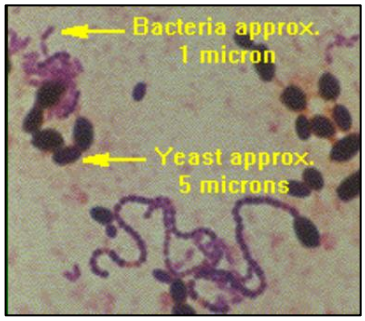
Lecture 1 - Introduction to mycology

- Mycology (myco=fungus, logy=study)
- Approximately 80,000 known species, less than 400 species are medically important and less than 50 Species presently known to be pathogenic for humans and other animals.
- Fungi are eukaryotic organisms that do not contain chlorophyll but have cell wall.
- Fungi initially classified with plant kingdom, and then fungi have transferred to the kingdom fungi.



Importance of Fungi:

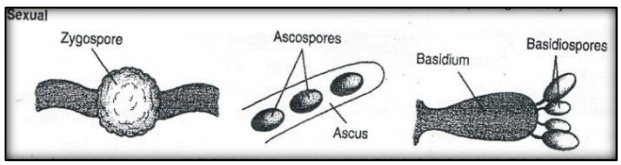
Drug manufacturing (usually their waste products are to our benefit)

- Citric acid
- Ethanol (yeast)
- Antibiotic griseofulvin, penicillin
- Cortisone (Rhizopus)
- Immunosuppressive agents (cyclosporine)

Classification in mycology:

Fungi are classified on their ability to reproduce sexually, asexually or by combination of both.
The first criteria are sexual morphological form; the second set of criteria is based upon a sexual reproductive structure

1) **Ascomycota** – sexual reproduction in a sack called an Ascus with the production of ascospores.
2) **Basidiomycota** – sexual reproduction in a sack called a Basidium with the production of basediospores.
3) **Zygomycota** – A sexual reproduction by gametes while sexual reproduction with the formation of Zycospores.
4) **Fungi imperfecti** – nonrecognizable form of asexual reproduction most pathogenic fungi.



Structure

Molds	Yeasts
• Molds are aerobic, filamentous fungi including (mildews, rusts & smuts) • Molds tend to grow on surfaces rather than throughout substrates.	• Unicellular / nonfilamentous • Yeast are fungi which are: Typically sepherical or oval & Faculatively anaerobic • They are often observed as powdery coatings on plant material

- The fungal cell has typical eukaryotic features including a nucleus with a nucleolus, nuclear membrane and linear chromosomes.
- The cytoplasm contains organelles such as mitochondria and the Golgi apparatus fungal cells, which have a rigid cell wall external to the cytoplasmic membrane, differ from mammalian cells. The composition of that wall makes fungi different from bacteria and plants. Another important difference from mammalians involves the sterol makeup of the cytoplasmic membrane. In fungi, the dominant sterol is ergosterol. In mammalian cells, it is cholesterol.

Feature	Fungi	Bacteria
Diameter	Approximately 4 µm (Candida)	Approximately 1µm (staphylococcus)
Nucleus	Eukaryotic	Prokaryotic
Cytoplasm	Mitochondria and endoplasmic reticulum present	Mitochondria and endoplasmic reticulum absent
Cell membrane	Sterol present	sterol absent (except Mycoplasma)
Cell wall content	Chitin	peptidoglycan
Spores	Sexual and asexual reproduction	Endospores for survival, not for reproduction
Metabolism	Require organic carbon; no obligate anaerobes	Many do not require organic carbon; many obligate anaerobes

Metabolism

Fungal growth requirements

In contrast to bacteria, fungi tend to grow in places that are:

- More acidic
- Have higher osmotic pressure
- Are lower in moisture
- Are lower in nitrogen
- Contain coplex carbohydrates

Reproduction

- Fungi may reproduce sexually or asexually. Reproductive elements produced a sexually are termed conidia. Those produced sexual are termed spores, spores may be either sexual or a sexual in origin, sexual spores includes ascospors, Basidiospores or Zygospores. Sexual reproduction occurs by the fusion of two haploid nuclei followed by meiotic division of diploid nucleus. Asexual spores are produced in sac like cell called sporangia and called sporangiospores. Asexual reproduction results from division of nuclei by mitosis. Fungi that do not form sexual spores called Fungi imperfecti.
- **Basidiomycetes**
  Basidiospore. Examples: boletes, puffballs, smuts, stinkhorns & tooth fungi
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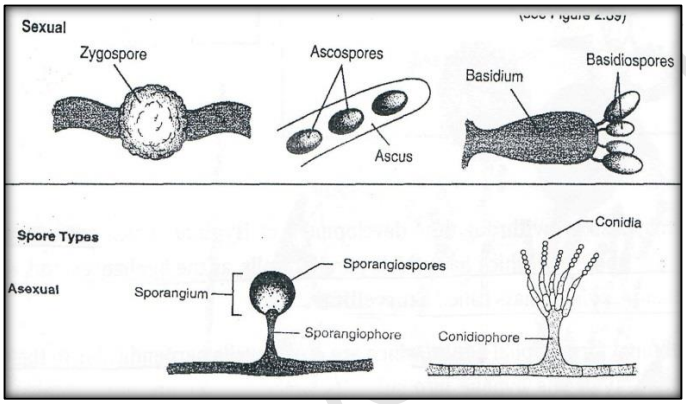
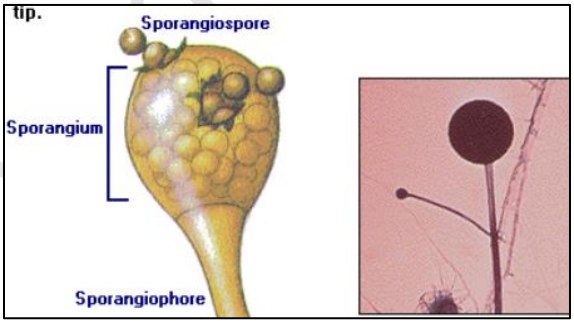


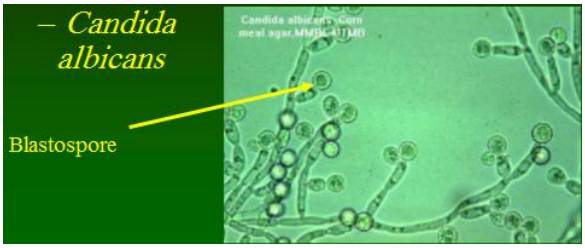
- **Culture**
  In vitro, culture at room temperature with low pH & minimal nutrients, supports the growth of environmental (mycelial) phase. Incubation at body temperature with media supplemented with blood & amino acids supports the growth of the body (yeast) phase of dimorphic fungi.
  Yeast & other filamentous fungi may grow in either condition

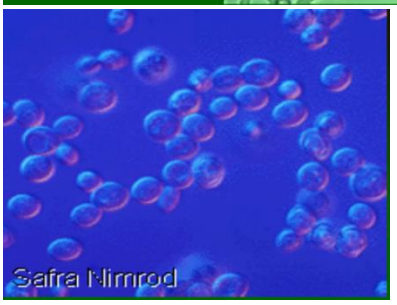
Asexual reproduction

- **Conidial fungus**
  - Reproduces by means of asexual spores called conidia
  - Conidia vary greatly in shape, size & color
  - Most of the common household molds & mildews are conidial fungi
- **Asexual spores**
  - **Conidiaspore**
    - Multiple (chains) or single spores formed at the end of an aerial hypha
    - Not enclosed within a sac
    - Aspergillus spp.
    - Penicillium spp.
  - **Sporangiospores (sporulation)**
    - Hundreds formed within a sac (sporangium) at the end of an aerial hypha (hyphal tip)
    - Rhizopus spp.



- **Entry**
  Fungi infect the body through several portals of entry. The first exposure to fungi that most humans experience occurs during birth, when Candida albicans encounter while passing through the vaginal canal. During this process the fungus colonizes the buccal cavity and portions of upper and lower gastrointestinal tract of newborn and maintains a lifelong as a commensal. Other fungi, malassezia furfur is common in areas of skin in sebaceous glands. The mechanism of disease with these two fungi is called endogenous both M. furfur and C. albicans are considered part of normal flora. Other fungi that have implicated in human diseases come from **exognous** sources, where exist as saprophytes.
- **Blastospores**:
  - Another type of conidiophore
  - A bud coming off the parent cell
  - Candida albicans





Diagnosis

- **Skin scrapings**
  Suspected to contain dermatophytes or pus from lesion can be mounted in 10-20 % KOH on a slide (wet preparation) to dissolve tissue materials leaving the fungus intact or stained with special fungal stains and examined directly under the microscope.
  Skin test is used be popular as a diagnostic tool, but this is now discouraged.
- **Serology**
  May be helpful when it is applied to a specific, these tests for the presence of antibodies in the patient's serum or CSF which are useful in diagnosing systemic mycosis.
  The most common serological test for fungi based on double immunodiffusion, complement fixation. The complement fixation test is most frequently used in suspected cases of Coccidioidomycosis, Histoplasmosis .
  If Cryptococcal meningitis, the presence of the polysaccharide capsular antigen of C.neoformas in CSF can be detected by Latex Agglutination text.
  Direct fluorescence microscopy may be used for fungal identification, calcofluor white is a fluorescent dye that binds to fungal wall and useful for identification of fungi in tissue specimen or cultures.
- **Biopsy and histopathology:**
  A biopsy may be very useful for the identification of tissue invading fungi. Gomori methenamine silver, H&E stain or Geimsa stains can used.
- **DNA probe:**
  This test is rapid (2 hours) and species – specific. Can identify colonies growing in culture at earlier stage of growing than can based on visual detection of colonies DNA probe are available for Coccidioidomycosis, blastomycosis, Histoplasmosis and cryptococcosis
- **Culture:**
  A definite diagnosis requires a culture. Pathogenic fungi are usually grown on Sabouraud dextrose agar it has a slightly acidic pH (5.6).
  Cycloheximide, penicillin or other inhibitory substances are often added to prevent bacterial overgrowth. Two cultures are inoculated and incubated at 25 degree C and 37 degree C to reveal dimorphism, the cultures examined macroscopically and microscopically, the appearance of the mycelium and the nature of a sexual spore are sufficient for identify of the organism.

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