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The *Fungi* (*Eumycota*)

True Fungi: Eumycota

- Eukaryotic, spore-bearing
- Chemoorganoheterotrophs with absorptive metabolism
- Saprophytes
  - absorb nutrients from dead organic material by releasing degradative enzymes
  - osmotrophy - absorb soluble products
- Lack chlorophyll
- Reproduce sexually and asexually

Terminology

- Mycology – study of fungi
- Mycologists – scientists who study fungi
- Mycoses – diseases caused by fungi
- Mycotoxicology – study of fungal toxins and their effects

Fungal Distribution and Importance

- Primarily terrestrial, few aquatic
  - global from polar to tropical
- Primarily terrestrial
  - few aquatic species
- Many are pathogenic in plants or animals
- Some form associations
  - mycorrhizae – associations with plant roots
  - lichens
    - associations with algae or cyanobacteria

Fungal Distribution and Importance…

- Decomposers
  - degrade complex organic material in the environment to simple organic compounds and inorganic molecules
  - carbon, nitrogen, phosphorus, and other critical constituents are recycled for other living organisms

Fungal Distribution and Importance…

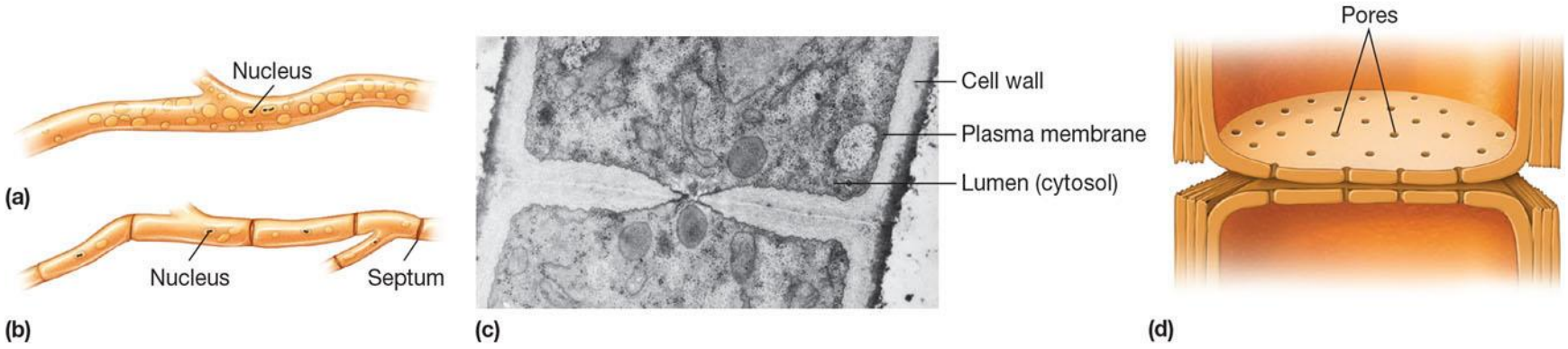
- Industrial importance
  - fermentation – yeast used in making bread, wine, beer, cheese, soy sauce
  - organic acids – citric and gallic acid
  - certain drugs – ergometrine, cortisone
  - antibiotics – penicillin, griseofulvin
  - immunosuppressive agents - cyclosporin

Fungal Distribution and Importance…

- Research use
  - geneticists, cytologists, biochemists, biophysicists, and microbiologists
  - *Saccharomyces cerevisiae*
    - yeast model system for cell biology, genetics, and cancer

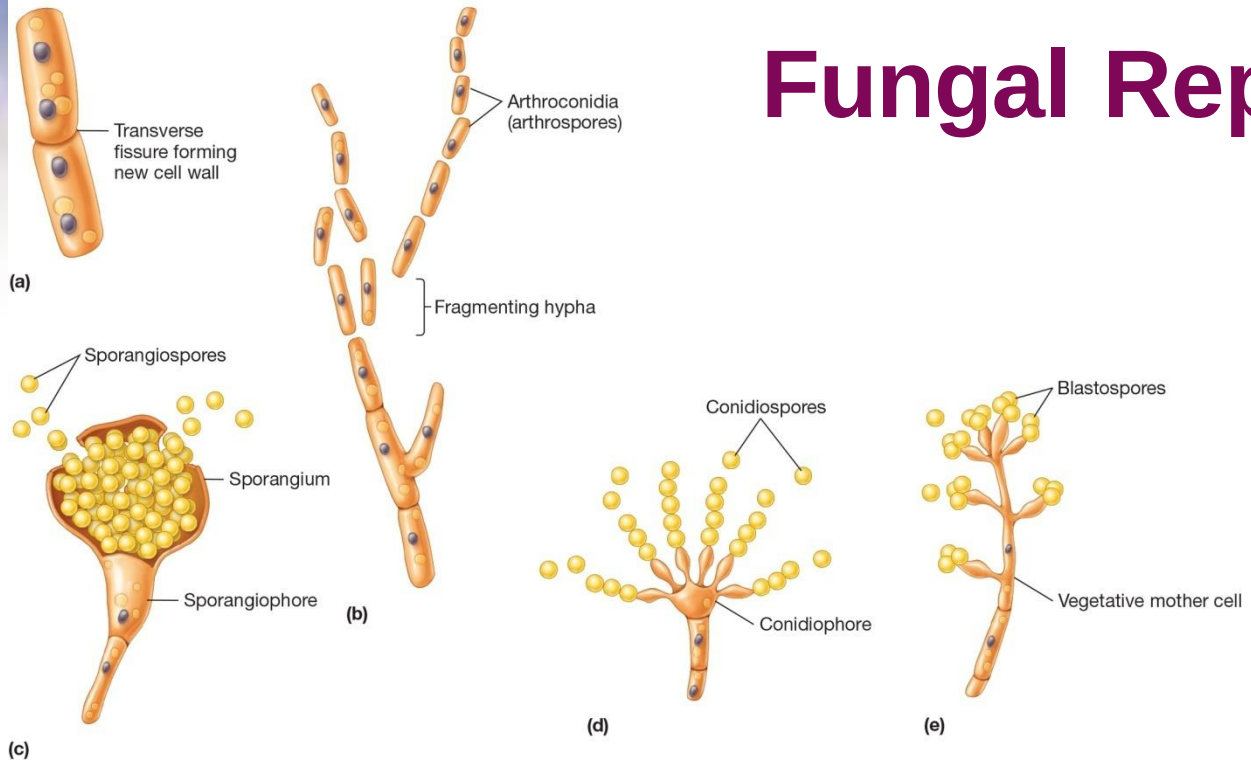
Fungal Structure

- Cell walls composed of chitin polysaccharide
- Single-celled microscopic fungi = yeasts
- Body/vegetative structure of a fungus = thallus (pl. thalli)
  - multicellular fungi are called molds
  - thallus consists of long, branched hyphae filaments tangled into a mycelium mass



Courtesy of Dr. Garry T. Cole, Univ. of Texas at Austin

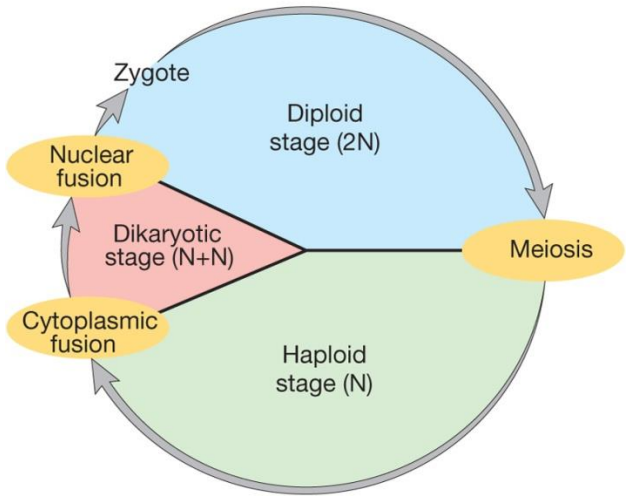
Fungal Reproduction



- Asexual reproduction
  - Parent cell undergoes mitosis to form daughter cells
  - Mitosis in vegetative cells may be concurrent with budding to produce a daughter cell
  - May proceed through a spore form

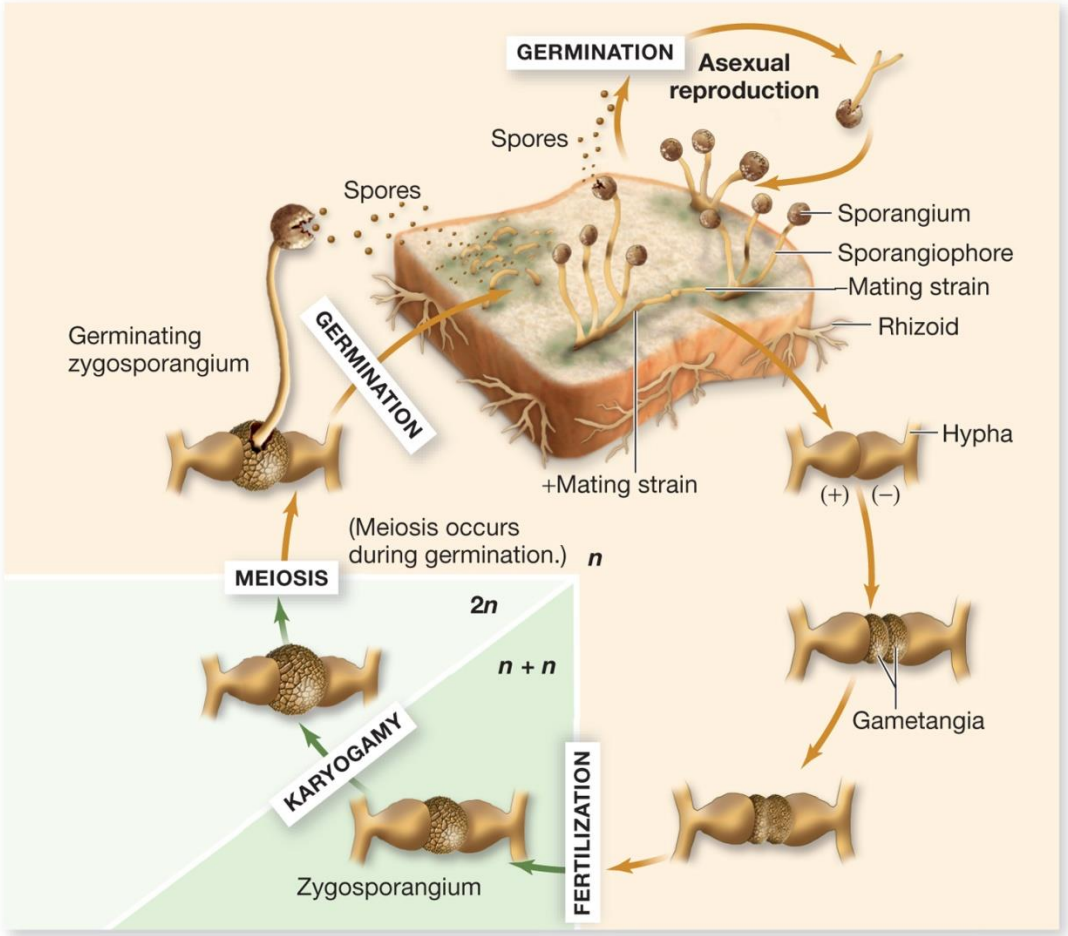
Fungal Reproduction

- Sexual reproduction
  - Involves fusion of compatible nuclei
    - Homothallic: Sexually-compatible gametes are formed on the same mycelium (self-fertilizing)
    - Heterothallic: Require outcrossing between different, yet compatible mycelia
      - A dikaryotic stage can exist temporarily prior to fusion of two haploid nuclei



Genus *Rhizopus*

- *R. stolonifer*
  - grows on surface of moist carbohydrate rich foods such as bread
  - hyphae quickly cover surface as rhizoids, absorb nutrients
  - stolon hyphae become form new rhizoids



Importance of Genus *Rhizopus*

- *Rhizopus-Burkholderia* symbiosis
  - seedling blight in rice bacterium *Burkholderia* growing within *Rhizopus* produces toxin
- Used to produce tempeh from soybeans
- Used with soybeans to make sufu curd
- Commercially
  - used to produce anesthetics, birth control, alcohols, meat tenderizers, yellow coloring in margarine

More about *Ascomycota*

- *Claviceps purpura*
  - parasite on higher plants
  - ergotism
    - toxic condition from eating infected grain
    - due to lysergic acid diethylamide (LSD)

- *Candida, Blastomyces, Histoplasma*
  - human pathogens
- *Stachybotrys* – "sick building syndrome"
- *Aspergillus* – aflatoxins and cancer

From Andersson, M.A. et al., Bacteria, Molds and Toxins in Water-damaged Building Materials, 1997 63(2)387–393, fig. 1, p. 388, *Applied and Environmental Microbiology*, American Society from Microbiology. Image courtesy of Maria Anderson and Mirja

Human Impact *Basidiomycota*

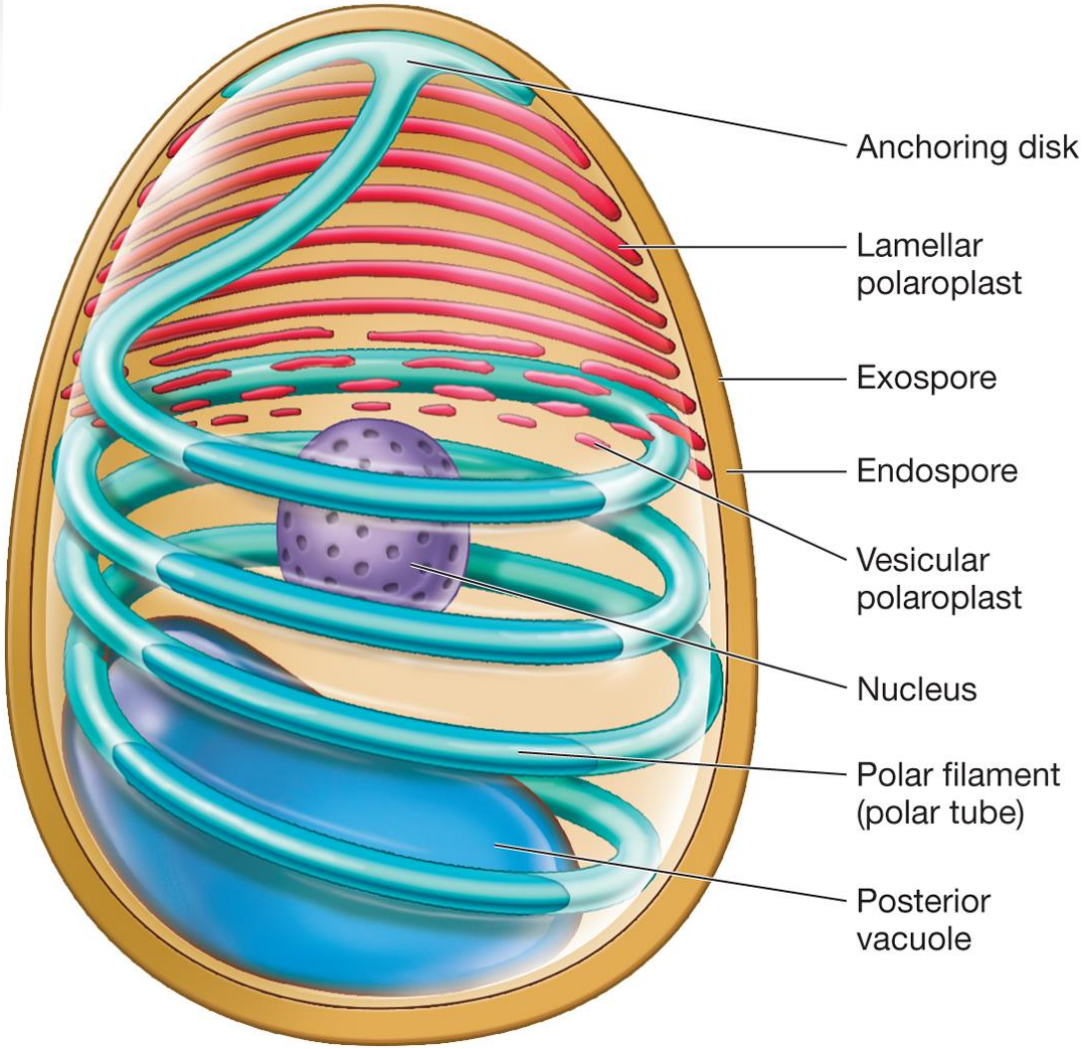
- Decomposers
- Edible and non-edible mushrooms
  - toxins are poisons and hallucinogenic
- Pathogens of humans, other animals, and plants
  - e.g., *Cryptococcus neoformans* – cryptococcosis
    - systemic infection, primarily of lungs and central nervous system

JK Pataky, University of Illinois

Microsporidia

- Obligate intracellular fungal parasites that infect insects, fish, and humans
  - Aquatic birds are common hosts and contribute to large numbers of spores in environment
- Transitional form is a spore structure capable of surviving outside the host
- Structurally similar to ‘classic’ fungi
  - contain chitin, trehalose, and mitosomes
  - however, lack mitochondria, peroxisomes and centrioles
  - unique morphology is polar tube essential for host invasion

Microsporidia Pathogenesis



- Human infections
  - *Enterocystozoon bieneusi*
    - diarrhea
    - pneumonia
  - *Encephalitozoon cuniculi*
    - encephalitis
    - nephritis
  - severe in HIV/AIDS patients