# Microbiology/ Mycology

## Introduction

**Mycology** is the branch of biology concerned with the study of fungi, including their genetic and biochemical properties, their taxonomy and their use to humans as well as their dangers, such as toxicity or infection.

Fungi are fundamental for life on earth in their roles as symbionts and many fungi are able to break down complex organic biomolecules such as lignin, the more durable component of wood, and pollutants such as xenobiotics, petroleum, and polycyclic aromatic hydrocarbons. By decomposing these molecules, fungi play a critical role in the global carbon cycle.

Fungi are economically and socially important, as some cause diseases of animals (including humans) and of plants.

## Differences between Bacteria and fungi

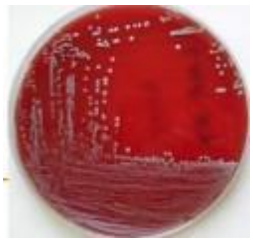
| **Basis for Comparison** | **Bacteria** | **Fungi** |
|---|---|---|
| **Definition** | Bacteria are single-celled microscopic organisms that are characterized by the presence of incipient nucleus and few membrane-less cell organelles. | Fungi, singular fungus, are eukaryotes that are characterized by the presence of chitin in the cell wall. |
| **Cell Type** | All bacteria are prokaryotes. | All fungi are eukaryotes. |
| **No. of cells** | Bacteria are unicellular organisms with simpler cellular structure. | Most fungi are multicellular with complex cellular structures. Some fungi like yeast might be unicellular. |
| **Cell wall** | The cell wall of bacteria is made up of peptidoglycan under which a cell membrane is present. | The cell wall of fungi is made up of chitin. |
| **Morphology** | Bacteria are found to have three distinct shapes : round (cocci), spiral (Spirilla), and rod-shaped (bacillus). | Fungi are found to have varying shapes, but most of them are spotted in the form of a thread-like structure called hyphae. |
| **pH** | Bacteria grow best in the neutral | Fungi mostly prefer a slightly |

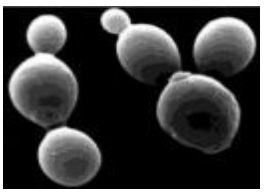
| | | |
|---|---|---|
| | environment of pH range 6.5-7. | acidic environment with pH value 4-6. |
| **Mobility** | Some bacteria are motile with flagella. | Fungi are immobile organisms. |
| **Reproduction** | Bacteria reproduce by an asexual method like binary fission. | Fungi reproduce through both asexual and sexual methods. Sexual reproduction takes place through fungal spores. |
| **Nutrition** | Bacteria can be autotrophs or heterotrophs. | Fungi are mostly heterotrophs that feed on dead and decaying matter. |
| **Respiration** | Bacteria perform aerobic and anaerobic respiration. | Most fungi like yeast perform ethanol fermentation or anaerobic respiration. |
| **Cell cycle** | Bacteria have shorter cell cycles ranging from 20 to 60 minutes. | Fungi have longer cell cycles ranging from 12 to 24 hours. |

**Morphological classification of fungi**

**A.Yeasts**
Unicellular, Nucleated rounded fungi

Ex: Saccharomyces cerevisiae

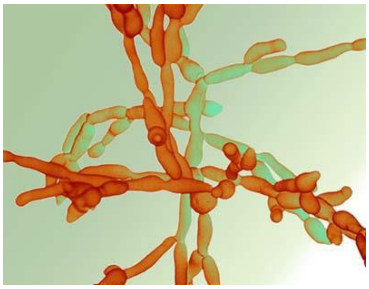


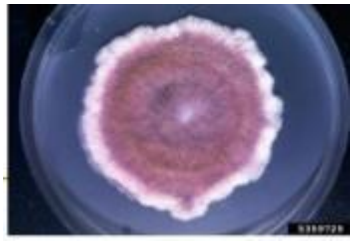
•Reproduce by budding
•Colony on solid media are usually white to beige and appear much like bacterial colonies
•Some genera produce mucoid colonies
•Yeast are used in the preparation in the variety of foods

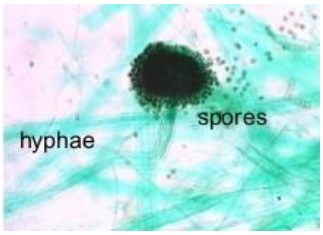
**B.Yeast like fungi**

•Grow partly as yeasts and partly as elongated cells resembling hyphae which are called pseudo hyphae
•e.x. Candida albicans

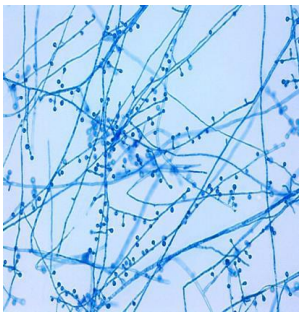


**C.Molds**
Multicellular hyphae
•Produce conidia (conidiospores)
•Colonies on solid agar are downy, fluffy, cottony
•Most mold colonies are pigmented and are useful in identification
•ex: *Penicillium* and *Cephalosporium*






**D.Dimorphic fungi**
•Occur in 2 forms:
Molds (Filaments) at 25 $^{0}$C (in soil), and Yeasts at 37 $^{0}$C (in host tissue)
•Most fungi causing systemic infections are dimorphic:
Histoplasma capsulatum
Blastomyces dermatidis



**E.Fleshy fungi**

**A mushroom or toadstool** is the fleshy, spore-bearing body of a fungus, tupically produced over ground, on soil, or on its food source . it belong to the phylum **Basidiomycota**

**Fungi reproduction (sexual and asexual)**

Asexual reproduction: also called somatic or vegetative.

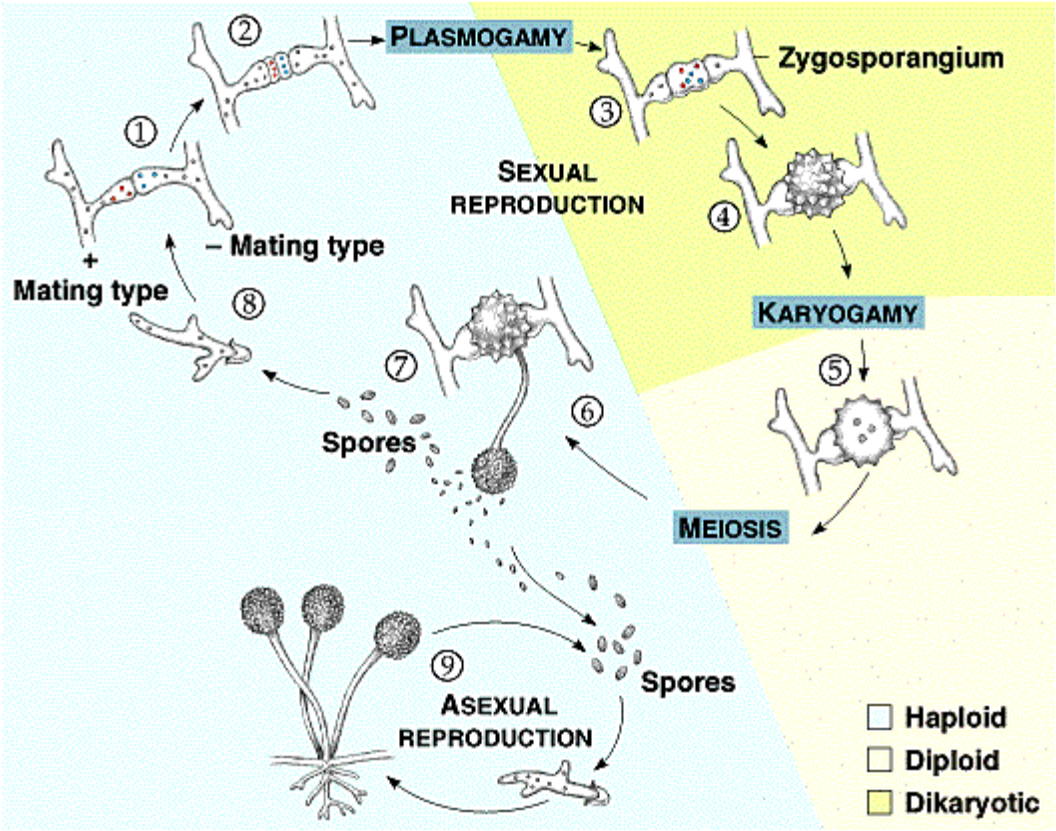
- Vegetative fragmentation method
- Transverse fission
- Budding
- Sclerotia
- spores

  sexual reproduction: it done in three consecutive steps

  1-plasmogamy

  2-karyogamy

  3-meiosis




**Classification of fungal diseases**

**A.Superficial mycosis**

**•The skin, hair, nail and mucous membranes**

1.Dermatophytosis (Ringworm) Form

Is a complex of diseases affecting the outermost keratinized tissues of hair, nail and parts of the skin Caused by dermatophytes mold fungi

2.Yeast infections
Affect the skin, nail and the mucous membrane of the mouth and vagina
Usually caused by *Candida* species

**B.Subcutaneous mycosis**
Subcutaneous types include : sporotrichosis, mycetoma and chromoblastomycosis, which generally affect deeper tissues in the epidermis and the dermis**.** There is usually a rash with superficial infection. Fungal infection within the skin or under the skin may present with a lump and skin changes.

**C.Systemic mycosis**
Are more serious fungal infections and include : cryptococcosis( yeast Cryptococcus) , histoplasmosis (Histoplasma ), pneumocystis pneumonia, aspergillosis( Aspergillus) and mucormycosis. Initially as a pulmonary infection through inhalation of air-borne spores ,then may disseminated to other organ.

–Caused by:
•Primary pathogens
•Opportunistic pathogens

**Black fungus disease (**Mucormycosis) is a severe invasive fungal infection caused by fungal species of mucorales typically seen in immunocompromised individuals. There has been an increased incidence of this fungal infection in patients suffering from **COVID 19 disease.** It most commonly infects the nose, sinuses, eye, and brain resulting in a runny nose, one-sided facial swelling and pain, headache, fever, blurred vision, bulging or displacement of the eye (proptosis), and tissue death. Other forms of disease may infect the lungs, stomach and intestines, and skin.

It is spread by spores of molds of the order Mucorales, through inhalation, contaminated food, or contamination of open wounds. These fungi are common in soils, decomposing organic matter (such as rotting fruit and vegetables), and

animal manure, but usually do not affect people. It is not transmitted between people. Risk factors include diabetes with persistently high blood sugar levels or diabetic ketoacidosis, low white cells, cancer, organ transplant, iron overload, kidney problems, long-term steroids or use of immunosuppressant, and HIV/AIDS.

**Laboratory diagnosis**

**Direct examination**

**1-potassium hydroxide (10-20%)**

The most rapid method for direct examination of infected material, a small piece of infected position should be mixed with KOH (10-20% OR 30%), gently heating the slide, then cover it with cover slip. The heating will increase the rate of clearing & the fungus should be more observed. The penefit of using KOH is to decoposition of natural skin.

**2-cultivation of fungi**

Place a small amount of hyphae or spores (or both) on the center of the agar medium in a Petri dish by using inoculating needle .

Temperature requirements : majority of fungi (37˚ C), superficial mycosis(30˚ C), Dimorphic fungi(25-37˚C).

Incubating time : usually cultures are obtained in 7-10 days, Candida & Aspergillus (24-72 hours) and Cryprococcus (up to 6 weeks).

Observe the development of colony over a period of incubation, noting **rate of growth**, **texture**, **pigmentation** on the surface and reverse side, as well as **folds or ridges** on the surface.

**Other tests:**

•Histology
•Serology
–ELISA
–Immunodiffusion
•Molecular biology
–PCR

**Antifungal therapy**

Fungal infections are hard to treat and can take a while to completely disappear. Treatment usually involves antifungal medications **fluconazole, ketoconazole, terbinafine and itraconazole** are orale agents reserved for extensive or severe infection which topical antifungal agents are inappropriate or ineffective, because of high cost, potential side effects and drug interactions

Topical antifungals ( creams, liquids or spray) are used to treat fungal infections of the skin and nails . they include **clotrimazole, econazole, ketoconazole, miconazole, terbinafine, and amorolfine**. They come in various different brand names.

## Critical thinking

1. Most fungi causing systemic infections are …….

A. molds

B. Superficial mycosis

C. toxic

D. dimorphic

2. …….. Is a complex of diseases affecting the outermost keratinized tissues of hair, nail and parts of the skin

A. Yeast infections

B. Mycetoma

C. Dermatophytosis

D. trauma

3. Penicillin is antibiotic produced by

A. Saccharomyces spp.

B. Penicillium notatum

C. Claviceps purpurea

D. mushrooms

4. People can get ……from their pets( Dogs and cats).

A. Histoplasmosis

B. blastomycosis

C. meningitis

D. ringworm