergosterol •

Nucleus (16 chromosomes; 6250 genes)

Roles of fungi

- decomposers of dead plants and animals
- sources of antibiotics
- used in making foods & in genetic studies
- adverse impact – food spoilage, **mycoses**, toxin production

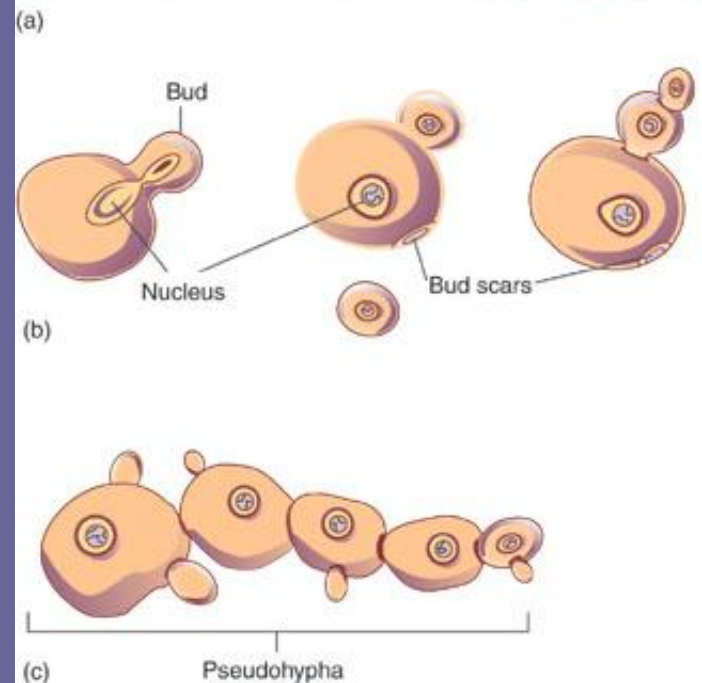
microscopic fungi

- exist in 2 morphologies
 1. **yeast** – unicellular, round ovoid shape, asexual reproduction (budding or transverse division) – also can form pseudohyphae
 2. **Filamentous (“mold”) - hyphae** – long filamentous **fungi** or **molds**; forms tangled mass=**mycelium**
- some exist in either form – **dimorphic** – characteristic of pathogens

yeasts

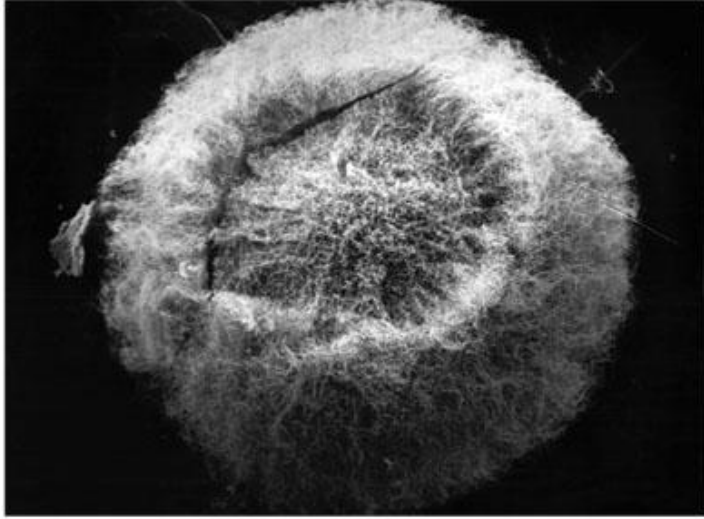
- Reproduces by budding or transverse division (asexual)
- Can form pseudohyphae (chains)
- Some can also form spores (sexual repro)
- Example: *Saccharomyces cerevisiae* (Brewer's or baker's yeast)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

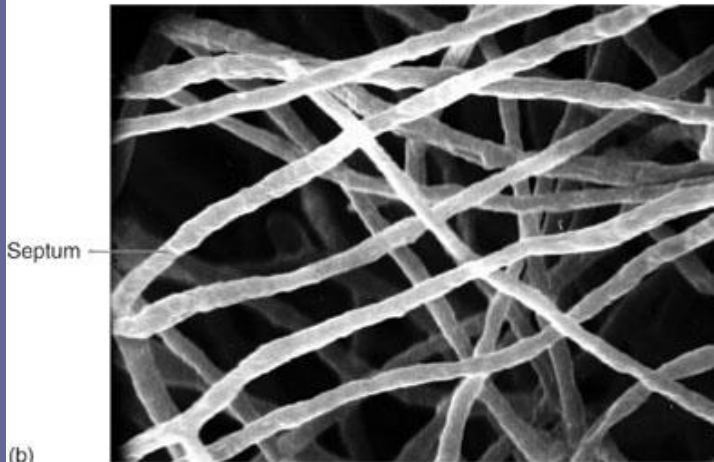


Molds (hyphae)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

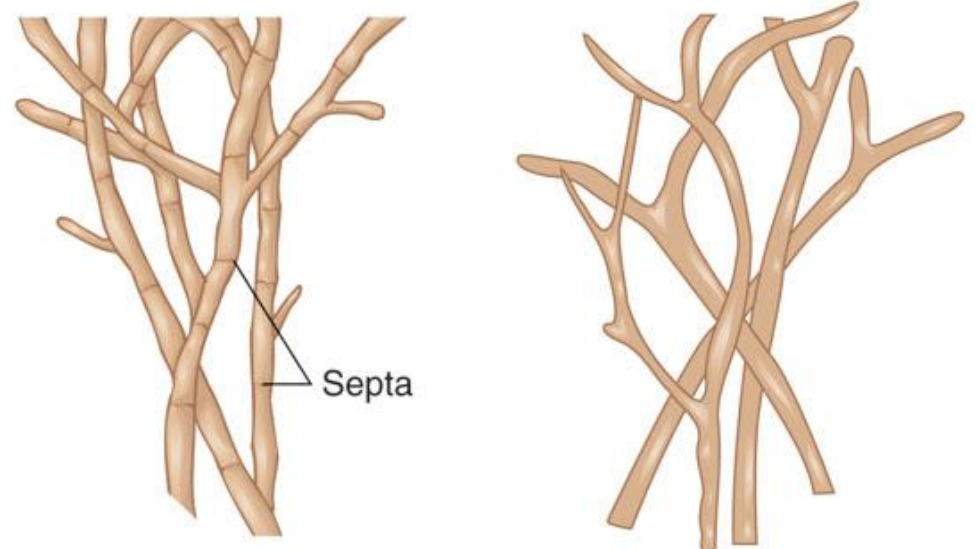


(a)



(b)

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Septate hyphae

Nonseptate hyphae

as in *Penicillium*

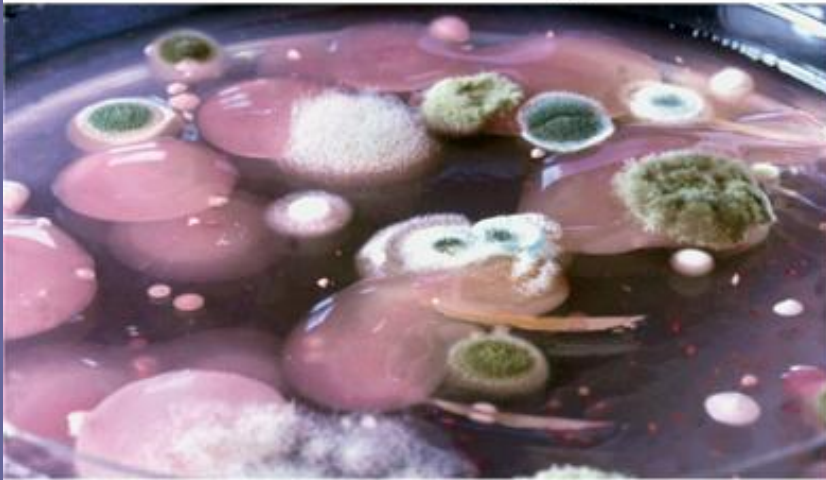
as in *Rhizopus*



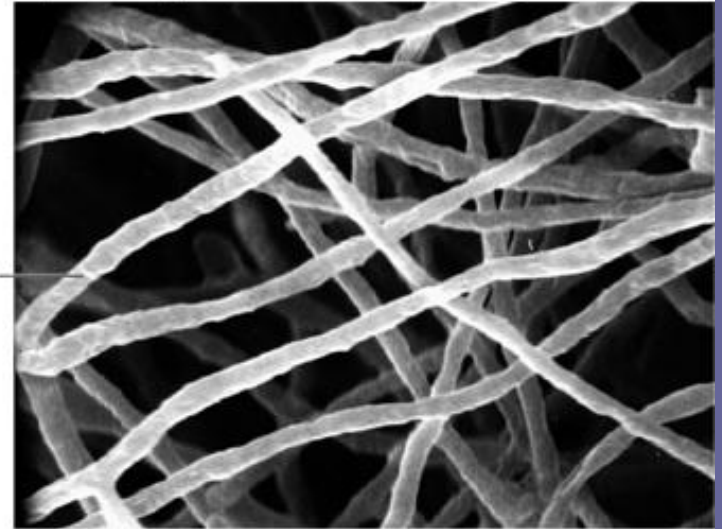
(c)

Figure 5.15

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



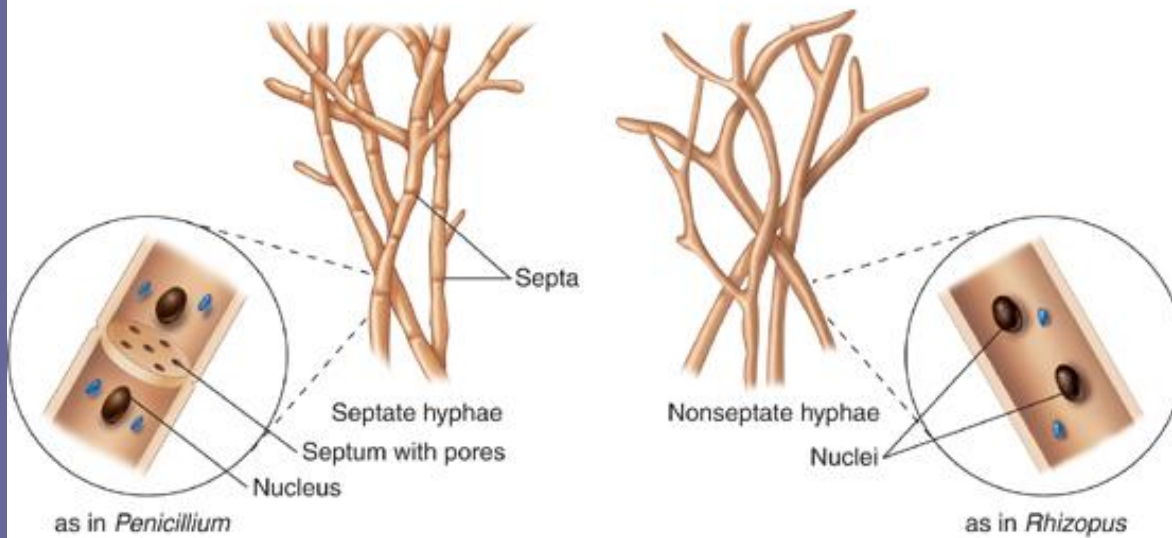
(a)



(b)

© Dr. George L. Barron

© Dr. Judy A. Murphy, San Joaquin Delta College, Department of Microscopy, Stockton, CA



(c)

Fungal nutrition

- all are **heterotrophs**
- majority are harmless **decomposers** living off dead plants & animals (saprophytes)
 - secrete hydrolytic enzymes, digest externally
- some are parasites, living on the tissues of other organisms, but none are obligate; Mycosis = fungal infections
- growth temperature 20°-40°C

Fungal Reproduction

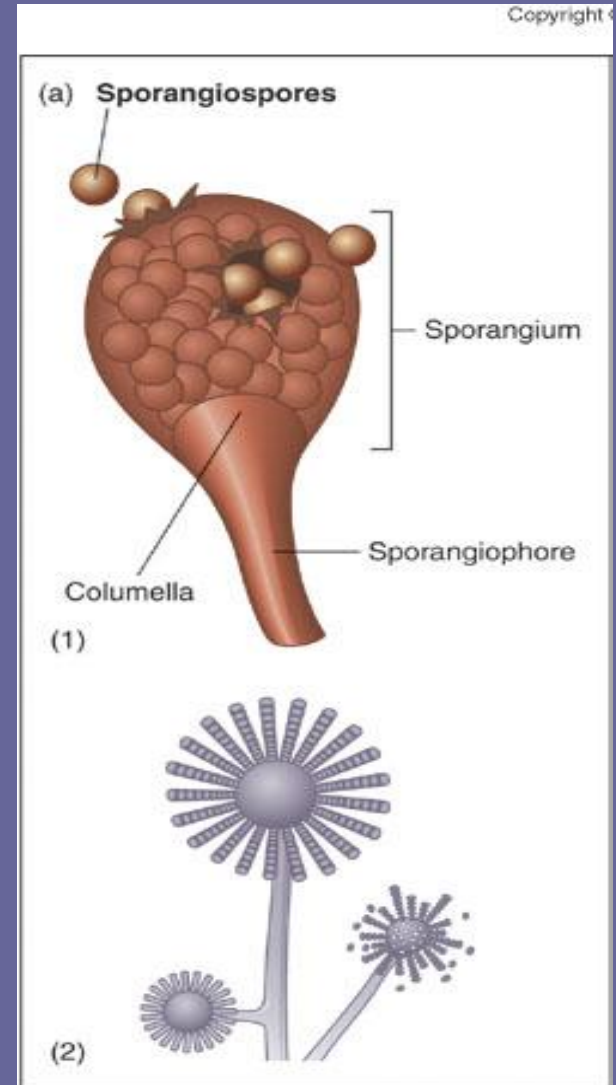
- **asexual reproduction** – spores are formed through budding (yeasts) or (molds)
- **sexual reproduction** – spores are formed following **fusion of male & female** strains & formation of sexual structure
- **sexual spores are one basis for variation**

I. Asexual reproduction

- Transverse fission
- Budding
- Spores (most common)
 - **Sporangiospores** – spores enclosed in head (sporangium) – sits atop stalk
 - **Conidia** – free spores

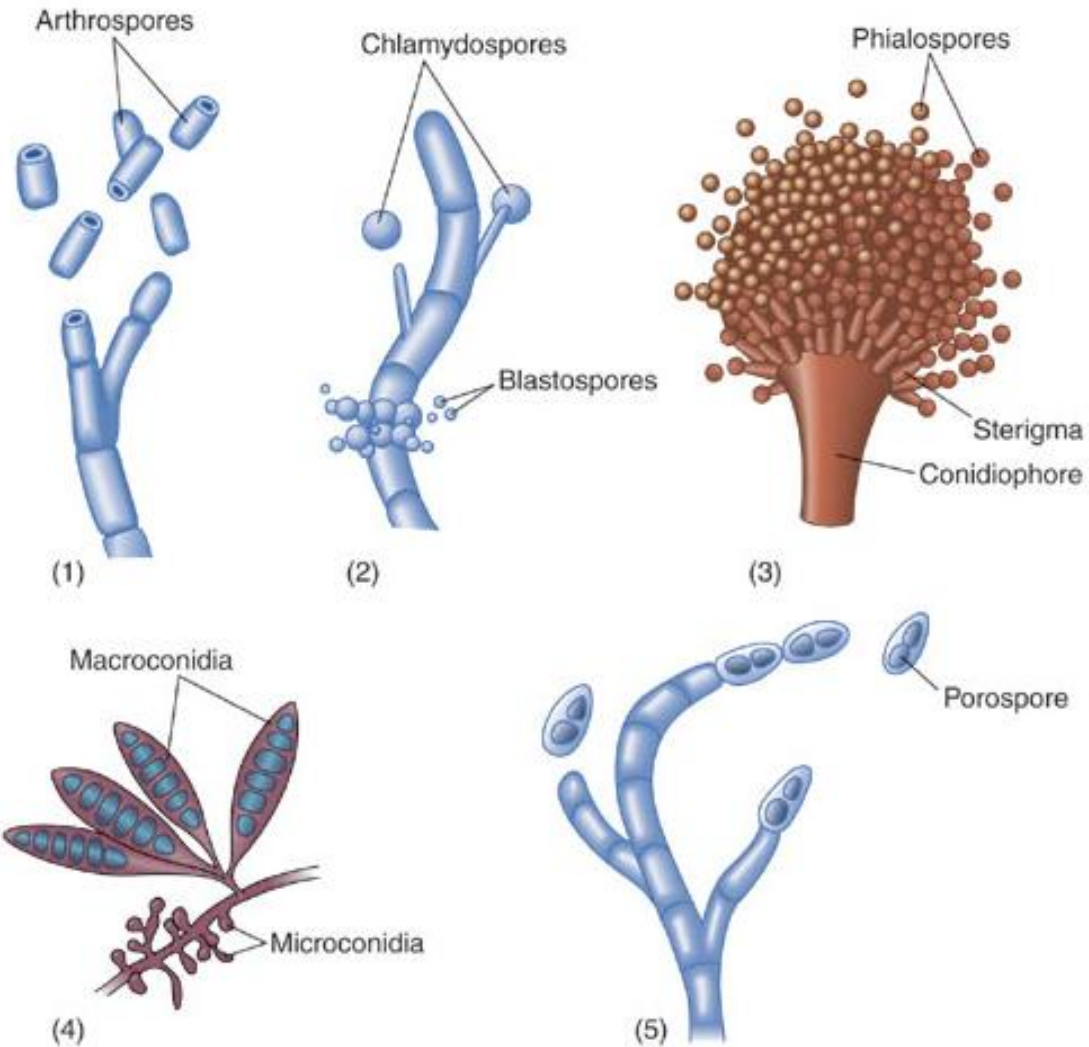
Sporangiospores

- Stalk =
- Sac =
- Spores =



Conidia

(b) Conidia



II. Sexual reproduction

- Involves **fertilization** – union of compatible nuclei
- Some can self-fertilize

★ Fungal pathogenesis (mycosis)

- Most fungi are not true pathogens (they don't attack healthy people)
- Most are opportunistic—invade those with compromised immune systems (AIDS, cancer, diabetes)
- Degree of mycosis (disease) varies by mode of infection and organs involved

TABLE 5.3 Major Fungal Infections of Humans

Degree of Tissue Involvement and Area Affected	Name of Infection	Name of Causative Fungus
Superficial (not deeply invasive)		
Outer epidermis	Tinea versicolor	<i>Malassezia furfur</i>
Epidermis, hair, and dermis can be attacked	Dermatophytosis, also called tinea or ringworm of the scalp, body, feet (athlete's foot), toenails	<i>Microsporum</i> , <i>Trichophyton</i> , and <i>Epidermophyton</i>
Mucous membranes, skin, nail	Candidiasis, or yeast infection	<i>Candida albicans</i>
Systemic (deep; organism enters lungs; can invade other organs)		
Lung	Coccidioidomycosis (San Joaquin Valley fever)	<i>Coccidioides immitis</i>
	North American blastomycosis (Chicago disease)	<i>Blastomyces dermatitidis</i>
	Histoplasmosis (Ohio Valley fever)	<i>Histoplasma capsulatum</i>
	Cryptococcosis (torulosis)	<i>Cryptococcus neoformans</i>
Lung, skin	Paracoccidioidomycosis (South American blastomycosis)	<i>Paracoccidioides brasiliensis</i>

Considered the most pathogenic fungus

★ Important fungal diseases

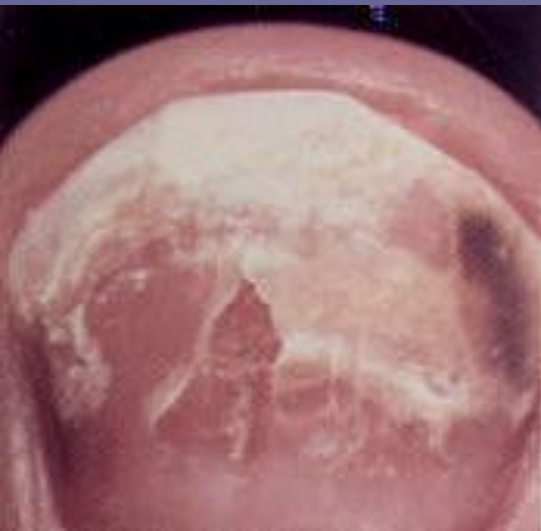
Microorganism	Associated Disease(s)
<i>Trichophyton</i> spp. <i>Epidermophyton</i> spp. <i>Microsporum</i> spp.	<u>Tinea capitis</u> (ringworm); Tinea cruris (jock itch); <u>Tinea pedis</u> (athlete's foot); Tinea unguum (finger and toenails); <u>Tinea corporum</u> (body); Tinea barbae (beard)
<i>Candida albicans</i>	vaginal yeast infections, oral thrush, nail fungus
<i>Coccidioides</i>	Coccidiomycosis – lung/systemic – VERY deadly
<i>Blastomyces dermatitidis</i>	blastomycosis (skin, lungs, organs)
<i>Aspergillus</i> spp.	aspergillosis



Athlete's foot



ringworm



Nail fungus



Tinea versicolor



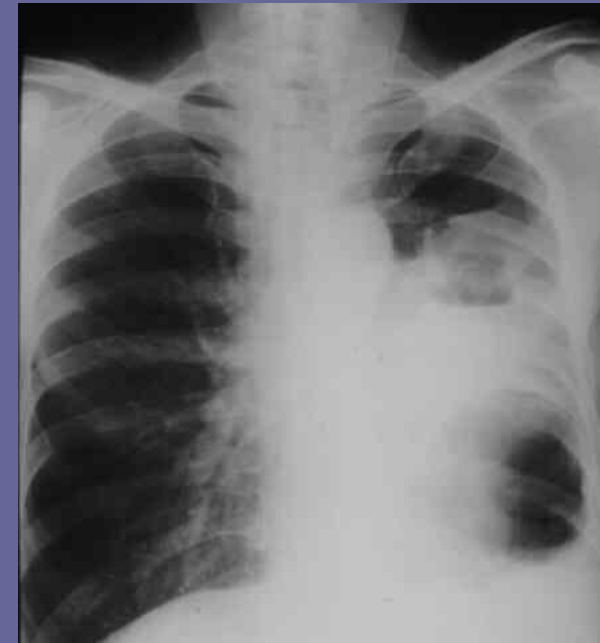
mycosis



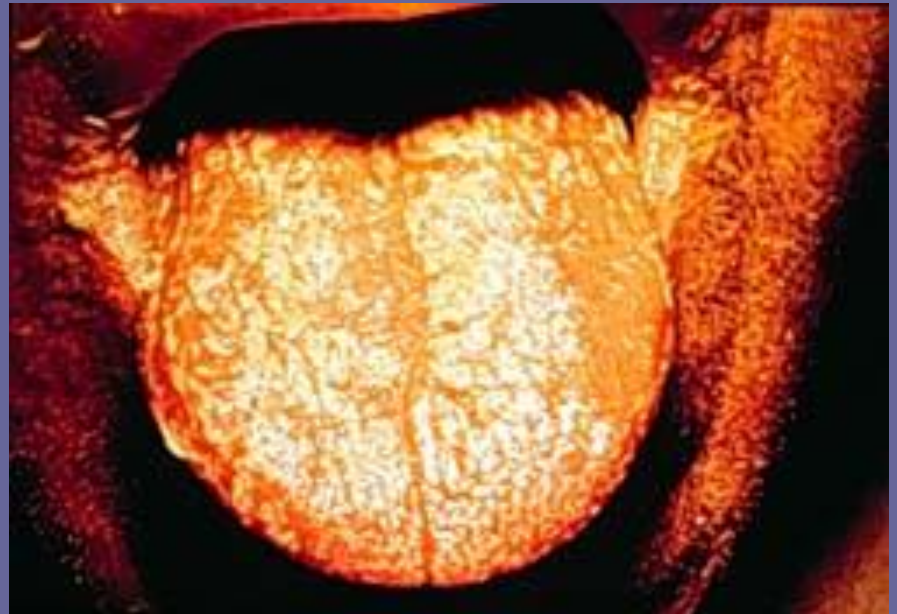
Blastomycosis



Coccidiomycosis

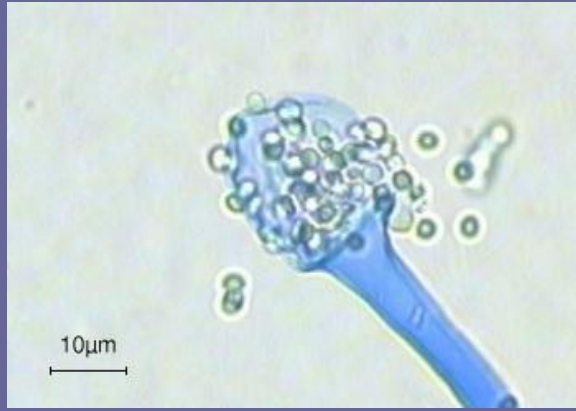


Oral thrush – *C. albicans*



Case study: mucormycosis

- *Mucor* sp. – common mold of soil, bread, fruit etc.
- **Opportunistic infection**
- Mark Tatum – steroids suppressed his immune system
- Inhaled spores → infection in sinus
- Had to have sinuses removed including nose, eyes and face



Benefits of fungi

- Decomposers of organic matter (recycle nutrients)
- Symbiosis with plant roots
- Produce antibiotics, organic acids, vitamins
- Fermentation (alcohol)
- Foods – bread, cheese; also eaten as foods

Identifying Fungi

- Media – cornmeal, blood, Sabouraud's agar
- ID by **asexual stages** (sexual not common in lab cultures)
- Also **physical characteristics**: hyphae, colony morphology, color, other characteristics
- Genetic tests

Antifungal Agents

Polyene antibiotics (macrolides)

Amphotericin B - binds to ergosterol moiety in the plasma membrane causing disarrangement of the membrane integrity and leakage of cytoplasmic contents.

Administered systemically .

Nystatin - binds to ergosterol and disrupts plasma membrane. Highly insoluble and toxic and therefore used topically only .

Azoles

- Block ergosterol synthesis causing selective leakage and increased osmotic sensitivity).
- They also disrupt chitin synthesis

Fluconazole (Oral, Topical)

Miconazole (IV, Intrathecal-into spinal canal of CNS, Topical)

Terconazole (Suppository, Topical)