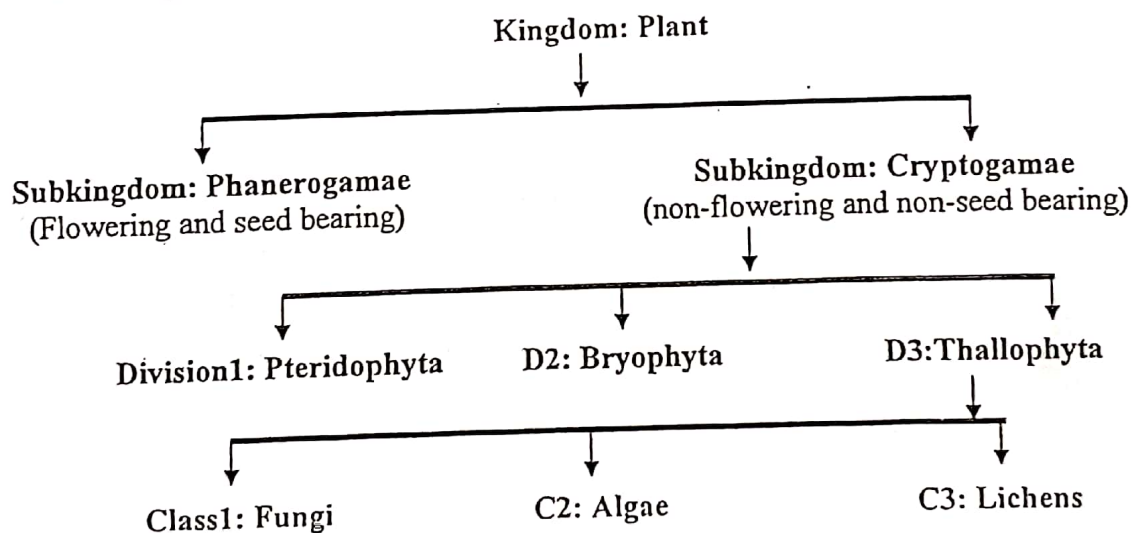


**Importance of Fungi:**

1. Fungi are the agents responsible for much of the disintegration of organic matter and such they affect us directly by destroying food, fabrics, leather and other consumer goods manufactured from materials subject to fungal attack; they cause majority of plant disease, and many diseases of animals and humans
2. They are the basis of a number of industrial processes involving fermentation, such as making of bread, wines, beers, the fermentation of cacao bean and the preparation of certain cheeses.
3. Production of many organic acids of some drugs such as ergotamine and cortisone and some vitamin preparations and are responsible for manufacture of a number of antibiotics, notably penicillin and grisofulvin.
4. Many fungi are particularly important in the decomposition of plant debris because of their ability to utilize cellulose.
5. Some of them are good for human such as *Agaricus bisporus*-edible mushroom
6. Use it as important research tools in cytologists, Geneticists, and Biochemists such as *Neurospora*.

The first classification system of fungi has been created by Eichler in 1883 who classified fungi as a class in kingdom plant as following:-

**This classification system was rejected for many reasons:**

- 1-Fungi have not chlorophyll, so the nutrition of fungi need ready media supply- Saprophyte- or some fungi are parasites.
- 2- Cell wall contains large amount of chitin except some of flagellates.
- 3- The growth in fungi by hyphal tips.
- 4- The fungal mycelium contains septum – in most fungi.
- 5- The growth rate, mitosis and life cycle are differing from plants.

Lecture 1

**The second classification system** was done by Whittaker in 1969, who divided the organisms into five kingdoms as following:-

Kingdom 1: Monera: This involves the unicellular or multicellular organisms but prokaryote such as Bacteria and cyanobacteria.

Kingdom 2: Protista: This involves the unicellular or multicellular organisms but Eukaryote such as Protozoa.

Kingdom 3: Mycetae : Mycota: This involves fungi , unicellular or multicellular organisms but heterotrophs.

Kingdom 4: Metaphyta: This involves all higher plants.

Kingdom 5: Metazoa: This involves all animals.

**What are fungi?**

At present, Biologists use the term fungi – fungus- to include: Eukaryotic, spore-bearing, Achlorophyllous organisms that generally reproduce sexually and asexually, and usually filamentous branched. Somatic structures are typically surrounded by cell wall containing chitin, cellulose or both.

**How fungi differ from Bacteria:**

1. All true fungi are aerobic, that mean they need oxygen for their development, reproduction and metabolisms, while bacteria are aerobic, anaerobic and facultative.
2. Cell type: Fungi are Eukaryote they have nuclear materials which is organized into chromosomes- nuclei of fungi are similar to the nuclei of mammalian cell- while bacteria are prokaryotic type – lack nuclear membrane.
3. Hydrogen ion concentration-pH- : In contrast to bacteria, fungi prefer an acid medium for growth, pH range for fungi between 3.8-5.6, with a pH 5.5 being near the optimum for most species investigated. While bacteria need pH for growth between 7.0-7.6 .
4. Temperature: Most fungi grow well between 0-35°C, but optimal temp. range is 20-30°C – Room temp. There are number of thermophilic fungi –have a maximum temp. for growth at above 50°C and a minimum at or above 20°C. While bacteria need 37°C- Human body temp.-
5. Cell wall structure: Cell wall contains large amount of chitin, cellulose, hemicellulose-N-acetyl glucosamine, 5-10% protein, 50-60% carbohydrate - Glucan-, While bacteria contain peptdoglycan. Furthermore, it has been shown



- that external factors such as composition of the media, pH value, and temp. may influence the composition of the fungal cell wall.
6. All fungi require very high sugar concentrations in the Lab. Media for the growth- 4-5%- While bacteria require 1.5% of sugar.
  7. All fungi are Gram positive structure.
  8. All fungi are sensitive to antifungal agents and resist to antibacterial agents according to cell wall structure.

### Morphology of fungi:

When fungi are grown on suitable medium, produce long, branching filaments, those called Mold. Each filament is called hyphae. Hyphae are long, slender transparent, wall filled or lined with a large of protoplasm varying in thickness. Generally 3-10 microns in diameter. If hyphae have cross wall, the fungus is said to be septate, if not aseptate or non septate or coenocytic hyphae Figure 1.

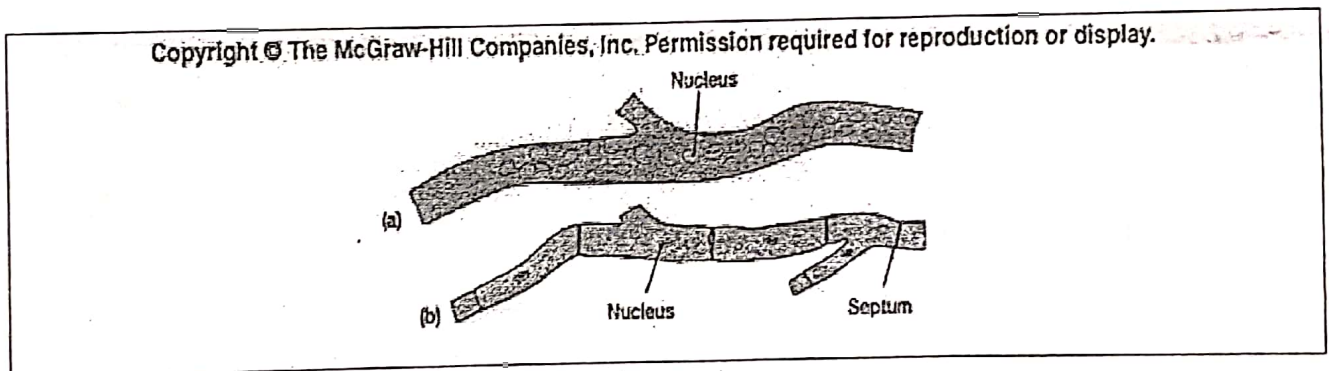


Figure 1

The presence or absence of these cross wall can be important in differentiating between certain classes. Hyphae may become divided into a chain of cells by the formation of septa- septum. As the hyphae continue to growth and branched a mat of growth called mycelium. The part of growth which project above the surface of substrate called aerial mycelium which hold the spores.

The part which penetrate into the substrate and absorbs food is known vegetative mycelium. The mycelium of parasitic fungi grows either by spreading between the cells or penetrating into them. The mycelium of fungus generally beings as a short-germ-tube emerging from a germinating spore. Fungal colony tend to be circular in out-line on solid medium, while the mycelium has a tendency to grow more or less equally in all directions from central point, and to develop colony- you can observe this by growing certain fungi on liquid and solid media-Figure 2.

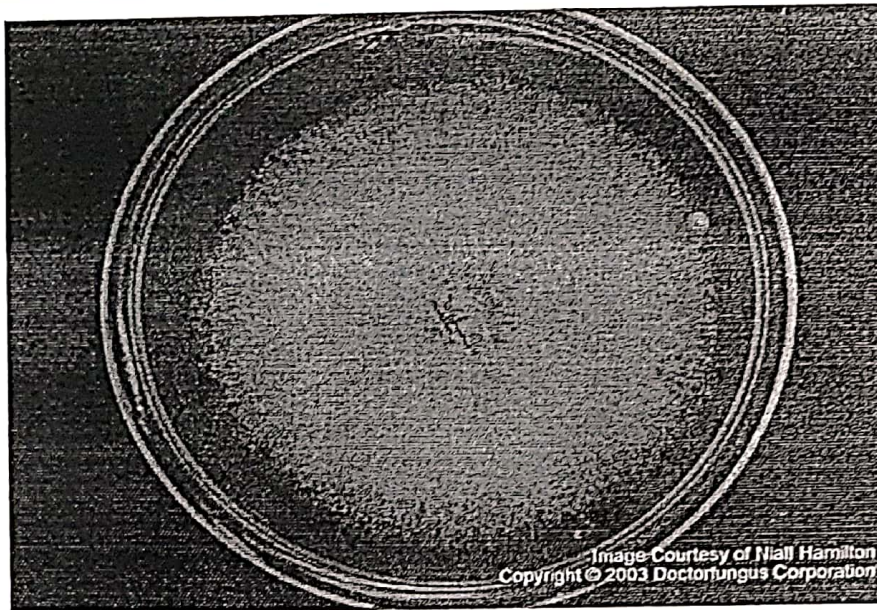
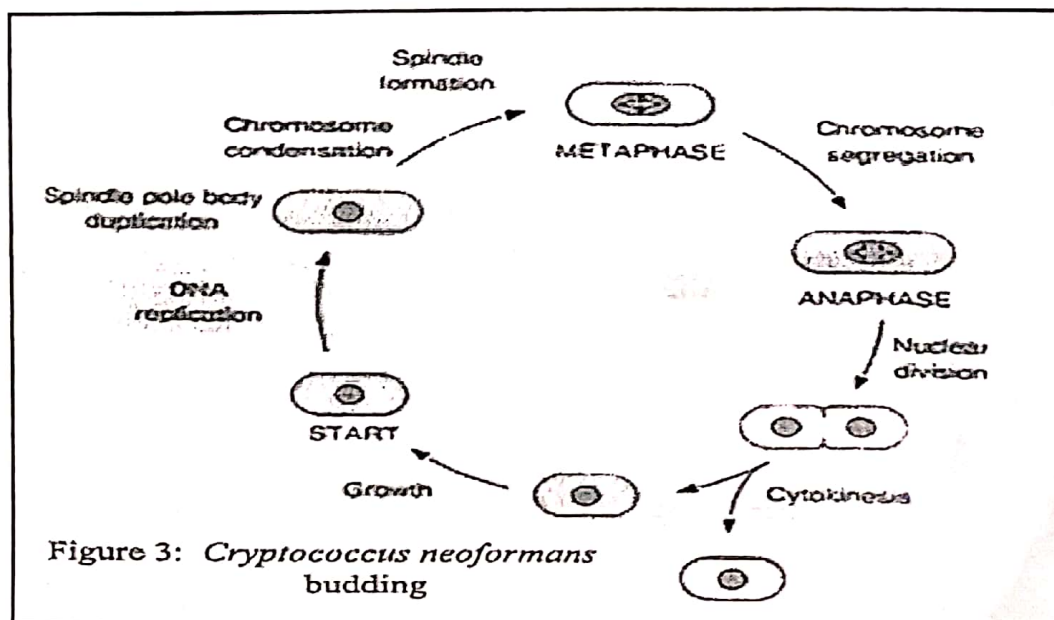


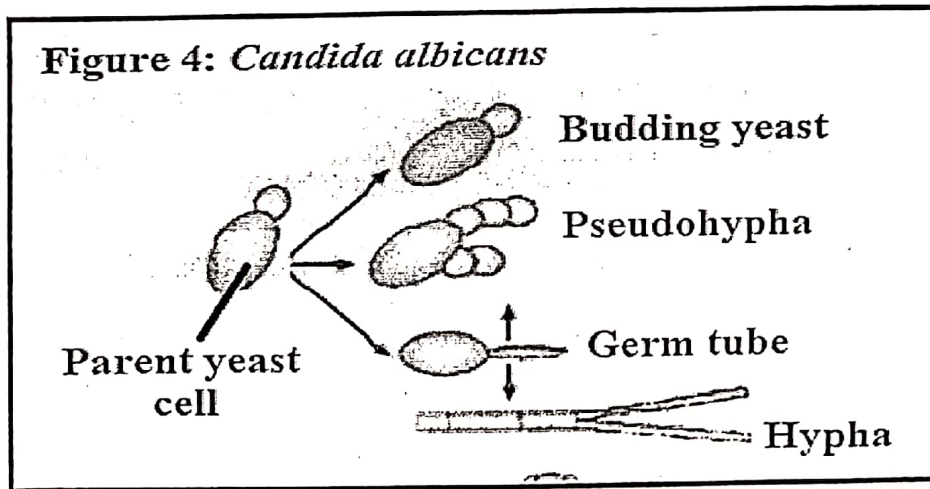
Figure 2

Fungi can be classified into four groups according to their morphology:

1. Mold – Mould: Which grow as branching filaments (hyphae) and produce the mycelium.
2. Yeast: Unicellular cells which appears as round cells, do not form spores but reproduce by budding of the parent cells. This process of budding results in the production of two cells. Most are single celled structure with a thick cell wall such as *Cryptococcus neoformans* Figure3.
3. Yeast-like fungi: Also reproduce by budding and grow as non branching filament- pseudohyphae- such as *Candida albicans* Figure 4.
4. Dimorphic fungi: They grow as yeast form in tissue when incubated at 37°C *in vitro*, but when incubated at 22°C grow as mycelium form. This group of fungi have two phases of growth – Dimorphic such as:- *Histoplasma capsulatum* ; *Blastomyces dermatitidis*.







### Reproduction:

Most fungi reproduce by forming spores. Spore – seed- : a simple propagating unit without an embryo that serves in the production of new individuals of the same species. Fungi do not possess stems, roots, or leaves; they are usually filamentous and multicellular. Spores are similar to the seed of higher plants in their functions.

There are two types of spores:

1 - **Asexual spores:-** Which occurs by the process of mitosis. This is most common process by which spores are reproduced in fungi.

There are four types of medically important:

- a. **Blastospores:** The type of spore develop by budding.
- b. **Chlamyospores:** In some fungi the hyphal cell become specialized spore when the cell enlarged and develop thick walls.
- c. **Arthrospores:** Other hyphal cells break apart and produce arthrospores. Fragmentation may also happen naturally by the action of wind, soil movement or insects.
- d. **Conidia:** A conidium is produced on a specialized structure called conidiophore. A spore which is produced directly on a hyphae or hyphal tips is called Aleuriospore, when a fungus produce two sizes of aleuriospores : The large one is called Macro- aleuriospore., The smaller one is called Micro-aleuriospore.

2- **Sexual spores:** Reproduce by meiosis

- a. **Ascospores:** Usually 4-8 spores found in a cell called ascus- asci.
- b. **Basidiospores:** Usually 4- spores found in the surface of cell called basidium.
- c. **Zygosopores:** Large-thick walled spore formed on hyphae.
- d. **Oospores:** This type of spore formed inside cell called oogonium.