

By Prof. Hala Tabl

AN INTRODUCTION TO MYCOLOGY



Mycology

Is the study of fungi

From greek “mykes” i.e mushroom



What are fungi



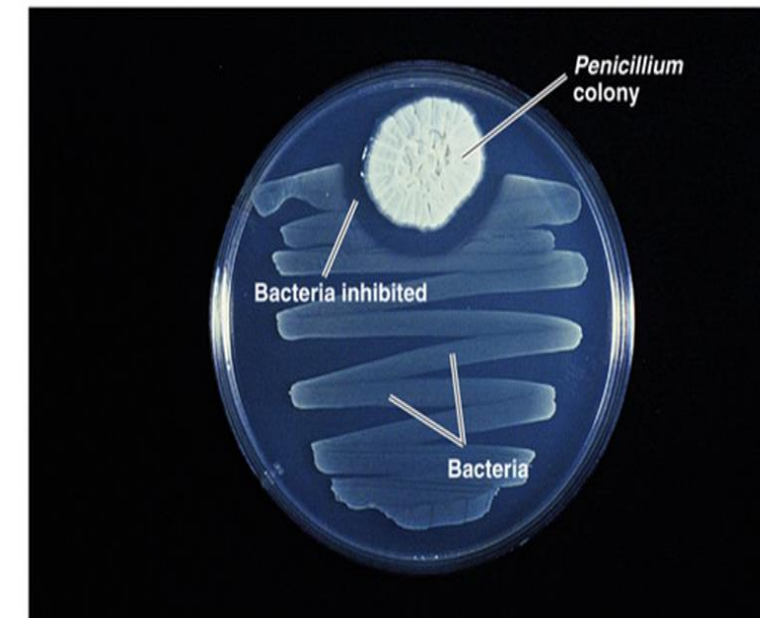
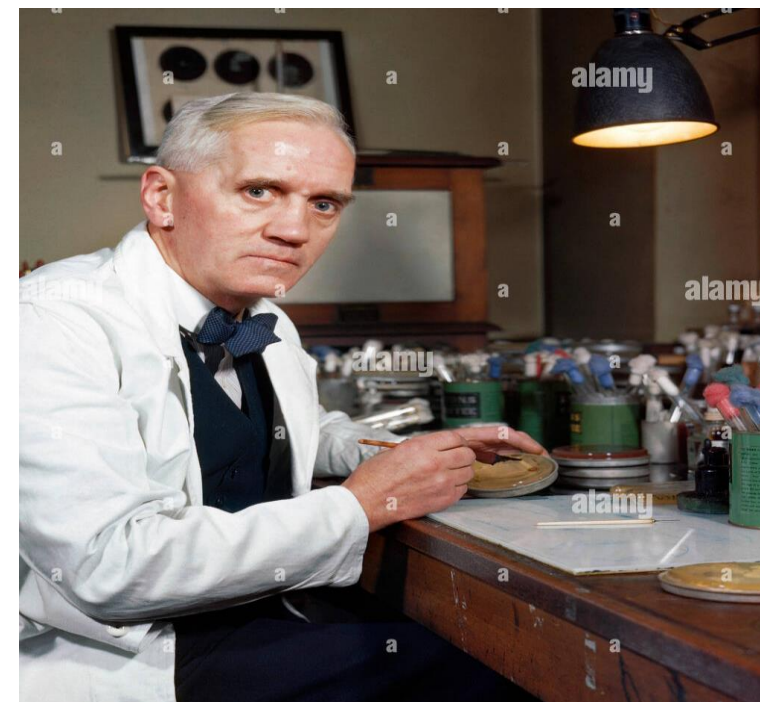
- Fungi are eukaryotic organisms.
- All fungi have a heterotrophic existence as:
Saprophytic, Symbiotic, Commensals or Pathogenic.
- The natural habitat of most fungi is the environment. An important exception is **Candida albicans**, which is part of the normal human flora.

Importance of fungi

“Fungi has both beneficial and harmful aspects”

1) **Alexander Fleming**; "When I woke up just after dawn on September 28, 1928, I certainly didn't plan to revolutionise all medicine by discovering the world's first antibiotic, or bacteria killer“. But I suppose that was exactly what I did.”

1945 Nobel Prize in Medicine for the **discovery of penicillin** from saprophytic mold called “*Penicillium notatum*”.



2) **In Medicine:** *Production of many important drugs and antimicrobials, vaccines,...



Antifungal Griseofulvin
from *Penicillium
griseofulvum*.



Ergot, used to induce uterine
contractions, from *Claviceps
purpurea*

*Fungi are widely used model organisms in genetic engineering.



Blue cheese



Wine



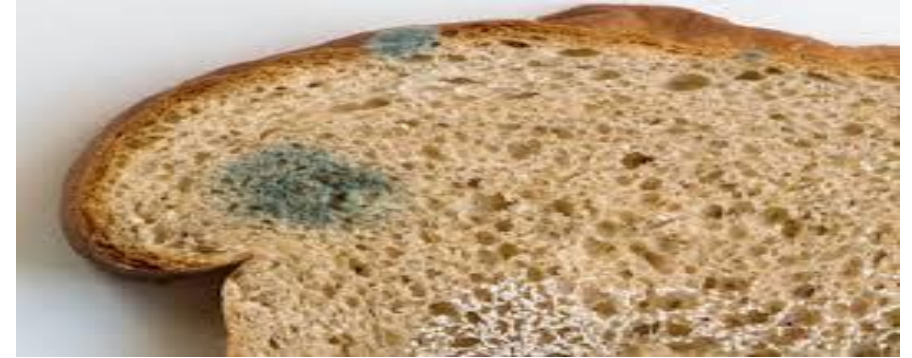
Soy Sauce.

3) Food industry and processing:

Fungi are used in the production of important foods (e.g., bread, cheese, wine,...).



Bread



4) They are common cause of damage to:
crops, foodstuffs, fabrics and building materials.



5) Few species of fungi can cause disease in human and animals.

Fungal diseases may be due to either:

Infection

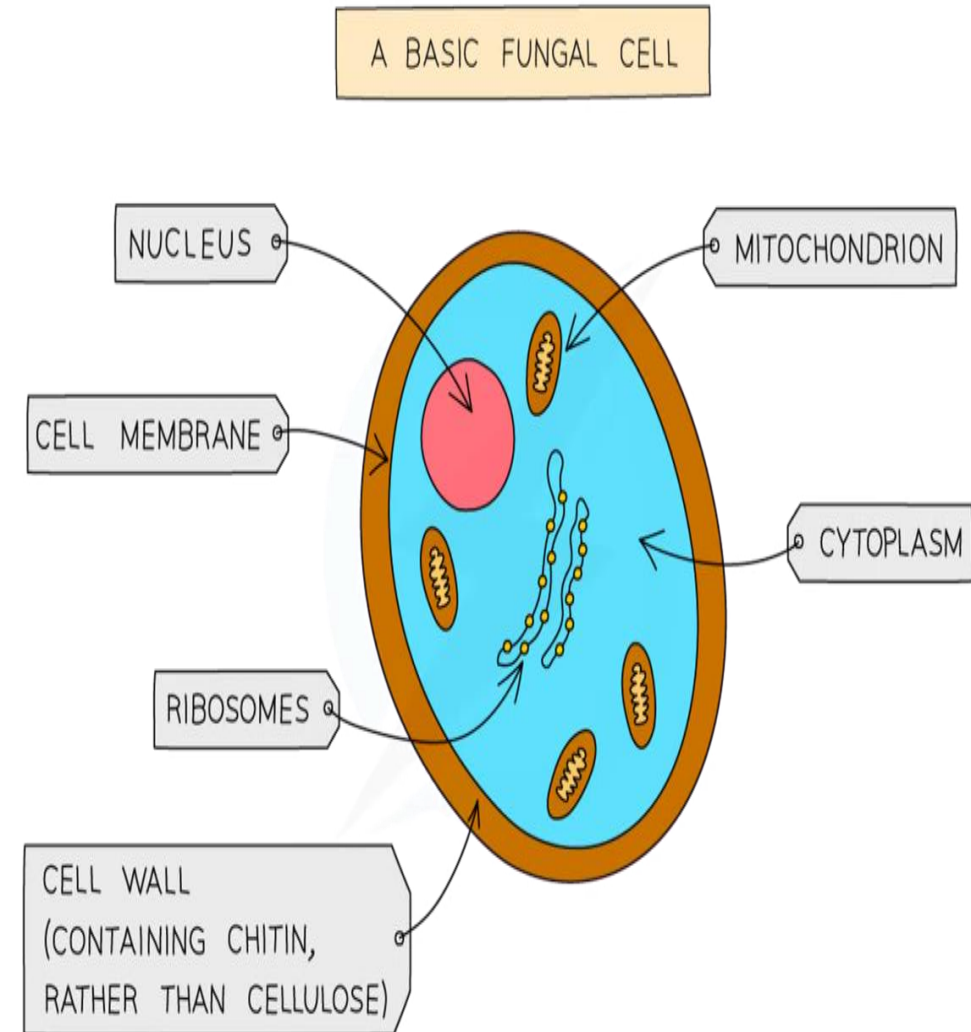
Allergies

Mycotoxins

Structure of Fungi

Fungi are **Eukaryotic** organisms

1. Have a **true nucleus** with nuclear membrane.
2. Have **membranous organelles** (e.g. Golgi apparatus, endoplasmic reticulum and mitochondria).



3. Their cell membrane containing ergosterol.

➤ In contrast to:

-Human cell membrane, which contains cholesterol.

-Bacterial cell membrane, which contains phospholipids.

➤ The main **target** of some antifungal drugs e.g. Polyne and azole drugs.

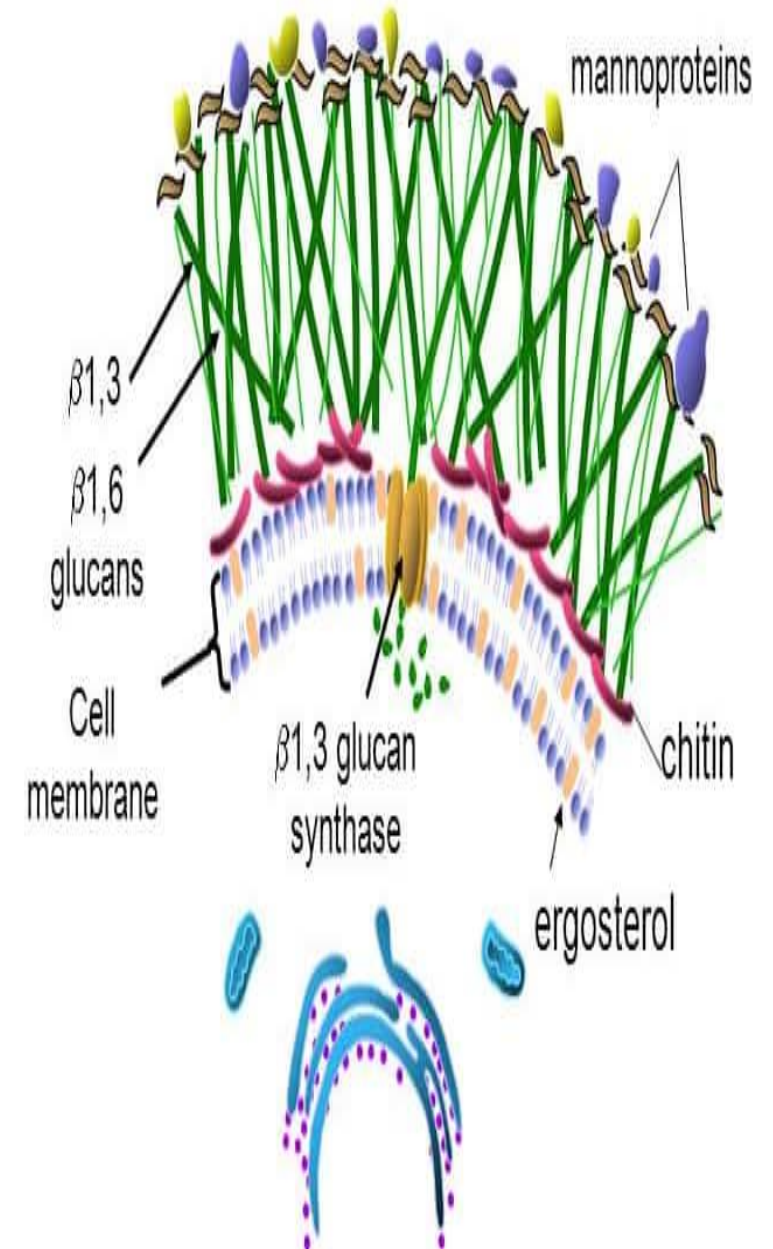
4. Their cell wall consists mainly of polysaccharides:

a) Chitin

b) β -glucan

Medical importance of fungal cell wall:

- There is **NO** peptidoglycan as in bacteria; thus fungi are **insensitive** to antibiotics, such as penicillin.
- **β -glucan** is the target of the antifungal drug, Echinocandin (e.g. Caspofungin).
- **Hypersensitivity** to its components.



5. Capsule :

- Polysaccharide capsule.
- Antiphagocytic activity.
- By some fungi as (*Cryptococcus neoformans*).

Comparison between Fungi and Bacteria

Feature	Fungi	Bacteria
Diameter	Approximately 4 μm (<i>Candida</i>)	Approximately 1 μm (<i>Staphylococcus</i>)
Nucleus	Eukaryotic	Prokaryotic
Cytoplasm	Mitochondria and endoplasmic reticulum present	Mitochondria and endoplasmic reticulum absent
Cell membrane	Sterols present	Sterols absent (except <i>Mycoplasma</i>)
Cell wall content	Chitin	Peptidoglycan
Spores	Sexual and asexual spores for reproduction	Endospores for survival, not for reproduction
Thermal dimorphism	Yes (some)	No

Prokaryotes (Bacteria)

Eukaryotes (Fungi)

0.1-10 um

10-100 um

No nuclear membrane

Nuclear membrane

Single chromosome

multiple

No histones

Histones

Binary fission

Mitotic division

No organelles

Organelles

Peptidoglycan

Chitin

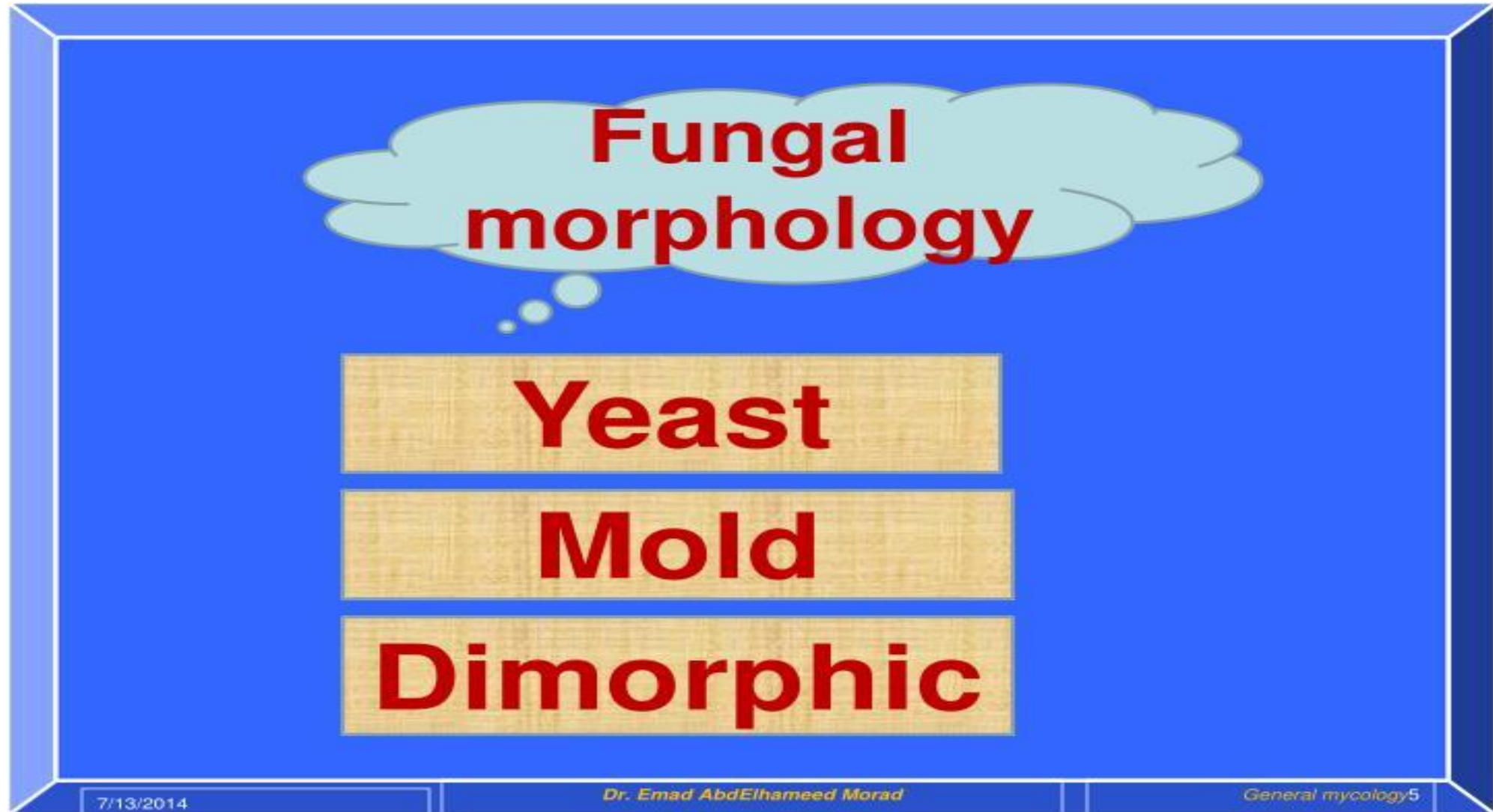
No ergosterol

Ergosterol

70 S ribosomes

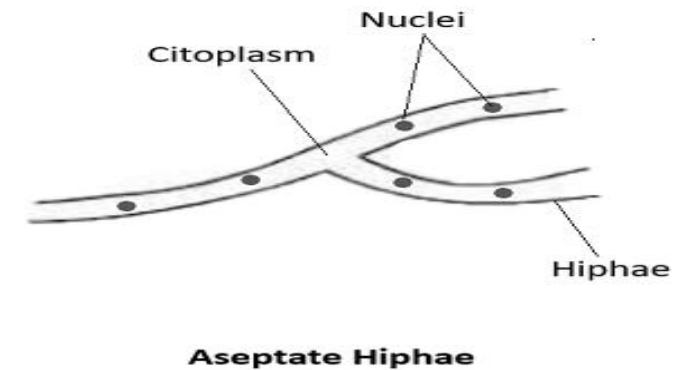
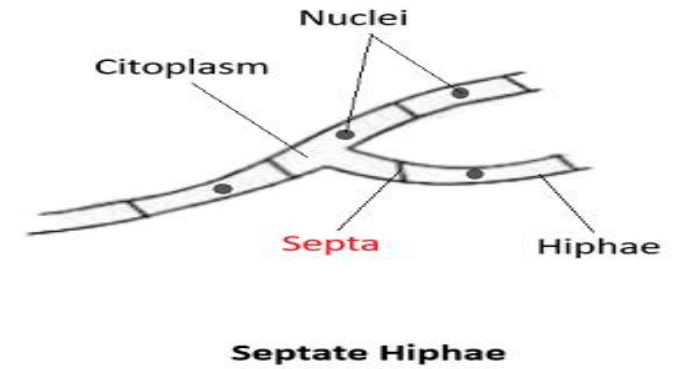
80 S ribosomes

Morphological classification of fungi



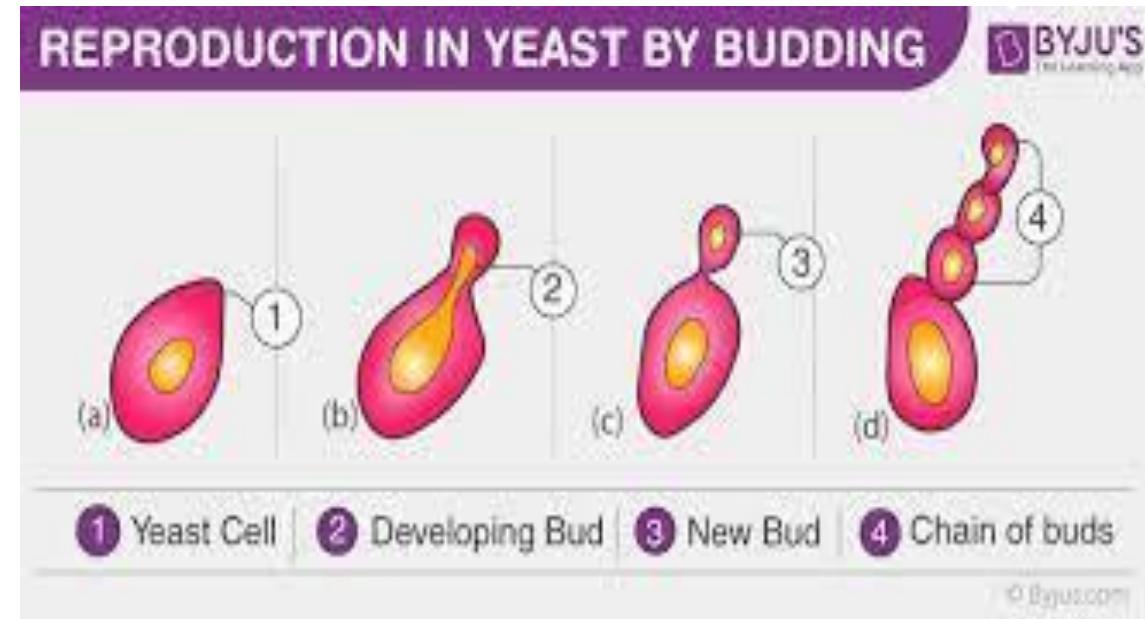
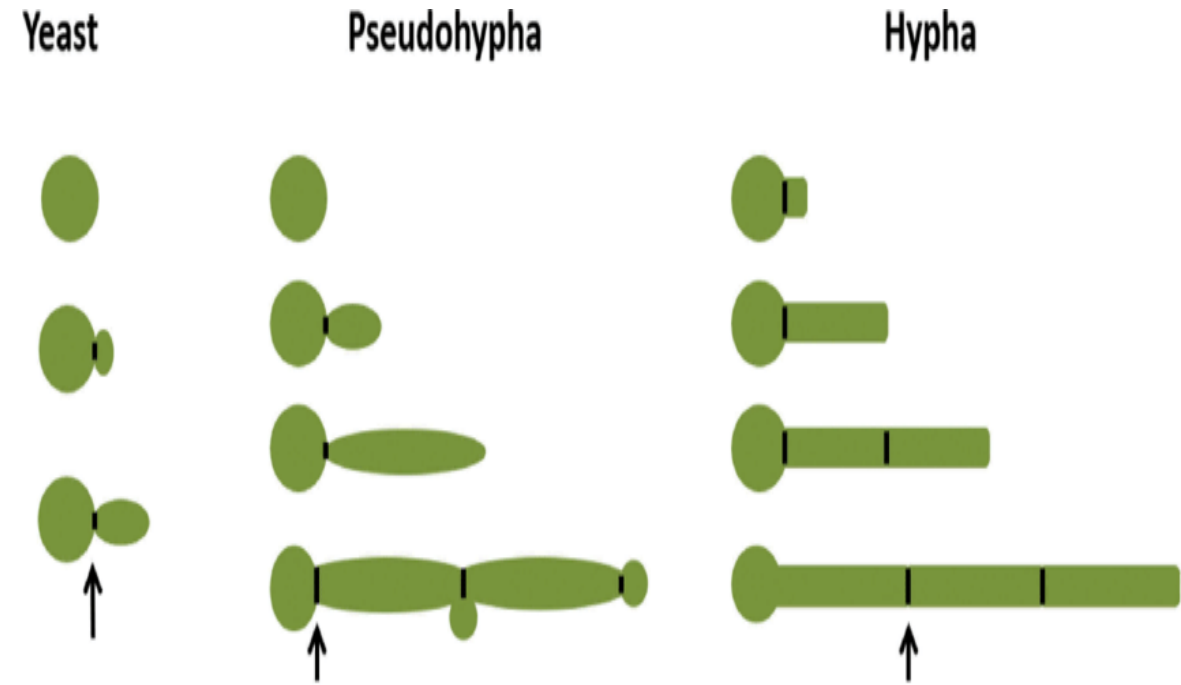
1-Mold (filamentous fungi):

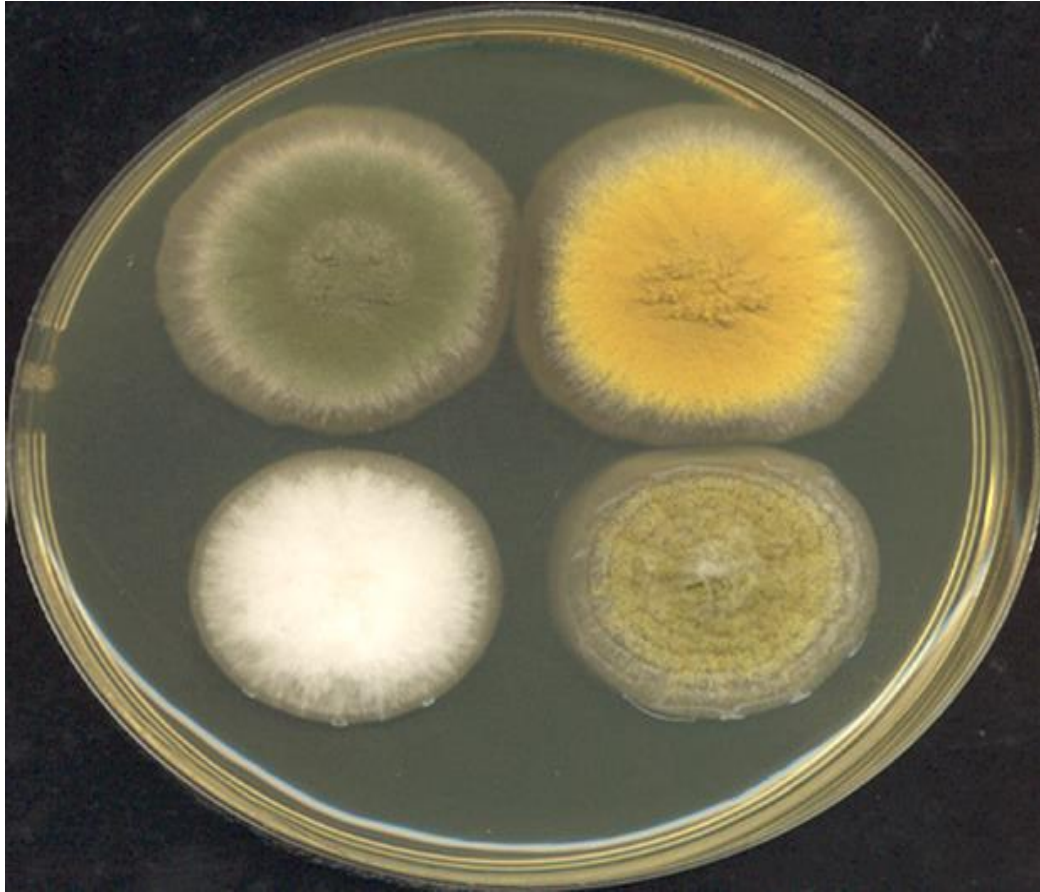
- They are multicellular fungi which produce **hyphae** (i.e) microscopic long branching filaments.
- There are 2 types:
 - a-Molds with **septate** hyphae (i.e) with cross walls in hyphae.
 - b-Molds with **aseptate** hyphae (i.e) without cross walls in hyphae.
- **Mycelium**: a mass of hyphae.
- Example: **Dermatophytes & Aspergillus.**



2-Yeasts (Budding fungi):

- Oval or rounded single cells.
- Reproduce by **budding (blastospore)**.
- Have **NO** hyphae, but some yeasts may have elongated budding cells linked in branches called **pseudo-hyphae**.
- Example: **Candida & Cryptococcus**.





Mold colonies



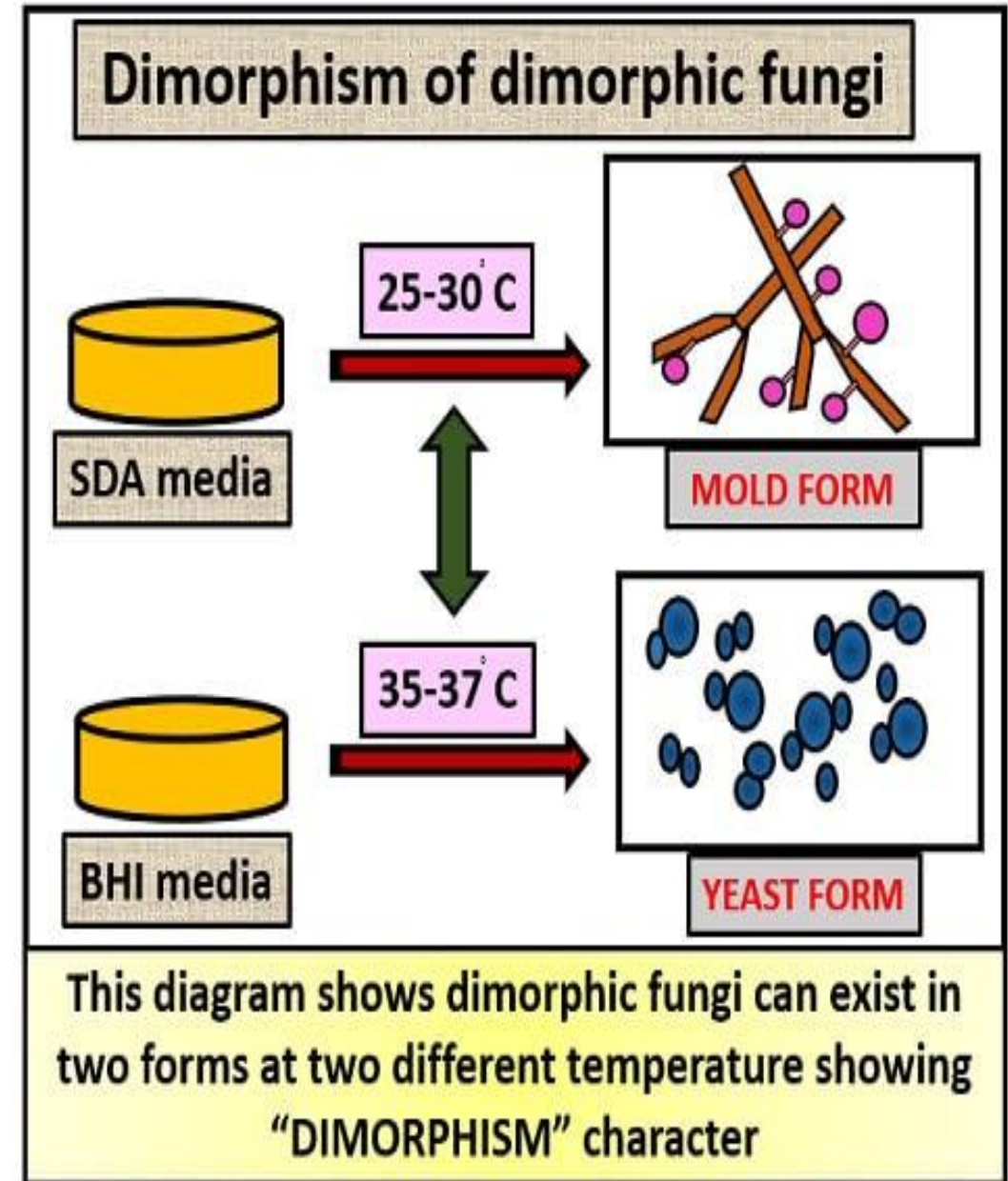
Yeast colonies

3-Dimorphic fungi: (Dimorphism)

Some fungi can occur in 2 different forms:

- In nature or in culture at room temperature, they occur in a filamentous form (**molds**).
- In infected tissues or when incubated at 37°C they occur in a **yeast** form.

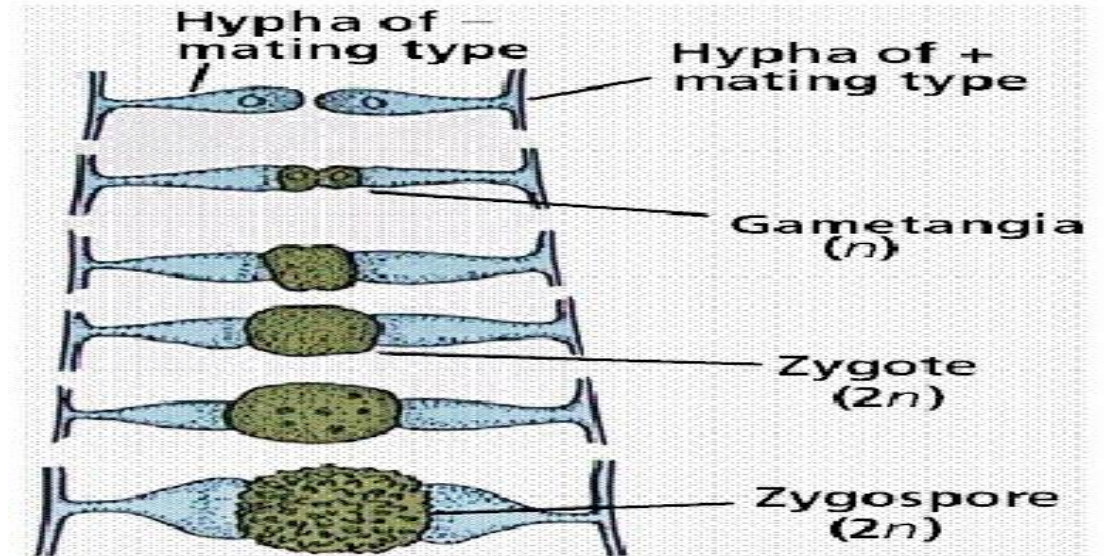
Example: *Histoplasma capsulatum* & *Sporothrix schenckii*



Fungal reproduction

(1) Sexual reproduction (perfect fungi):

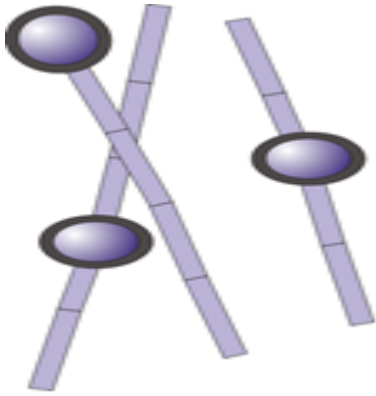
When two parents' spores combine to produce a zygospore.



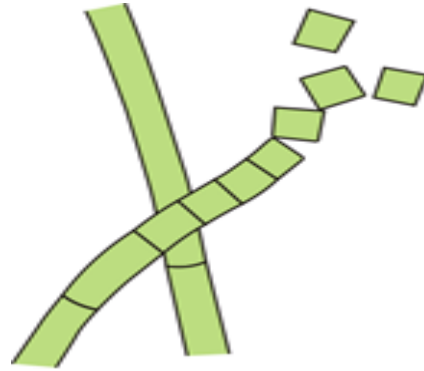
(2) Asexual reproduction (imperfect fungi):

-**Most** of the common pathogenic species are **imperfect** fungi and propagate by forming **conidia** (Asexual spores).

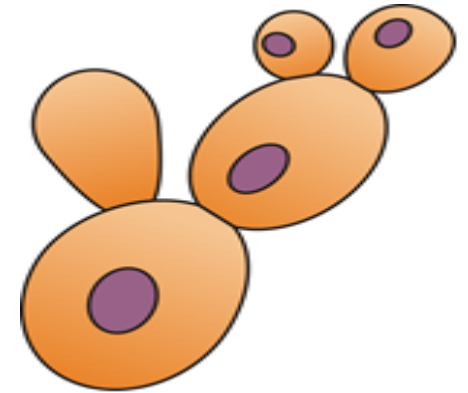
The principle types of fungal asexual spores



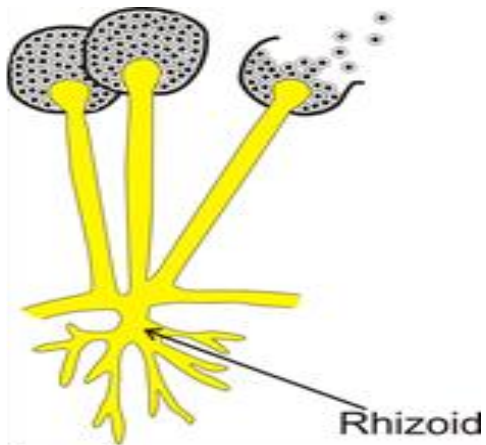
Chlamydospore



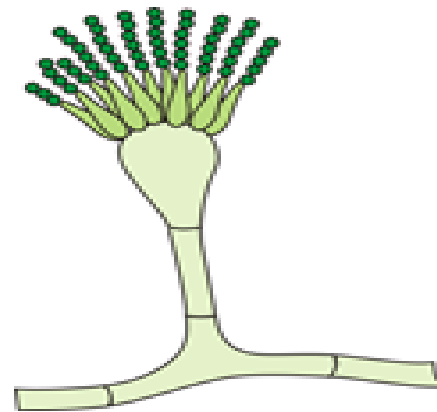
Arthrospore



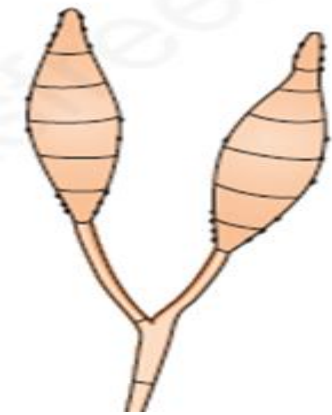
Blastospore (budding)



Sporangiophore



Microconidium



Macroconidium

HUMAN MYCOSES

(Clinical classification of fungi)

According to the **site** of the body affected, human mycotic infections are grouped into:-

- (1) Superficial mycoses.**
- (2) Subcutaneous mycoses.**
- (3) Systemic (deep) mycoses.**

Superficial Mycoses

Affect the **skin** and / or **mucous membrane, hair or nails.**

The important superficial mycoses include:

- (1) Pityriasis versicolor (Tinea versicolor).**
- (2) Candidiasis of the Skin and / or mucous membranes.**
- (3) Dermatophytosis (Ringworm infection).**

Pityriasis versicolor (Tinea Versicolor)

- Caused by **Malassezia furfur**.
- Affect the **skin** and the infected areas are recognized by their **de-pigmentation** especially on tanned skin in the summer.
- Usually asymptomatic, only cosmetic importance.



Candidiasis (Moniliasis)

- Caused by *Candida*, a budding **yeast**.
- *Candida albicans* (the commonest cause of candidiasis) is a member of the normal flora of the mucous membranes of respiratory, gastrointestinal and female genital tracts.
- *Candida albicans* are **opportunistic** fungi which may dominate and become associated with pathological conditions. Among the **predisposing factors** are the following:
 - 1- Diabetes mellitus (high glucose level).
 - 2- Immunodeficiency e.g. HIV infection, corticosteroid therapy and immunosuppressive drugs.
 - 3- Prolonged broad spectrum antibiotic therapy (alter the normal bacterial flora).
 - 4- Pregnancy and contraceptive pills (high progesterone level).

Superficial candidiasis include:

1- Candidiasis of the **skin** especially in:

- Axilla, Groin, intergluteal folds, diaper rash (warm, moist areas). The lesion is itchy, flat, red with smaller "satellite lesions" nearby.

2- Candidiasis of **mucous membranes**:

- Oral thrush, esophagitis, vaginal thrush.

3- **Mucocutaneous** Candidiasis.

- Angle of the mouth.



Candidiasis of the skin



Oral thrush

Mucocutaneous Candidiasis

Dermatophytes (Ringworm):

- They are **filamentous** fungi.
- They are classified into 3 genera:



1) Microsporum

2) Trichophyton

3) Epidermophyton

- They infect only the superficial **keratinized** layers of the **Skin, Hair** and **Nails**. They **never** spread to deeper tissues.
- Infections acquired from soil or active ringworm lesions (**contagious disease**).
- The spores settle on the skin, germinate, and form a mass of branching hyphae which-grows out radially to produce circular or **ring-like lesions** (**hence the name ringworm**).

Clinically Ringworm is referred to as **Tinea**. The lesion is itchy, scaly and red (with central clearing and raised border). According to the affected site, tinea may be:



Tinea capitis (scalp)



Tinea corporis (body)



Tinea cruris (groin)



Tinea of the nails (onychomycosis)



Tinea pedis (Athlete's foot)

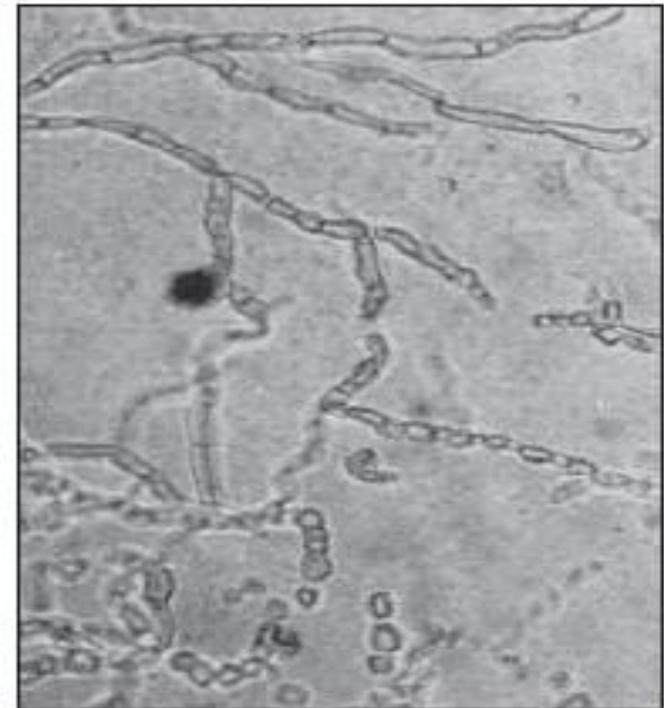
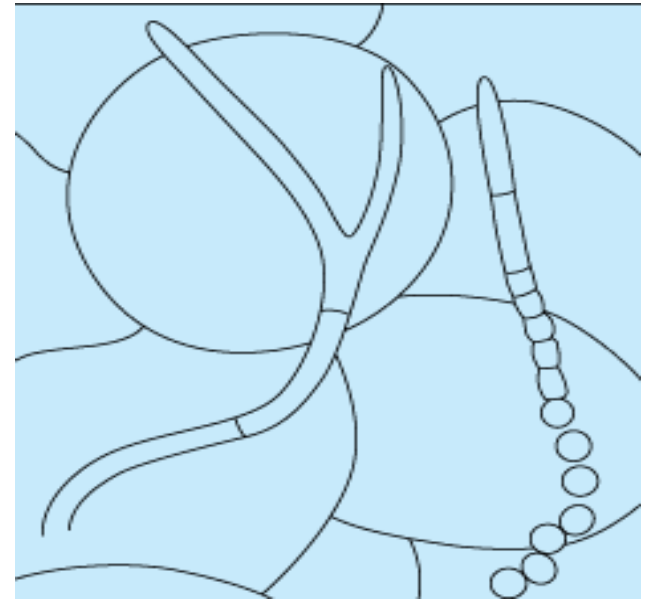
Laboratory diagnosis of dermatophytosis

Specimen:

Skin scrapings, Nail piece or Hairs.

Direct microscopy

- Specimen is placed on a slide with a drop of **20% KOH** to digest the keratin surrounding the fungus.
- All species of dermatophytes appear as **septate hyphae** and **arthrospores**.



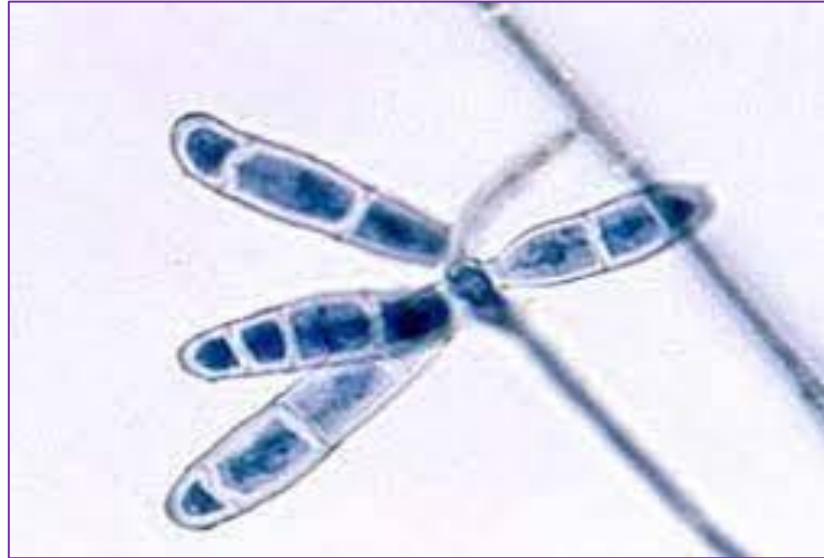
Culture

On sabouraud's agar: Incubate at room temp (22- 25°C) for up to 3 weeks.

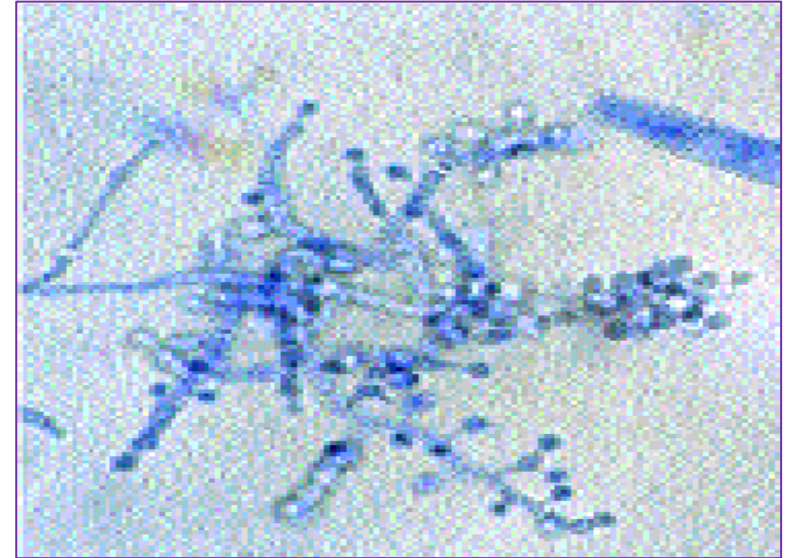
A lactophenol cotton blue stained film show **spores** of the three genera of dermatophytes



Microsporum
Spindle shaped



Epidermophyton
Club shaped



Trichophyton
Rounded or oval

The Quiz Time



Which statement regarding fungi is correct?

- (A) All fungi are able to grow as yeasts and molds.
- (B) Although fungi are eukaryotes, they lack mitochondria.
- (C) Dimorphic fungi produce hyphae in the host and yeasts at 25°C.
- (D) The major components of fungal cell walls are chitin & glucans.
- (E) Fungi have single chromosome.

A 10-year-old child complains of a burning sensation in his mouth and pain on swallowing. He has a history of two weeks antibiotic treatment for previous chest infection. On examination, whitish lesions are seen on his tongue, palate and pharynx. Gram stain of a swab from the lesions demonstrates budding yeast. The most likely diagnosis is:

- A) Infection with *Herpes simplex* virus.
- B) Infection with *Candida albicans*.
- C) Infection with *Cryptococcus neoformans*
- D) Infection with *Histoplasma capsulatum*.
- E) Infection with *Microsporium canis*.

An 8-year-old girl has an itching rash on her chest. The lesion is round with an inflamed raised border and central clearing. What do you expect to see in KOH preparation of skin scrapings from his lesion?

- A) Pseudo-hyphae.
- B) Septate hyphae and chlamydospores.
- C) Budding cells.
- D) Septate hyphae and arthrospores.
- E) Aseptate hyphae and arthrospores.

Dermatophytes are fungi that:

- A) Infect the superficial keratinized areas of the body.
- B) Cause inapparent systemic infections.
- C) Invariably invade the subcutaneous tissues.
- D) Produce morphologically identical spores by all genera.
- E) Best grow at 37°C.

Thank
you

