General Mycology

Level 1, Semester 2

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Learning Outcomes

- Explain the general structure of fungi.
- Discuss the morphology of fungi.
- Describe the methods of multiplication of fungi.
- State the sources and mode of transmission of fungi.
- Outline the classification of common medically important fungi.
- Define and compare superficial, cutaneous, subcutaneous, and systemic mycosis, with respect to the tissue involved.

Agenda

- Structure and Morphology of Fungi.
- Reproduction of Fungi.
- Source and mode of transmission.
- Classification of medically important fungi.
- Mycosis

Case scenario

A 40-year-old woman came to the dermatology clinic complaining of erythematous scalp lesions and annular patches combined with hair loss. No other systemic symptoms were found. She denied contact with animals; other family members were asymptomatic.

- What is the most likely case diagnosis?

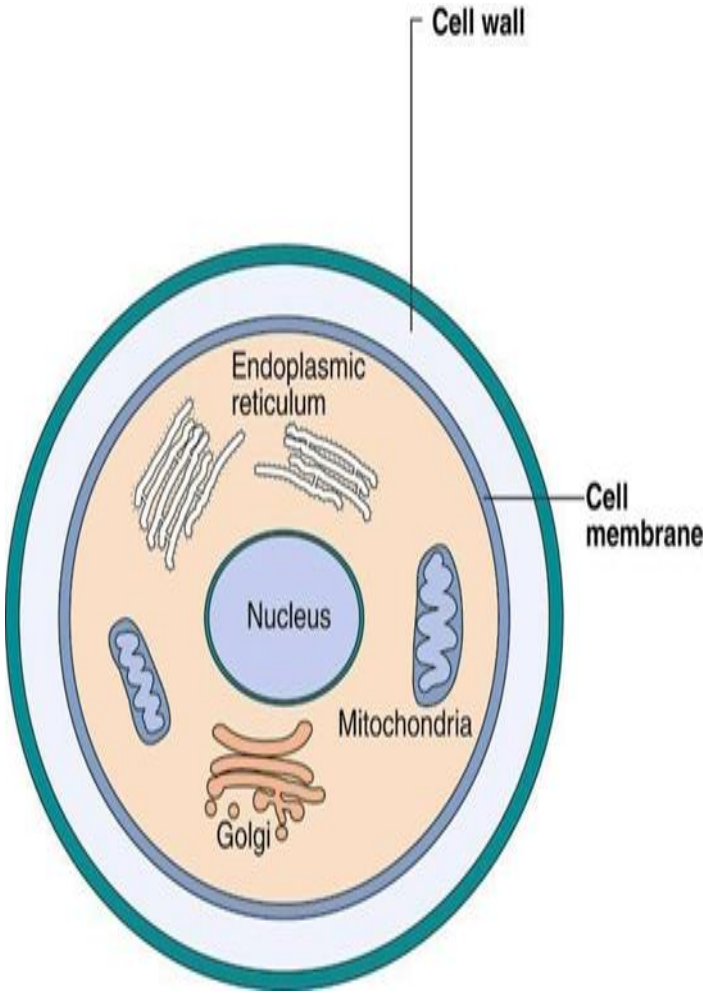
Structure and Morphology of fungi

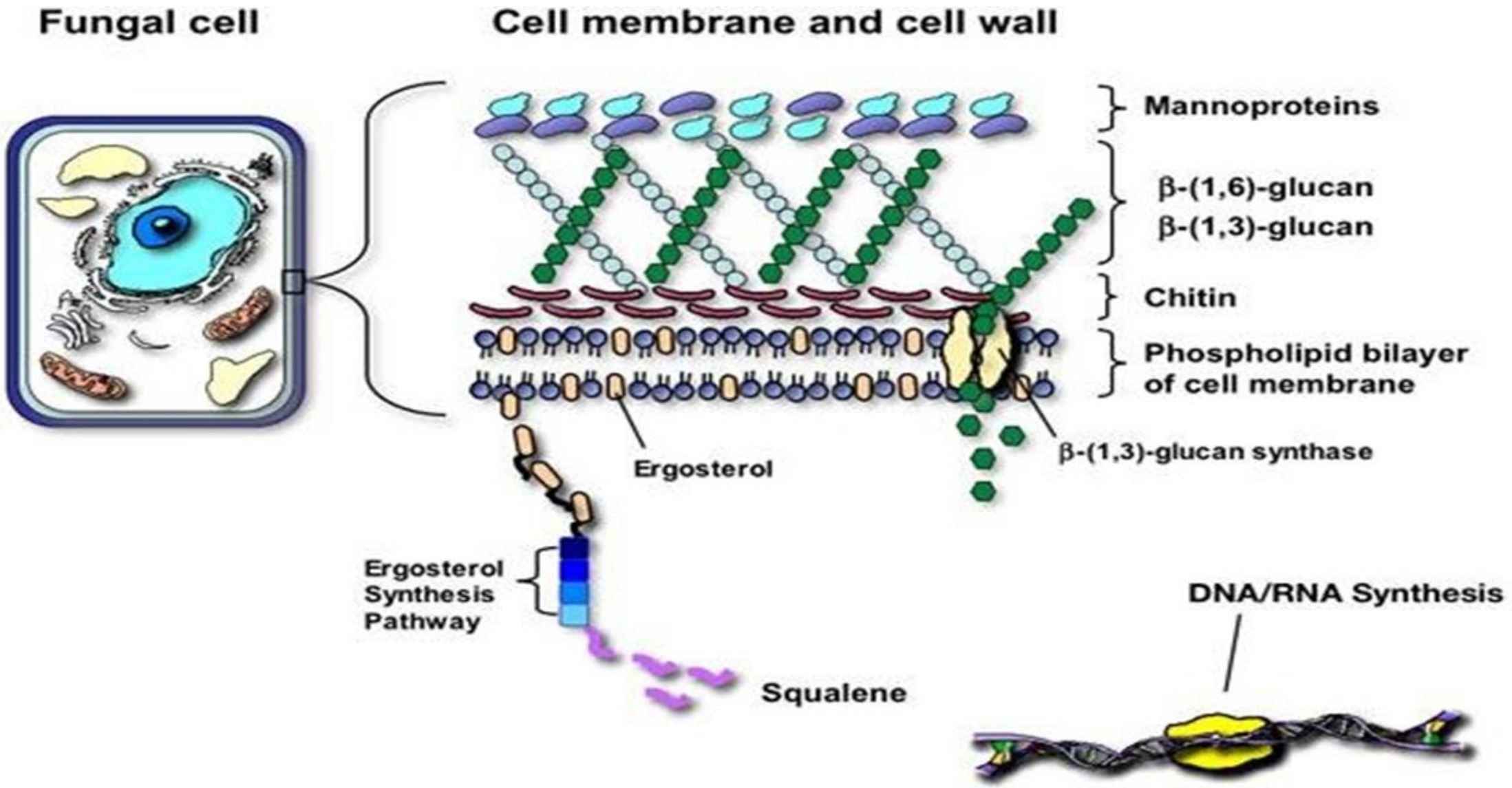
Structure of fungi

- Fungi are eukaryotic organisms having true nuclei with definite nuclear membrane, nucleolus, cytoplasmic organelles

- Fungi possess rigid cell wall made of chitin (a polymer of N-acetyl glucosamine), glucans, mannans & complex polysaccharide.

- Cell membrane contains ergosterol and encloses the cytoplasm, vacuoles, Endoplasmic reticulum, mitochondria.



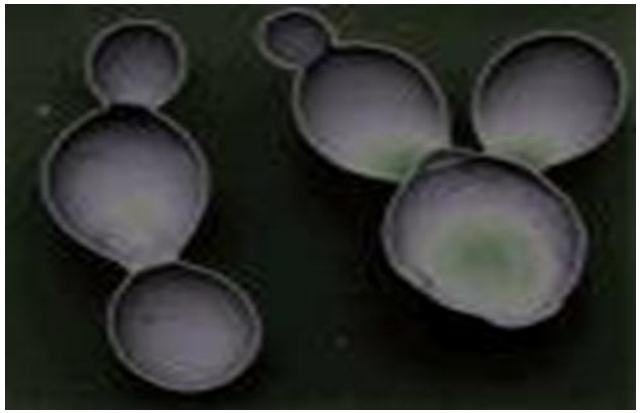

Fungal cell
Cell membrane and cell wall
Mannoproteins
β-(1,6)-glucan
β-(1,3)-glucan
Chitin
Phospholipid bilayer of cell membrane
β-(1,3)-glucan synthase
Ergosterol
Ergosterol Synthesis Pathway
Squalene
DNA/RNA Synthesis

Morphology of Fungi

- **There are 3 main groups based on cell morphology:**

1. Yeast & yeast like:

a. Yeast:

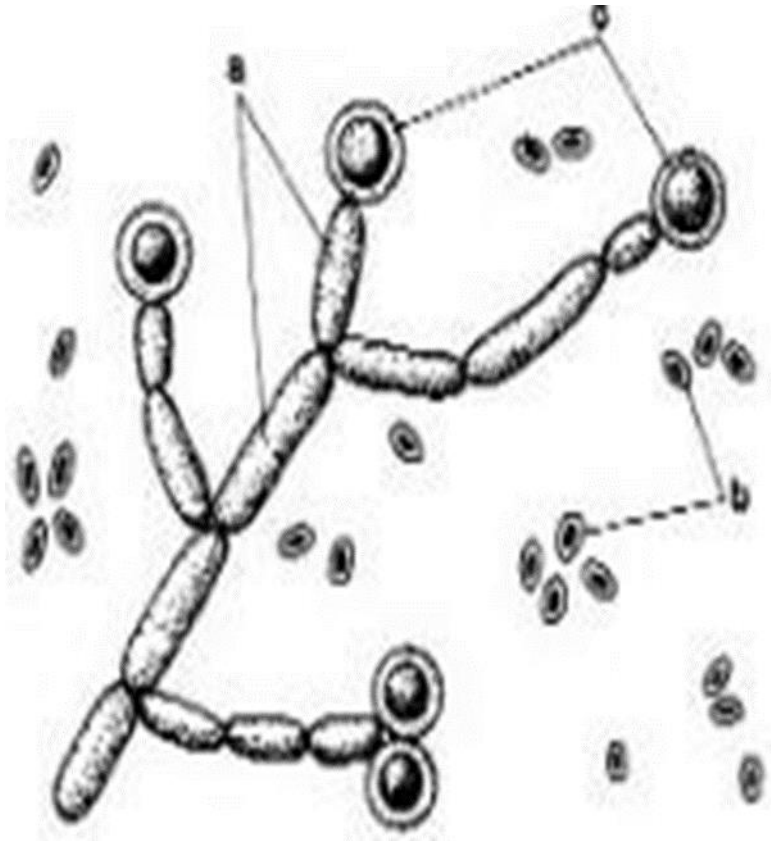


- **round to oval unicellular fungi which reproduce by budding or fission a progenitor then detached from mother cell**
- **The only example of pathogenic yeasts is Cryptococcus neoformans.**

Morphology of Fungi

b. Yeast like:

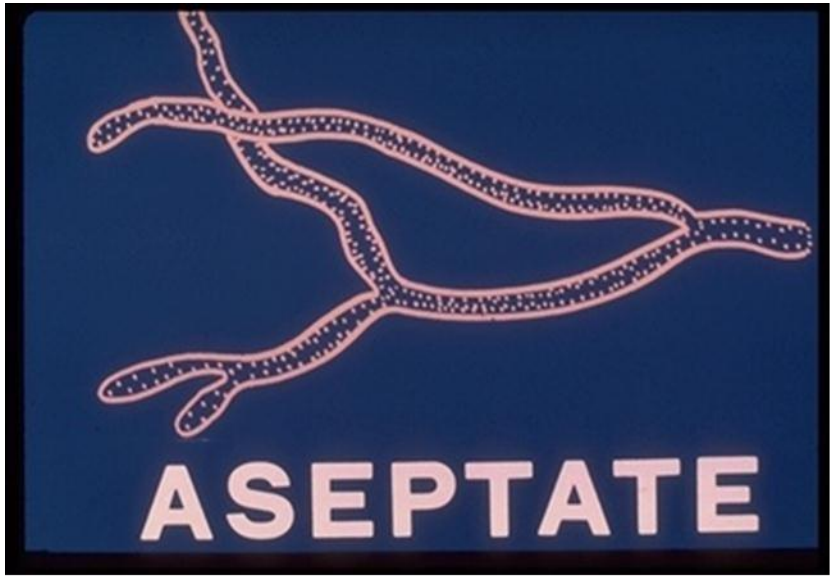
- **Round to oval unicellular fungi reproduce by budding but a progenitor remain attached to mother cell giving a chain of elongated yeast cell called pseudohyphae.**
- **Example: Candida**



Morphology of Fungi

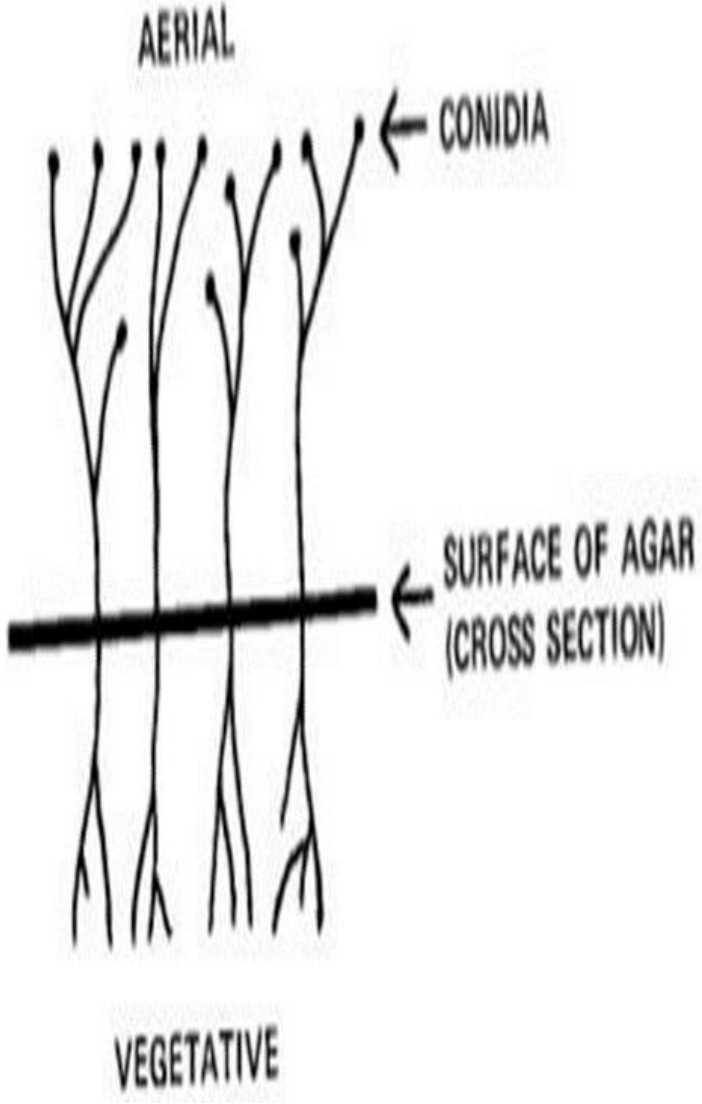
2- Moulds (Filamentous fungi):

- **Tubular, branching structure may or may not be separated by porous cross walls (septa) forming septated or aseptated hyphae . e.g. (Aspergillous spp.).**



Morphology of Fungi

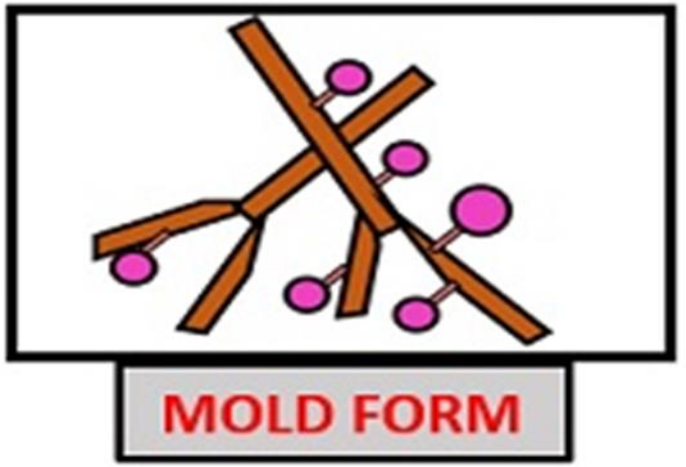
- **Aerial hyphae:The part that project above & carry the reproductive structure**
- **Vegetative hyphae:The part of the hyphae that anchor the colony, absorb nutrients**

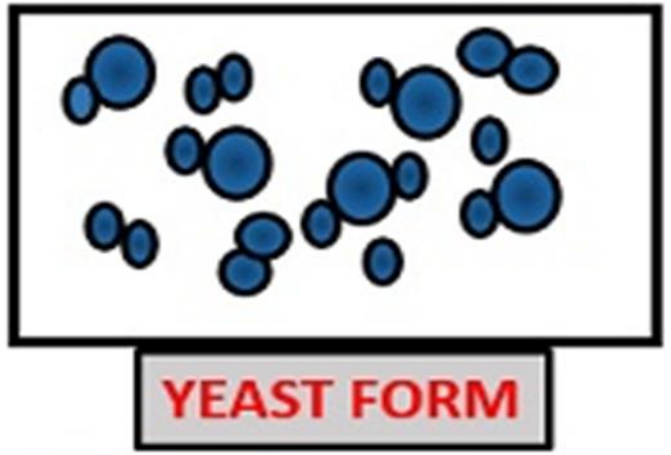


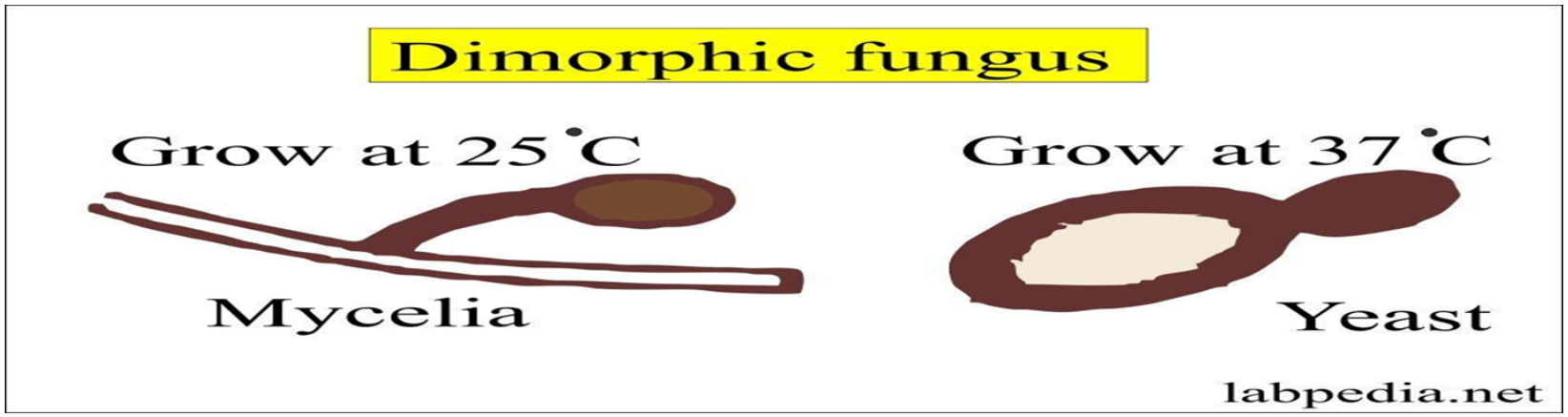
Morphology of Fungi

3. Dimorphic fungi:

- Dimorphic fungi exist either as yeast or filaments depending on the condition of growth.
- Can grow as yeast during infection in the body & on incubating culture at 37 ºC.
- –Can grow as moulds or filaments when inoculated at room temperature.
- Example: Histoplasma capsulatum, Coccidioides





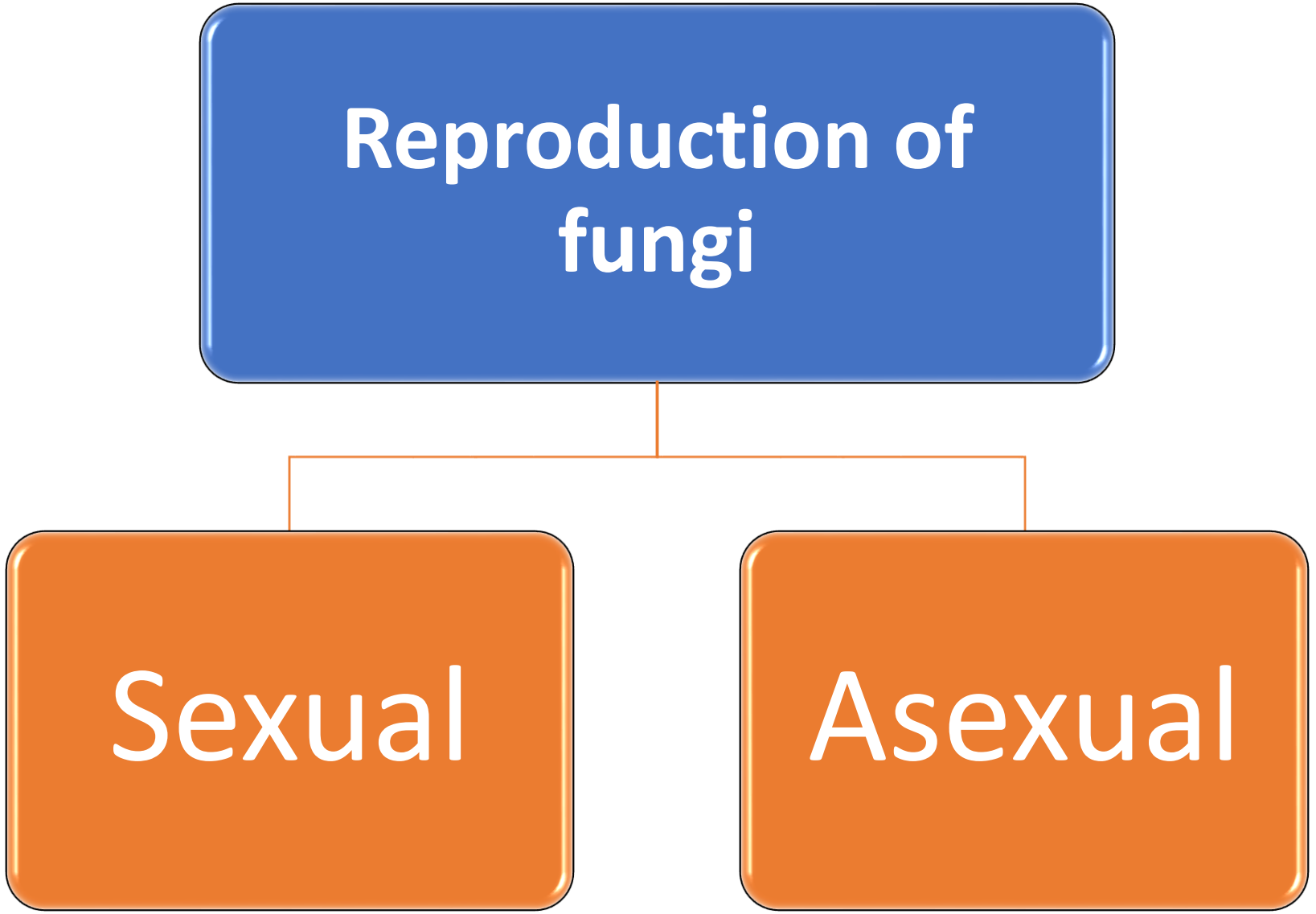


Quiz!!!

What are the 3 main morphological groups of fungi?

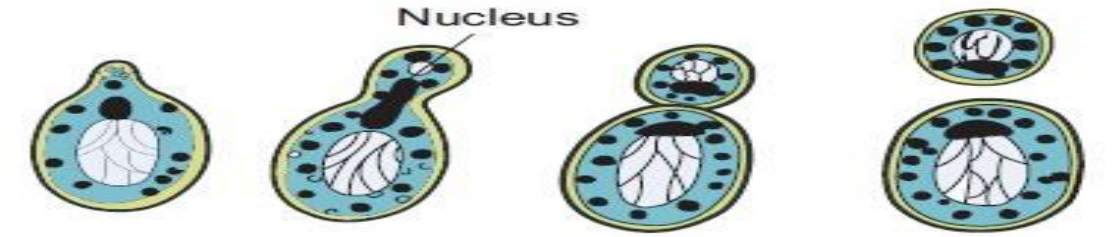
Fungal Cell membrane contains ergosterol (true or false)

Reproduction of fungi

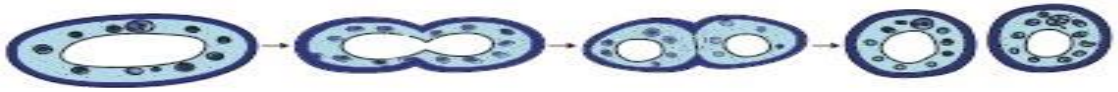

Reproduction of fungi
Sexual
Asexual

Reproduction of fungi

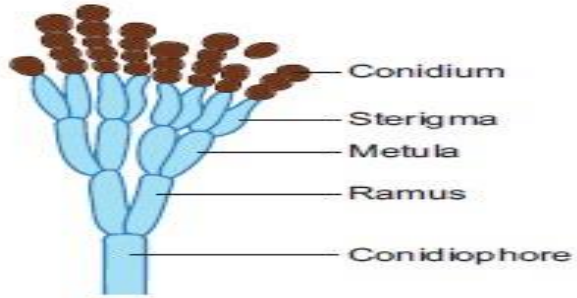
- Fungi reproduce by the formation of spores either asexual or sexual
- A single fungus may contain both modes of reproduction (sexual and/or asexual).



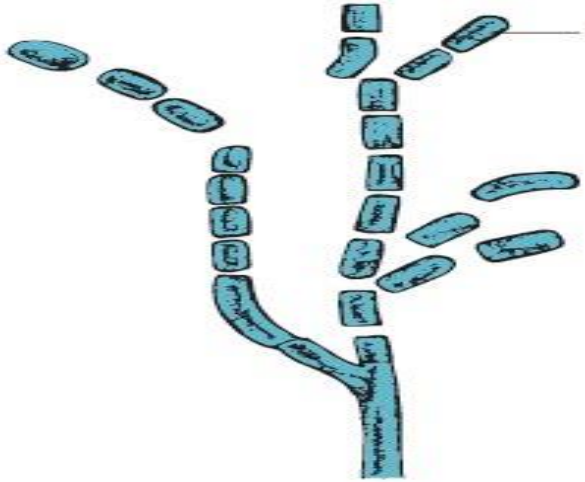
(a) Budding - Yeast



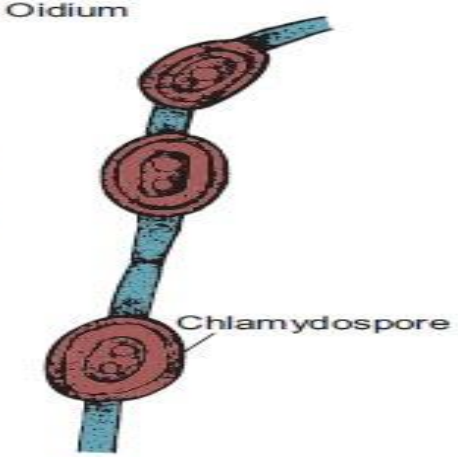
(b) Fission - Yeast



(c) Conidia formation - *Penicillium*



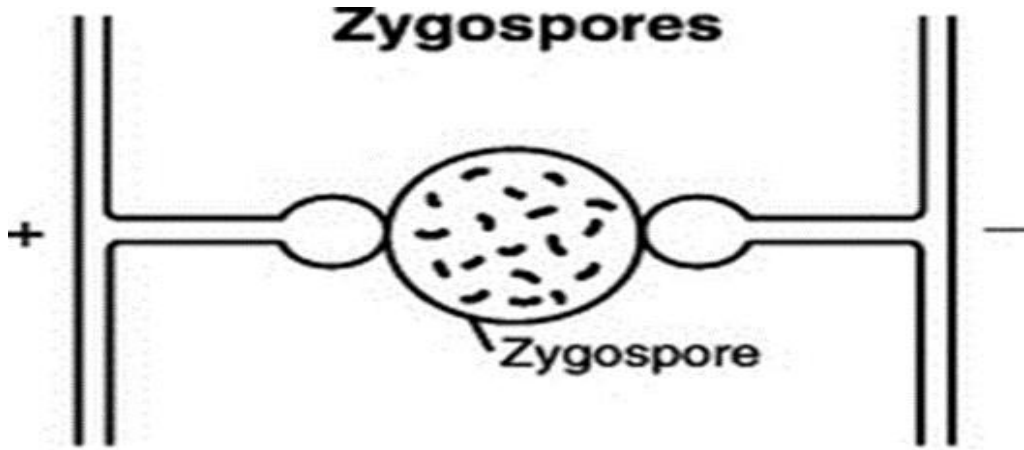
(d) Thallospore - *Erysiphe*

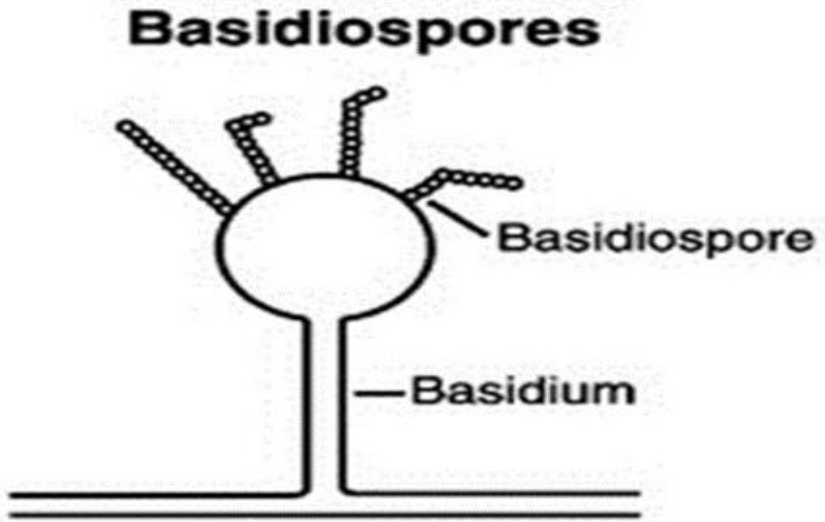


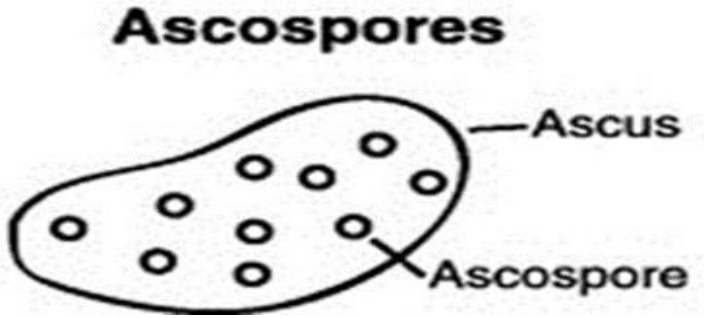
(e) Chlamydospore - *Fusarium*

Sexual Reproduction

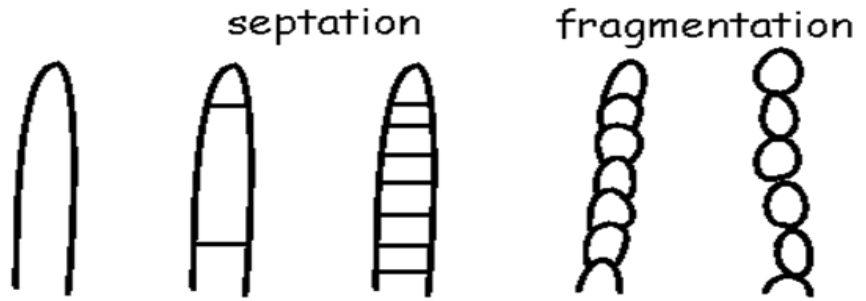
- Involves the union of 2 nuclei or 2 sex cells or 2 sex organs.
- During sexual reproduction, haploid cells of compatible strains mate to form diploid cells. Meiosis of this diploid cells to form sexual spores





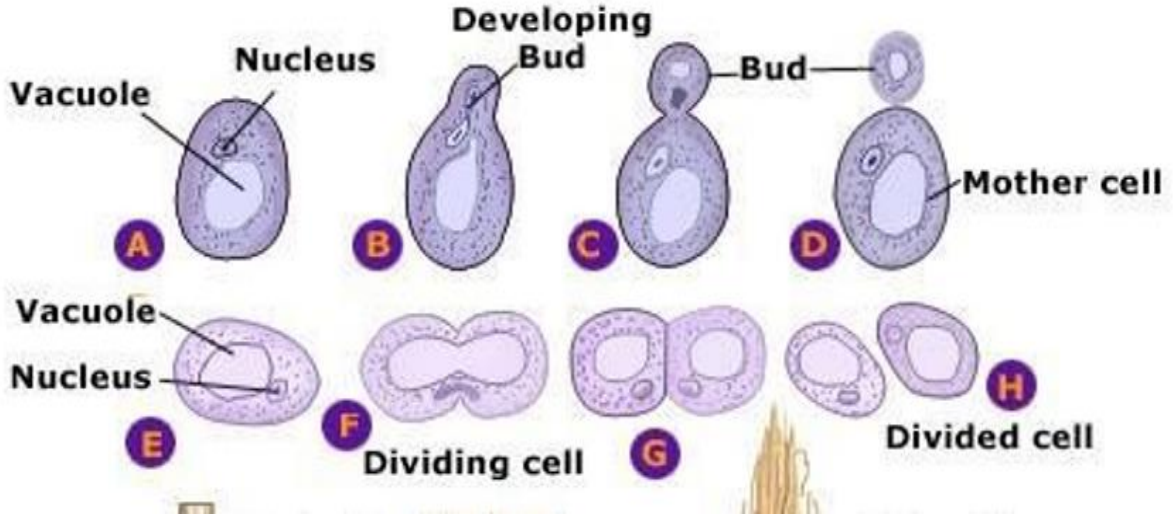


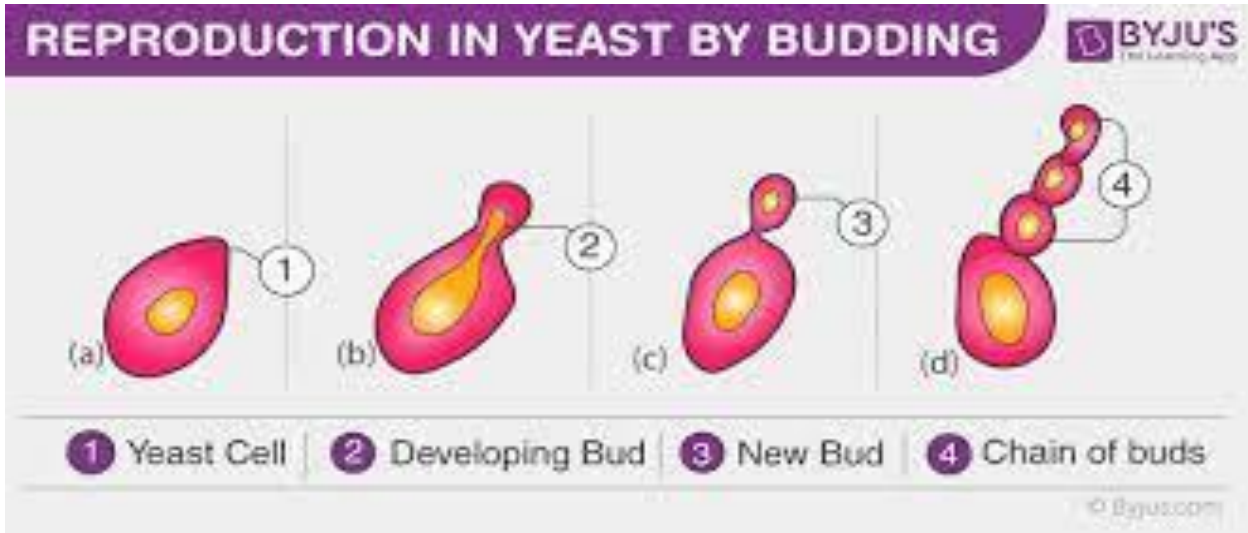
Asexual Reproduction



- It is the main method of reproduction.
- Formation of mitotic asexual spores
- Methods:

1. Fragmentation of hyphae & each fragment grows into a new individual fungus.
2. Budding of cells, each bud produce new individual (e.g. Candida).
3. Fission of cell into 2 daughter cells (similar to binary fission in bacteria).





Source of infection & Mode of transmission

Source of infection

1. Endogenous:

- Normal flora and it is the main source in nosocomial infection (because those people in hospitals are immunocompromised)

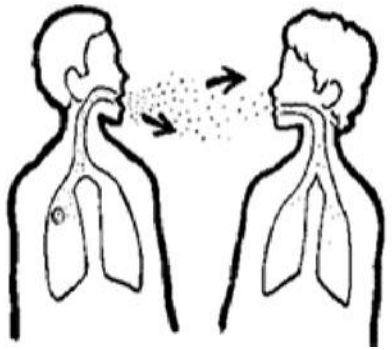
2. Exogenous:

- This is the main source of fungal infection mainly from the environment.

Mode of transmission

1. Respiratory tract (air borne infection).
2. GIT (food & water borne infection).
3. Blood stream injection.
4. Skin = contact.
5. Sexually.

Most fungal diseases are <u>not communicable</u> between human or animals.



Quiz!!!

- **Mention 3 methods of asexual reproduction of fungi?**
- **Most fungal diseases are communicable between human or animals (true or false)**

Classification of medically important Fungi

Classification of medically important Fungi

1. Primary pathogenic fungi:

- **Affect immunocompetent individuals e.g. dimorphic fungi**

2. Opportunistic fungi:

- **Affect immunocompromised individuals e.g. candida**

Types of Mycosis

Mycosis

Mycosis means diseases caused by fungi.

Fungal infections are classified according to affected tissue or organ into:

- Superficial mycosis
- Cutaneous mycosis
- Subcutaneous mycosis
- Systemic mycosis
- Opportunistic mycoses

Superficial mycosis

- Strictly surface infections limited to the outermost layers of skin and hair.
- Example: Pityriasis versicolour

Cutaneous mycosis

- Fungal infection which extend deeper into the epidermis, hair and nail.
- Example: Dermatophytosis caused by dermatophytes

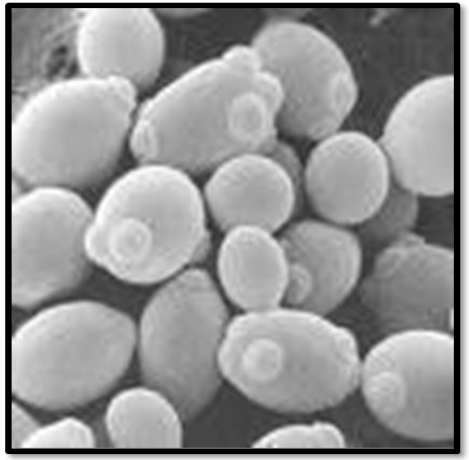
1. Tinea capitis affecting the scalp & hair
2. Tinea barbae affecting the beard hair
3. Tinea ungium affecting the nails
4. Tinea pedis affecting between toes
5. Tinea corporis affecting non-hairy smooth skin
6. Tinea cruris Affecting the groin, moist areas.

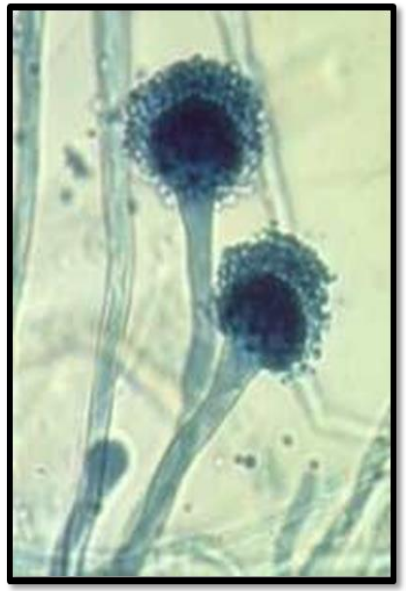
Subcutaneous mycosis

- Infection involving the dermis, subcutaneous tissue, muscle and fascia.
- Example: Mycetoma

Systemic mycosis:

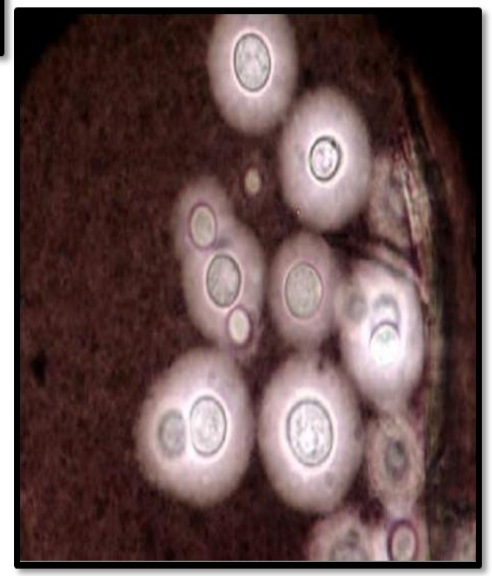
- Infections involving many organ systems.
- Caused by primary pathogenic dimorphic fungi i.e. Histoplasmosis





Opportunistic mycoses

- Group of mycoses caused by saprophytic fungi affecting immunocompromised individuals. e.g. Candidiasis, Aspergillosis, and Cryptococcosis



Quiz!!!

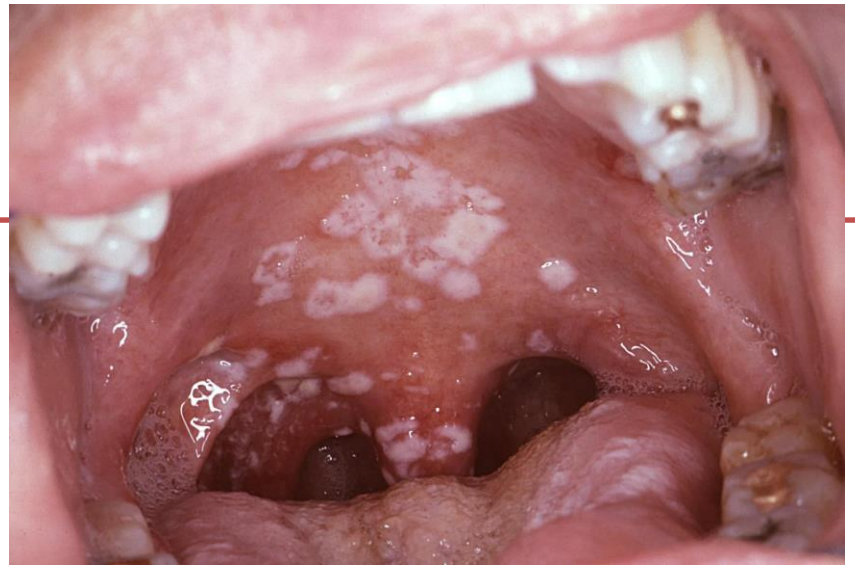
- **Classify mycosis according to affected tissue or organ.**
- **Mycetoma is an example of superficial mycosis (true or false)**

Candidiasis

- Candidiasis caused by the yeast *Candida albicans*, and other candida species, which are normal body flora found in skin, mouth, vagina, and intestines.
- There is more than 200 species of Candida, *Candida albicans* and *Candida tropicalis* are the most important species.

Candidiasis

Clinical diseases:



I. Superficial lesion:

a. Mucous membrane:

- ✓ **Oral thrush** characterized by discrete white patches on mucosal surface.
- ✓ Also, **vaginal thrush** appears as white lesion on epithelial surface of vulva, vagina and cervix.

Candidiasis

Clinical diseases:

I. Superficial lesion:

b. Skin:

- ✓ Infection occurs in moist warm area as axilla, groin, submammary fold.

Candidiasis

Clinical diseases:

I. Superficial lesion:

c. Nail:

✓ Infection of finger web, nail fold

d. Chronic mucocutaneous candidiasis

Candidiasis

Clinical diseases:

II. Systemic lesion

a. Candidal endocarditis follows heart valve surgery

b. Internal organ e.g. lung, kidney especially on pre-existing diseases (e.g. TB, cancer)

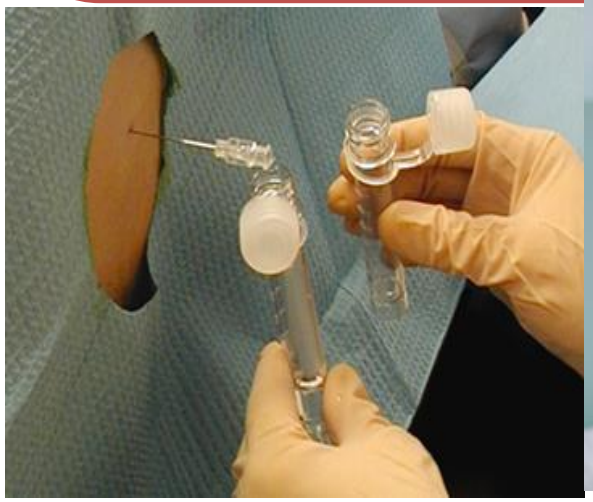
c. Meningitis in prematurity and after neurosurgery

d. Candidemia

Candidiasis:

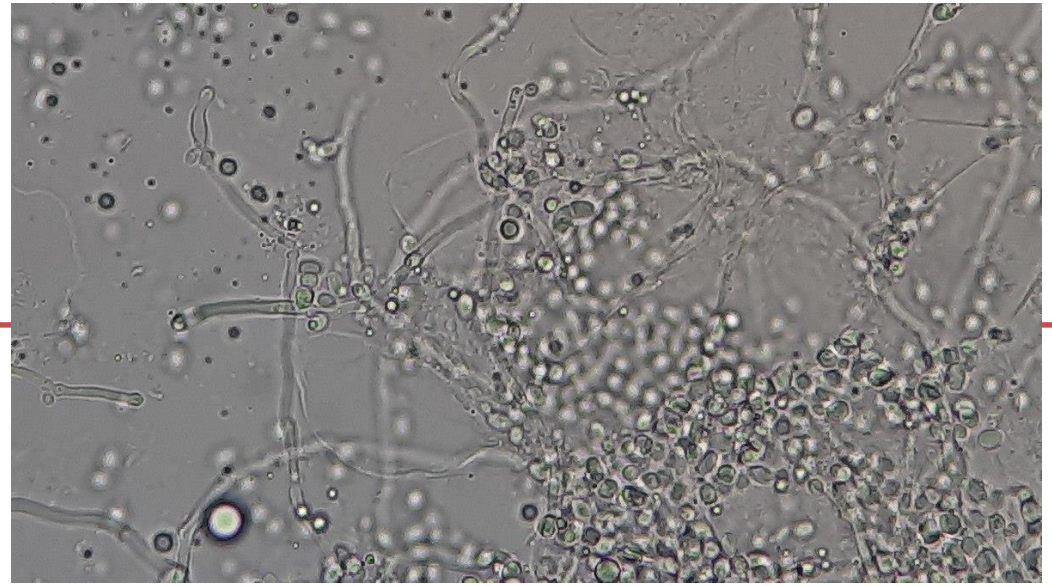
Diagnosis:

- **Specimen:**
  - ✓ according to site of infection.



Candidiasis

Diagnosis:



- **Examination:**

a. **Direct microscopy**: Candida appears as rounded or oval budding yeast.

Candidiasis

Diagnosis:

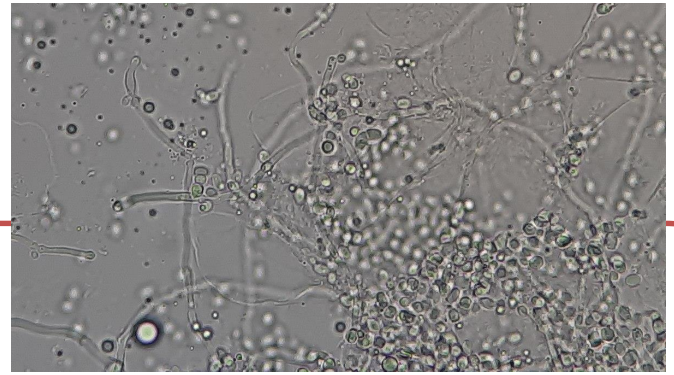
- **Examination:**

  b. **Culture:**

  - ✓ Media: Sabouraud's dextrose agar (SDA).
  - ✓ Optimum temperature: 37°C for 24-48 hours.
  - ✓ On SDA, colonies are white, creamy, and smooth with yeast odor.

Candidiasis

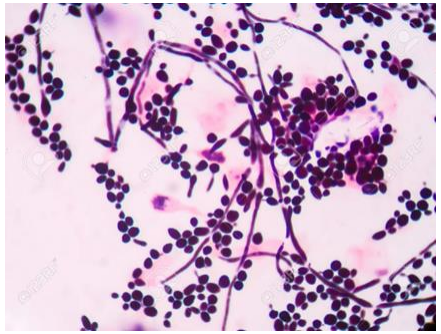
Diagnosis:



- **Examination:**

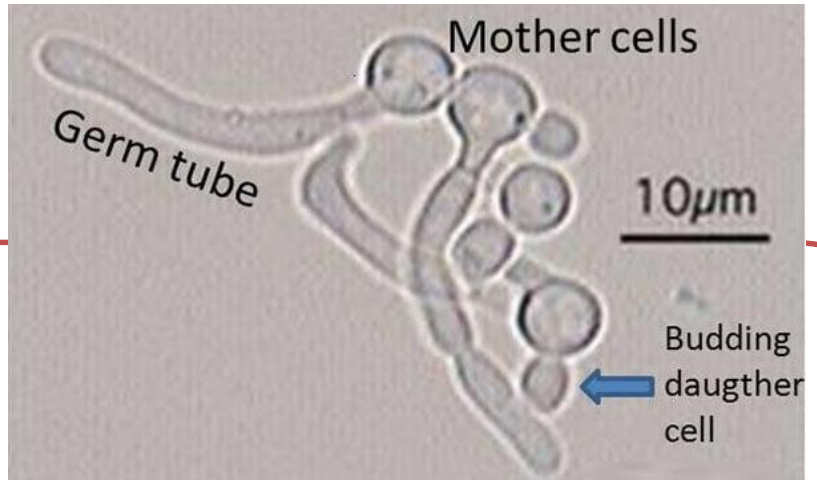
c. Identification: *C. albicans* is differentiated from other species:

- ✓ Film stained by lactophenol blue show budding yeast and filaments (pseudo-mycelium).
- ✓ Appear Gram positive by Gram stain



Candidiasis

Diagnosis:



- **Examination:**

c. Identification: *C. albicans* is differentiated from other species:

✓ **Filamentation in the serum (Germ tube formation):** When Candida is grown on human serum at 37°C for 4 hours, show **filamentous** outgrowth.

Candidiasis

Diagnosis:

- Animal inoculation: only *C. Albicans* are pathogenic to rabbit when injected intravenous it causes renal abscess and the animal die within 7 days.
- Serology
- Skin test: Candidin test.

Aspergillosis

- Aspergillosis caused by several species of genus Aspergillus but primarily by *Aspergillus fumigatus*. Other species as *A. niger*, *A. flavus*.

Aspergillosis

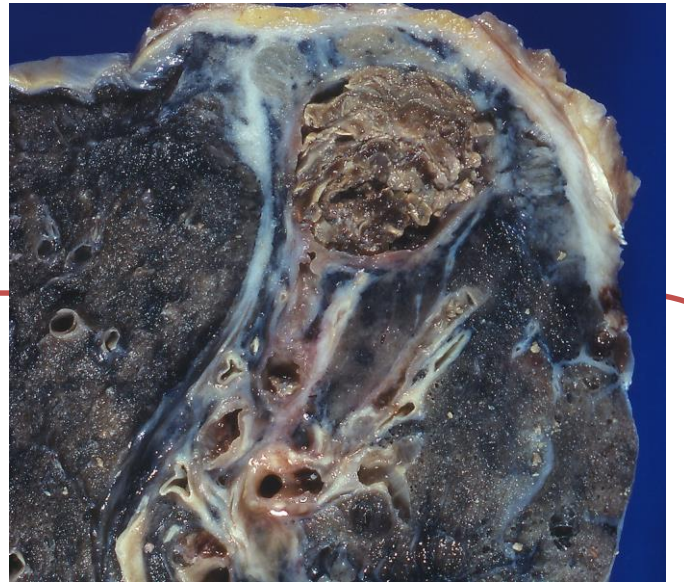
Clinical diseases:

I. Superficial Aspergillosis:

- ✓ Fungal colonization in paranasal sinuses, external ear, or eye

Aspergillosis

Clinical diseases:



II. Respiratory disease:

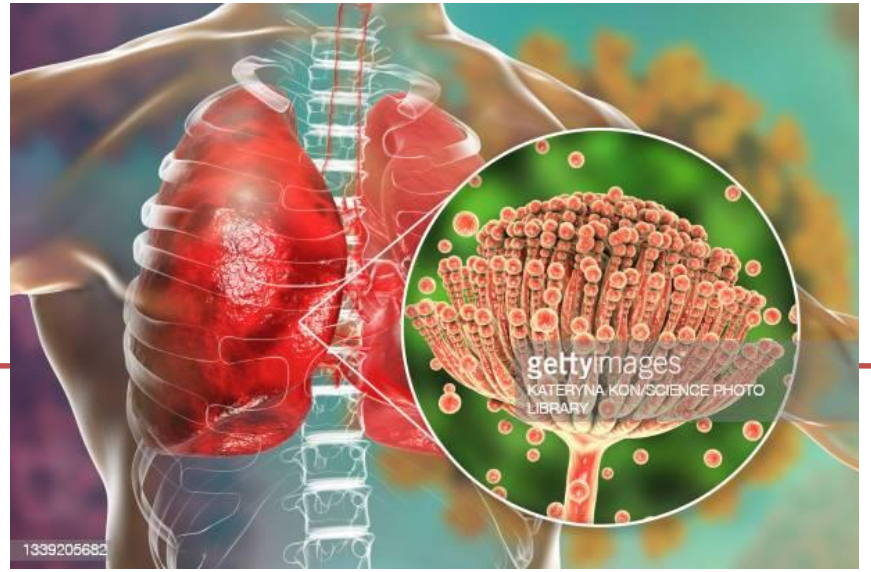
a. Bronchial asthma: following inhalation of spores.

b. Broncho-pulmonary Aspergillosis: the hyphae occlude lumen of bronchioles.

c. Aspergilloma: called fungus ball occur on preexisting lung cavity e.g. TB.

Aspergillosis

Clinical diseases:



III. Invasive Aspergillosis:

- ✓ Hematogenous spread of the fungus from lung to other organs.

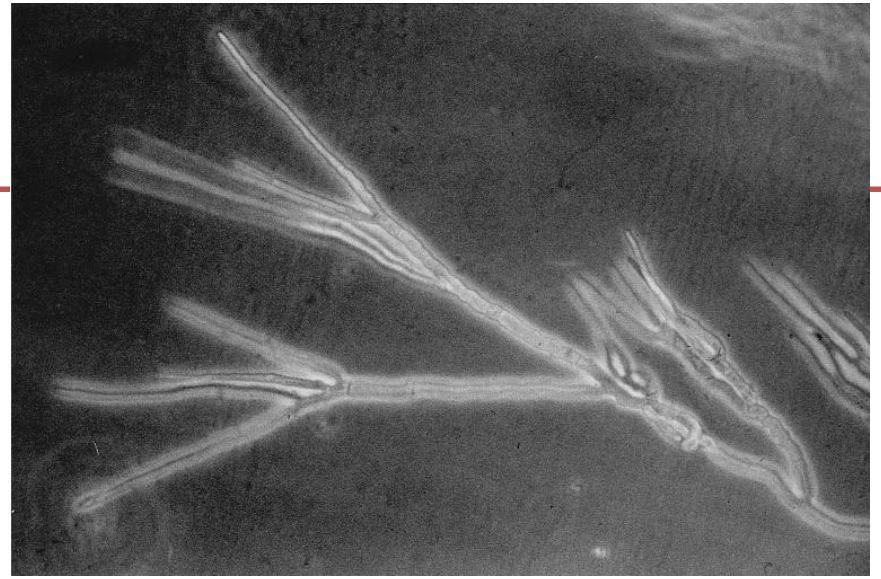
Aspergillosis:

Diagnosis:

- **Specimen:**
  - ✓ according to site of infection.

Aspergillosis

Diagnosis:

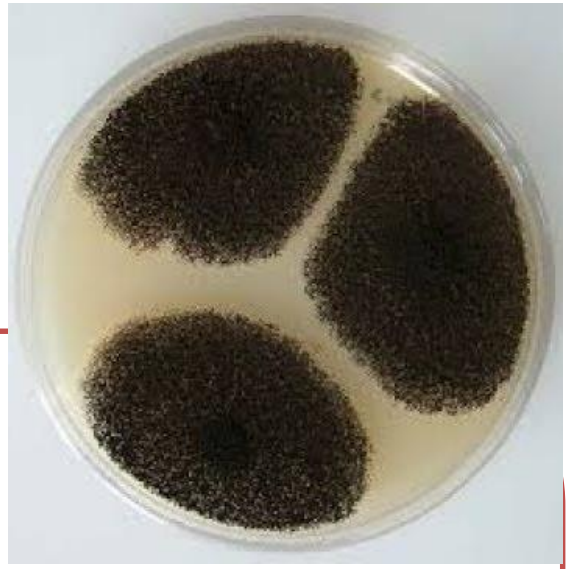


- **Examination:**

a. **Direct microscopy**: of sample shows dichotomous branching septated hyphae.

Aspergillosis

Diagnosis:



- **Examination:**

b. Culture:

- ✓ On SDA incubated at room temperature for 24-48 hr.
- ✓ Hairy colonies different in color according to the species e.g *A. niger* black colony and *A. fumigatus* green colony.
- ✓ Film stained by lactophenol blue: septated mycelium and Aspergillus head.

Aspergillosis

Diagnosis:

- **Serology**: for detection of antibodies or antigen.

Mycotoxicosis

- Fungi can generate substances with direct toxicity for humans and animals.
- Ingestion of these toxins leads to mycotoxicosis.

Mycotoxicosis

- General criteria of mycotoxicosis:

1- Not transmissible.

2- No effect of antifungal in treatment.

3- Seasonal.

4- Associated which foods ingestion.

5- The degree of toxicity depends on many host factors.

6- Examination of the food reveals fungal growth.

Mycotoxicosis

- Type of mycotoxins:

✓ There are large number of mycotoxins according to the fungus produce it. e.g: Aflatoxin, ochratoxins, amatoxin and phallotoxin.

Mycotoxicosis

- **Aflatoxins**

✓ Produced by *Aspergillus flavus*.

✓ Effects of aflatoxins on man:

1. This toxin can initiate liver cell carcinoma.
2. Immunosuppression.
3. Gastroenteritis.

Case scenario

A 40-year-old woman came to the dermatology clinic complaining of erythematous scalp lesions and annular patches combined with hair loss. No other systemic symptoms were found. She denied contact with animals; other family members were asymptomatic.

- What is the most likely case diagnosis?


Let's sum
it up...


Questions
???


THANK YOU!