



Microbiology

Subject :

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وَقُلْ رَبِّ زِدْنِي عِلْمًا

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: *They can not synthesis their own food* → لصيكت بتحتاج اجسام تانية حتى تحمل على غذائها

Saprophytic, Symbiotic, Commensals or Pathogenic. → *اذا مناعة الشخص قلت بتصير تتحول الى Pathogenic وتقل امراض*

➤ The natural habitat of most fungi is the environment. An important exception is **Candida albicans**, which is part of the normal human flora.

candida albicans انها تكون موجودة بشكل طبيعي بالجسم بتكون قليل جدا جدا واشهر مثال عليها

Saprophytic *بنلاقيها موجودة ع soil, على اجسام المتحللة, بالهواء, بالماء*

Symbiotic *بتكون عاملة attachment مع جسم اخر بعلاقة تشاركية كل واحد بفيد الثاني*

Importance of fungi

“Fungi has both beneficial and harmful aspects

عالم اسمه :

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

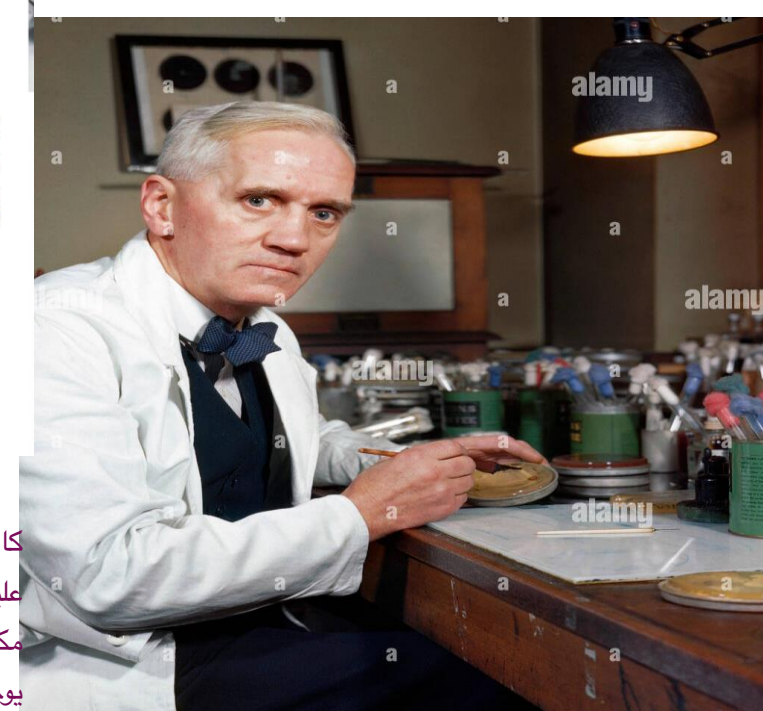
killer“. But I suppose that was exactly what I did.”

حبلته الشهيرة (مكتشف اول نوع Antibiotic)

1945 Nobel Prize in Medicine for the

discovery of penicillin from saprophytic

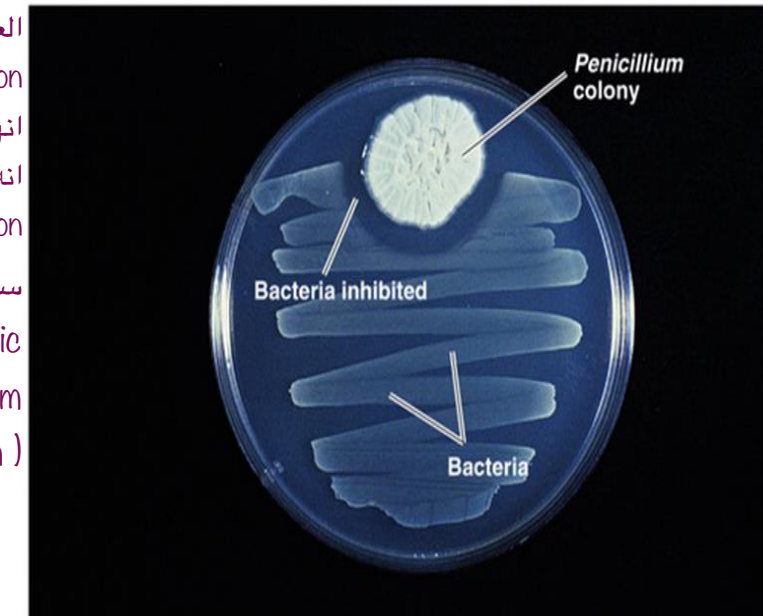
mold called “Penicillium notatum”.



كان يشتغل بتجربة وفي طبق مزروع عليه بكتيريا staph وترك هالطبق برا مكشوف ونسي يغطيه لما رجع بعد اكم يوم شاف نمو للfungi هالاشي متوقع

بس شو الاشني الي لفت انتباه العالم ؟ شاف حوالين ال colony صار clearance or inhibition للبكتيريا مع انها كانت طالعة بها لكان قبل استنتج انه ال fungi هاي افرت مادة عملت inhibition

سماه penicillin وهو نوع من antibiotic بتكون of fungi (penicillium notatum)



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



Antifungal Griseofulvin
from *Penicillium*
griseofulvum.

→ اسم
الفنجي



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

*Fungi are widely used model organisms in genetic engineering.

تعتبر كمنبع لو بدي عمل تكثير لجين معين



Blue cheese



Wine



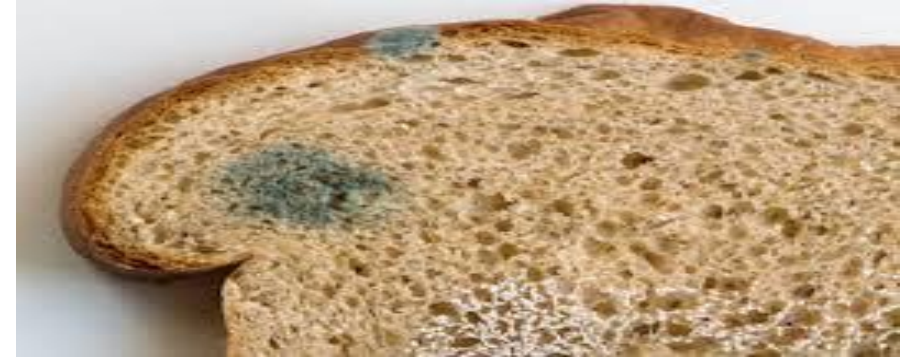
Soy Sauce.

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: الها دور سلبى بأنها بتعمل

المحاصيل

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 حساسية

* Mycotoxins

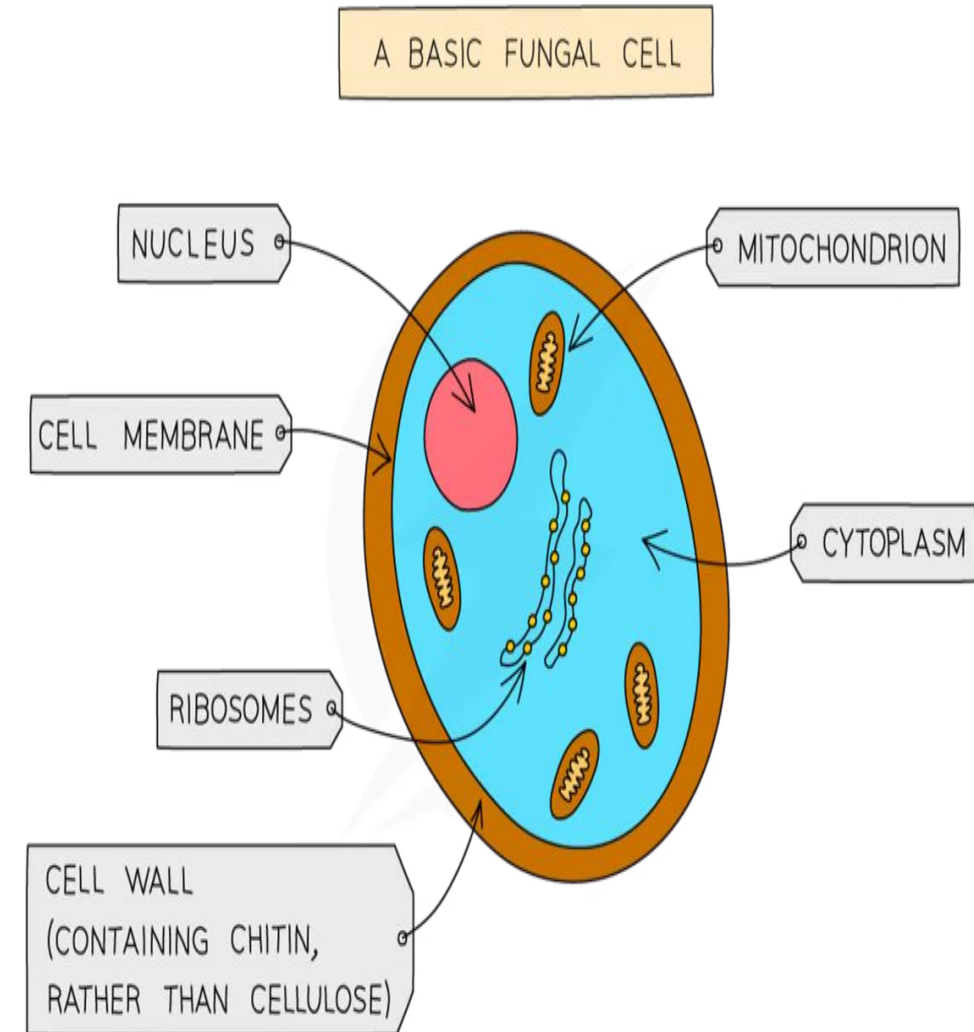
Structure of Fungi

Fungi are **Eukaryotic** organisms

هالاشياء مش موجوده بالكثير ما لانها Prokaryotic

1. Have a **true nucleus** with nuclear membrane.

2. Have **membranous organelles** (e.g. Golgi apparatus, endoplasmic reticulum and mitochondria).



ولهمة جدًا هاي المعلومة
↓

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.

سيتهدفوا الـ ergosterol
(inhibition of synthesis ergosterol)

4. Their **cell wall** consists mainly of polysaccharides:

a) **Chitin**

b) **β -glucan**

Medical importance of fungal cell wall:

البكتيريا الـ cell wall فيها يحتوي على Peptidoglycan اما الـ Fungi ما فيها

➤ There is **NO** peptidoglycan as in bacteria; thus fungi are insensitive to antibiotics, such as penicillin.

هو الـ Target of action لبعض انواع المضادات مثل Penicillin

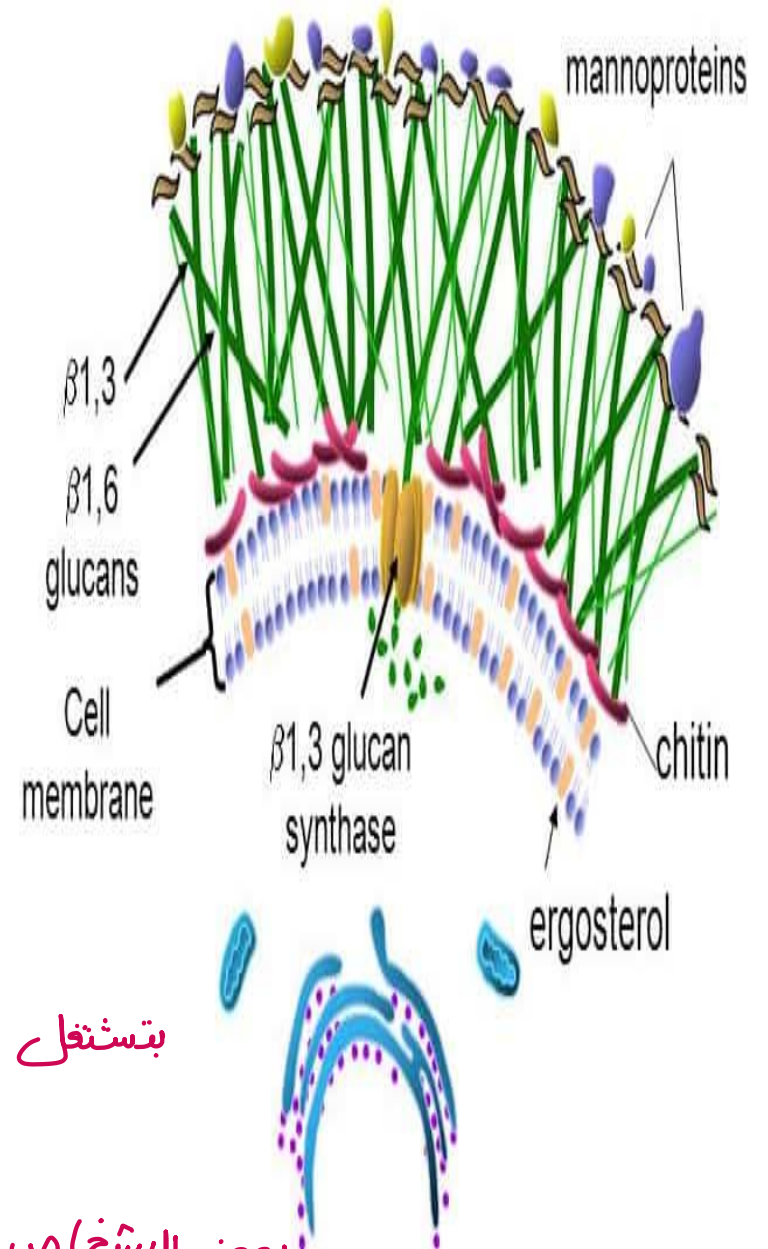
مطلوبه ان الـ Fungi ما الها Peptidoglycan بتدل على ان الـ Fungi insensitive (لا تستجيب لتنوع المضادات)

➤ **β -glucan** is the **target** of the antifungal drug, Echinocandin (e.g. Caspofungin).

بتستغل عن طريق انها تعمل inhibition لـ β -glucan

➤ **Hypersensitivity** to its components. بعض الاشخاص عند لها حساسية من ابي اسبي

بنلافى عند لها Hypersensitivity (حساسية من احد اوقا الع)



5. Capsule : تقس السكريا

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

Comparison between Fungi and Bacteria

Feature	Fungi <small>اکثر بالرجم</small>	Bacteria
Diameter	Approximately <u>4 μm</u> (<i>Candida</i>)	Approximately <u>1 μm</u> (<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 <small>للحماية البكتيريا بس تصير بمكان بيئته غير مناسبة بتبلش تبني حوالها spores</small>	Sexual and asexual spores for reproduction <small>بتساعد بالتكاثر</small>	Endospores for survival, not for reproduction
Thermal dimorphism	Yes (some)	No

Prokaryotes (Bacteria)

Eukaryotes (Fungi)

0.1-10 μm

10-100 μm

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

Fungal morphology

Yeast خميرة

Mold عفن

Dimorphic

ينتقل بين الجهتين الي فوق

1-Mold (filamentous fungi): *فكون filament*

➤ 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.

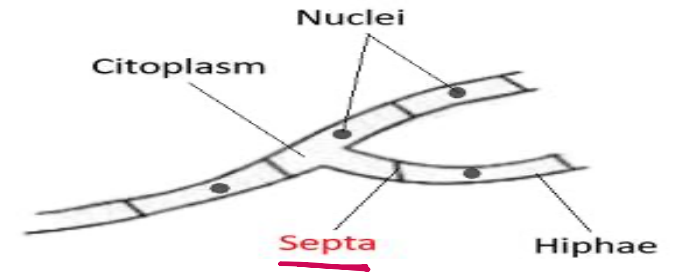
b-Molds with **aseptate** hyphae



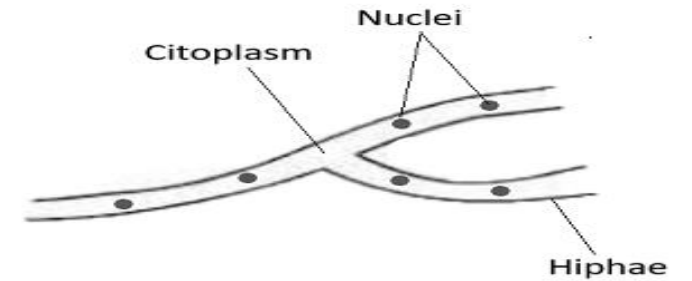
(i.e) without cross walls in hyphae.

➤ **Mycelium:** a mass of hyphae. → *هذي هيا الصورة بنكون كثير تحميت*

➤ Example: **Dermatophytes & Aspergillus.**



Septate Hiphae



Aseptate Hiphae



2-Yeasts (Budding fungi):

عبارة عن Fungi تتكاثر بالتبرعم .

unicellular

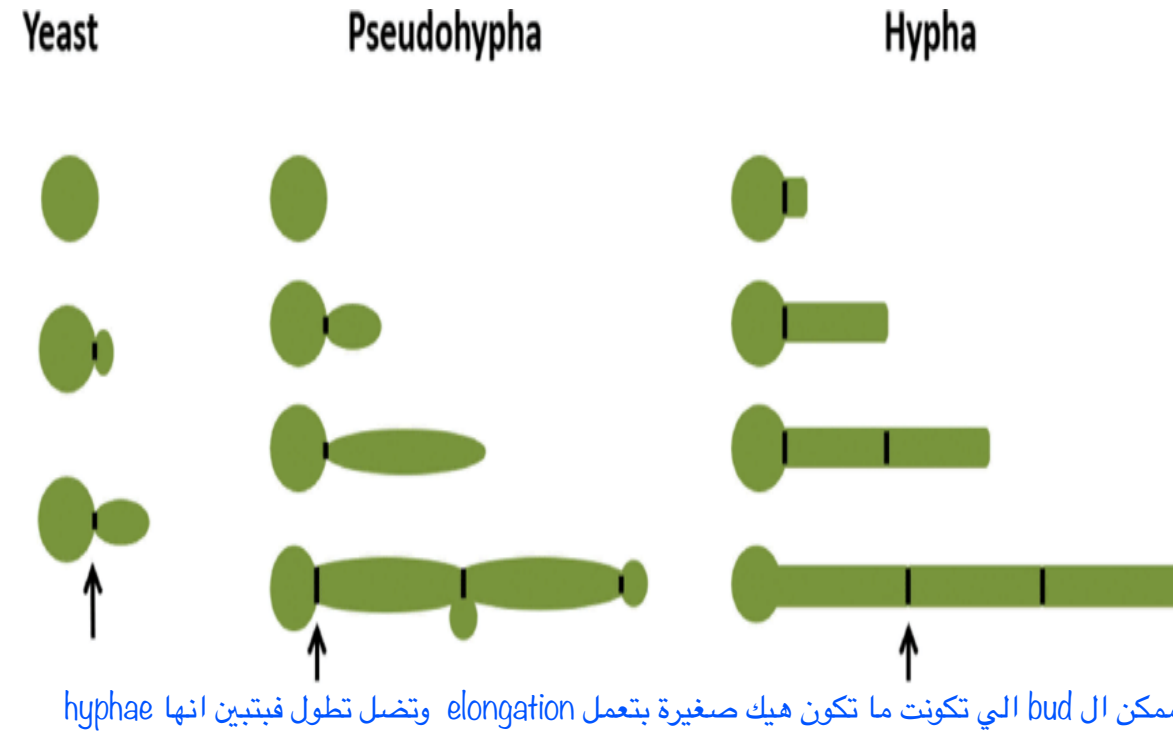
- Oval or rounded single cells.
- Reproduce by budding (blastospore).
- Have **NO** hyphae, but some yeasts may have elongated budding cells linked in branches called pseudo-hyphae.

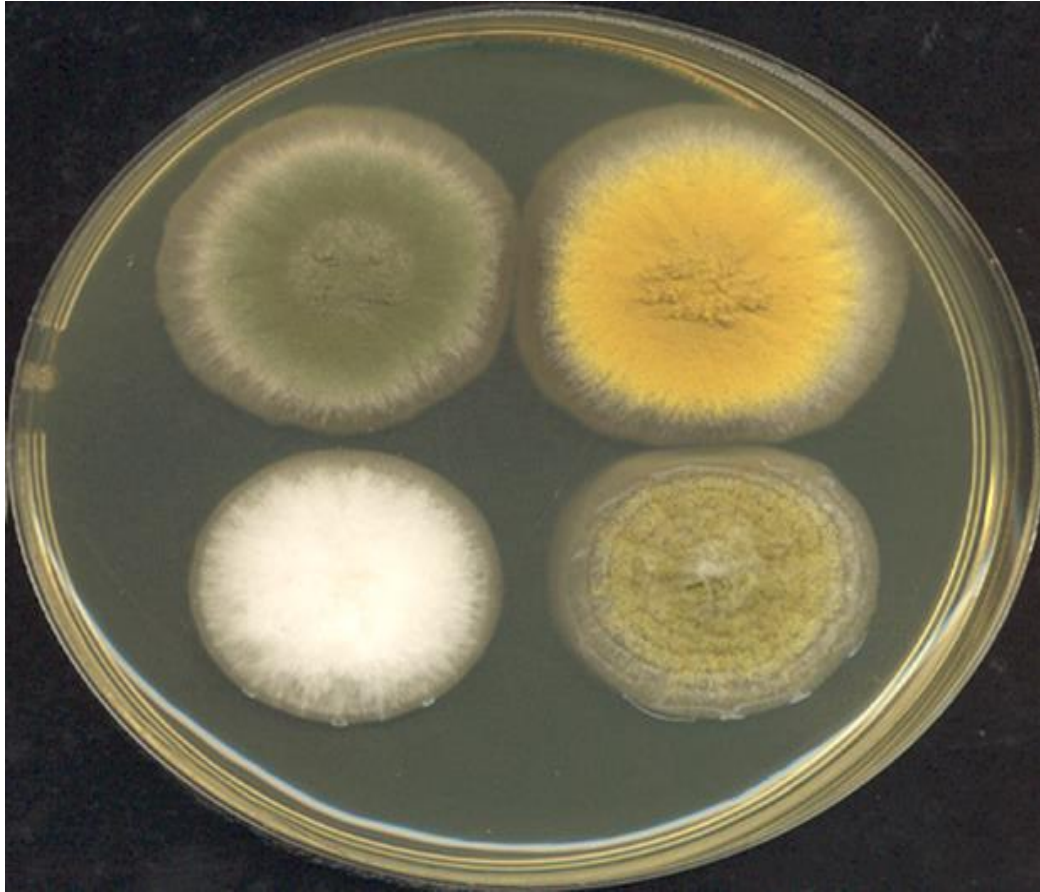
بس كونها مش hyphae حقيقية بسميها pseudo hyphae

- Example: **Candida & Cryptococcus.**

التي حكيها عنها فوق انها normal flora

عندها capsule





Mold colonies

بكون عامل زي القطن او الشعر الي طالع لبرا



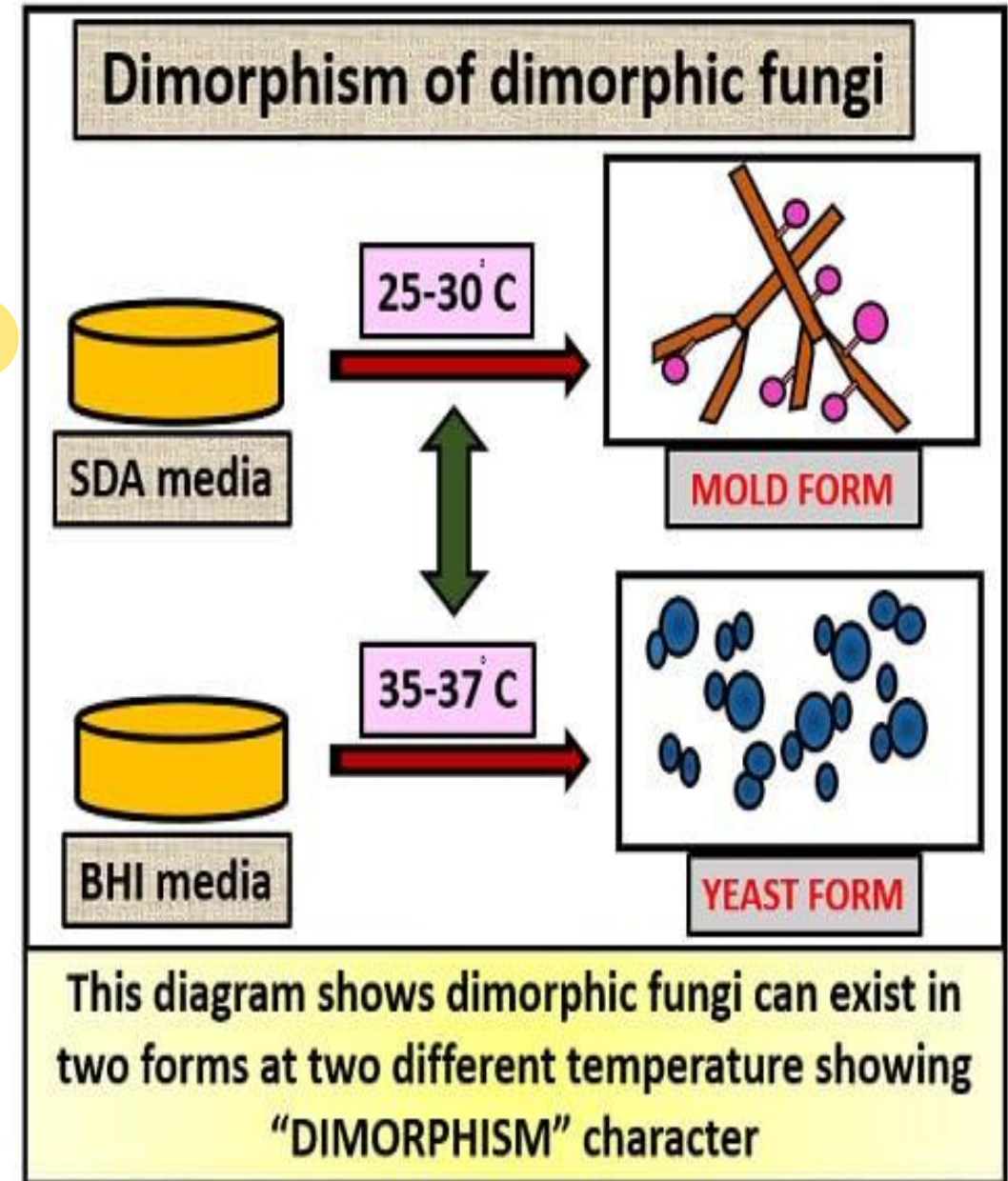
Yeast colonies

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.

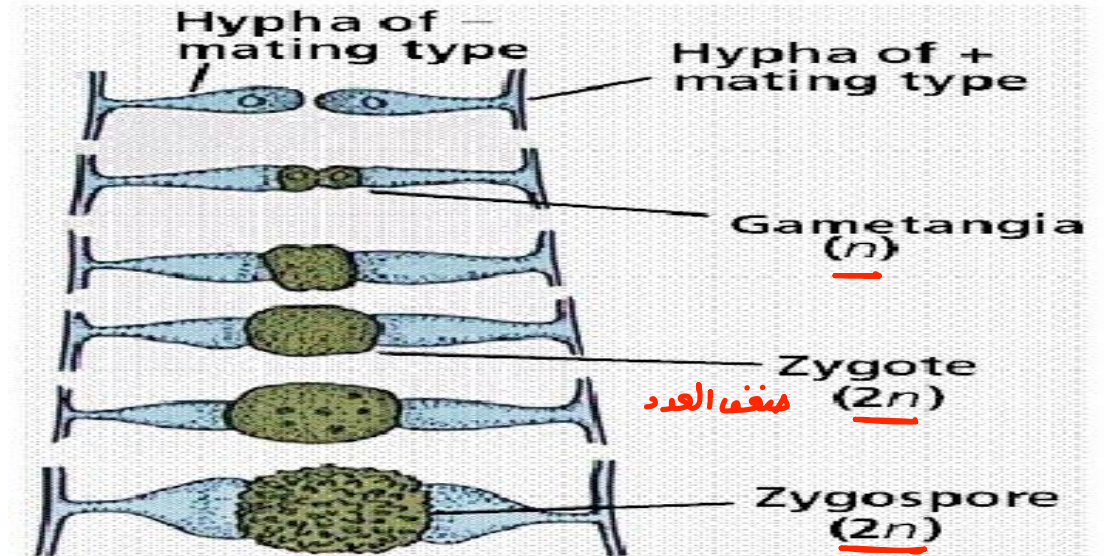
Example: *Histoplasma capsulatum* & *Sporothrix schenckii*



Fungal reproduction

(1) Sexual reproduction (perfect fungi):

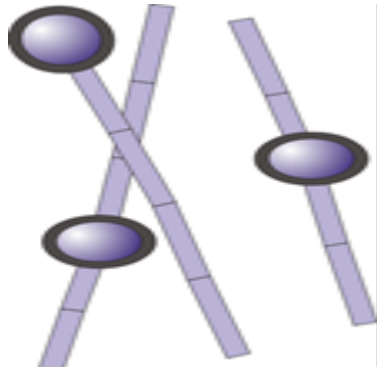
When two parents' spores combine to produce a zygospore.



(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



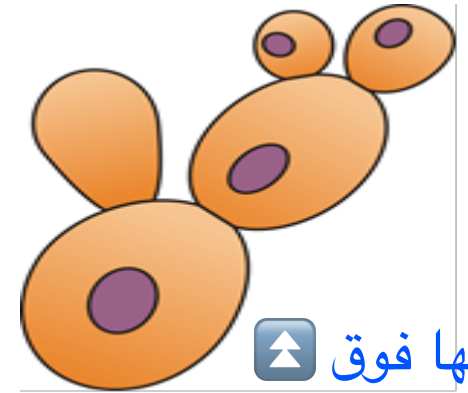
يكون thick-wall حوالي الـ organism ويعدين لما ينفصل عنه بوقع ع الارض ولما تتوفر البيئة المناسبة بتترجع تنمو وتكون نوع fungi جديد

Chlamydoconidia



ال hyphae ممكن ينفصل منها جزء واذا راحت ع ممان مناسب رح تترجع تعمل fungi جديدة

Arthrospores



حكيها عنها فوق

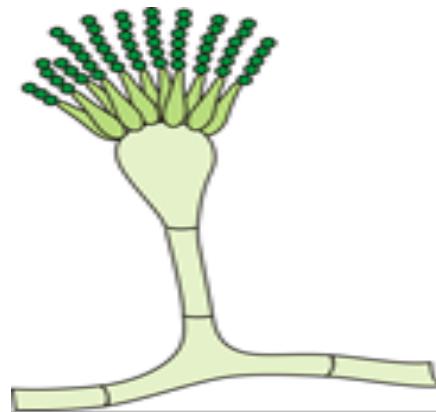
Blastospore (budding)



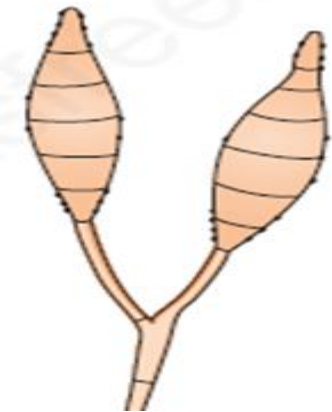
يكون في كيس ويتكون جواتها spores كثيرة ويتنفجر وهاي الـ spores رح تنتشر وبتترجع تكون fungi جديدة

Rhizoid

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

بتصيب ال superficial layer من الجسم

Affect the ¹skin and / or ²mucous membrane, ³hair or ⁴nails.

The important superficial mycoses include:

اي اشئ الة اسمين مهم نركز عليهم ونحفظهم منيح

(1) **Pityriasis versicolor (Tinea versicolor).** النخالة الملونة / النخالة المبرقشة

(2) **Candidiasis of the Skin and / or mucous membranes.**

(3) **Dermatophytosis (Ringworm infection).**

Pityriasis versicolor (Tinea Versicolor)

- Caused by **Malassezia furfur**. مرض بأثر ع الجلد بسبب هذا الfungi
- Affect the **skin** and the infected areas are recognized by their **de-pigmentation** كل الي بعمله انه يكون ع الجلد زي بقع لأنو بمنع تكوين الميلانين بمكان البقع
especially on tanned skin in the summer.
- Usually asymptomatic, only cosmetic importance.



Candidiasis (Moniliasis) مهم مهم

نوع ال fungi التي يعمل ها المرض

➤ 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.

بتتصنف كمان ع انها فطريات انتهازية يعني بتستغل ضعف جهاز المناعة وبتتحول لضارة وبتعمل امراض

➤ *Candida albicans* are opportunistic fungi which may dominate and become associated with pathological conditions. Among the **predisposing factors** are the following:

بعض الحالات المرضية التي ممكن تسبب نقص بمناعة

1- Diabetes mellitus (high glucose level).

الشخص وبناءا عليها هاي الفطريات بتصير ضارة

2- Immunodeficiency e.g. HIV infection, corticosteroid therapy and immunosuppressive drugs.

عنده سرطان

3- Prolonged broad spectrum antibiotic therapy (alter the normal bacterial flora).

التي بستخدموا مضادات حيوية لفترة طويلة بأثر ع bacterial flora وبتقتلها وبتضل ال fungi هاي لحالها بصير عندها الفرصة تنمو وبتتحول الى فطريات ممرضة

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.

↑ بتروح على الافاكن الرطبة والدايفيت مثل

حكة



Candidiasis of the skin

2- Candidiasis of **mucous membranes**:

- Oral thrush, esophagitis, vaginal thrush.*

3- **Mucocutaneous** Candidiasis.

- Angle of the mouth.



Oral thrush

Mucocutaneous Candidiasis

Dermatophytes (Ringworm):



- They are **filamentous** fungi.
- They are classified into 3 ^{types} 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. ^{المناطق الي فيها كيراتين.}
- Infections acquired from soil or active ringworm lesions (**contagious** ^{معدية} **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**). ^{بتيجي هاي ال spors بتوقع ع جلد الشخص وبعدين بتبلش تنمو وبتبلش تنتشر بجميع الجهات ع شكل بسميه radially}

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)

هاي الاسماء
مهمة ومطلوبة

Laboratory diagnosis of dermatophytosis

Specimen:

العينة بتكون من:

1 Skin scrapings, 2 Nail piece or 3 Hairs.

Direct microscopy

بحرّفها على شريحة وبحمّ العرّب الكميائي KOH

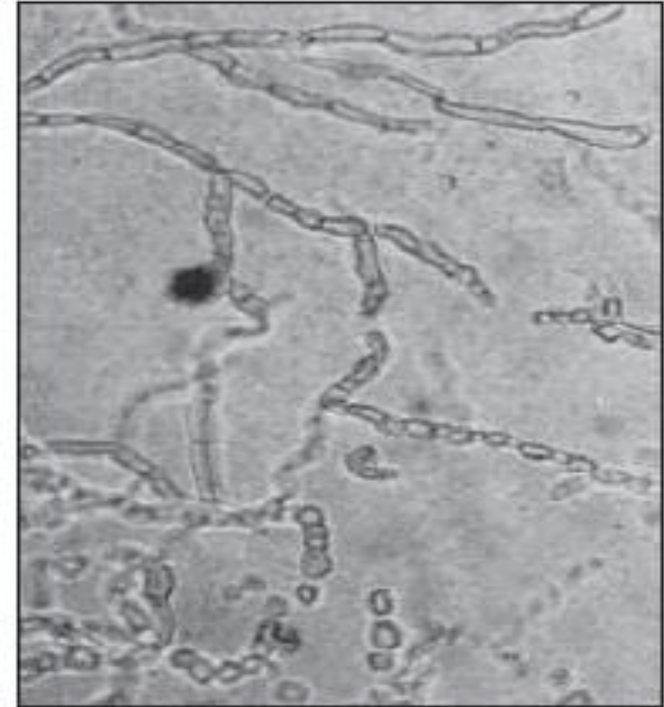
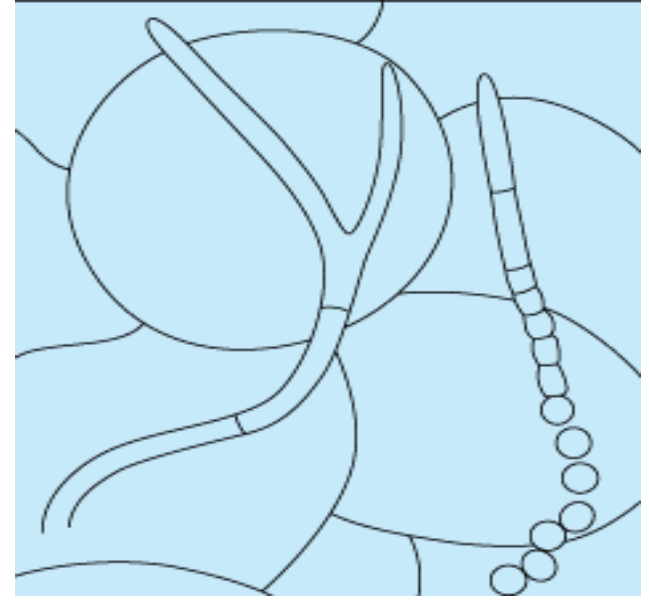
➤ Specimen is placed on a slide with a drop of **20% KOH**

to digest the keratin surrounding the fungus. الكيراتين طبقة عازلة بتكون مغطية الفطريات لهيك بحط KOH حتى تهضم الكيراتين ولما احطها تحت المجهر اشوف الفطريات

➤ All species of dermatophytes appear as **septate hyphae**

هاي النقطة مهمة

and arthrospores.

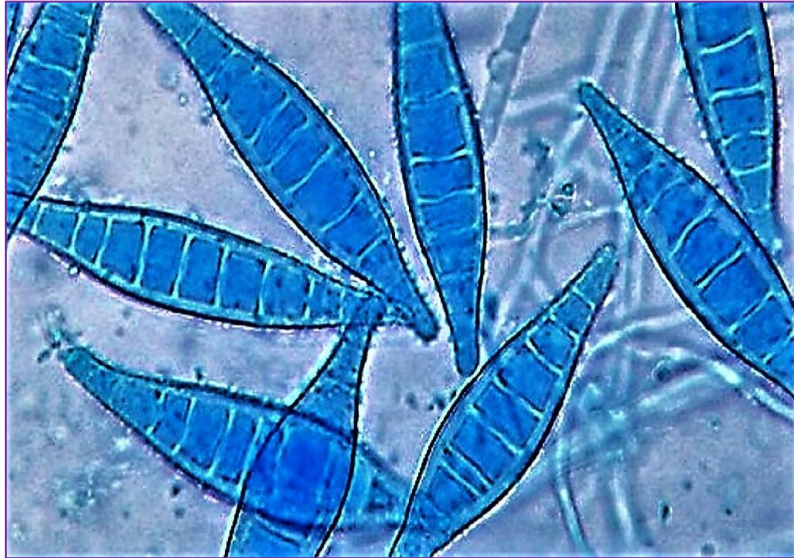


Culture

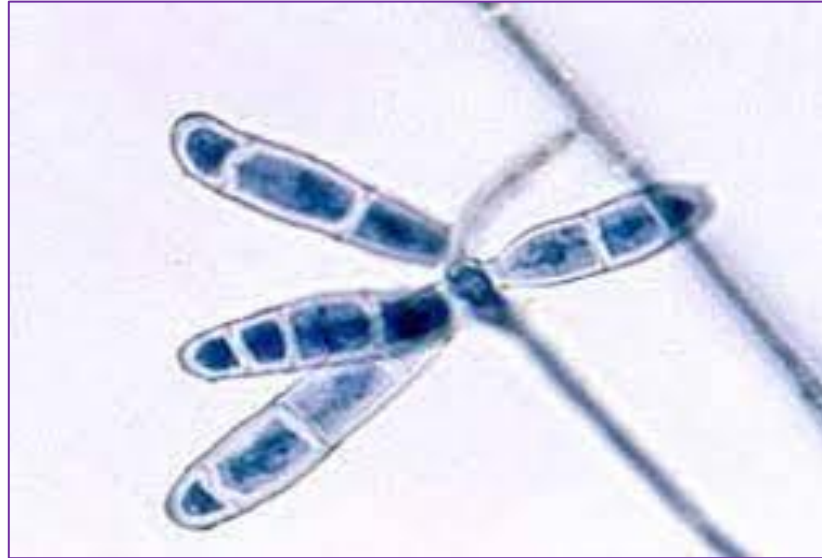
On sabouraud's agar: Incubate at room temp (22- 25°C) for up to 3 weeks.

اسم الصبغة الي بدي اصبغ فيها جزء من ال spors الي طلع عندي ع ال agar الي زرعتة

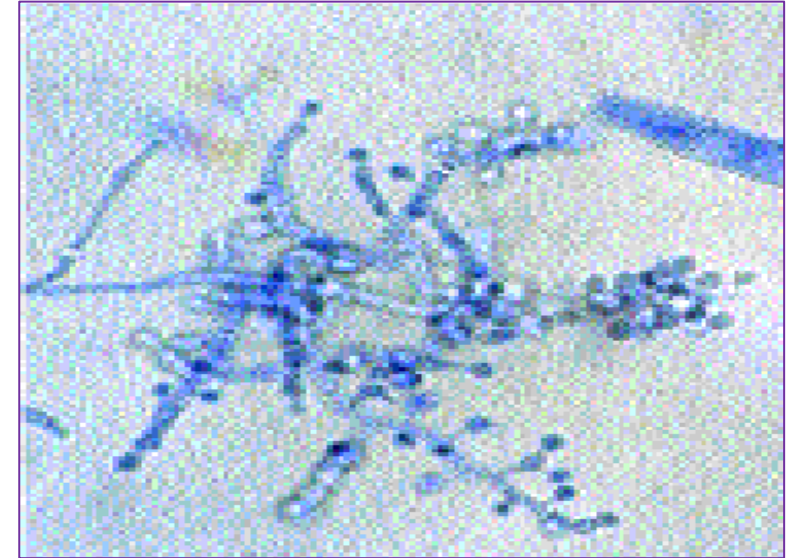
A lactophenol cotton blue stained film show **spores** of the three genera of dermatophytes



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

