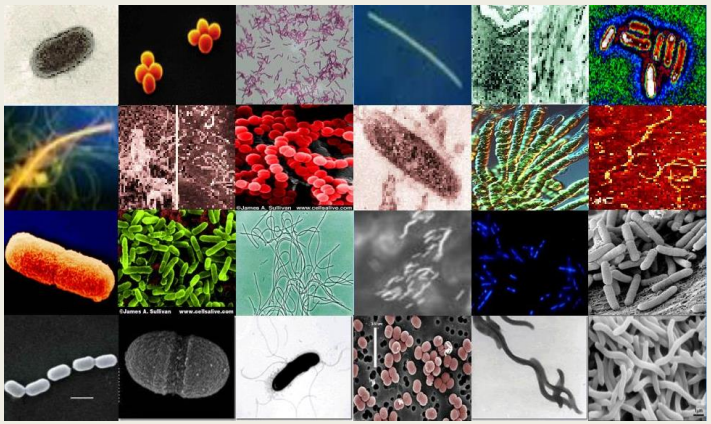
Microbial diversity



Dr.Roongtawan Muangmoon

LEARNING OBJECTIVES

1. Compare and contrast the differences among algae, protozoa, and fungi (e.g., photosynthetic ability, chitin in cell walls, etc.)

2. List five major infectious diseases of humans that are caused by protozoa and five that are caused by fungi

3. Define and state the importance of phycotoxins and mycotoxins

Introduction

Eucaryotic microbes include some species of algae and fungi, and all protozoa, lichens, and slime moulds.

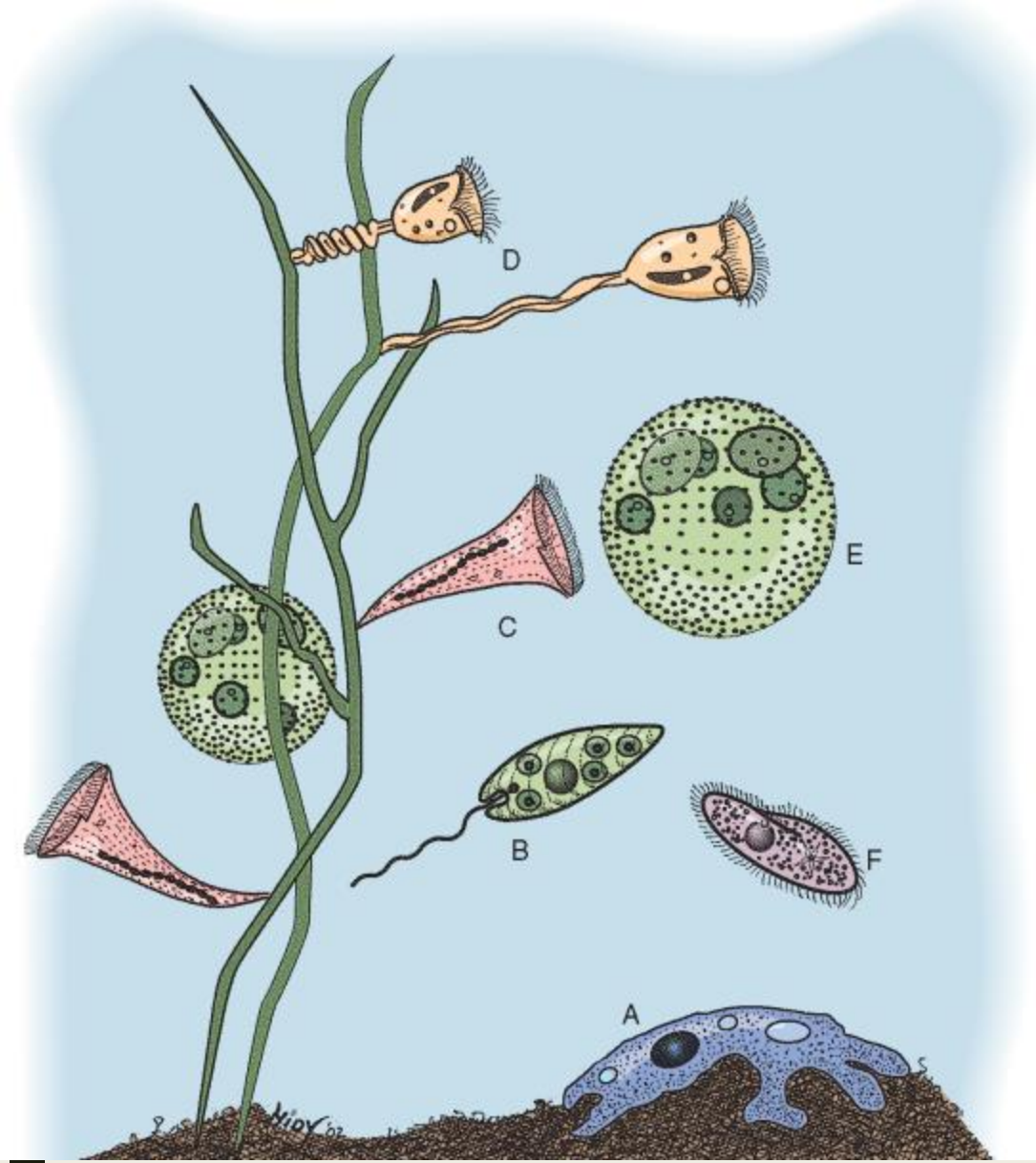
ALGAE

Algae and protozoa are referred to as protists because they are in the kingdom Protista.

Similarities and Differences between Algae and Plants

	ALGAE	PLANTS
Eucaryotic	Yes	Yes
Photosynthetic	Yes	Yes
Cells contain chlorophyll	Yes	Yes
Use carbon dioxide as an energy source	Yes	Yes
Store energy in the form of starch	Yes	Yes
Composed of roots, stems, and leaves	No	Most (bryophytes, such as mosses, are the exception)
Cell walls contain cellulose	Most (exceptions include diatoms and dinoflagellates; *Euglena* and *Volvox* do not have cell walls)	Yes
Method of reproduction	Both asexual and sexual	Sexual
Contain a vascular system to transport internal fluids	No	Most (mosses and other bryophytes are avascular)

Common pond water algae and protozoa.



(A) Amoeba sp.,

(B) Euglena sp.,

(C) Stentor sp.,

(D) Vorticella sp., in extended and contracted positions.

(E) Volvox sp.,

(F) Paramecium sp.,

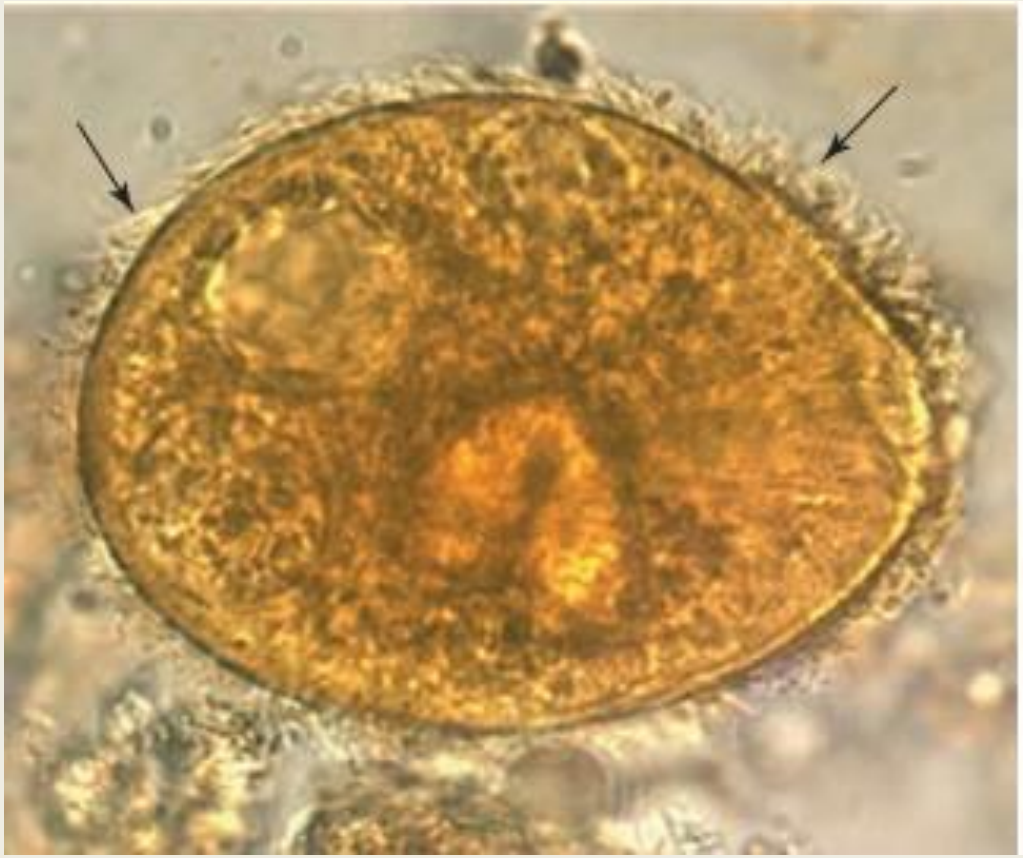
(B), and (E) are algae.

(A), (C), (D), and (F) are protozoa.

Green algae growing on shoreline rocks.

(Courtesy of http://www.imageafter.com)

Protazoa



Photomicrograph of B. coli, the only ciliated protozoan that causes human disease. B. coli causes a diarrheal disease called balantidiasis. Note the numerous short cilia (arrows) around the periphery of the cell.

(Courtesy of the Oregon Public Health Laboratory and the Division of Parasitic Diseases, CDC.)

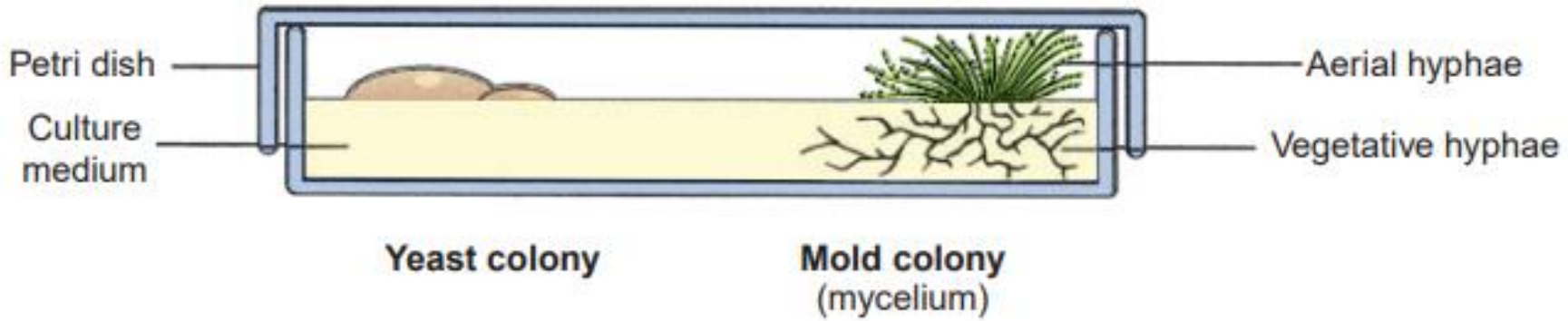
Scanning electron micrograph of *G. lamblia*, a flagellated protozoan that causes human disease. *G. lamblia* causes a diarrheal disease called giardiasis.

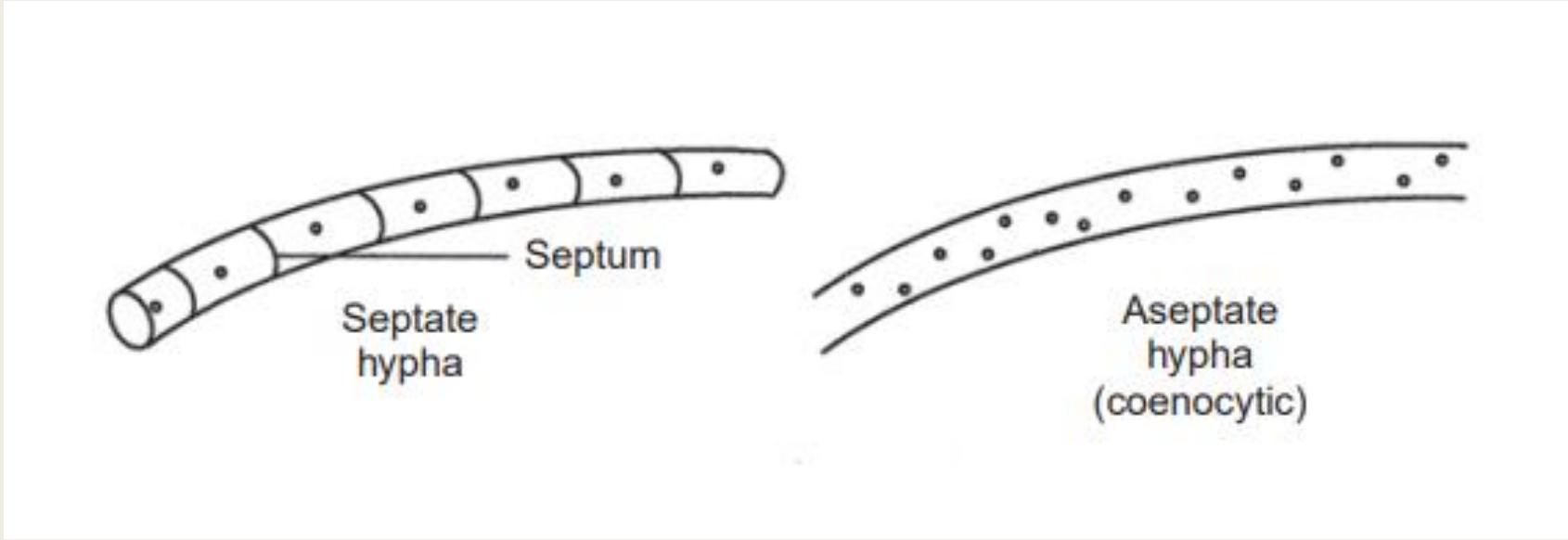
(Courtesy of Janice Carr and the Centers for Disease Control and Prevention.)

Fungi

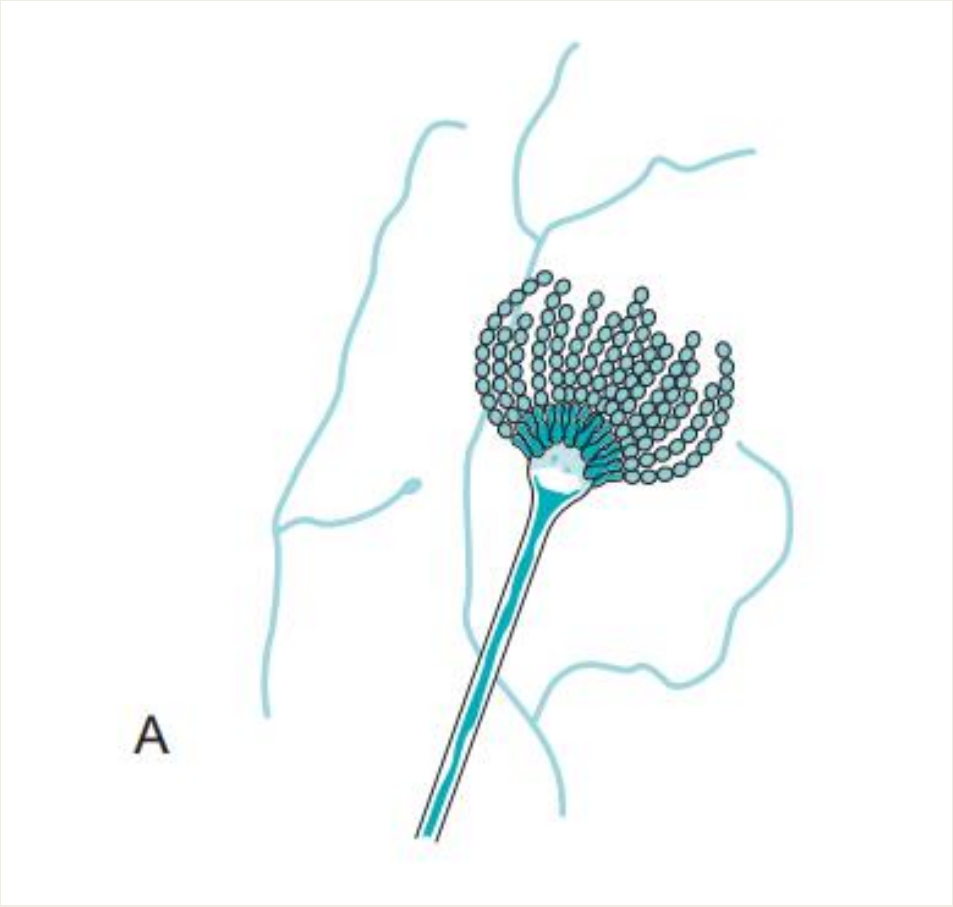
The study of fungi is called mycology.

Fungal colonies and terms relating to hyphae

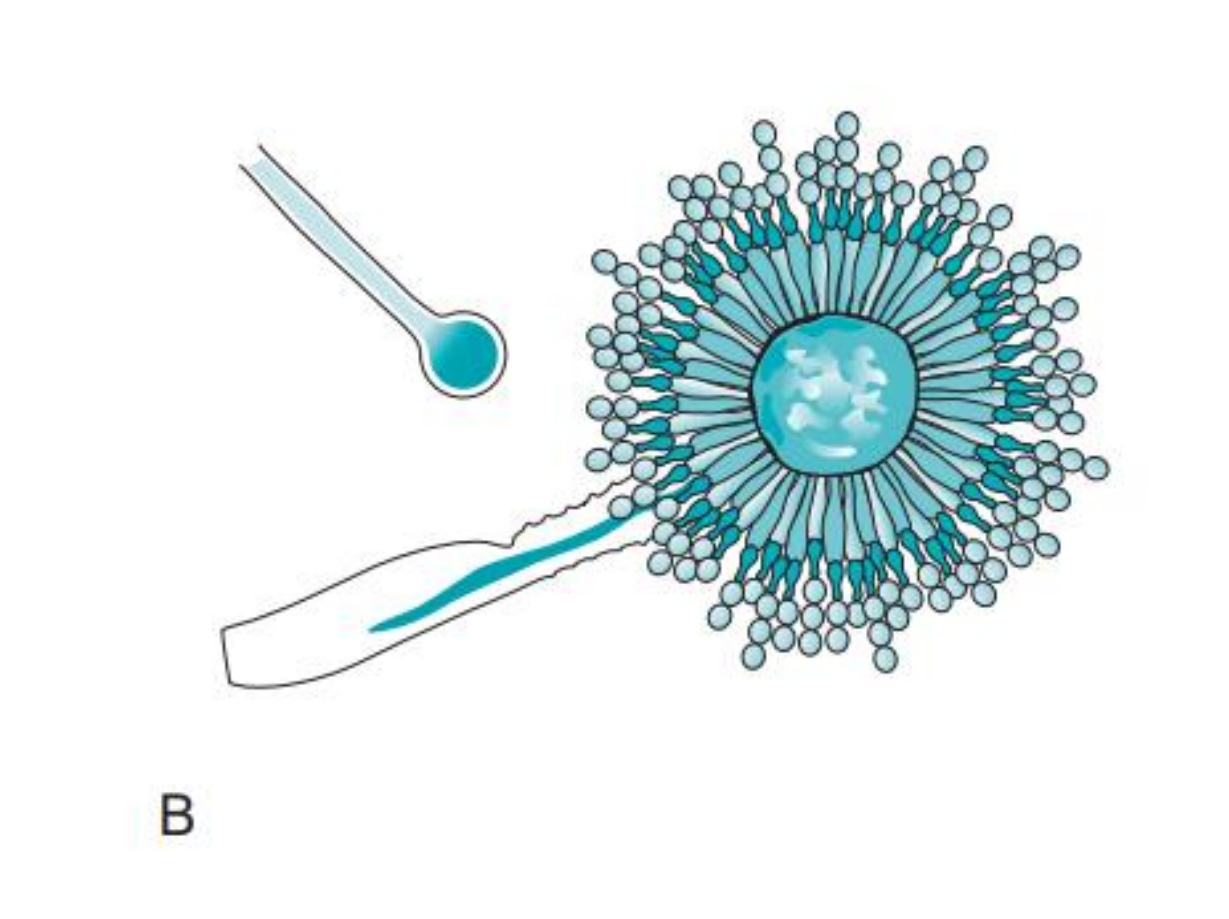



Septum
Septate
hypha
Aseptate
hypha
(coenocytic)

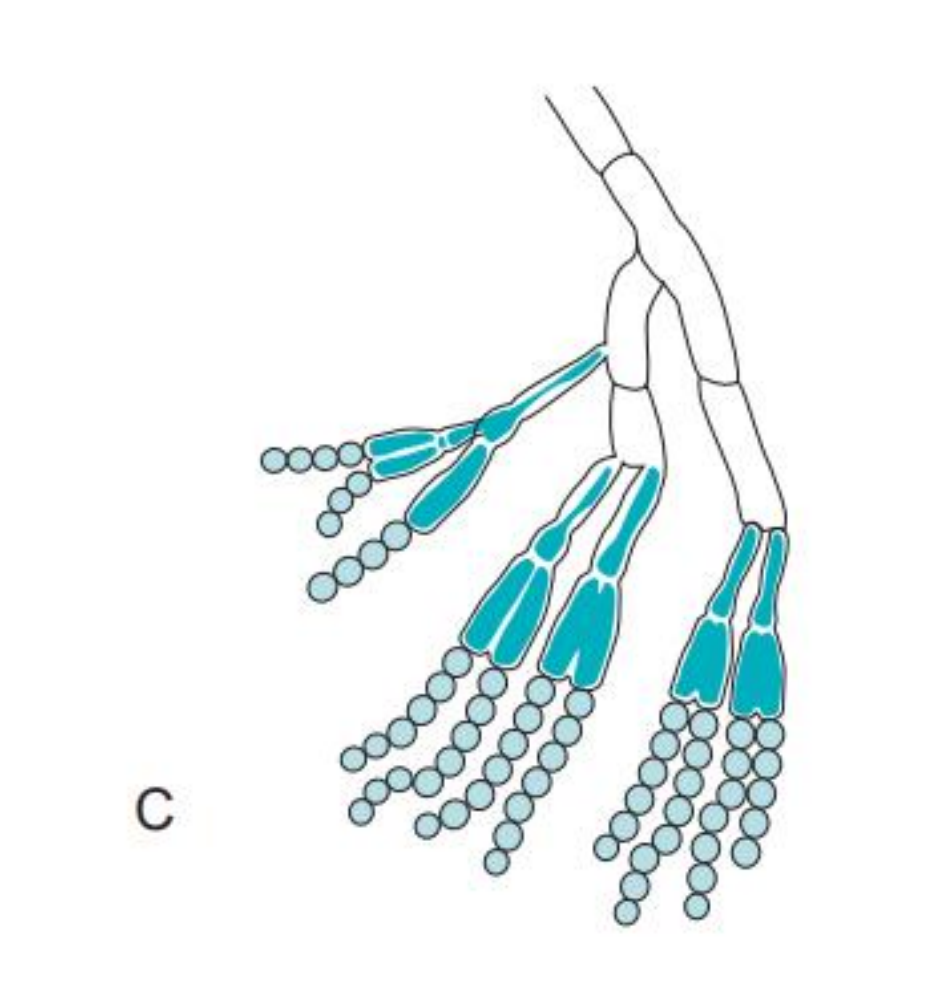
Microscopic appearance of various fungi.



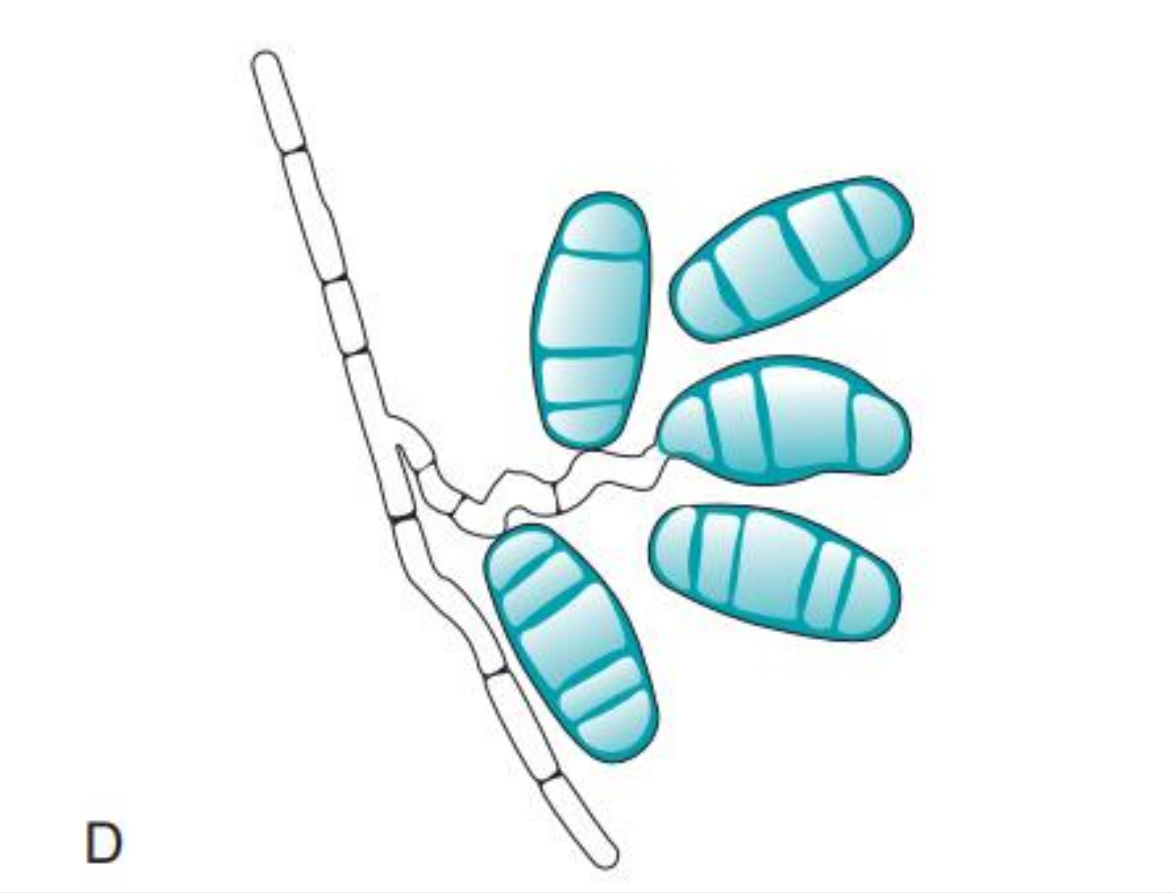
Aspergillus fumigatus.



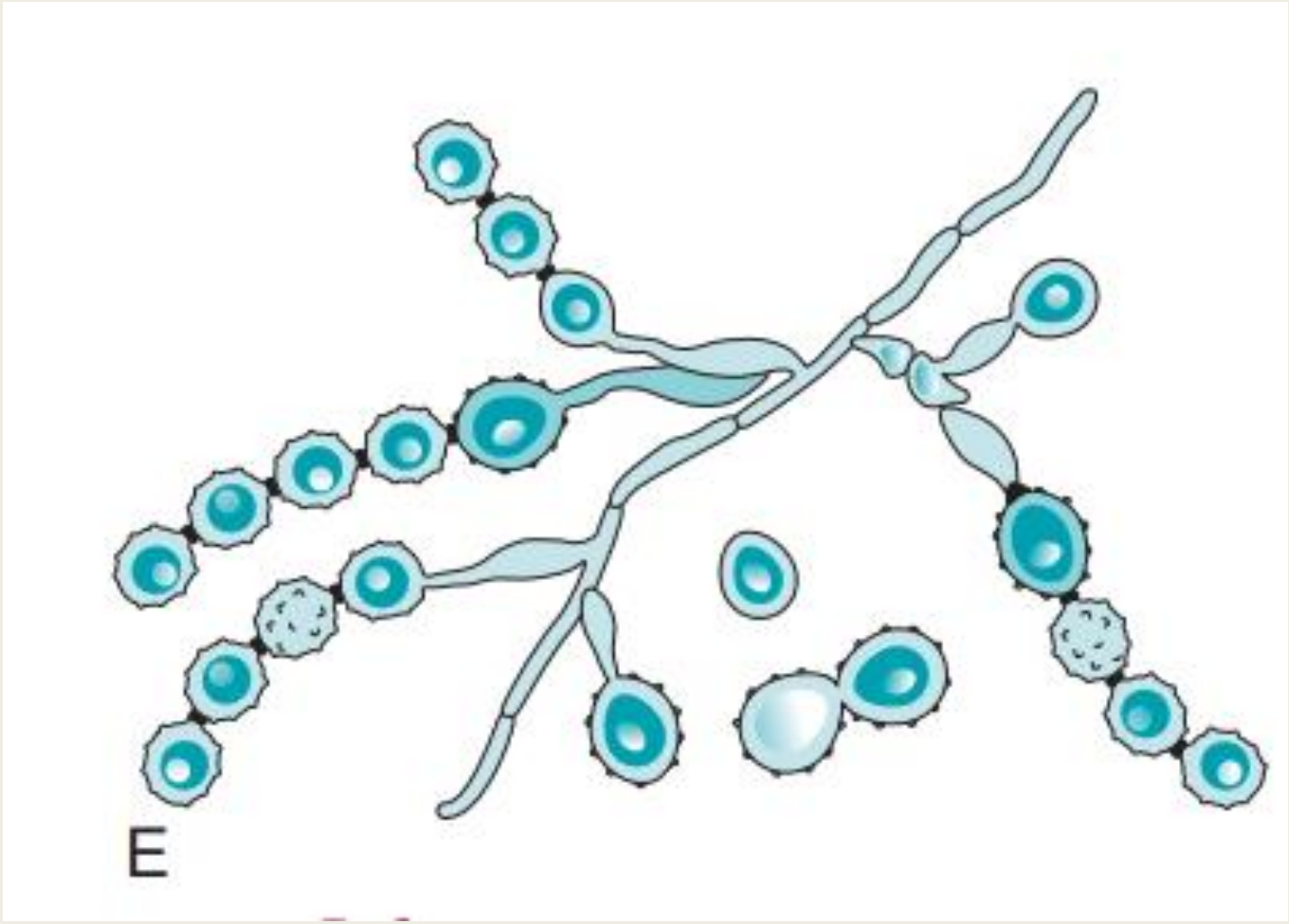
Aspergillus flavus.



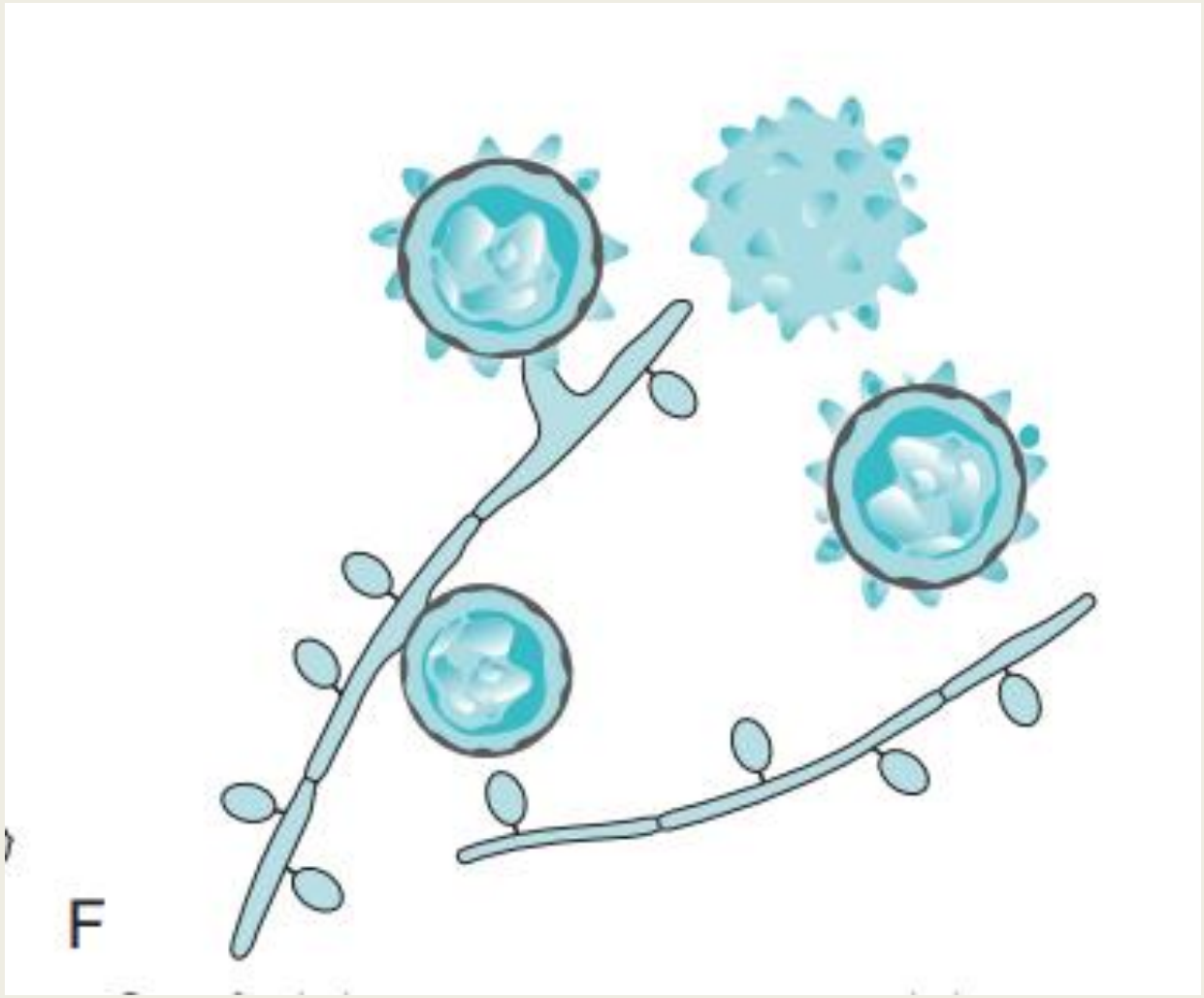
Penicillium sp.



Curvularia sp.



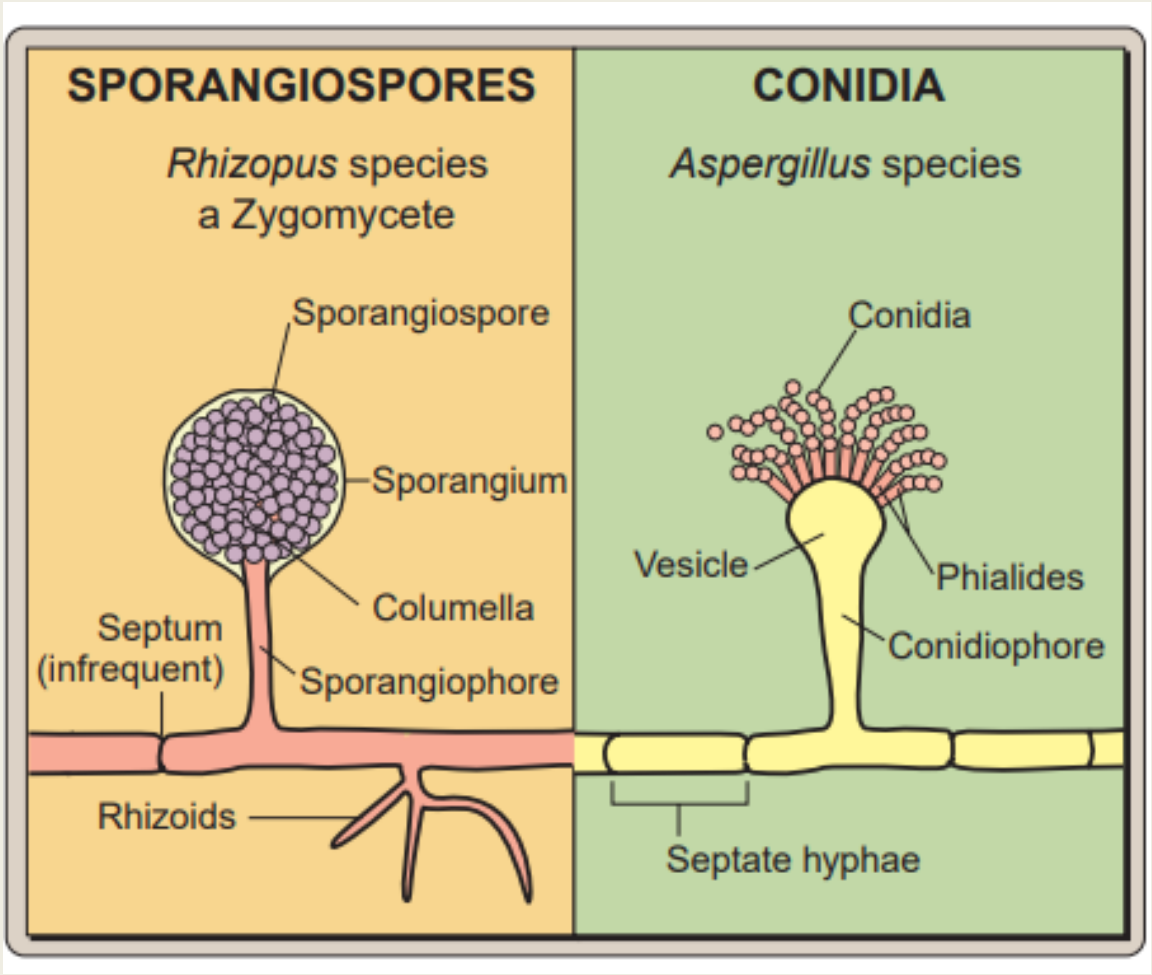
Scopulariopsis sp.



Histoplasma capsulatum

(From Winn WC Jr, et al. Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.)

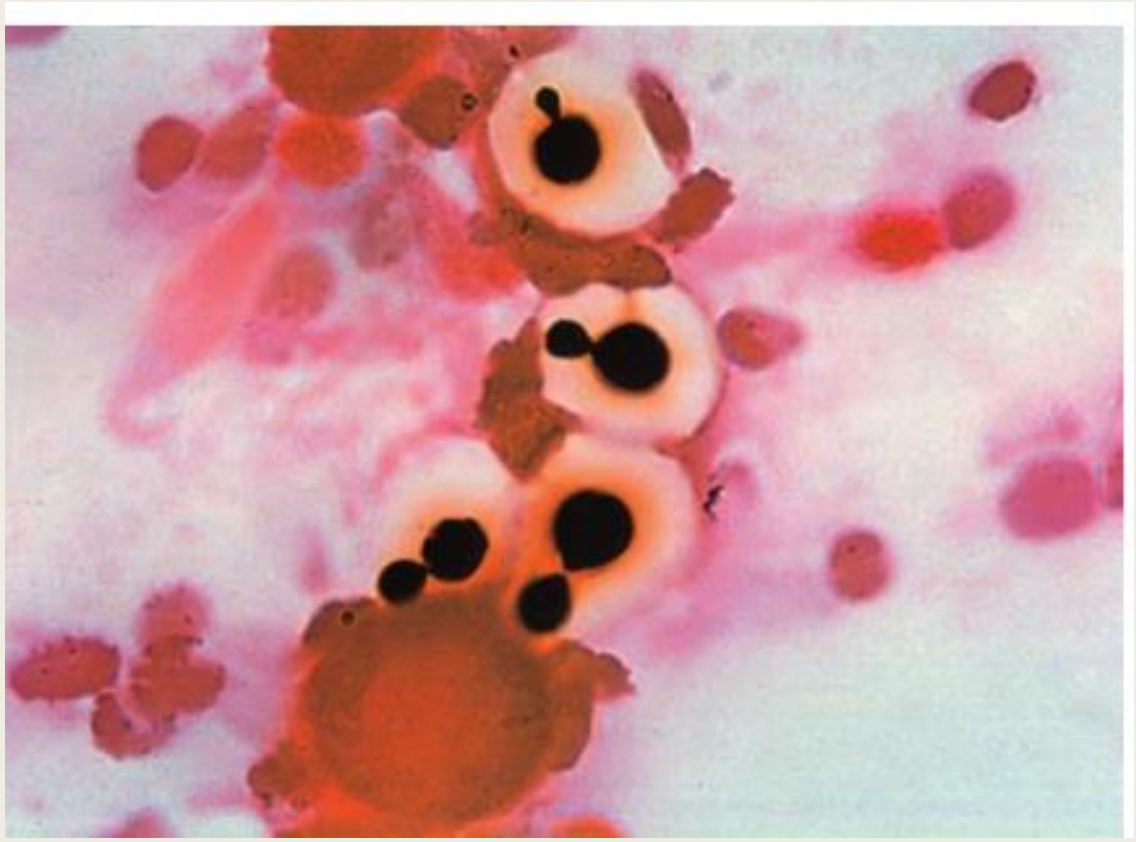
Asexual reproduction in Rhizopus and Aspergillus moulds. Illustrating the types of structures within and upon which asexual spores are produced.



(From Winn WC Jr, et al. Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.)

Selected Characteristics of the Phyla of Fungi

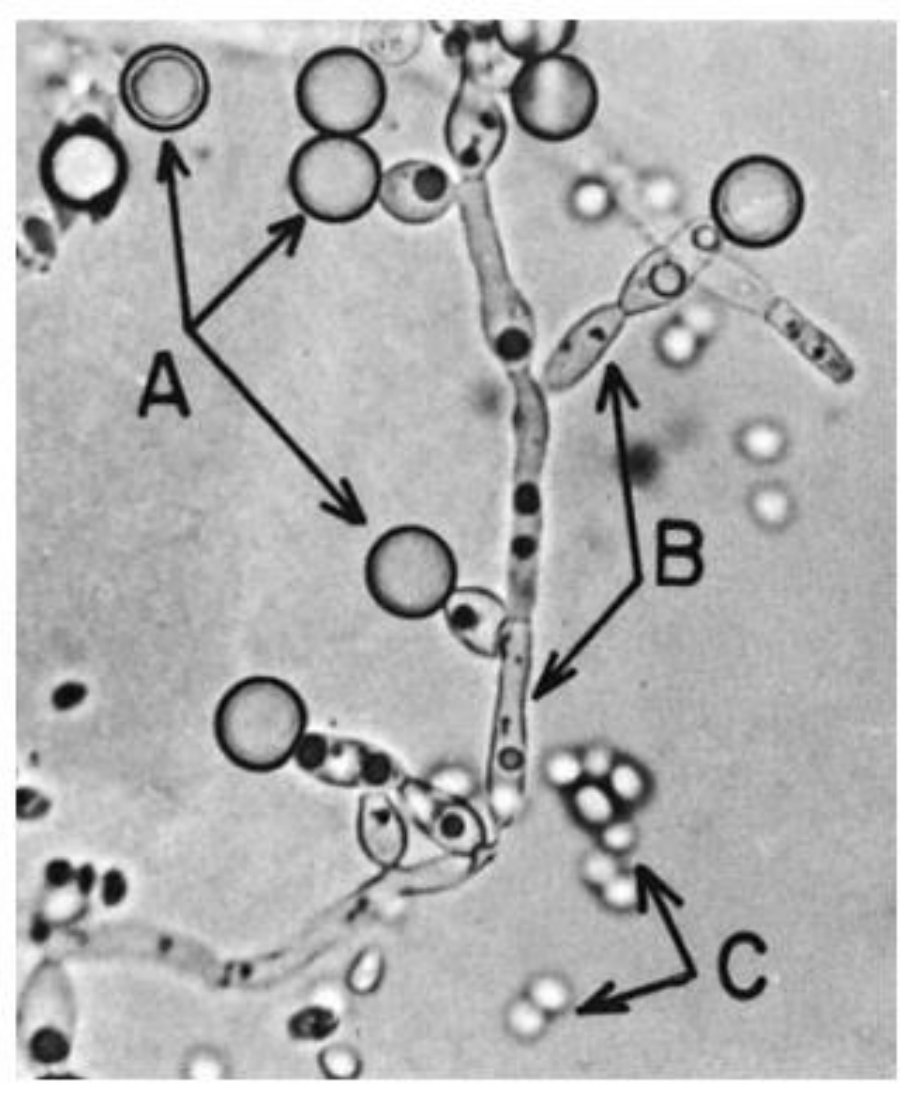
PHYLUM	TYPE OF HYPHAE	TYPE OF SEXUAL SPORE	TYPE OF ASEXUAL SPORE
Zygomycotina (Zygomycota)	Aseptate	Zygospore	Nonmotile sporangiospores
Chytridiomycotina (Chytridiomycota)	Aseptate	Oospore	Motile zoospores
Ascomycotina (Ascomycota)	Septate	Ascospore	Conidiospores
Basidiomycotina (Basidiomycota)	Septate	Basidiospore	Rare
Deuteromycotina (Deuteromycota)	Septate	None observed	Conidiospores



Gram-stained bronchoalveolar lavage specimen containing four darkly stained, narrownecked, budding yeasts, suggestive of a Cryptococcus species. The negatively stained halos surrounding the yeast cells are dense polysaccharide capsules. (From Marler LM, Siders JA, Allen SD. Direct Smear Atlas. Philadelphia: Lippincott Williams & Wilkins, 2001.)

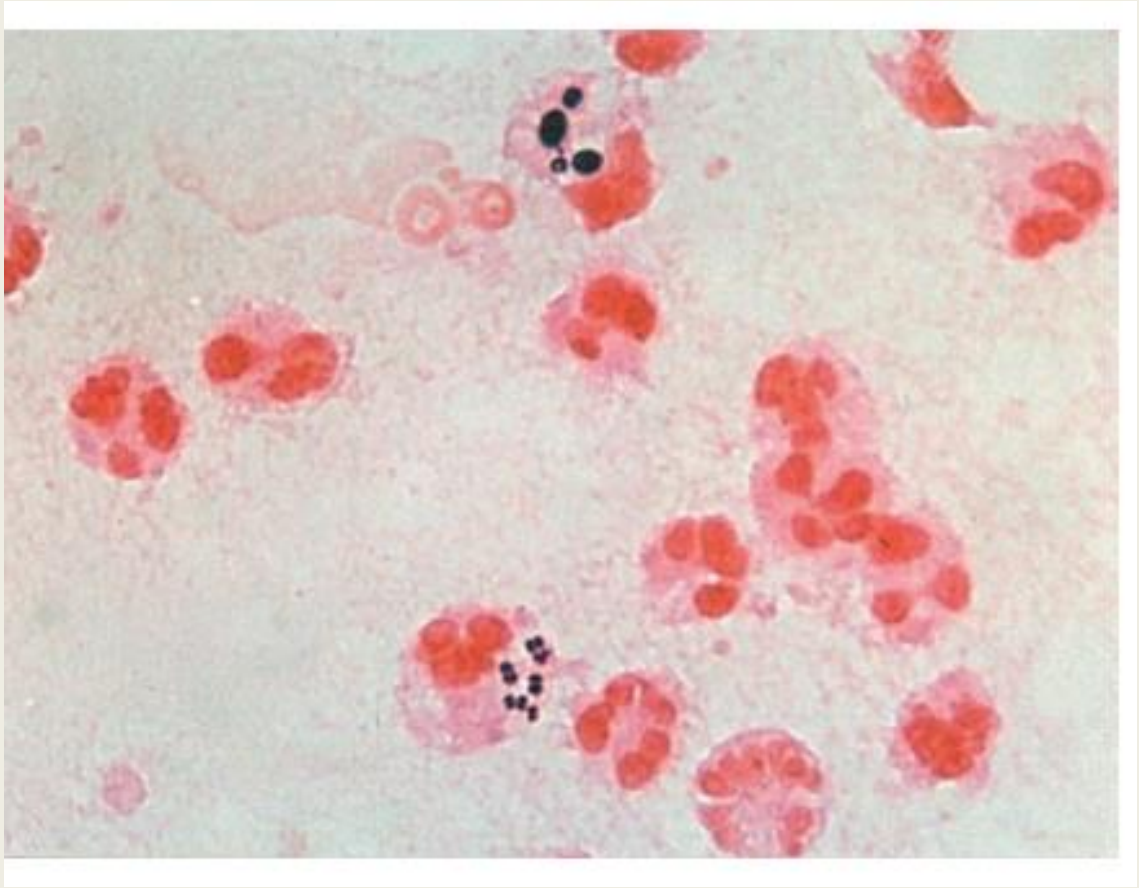
Colonies of the yeast, *C. albicans*, on a blood agar plate. The footlike extensions from the margins of the colonies are typical of this species.

(Winn WC Jr, et al. Koneman's Color Atlas and Textbook of Diagnostic Microbiology, 6th ed. Philadelphia: Lippincott Williams & Wilkins, 2006.)



Microscopic examination of a culture of *Candida albicans*. Seen here are (A) chlamydospores, (B) pseudohyphae (elongated yeast cells, linked end to end), and (C) budding yeast cells (blastospores).

(From Davis BD, et al. Microbiology, 4th ed. Philadelphia: Harper & Row, 1987.)



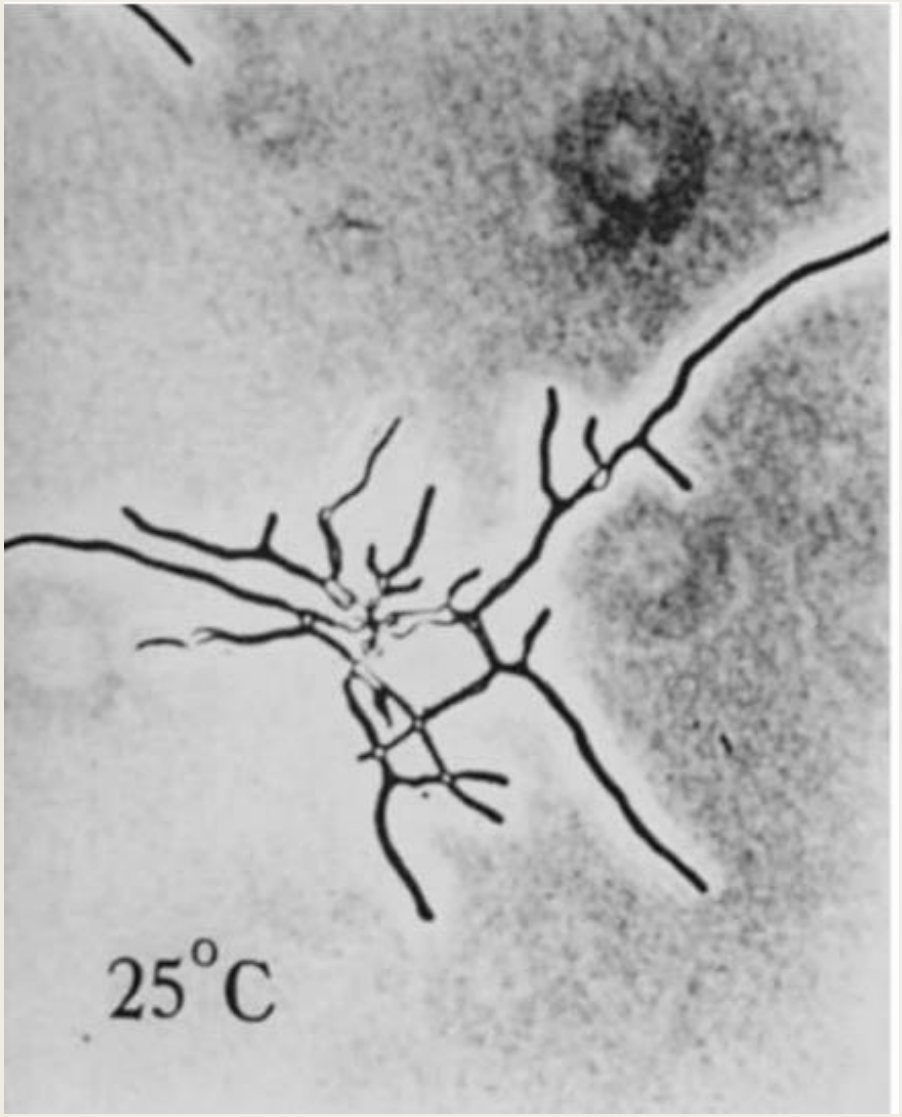
Gram-stained wound aspirate, illustrating the size differences among yeasts, bacteria, and white blood cells. Included in this photomicrograph are numerous white blood cells (red objects), two blue-stained budding yeast cells (top, center), and several Gram-positive cocci (small blue spheres near the bottom). The yeast and bacterial cells have been phagocytized by white blood cells.

(From Marler LM, Siders JA, Allen SD. Direct Smear Atlas. Philadelphia: Lippincott Williams & Wilkins, 2001.)

Fleshy fungi growing on the forest floor. The toxins produced by some fleshy fungi can cause human disease. (Photograph by PG Engelkirk.)

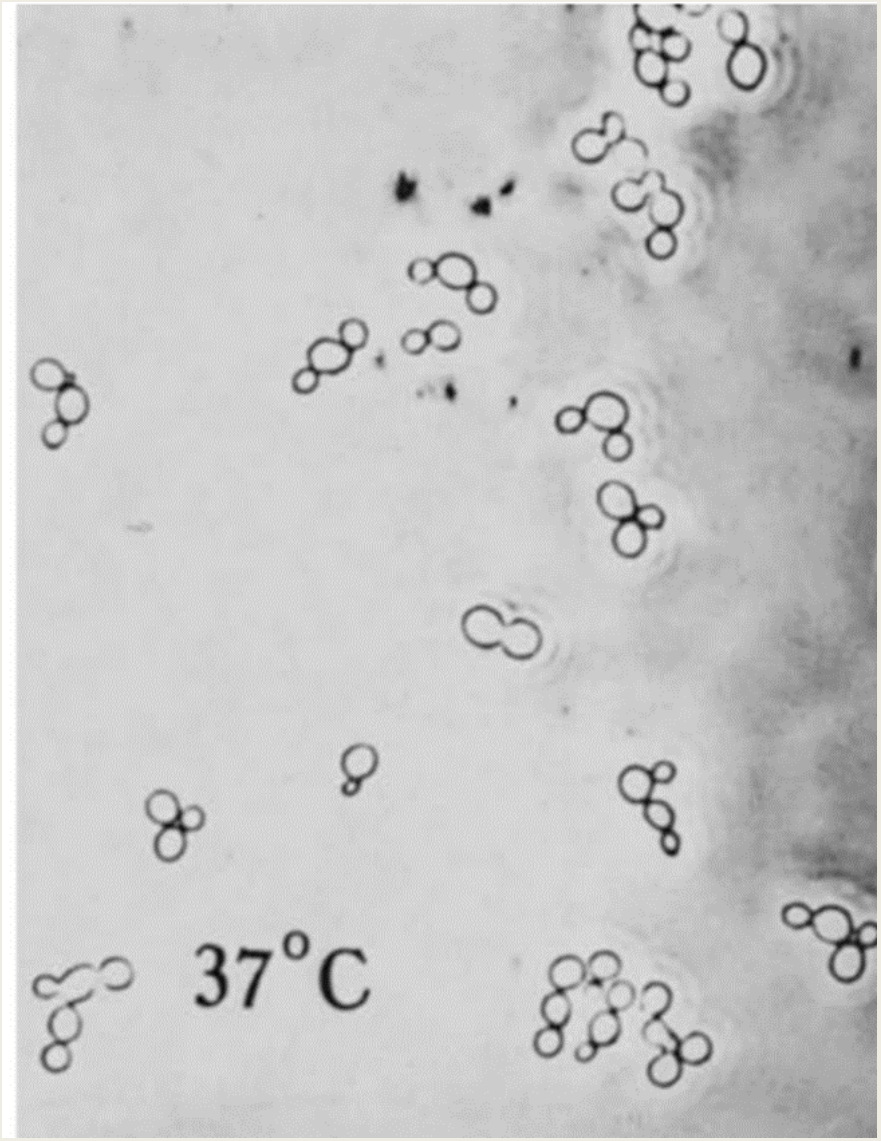
Selected Fungal Diseases of Humans

CATEGORY	GENUS/SPECIES	DISEASES
Yeasts	*Candida albicans*	Thrush; yeast vaginitis; nail infections; systemic infection
	Cryptococcus neoformans	Cryptococcosis (lung infection; meningitis, etc.)
Moulds	*Aspergillus* spp.	Aspergillosis (lung infection; systemic infection)
	Mucor and *Rhizopus* spp. and other species of bread moulds	Mucormycosis or zygomycosis (lung infection; systemic infection)
	Various dermatophytes	Tinea ("ringworm") infections
Dimorphic fungi	*Blastomyces dermatitidis*	Blastomycosis (primarily a disease of lungs and skin)
	Coccidioides immitis	Coccidioidomycosis (lung infection; systemic infection)
	Histoplasma capsulatum	Histoplasmosis (lung infection; systemic infection)
	Sporothrix schenckii	Sporotrichosis (a skin disease)
Other	*Pneumocystis jiroveci*	*Pneumocystis* pneumonia (PCP)



Dimorphism. Photomicrographs illustrating the dimorphic fungus, *H. capsulatum*, being grown at 25 °C

(From Schaeter M, et al., eds. Mechanisms of Microbial Disease, 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 1999.)



Dimorphism. Photomicrographs illustrating the dimorphic fungus, *H. capsulatum*, being grown at 37 °C

Lichens


B

SELF-ASSESSMENT EXERCISES

1. Which of the following statements about algae and fungi is (are) true?

a. Algae are photosynthetic, whereas fungi are not.

b. Algal cell walls contain cellulose, whereas fungal cell walls do not.

c. Fungal cell walls contain chitin, whereas algal cell walls do not.

d. all of the above

2. All of the following are algae except:

a. desmids.

b. diatoms.

c. dinoflagellates.

d. sporozoa

3. All of the following are fungi except:

a. moulds.

b. Paramecium.

c. Penicillium.

d. Yeasts

4. A protozoan may possess any of the following except:

a. cilia.

b. flagella.

c. hyphae.

d. pseudopodia

5. Which one of the following terms is not associated with fungi?

a. conidia

b. hyphae

c. mycelium

d. pellicle

6. If a dimorphic fungus is causing a respiratory infection, which of the following might be seen in a sputum specimen from that patient?

a. amebae

b. conidia

c. hyphae

d. yeasts

7. Which one of the following is not a fungus?

a. Aspergillus

b. Candida

c. Penicillium

d. Prototheca

8. Which one of the following terms is not associated with fungi?

a. conidia

b. hyphae

c. mycelium

d. pellicle