

Eukaryotic Microorganisms and Parasites

Lecture# 4

Pharmaceutical Microbiology

Dr. Rawan Abudalo

Department of Clinical Pharmacy and Pharmacy Practice

Faculty of Pharmaceutical Sciences

Hashemite University

Introduction

- A **parasite** is an organism that lives at the expense of another organism, called the **host**.

Parasites may cause moderate to severe damage. Parasites that cause disease are called **pathogens**.

- **Parasitology** is the study of parasites.

Parasites in Relation to Their Hosts

Are divided to:

- **Ectoparasites:** such as ticks and lice, which live on the surface of other organisms.
- **Endoparasites:** as some protozoa and worms, which live within the bodies of other organisms.
- **obligate parasites:** **They must spend** at least some of their life cycle in or on a host as causes malaria (*Plasmodium*) *must invade red blood cells*
- **facultative parasites:** **They normally** are free-living, such as some soil fungi, but they can obtain nutrients from a host, as many fungi do when they cause skin infections.

Parasites in Relation to Their Hosts

According to the duration of their association with their hosts:

- **Permanent parasites:** remain in or on a host once they have invaded it as tapeworms.
- **Temporary parasites:** feed on and then leave their hosts such as many biting insects.
- **Accidental parasites :**invade an organism other than their normal host. Such as Ticks that ordinarily attach to dogs or to wild animals sometimes attach to humans.

Parasites in Relation to Their Hosts

Hyperparasitism refers to a parasite itself having parasites. Some mosquitoes, which are temporary parasites, harbor the malaria parasite or other parasites.

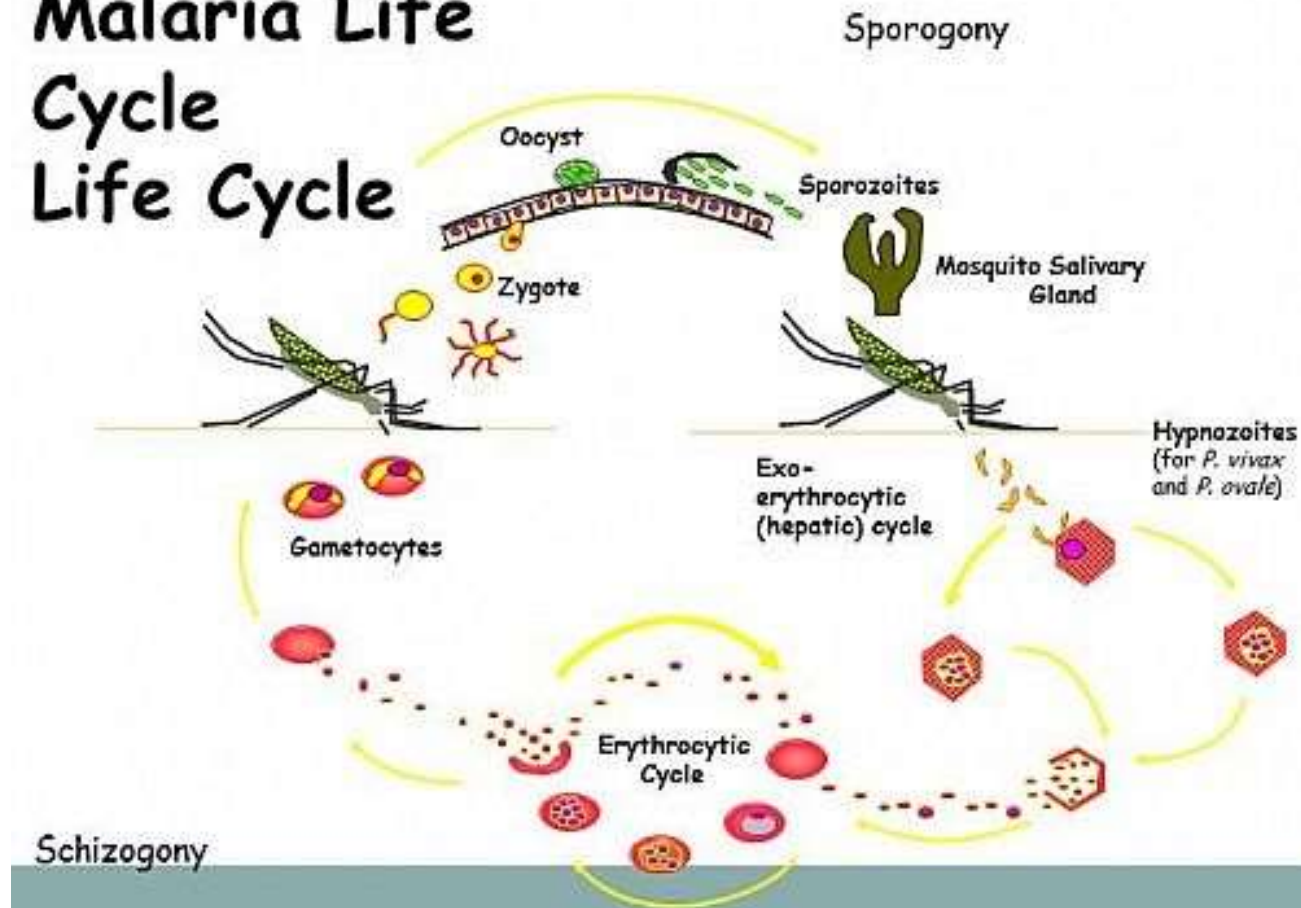
- An organism that transfers a parasite to a new host is a **vector**.
- **biological vector**: A vector in which the parasite goes through part of its life cycle as **The malaria mosquito** is both a host and a biological vector.
- A **mechanical vector** is a vector in which the parasite **does not** go through any part of its life cycle during transit. E.g Flies that carry parasite eggs, bacteria, or viruses from feces to human food are mechanical vectors.
- These insects serve as **vectors of many human parasitic diseases**

Parasites in Relation to Their Hosts

Host classification

- **definitive hosts** if they harbor a parasite while it reproduces sexually.
E.g The mosquito is the definitive host for the malaria parasite.
- **intermediate hosts** if they harbor the parasite during some other developmental stages
 - E.g: The mosquito is the definitive host for the malaria parasite because that parasite reproduces sexually in the mosquito; the human is an intermediate host.
- **Reservoir hosts** are infected organisms that make parasites available for transmission to other hosts. e.g. wild or domestic animals acting as reservoir hosts for human parasitic diseases.
- **Host specificity:** refers to the range of different hosts in which a parasite can mature. **Some parasites are quite host specific-they mature in only one host**

Malaria Life Cycle



Harmful Effects of Parasites

- All parasites rob their hosts of nutrients..
- Many parasites cause significant trauma to host tissues as they cause open sores on the skin, destroy cells in tissues and organs.
- trigger severe inflammatory and immunological reactions.

Protists

Characteristics of Protists-they share:

- eukaryotic organisms and most are unicellular
- Although most protists are microscopic, they vary in diameter from 5 μm to 5 mm.

- Classification:

Animal-like protists (protozoa)

Plant like protists (algae)

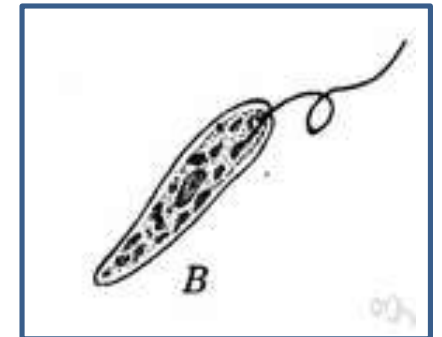
Fungus like protists (slime molds and water molds)

Protozoa

- Mostly unicellular organisms, but a few form colonies.
- Some are **commensals, which live** in or on other organisms without harming them, other are parasites.
- Classified on the basis of their means of locomotion:

1. **Mastigophorans** have flagella

- Trypanosomes cause African sleeping sickness.
- leishmanias cause skin lesions or systemic disease with fever
- Giardias cause diarrhea.
- Trichomonads cause vaginal inflammation

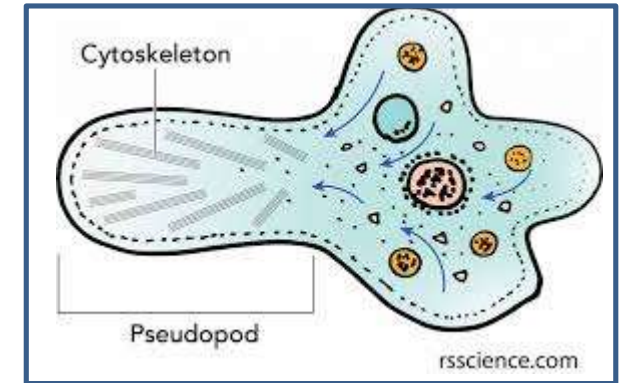


Protozoa

2. **Amebozoa** move by means of pseudopodia.

The more commonly observed genera:

- *Entamoeba*, *Dientamoeba*, and *Iodamoeba*—
cause amoebic dysenteries of varying degrees of severity.
- *Entamoeba gingivalis* is found in the mouth

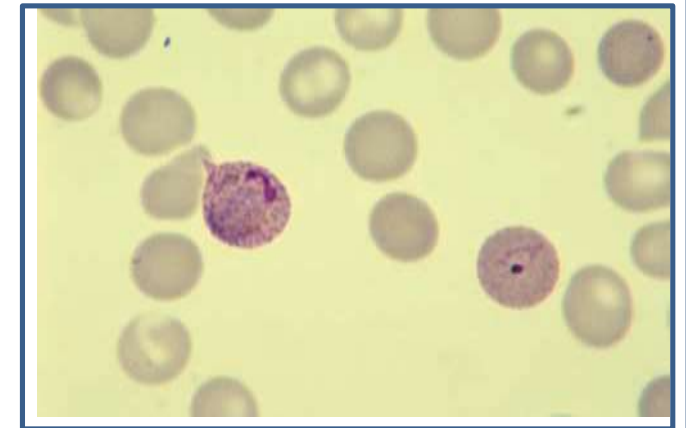


3. **Apicomplexans.**

- They are **immobile** parasites which have **enzymes in groups or complexes of organelles at the tips (apices) of their cells to digest their way into host cells**

e.g; Plasmodium causes malaria

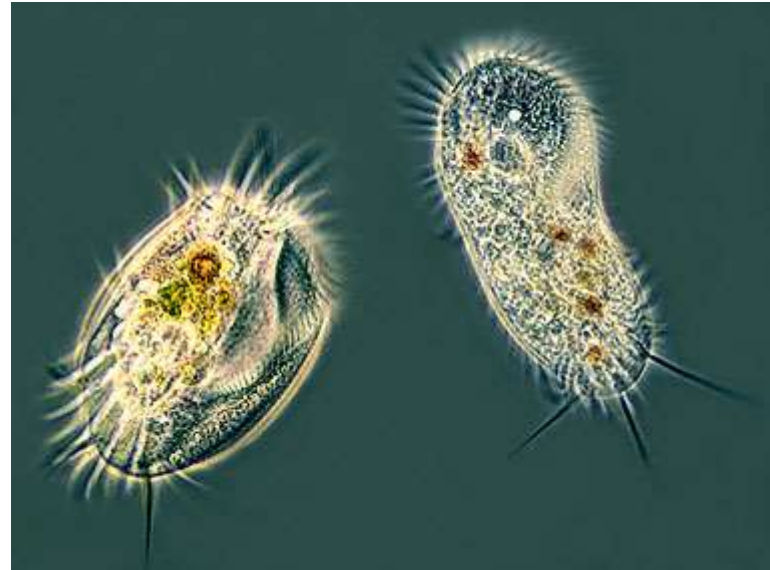
e. g Toxoplasma gondii causes toxoplasmosis



Protozoa

4. Ciliates.

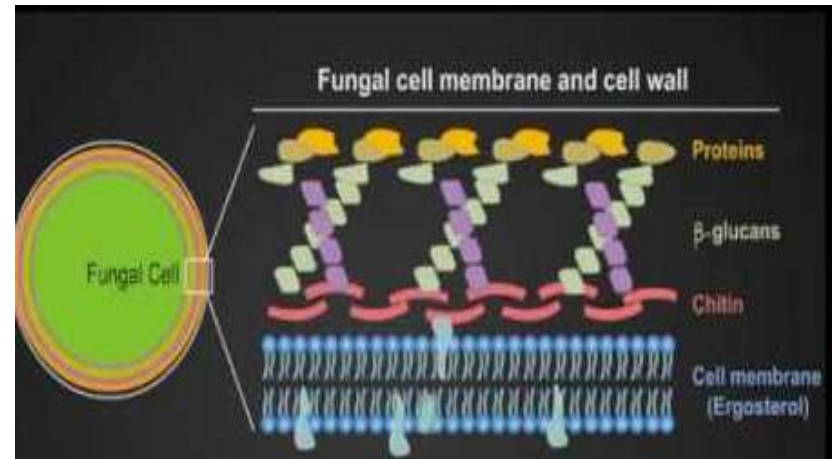
- **The largest group of protozoans** have cilia over most of their surfaces



Fungi

fungi (yeasts and molds) are **eukaryotic organism**

- fungal cell structures are important medically:
 1. The fungal cell wall consists primarily of chitin.
 2. Chitin is a polysaccharide composed of long chains of *N-acetylglucosamine*. *The fungal cell wall contains other polysaccharides as well, the most important of which is β -glucan, a long polymer of d-glucose.*
 3. The fungal cell membrane contains ergosterol, in contrast to the human cell membrane, which contains cholesterol.



Fungi

Characteristics of fungi:

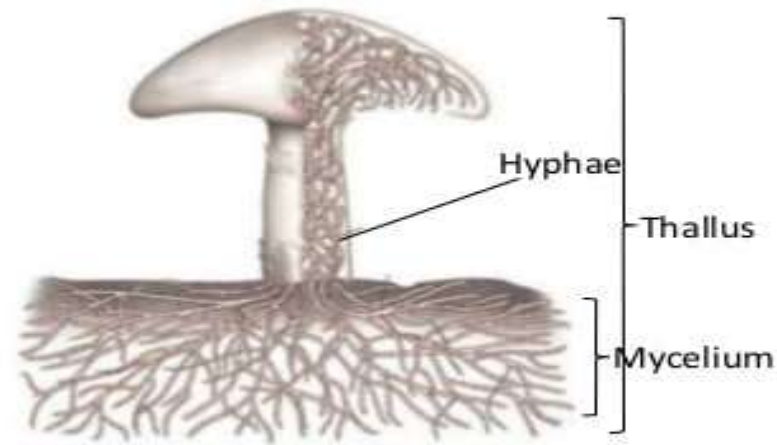
- Fungi are **heterotrophs**
- Many are **saprophytes (digest dead organic matter and organic wastes)**
- Some are **parasites that obtain nutrients from the tissues of other organisms** –Parasitic fungi can be destructive when they invade other organisms.

Fungi

- The body of a fungus is called a **thallus**. The thallus of most multicellular fungi consists of a **mycelium**. **A mycelium is a network of fungal threads or hyphae**
- The mycelium can be **embedded** in decaying organic matter, soil, or tissues of a living organism .
- Mycelial cells release **enzymes to digest** the surfaces of invaded matter and absorb small nutrient molecules.
- Hyphal cells are separated by cross walls called **septa**

Hyphae

- The vegetative bodies of most fungi is called thallus which constructed of tiny filaments called hyphae
- Tubular in shape
- Hyphae grow from their tips
- Branched (rarely unbranched)
- Multinucleate



Fungi-Morphology

1. Mold

- Multicellular, hyphae, septate & nonseptate, hyaline & dematiaceous, diameter 4-20 μm
- Sexual and asexual reproduction



Hyaline aseptate hyphae

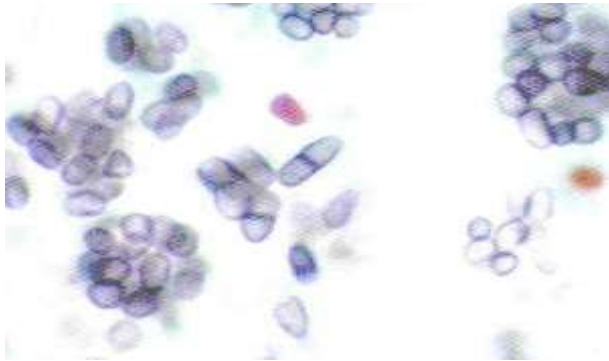


Hyaline septate hyphae

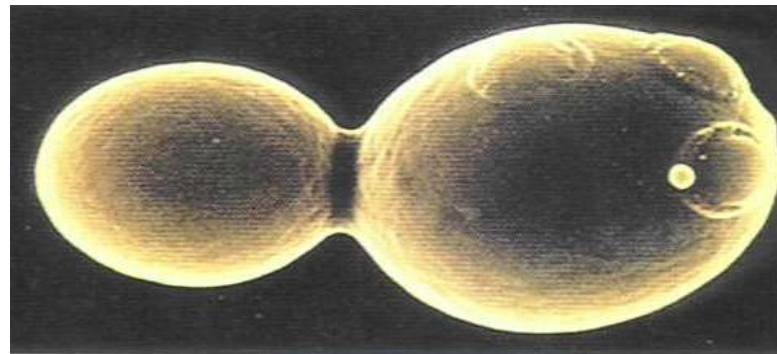
Fungi-Morphology

2. Yeast

- Unicellular, round or oval.
- **Method of reproduction:** budding, binary fission, sexual spores)

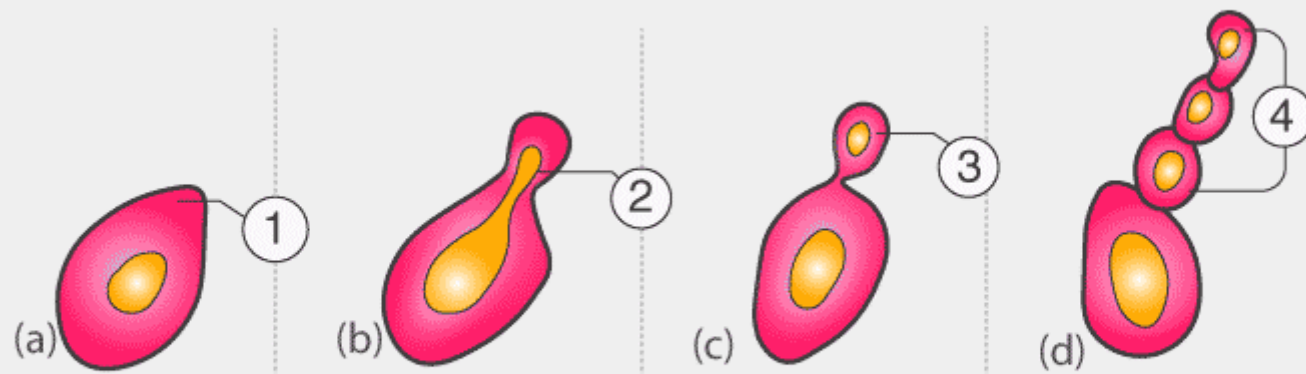


Binary fission



Budding
yeasts

REPRODUCTION IN YEAST BY BUDDING



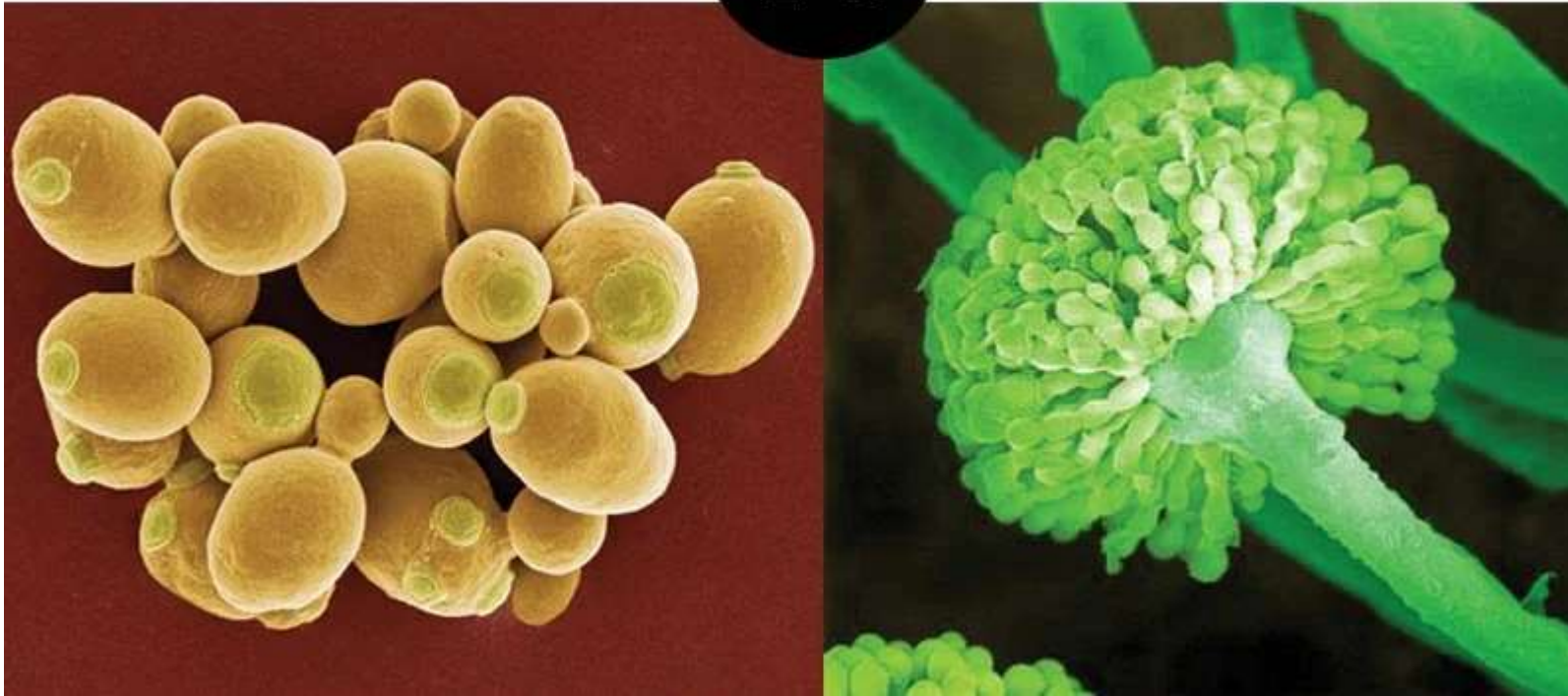
1 Yeast Cell

2 Developing Bud

3 New Bud

4 Chain of buds

Yeasts **VS** Molds



Differences between Yeasts and Molds



Yeasts



Molds

Comparison of 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

The Importance of Fungi

- fungi are used in the production of important foods (e.g., bread, cheese, wine, and beer).
- Fungi are also responsible for the spoilage of certain foods.
- Because molds can grow in a drier, more acidic, and higher osmotic pressure environment than bacteria, they tend to be involved in the spoilage of fruits, grains, vegetables, and jams.

The Importance of Fungi

- Important in **health sciences**, as **facultative parasites** -they can obtain **nutrients from nonliving organic matter or from living organisms**
- Are never obligate parasites because all fungi can obtain nutrients from dead organisms.
- Some fungi produce antibiotics that inhibit the growth of or kill bacteria

PATHOGENESIS

- Parasitic fungi can be destructive when they invade other organisms. These fungi have three requirements for invasion:
 - (1) proximity to the host.
 - (2) the ability to penetrate the host
 - (3) the ability to digest and absorb nutrients from host cells.
- Human fungal diseases are called **mycoses which are often caused by more than one organism**

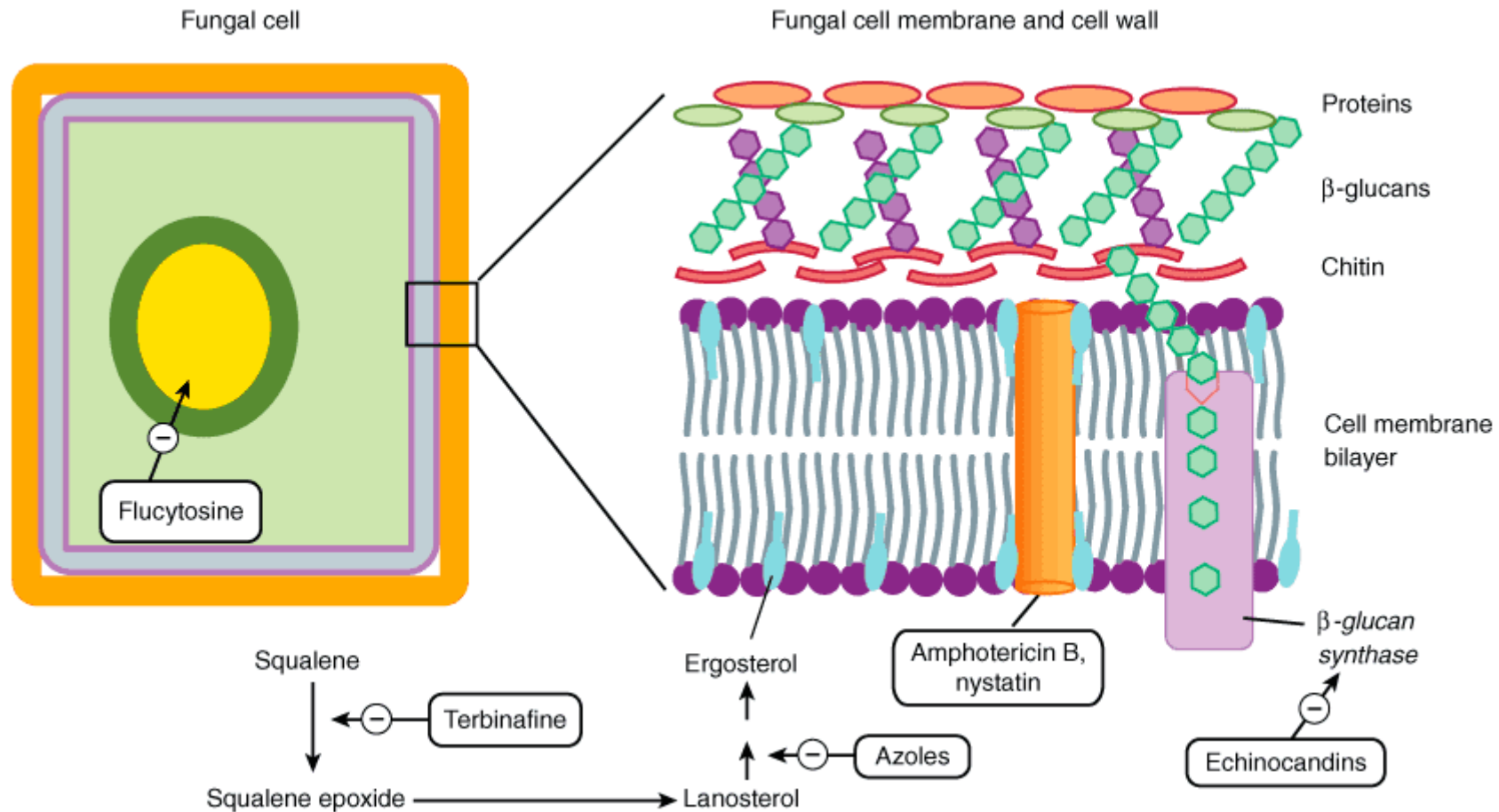
Examples of pathogenic fungi:

Candida, Aspergillus, Cryptococcus and Histoplasma

ANTIFUNGAL THERAPY

- The drugs used to treat bacterial diseases have no effect on fungal diseases. For example, penicillins inhibit the growth of many bacteria but do not affect the growth of fungi.
- This difference is explained by the presence of certain structures in bacteria
- E.g : **Amphotericin B** disrupts fungal cell membranes at the site of ergosterol and **azole drugs** inhibit the synthesis of ergosterol, which is an essential component of fungal membranes.

Mechanism of antifungals

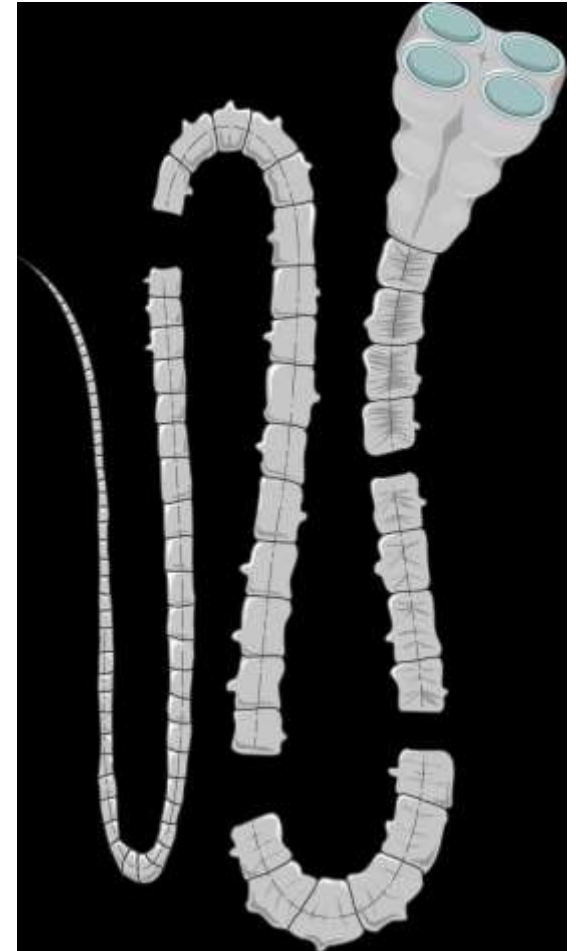


Some terms

- mycology
 - study of fungi
- mycologists
 - scientists who study fungi
- mycotoxicology
 - study of fungal toxins and their effects
- mycoses
 - diseases caused by fungi

Helminths (Worms)

- has a head and tail end, and its tissues are differentiated into three distinct tissue layers
- The worms that parasitize humans include
 1. **Flatworms**
 - no more than 1 mm thick, but some, such as large tapeworms, can be as long as 10 m
 - Have **suckers or hooks to attach to their hosts**
 - Examples: **tapeworm (*Taenia saginata*)**



Helminths (Worms)

2. Roundworms, or nematodes

- Have **cylindrical bodies** and they vary in **length from 1mm to 1m**
- Example: *Ascaris lumbricoides*

