

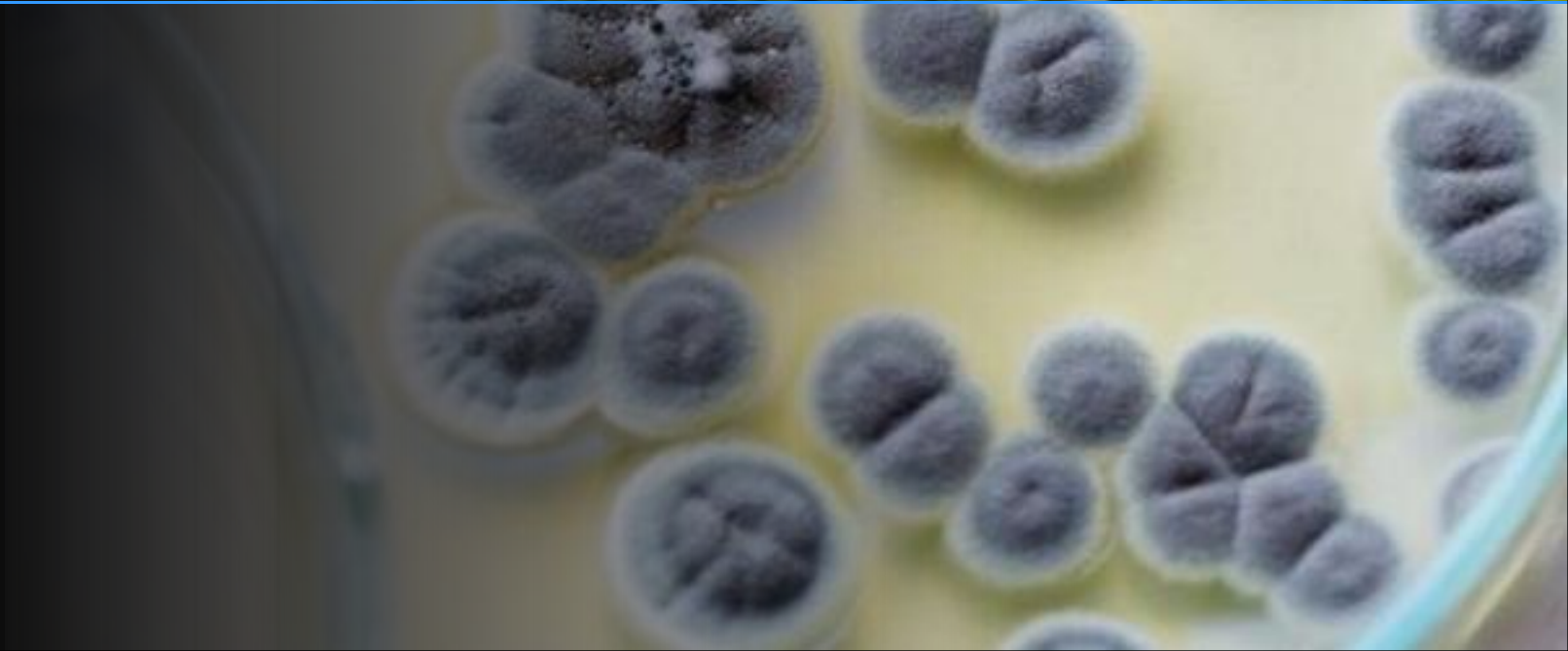
Course Title: Mycology

Course Code: PL PATH 501

Unit 1

Mycology: Introduction, Definition of Different Terms, Basic Concept

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Fungi : Introduction (Important facts)

Fungi are eukaryotic organisms; i.e., their cells contain membrane-bound organelles and clearly defined nuclei.

Historically, fungi were included in the plant kingdom; however, because fungi **lack chlorophyll and are distinguished by unique structural and physiological features (i.e., components of the cell wall and cell membrane)**, they have been separated from plants.

In addition, fungi are clearly **distinguished from all other living organisms**, including animals, by their principal **modes of vegetative growth and nutrient intake**.

Fungi grow from the tips of filaments (hyphae) that make up the bodies of the organisms (mycelia), and they **digest organic matter externally before absorbing it into their mycelia**.

Introduction

Body Form

- **Unicellular**
- **Filamentous (tube-like strands called hypha (singular) or hyphae (plural))**
- **Mycelium = aggregate of hyphae**
- **Sclerotium = hardened mass of mycelium that generally serves as an overwintering stage.**
- **Multicellular, such as mycelial cords, rhizomorphs, and fruit bodies (mushrooms)**

.



Characteristic s Features

- Fungi are **Not plants**
- **Non-photosynthetic**
- Eukaryotic
- Nonmotile
- Most are saprobes (live on dead organisms)



Characteristics Features

- **Absorptive Heterotrophs** (digest food first and then absorb it into their bodies.
- Release digestive enzymes to break down organic material or their host
- **Store food as glycogen**

Characteristics Features

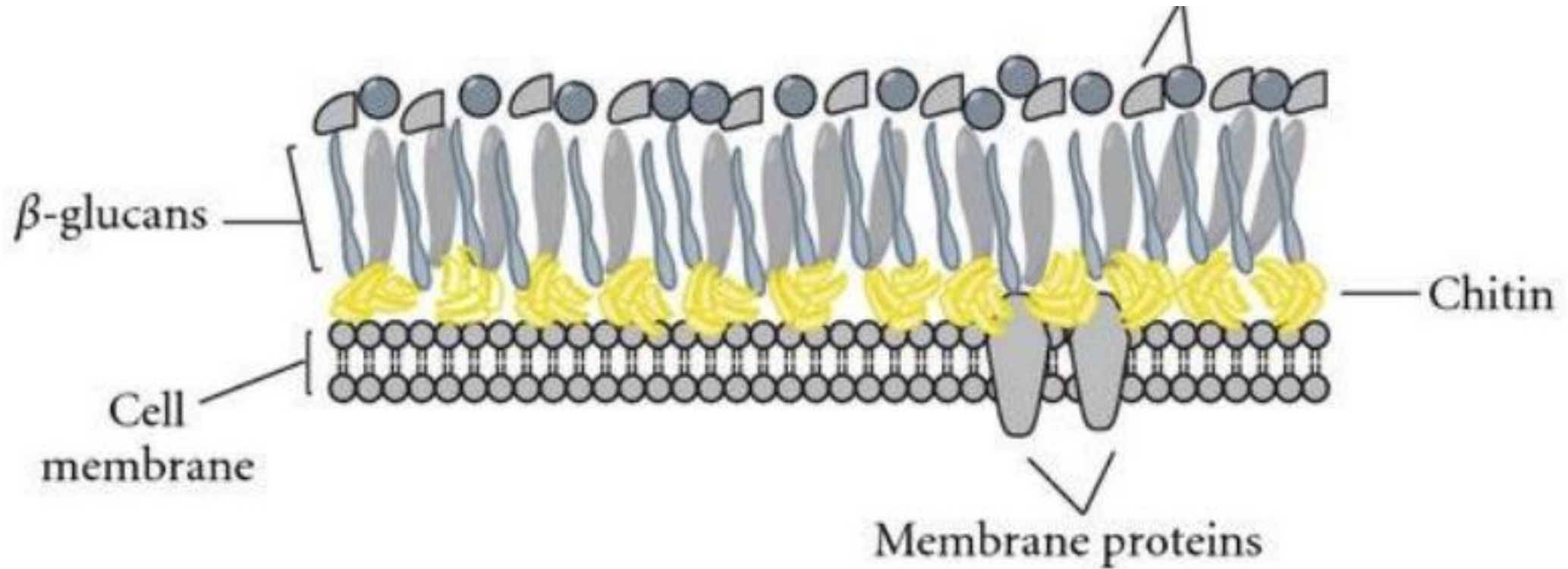
- **Important decomposers and recyclers of nutrients in environment**
- **Most are multicellular. Except unicellular yeast**
- **Lack true roots, stem, or leaves**



Unicellular Yeast



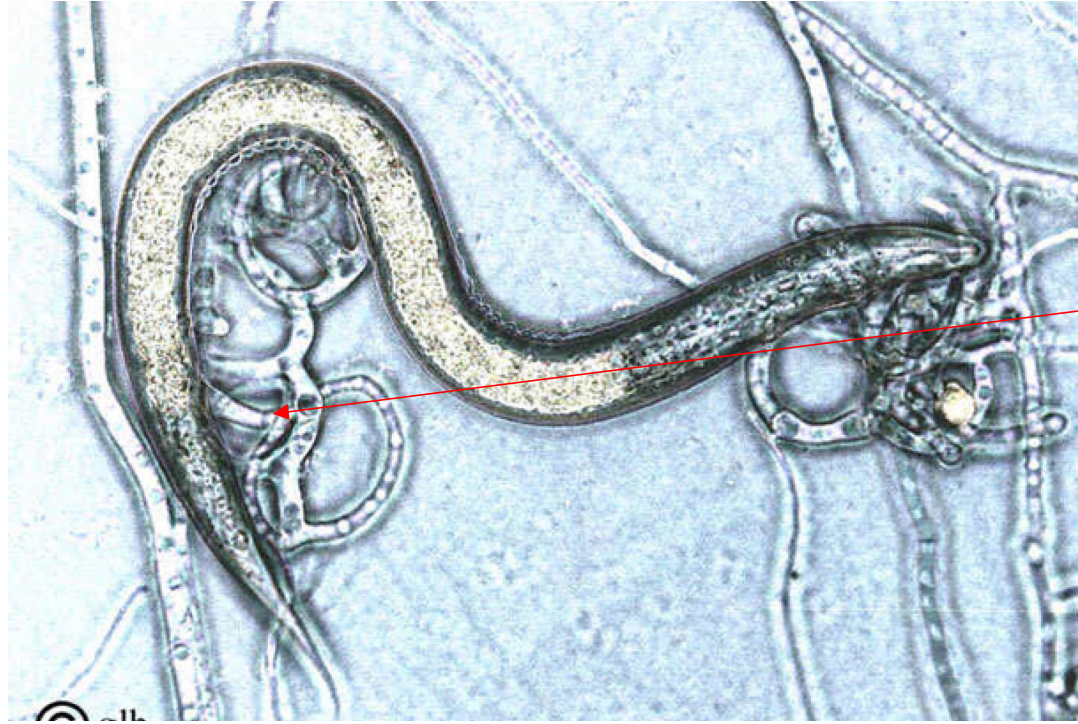
Multicellular Fungi



Cell wall of Fungi

Characteristics Features

- Cell walls are made of **chitin (complex polysaccharide)**
- Body is called Thallus
- Grow as microscopic tube or filaments called hyphae



Fungi feeding on nematode

Characteristic features

- Some fungi are internal or external parasites
- A few **fungi act like predators and capture prey like roundworms**



Ediable Fungi



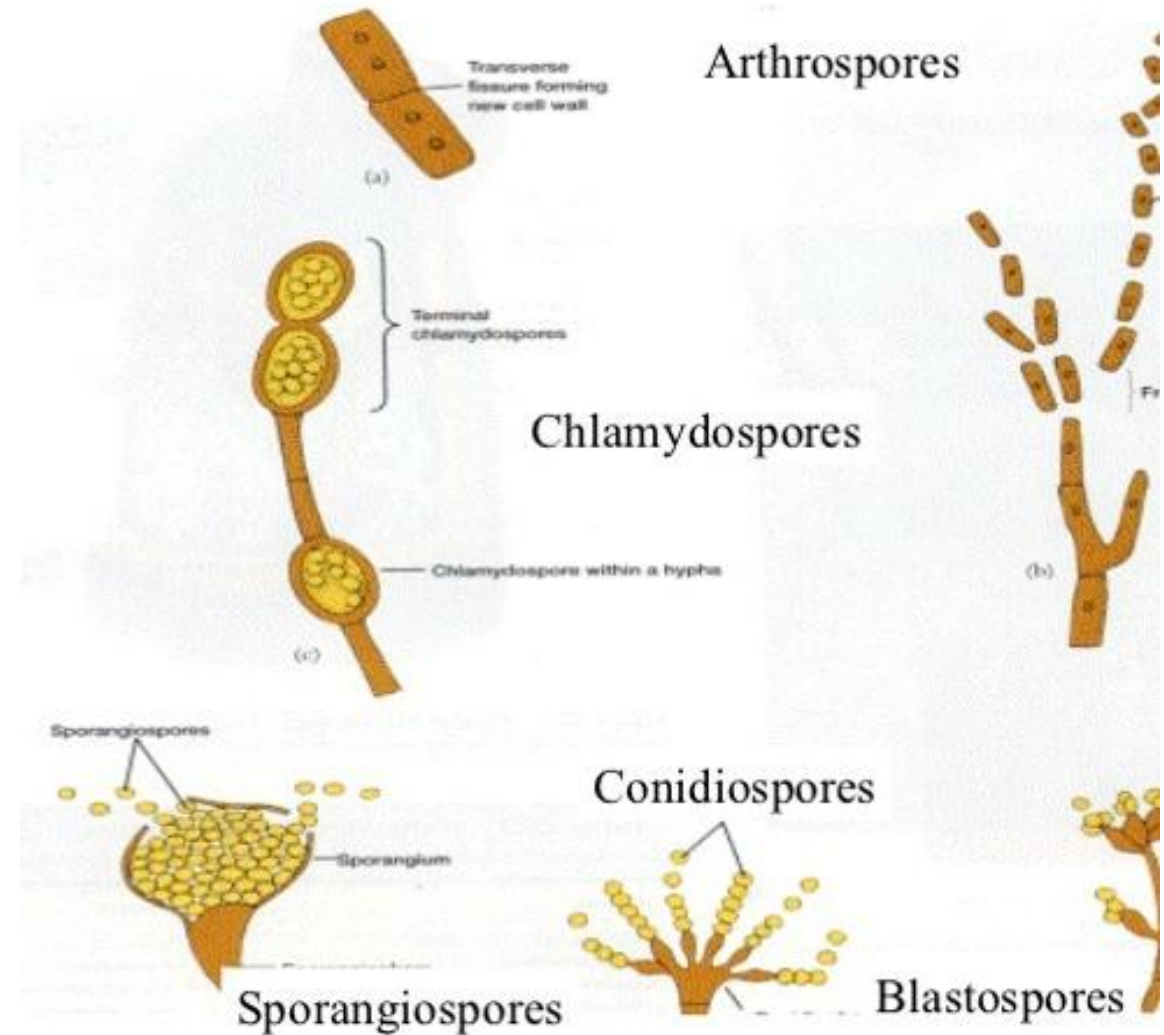
Poisonous Fungi
(Amanita)

Characteristic Features

- Some are edible while others are poisonous

Characteristic Features

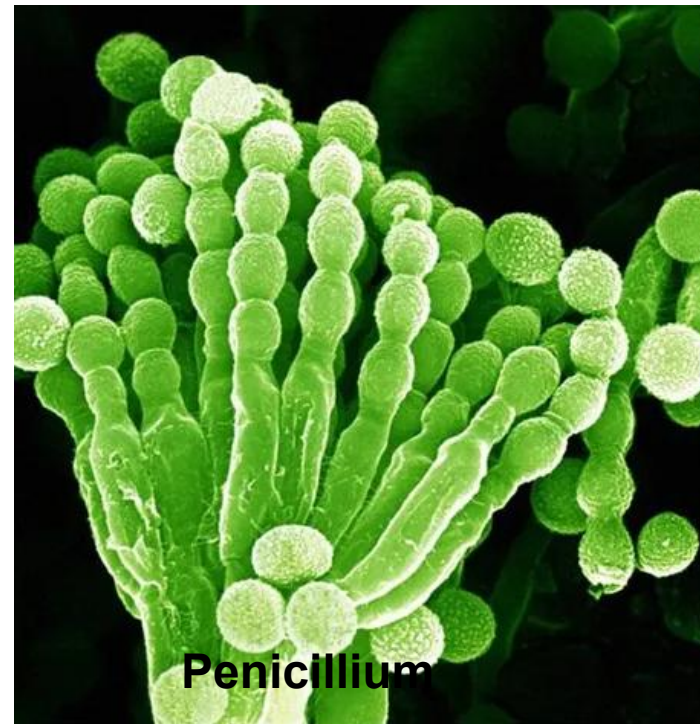
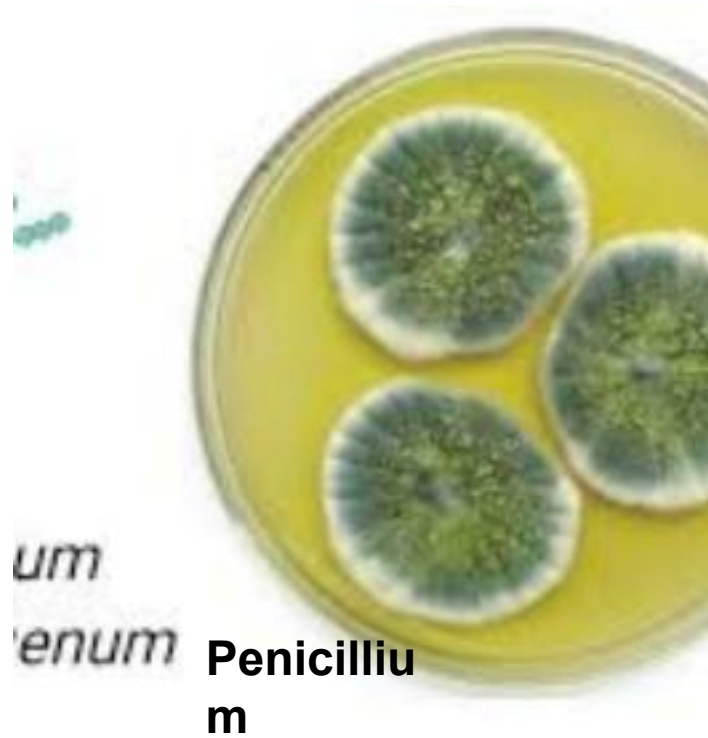
- Produce both sexual and asexual spores
- Classified by their sexual reproductive structures



Characteristic features

- Grow best in warm, moist environments
- **Mycology** is the study of fungi
- **Mycologist** study fungi
- A fungicide is a chemical used to kill fungi





Characteristic features

- Fungi include **Puffballs**, yeast, mushrooms, toadstools, rusts, smuts, ringworm and molds.
- The **antibiotic penicillin** is made by the **Penicillium** mold

Fungi size

- Fungi range from Unicellular yeast to large **Puff balls** 20-60 cm in diameters



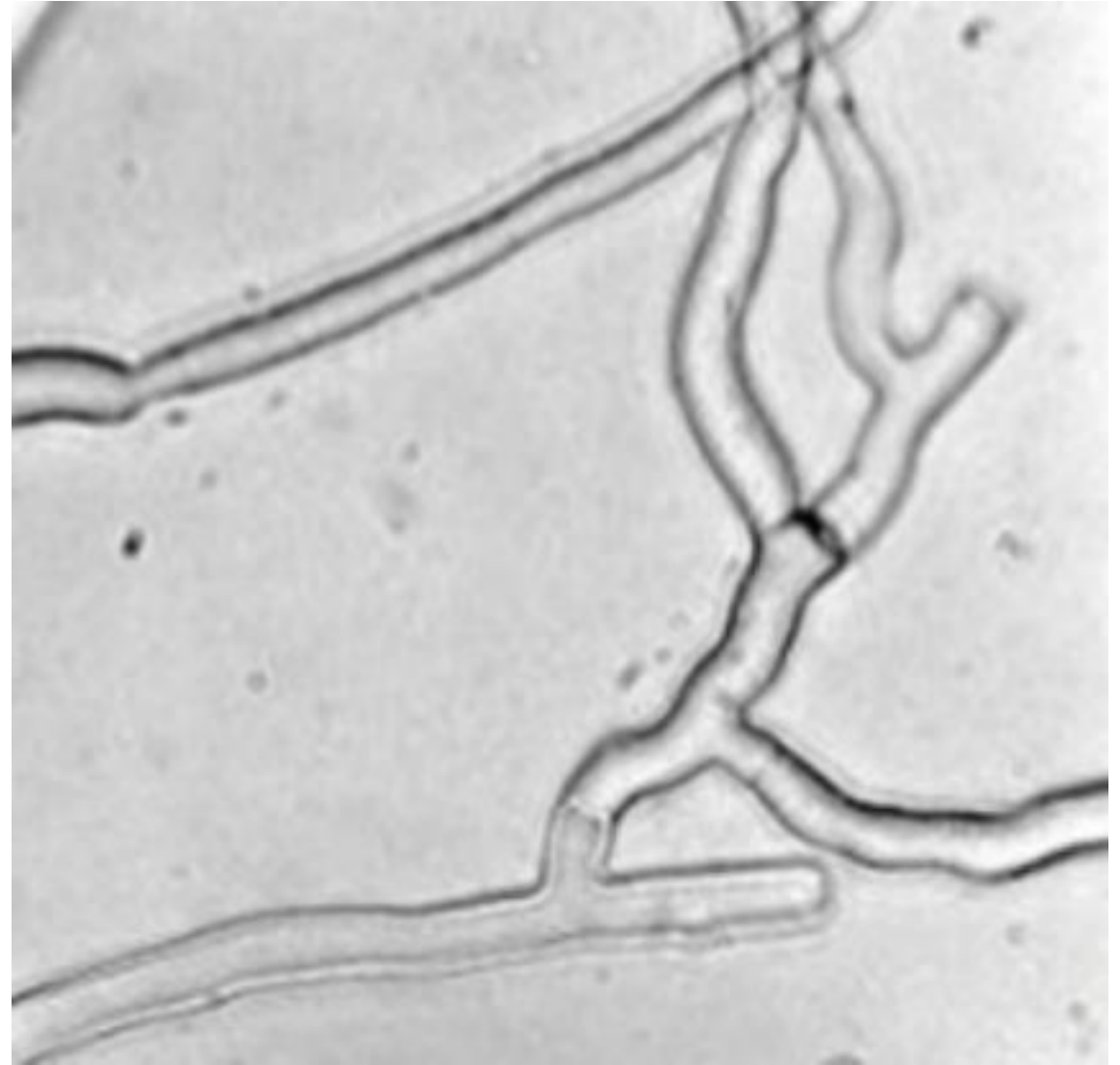
Giant Puff balls



Yeast

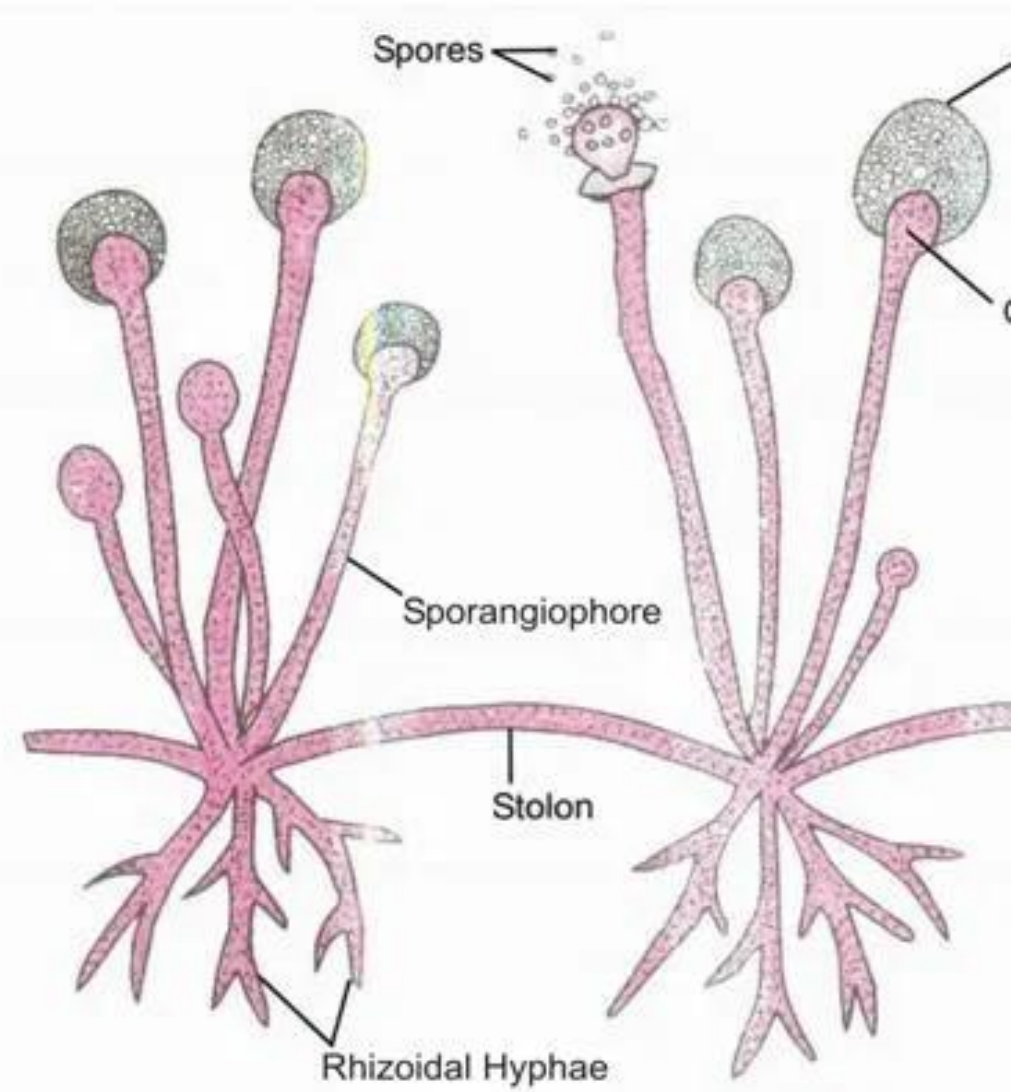
Structure: Hyphae

- Tubular shape
- One continuous cell
- **Filled with cytoplasm and nuclei**
- **Multinucleate**
- Hard cell wall of chitin also in insect exoskeletons



Characteristic features

- Stolons: Horizontal hyphae that connect groups of hyphae to each other
- Rhizoids: Root like parts of hyphae that anchor the fungus



Characteristic features

- Cross wall called septa may form compartments
- Septa have pores for movement of cytoplasm
- **Form network called mycelia that run through the thallus(body)**

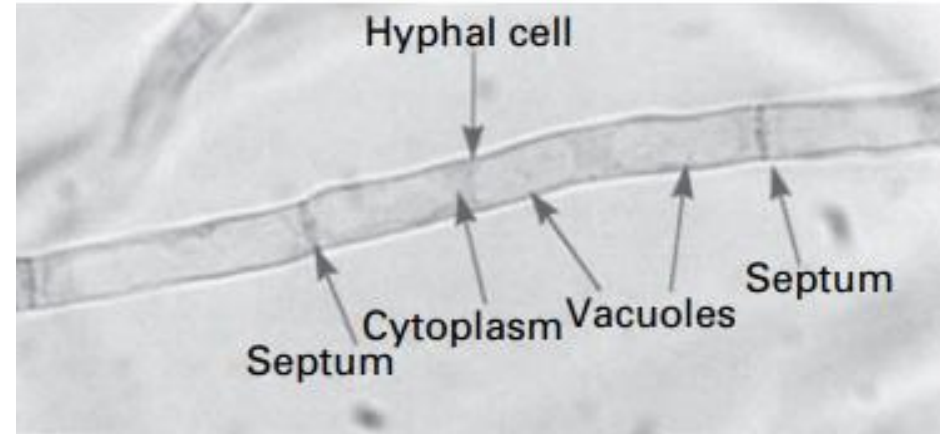
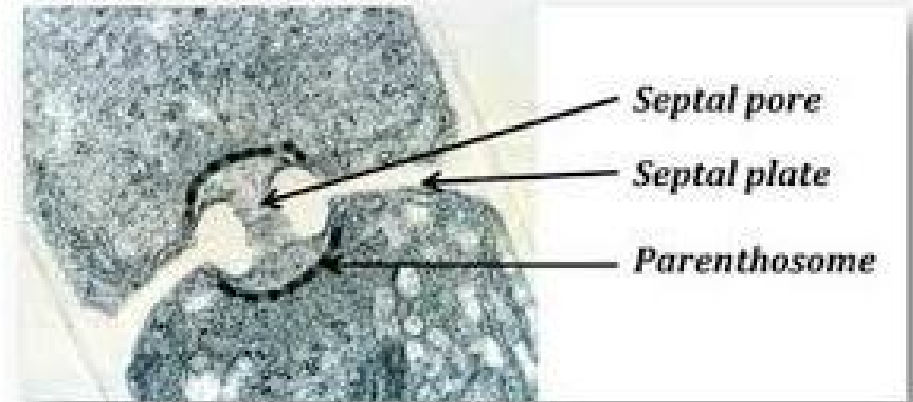
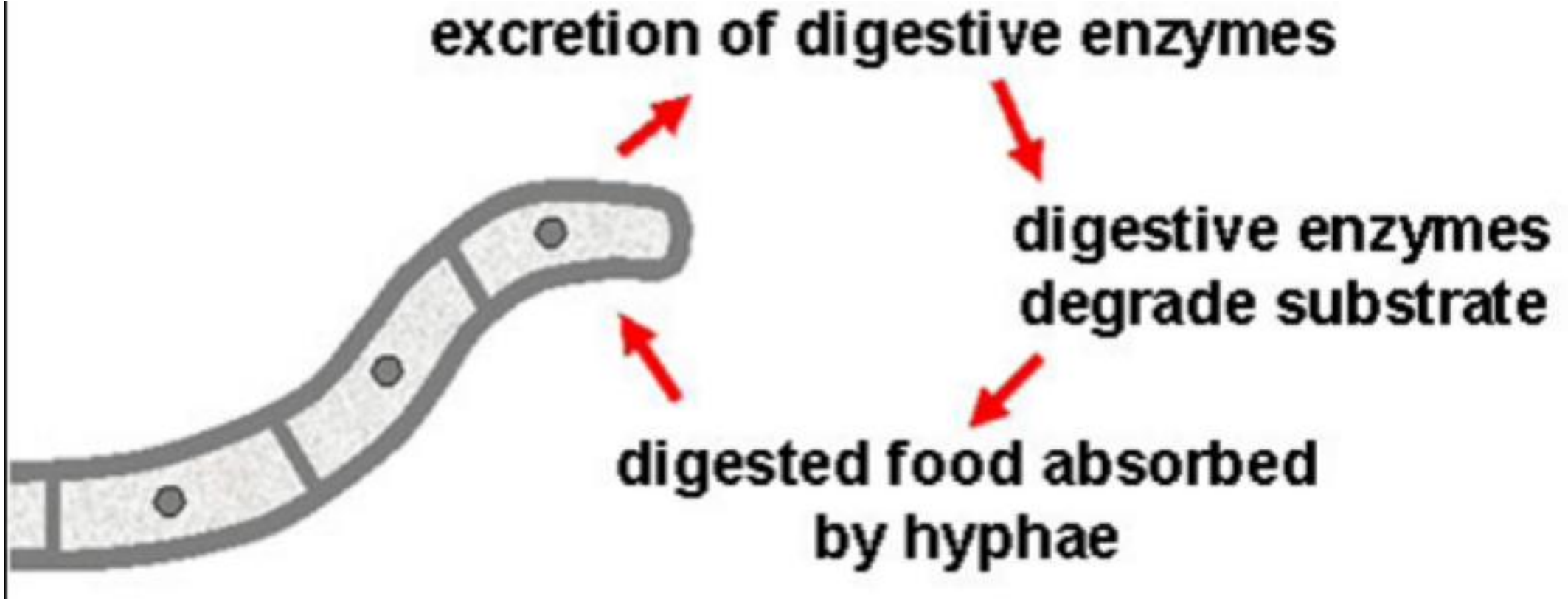


Figure 4.1 Septate hyphae of *Aspergillus fumigatus*.



Dolipore Septum of Basidiomycetes

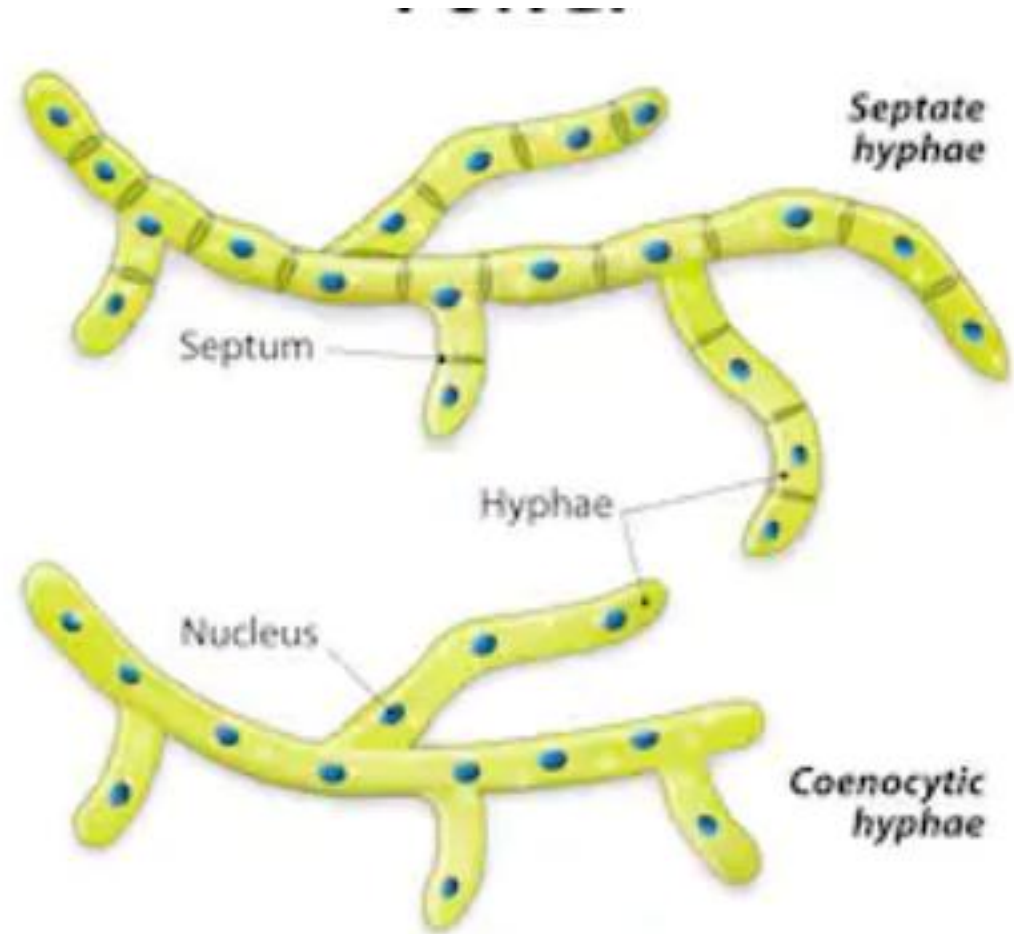


Absorptive Heterotroph

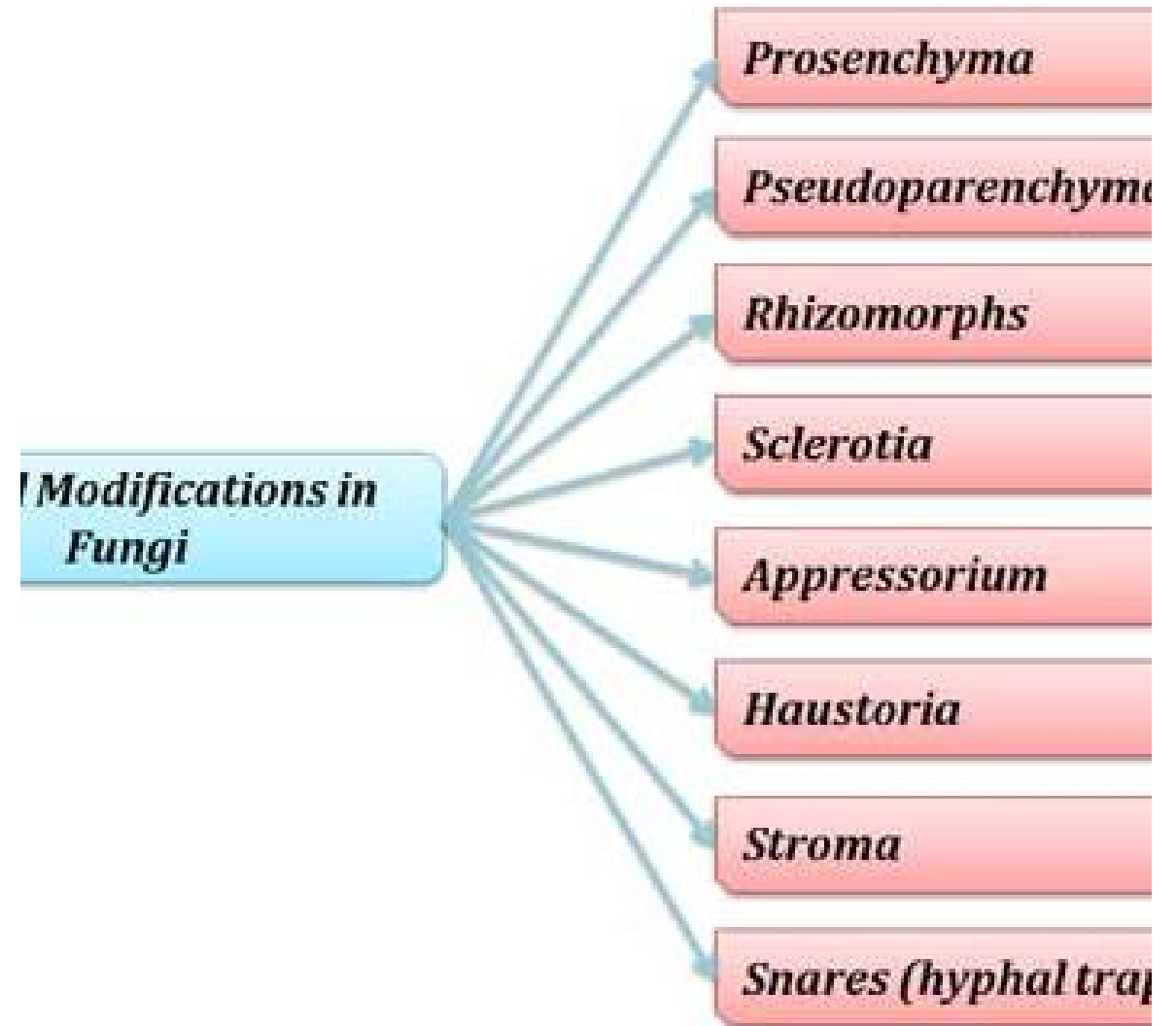
- Fungi get carbon from organic sources
- **Tips of hyphae release enzymes**
- Enzymatic breakdown of substrate
- **Products diffuse back into hyphae**

Structure

- The plant body of fungi typically consists of branched and filamentous hyphae, which form a net like structure known as mycelium.
- The hyphae are aseptate and coenocytic (as in **Phycomycetes**) or septate and uni or bi or multinucleate (As in Ascomycetes, Basidiomycetes and Deuteromycetes).



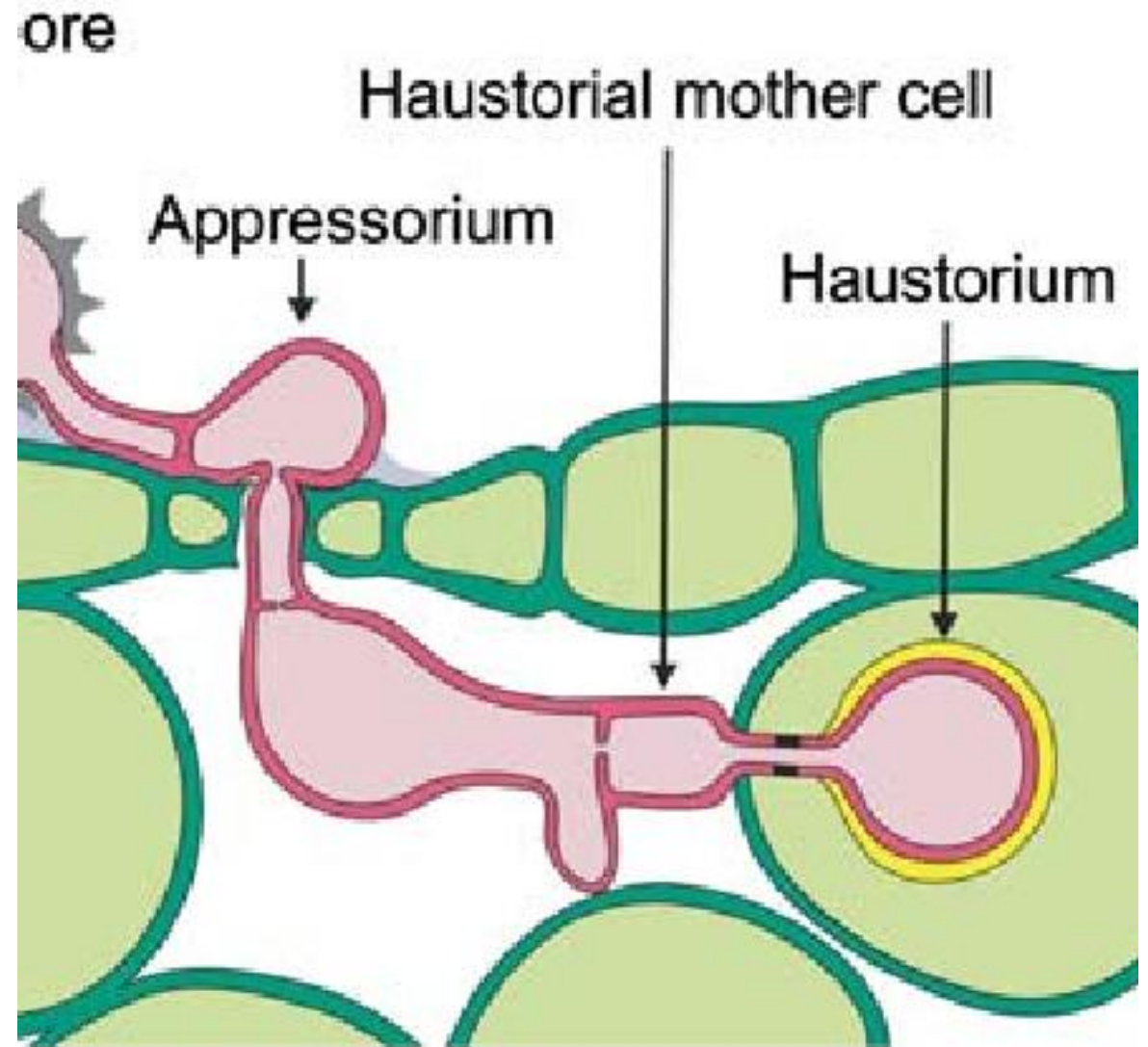
Modification n of Hyphae



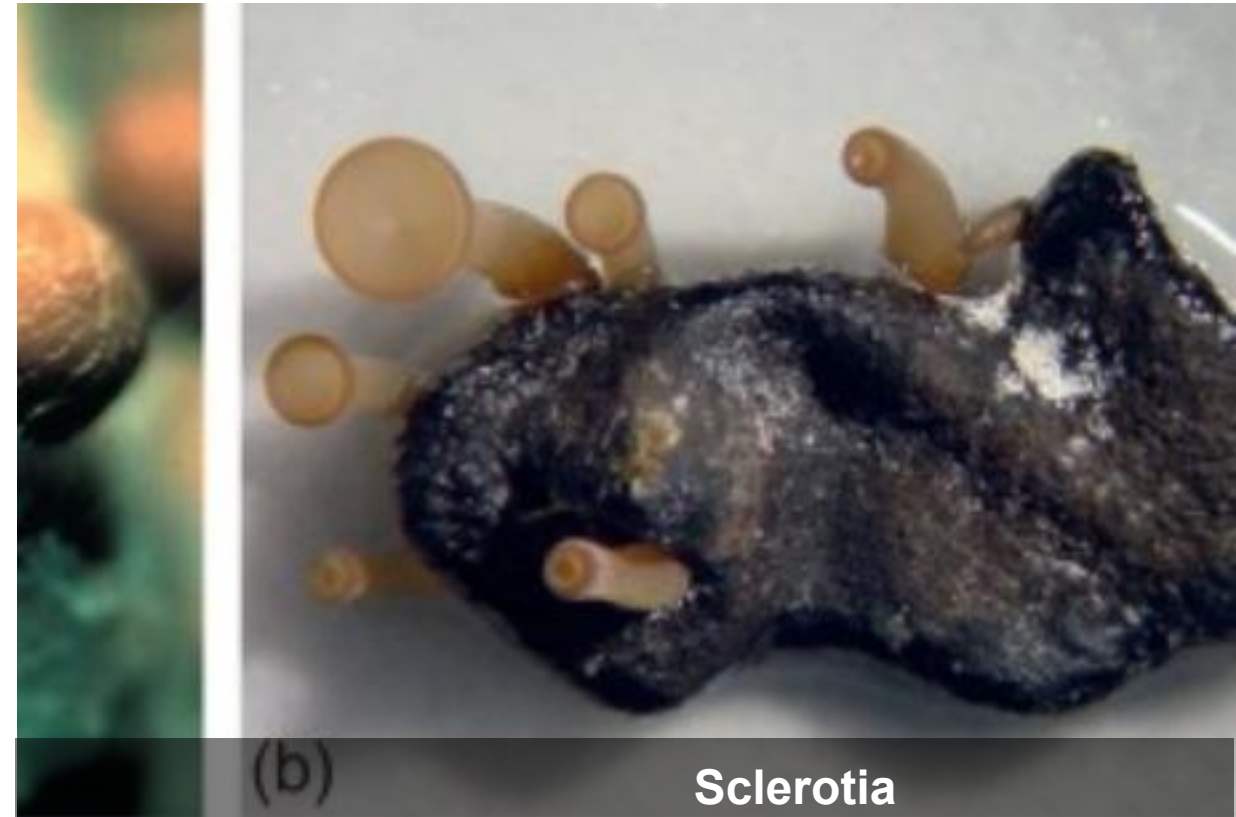
Modification of Hyphae

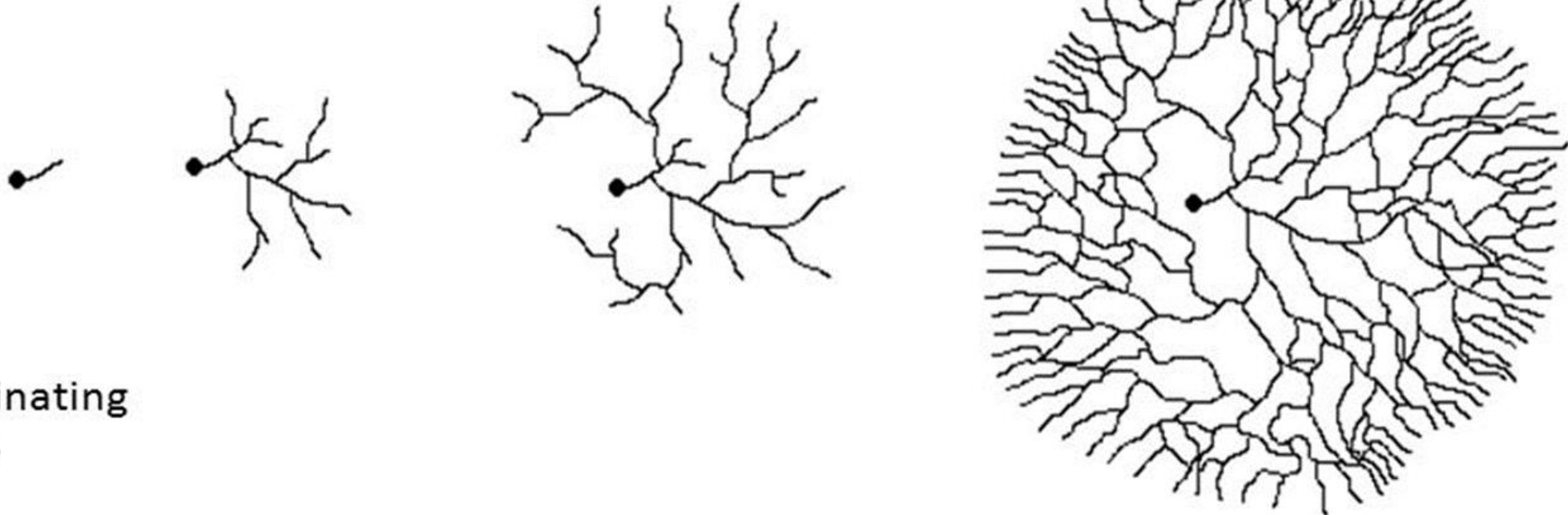


Modification of Hyphae



Modification of Hyphae





The diagram illustrates the process of hyphal growth in four stages from left to right. Stage 1: A single black dot representing a germinating spore. Stage 2: A short line (germ tube) emerging from the spore. Stage 3: The germ tube branching into several hyphae. Stage 4: A dense, circular network of many branching hyphae. Each stage has a black dot at its base, indicating the point of origin.

germinating
spore

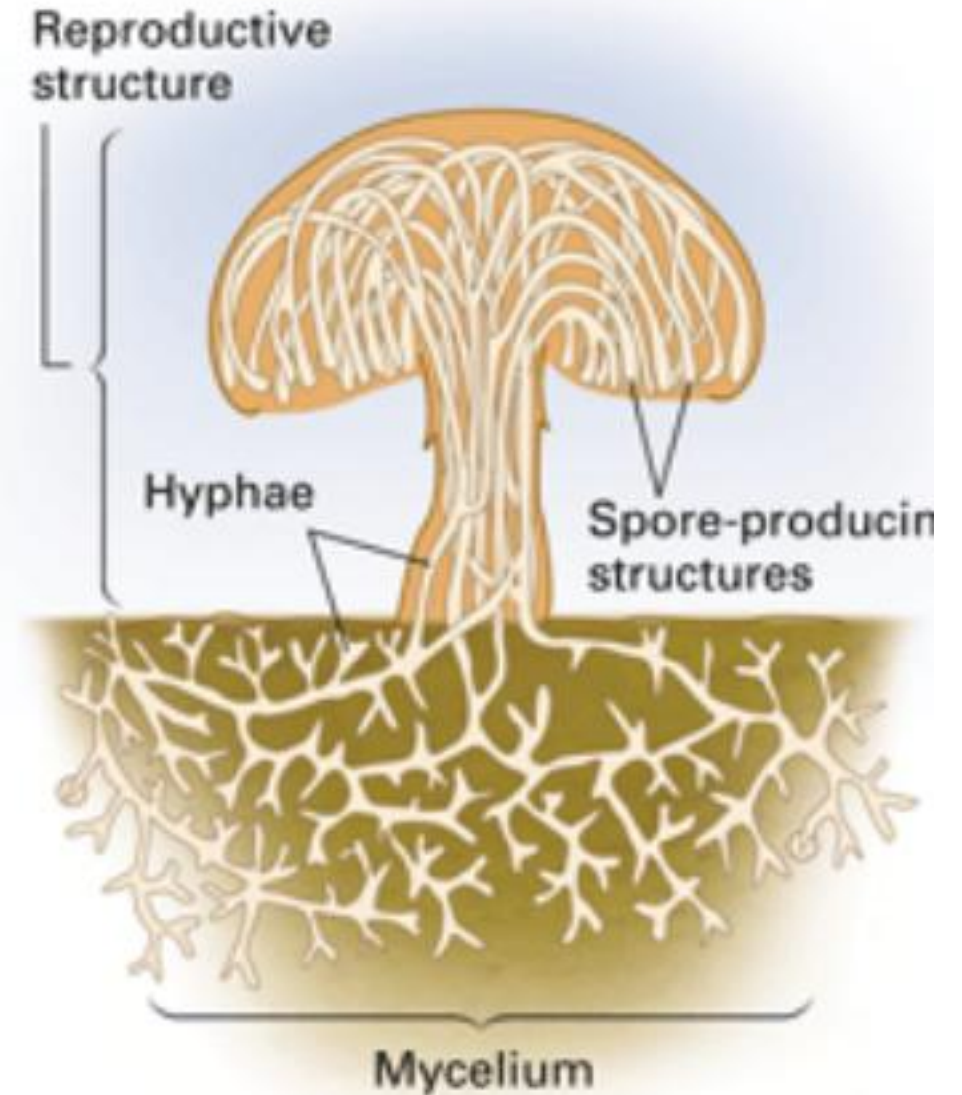
mycelium

Hyphal Growth

- Hyphae grow from their tips
- **Mycelium** is an extensive, feeding web of hyphae
- **Mycelia are the ecologically active bodies of fungi**
- Mycelia have a huge surface area
- More surface area aids digestion and Adsorption of food

Reproduction in Fungi

- Most fungi **reproduce Asexually and Sexually by spores**
- **Asexual reproduction** is most **common** method and produce genetically identical organisms
- Fungi **reproduce Sexually** when **conditions are poor and nutrients scarce**

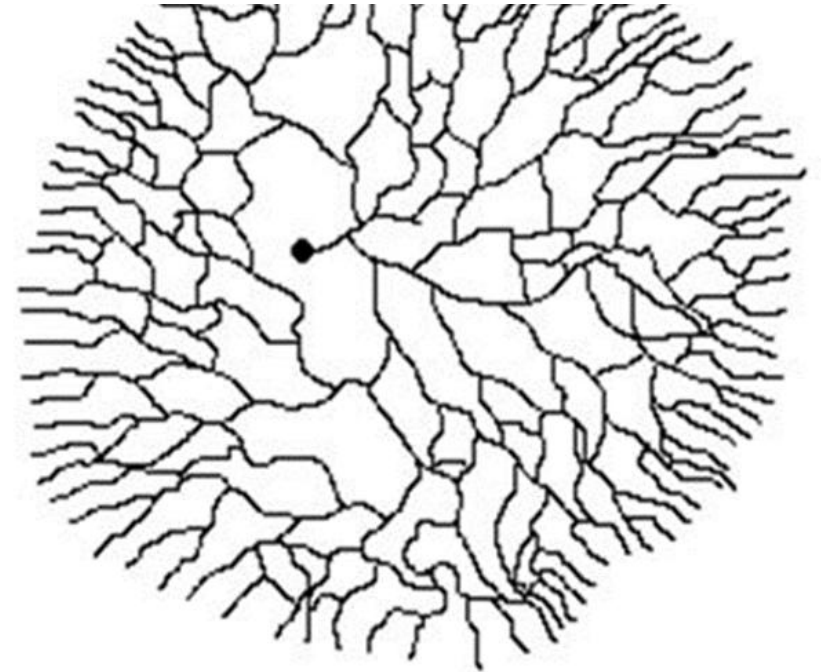
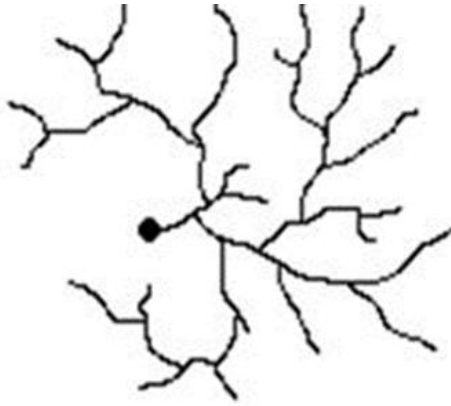


Hyphal growth from spore

- Mycelia have a huge surface area
- More surface area aids digestion and Adsorption of food



germinating
spore



Asexual Reproduction

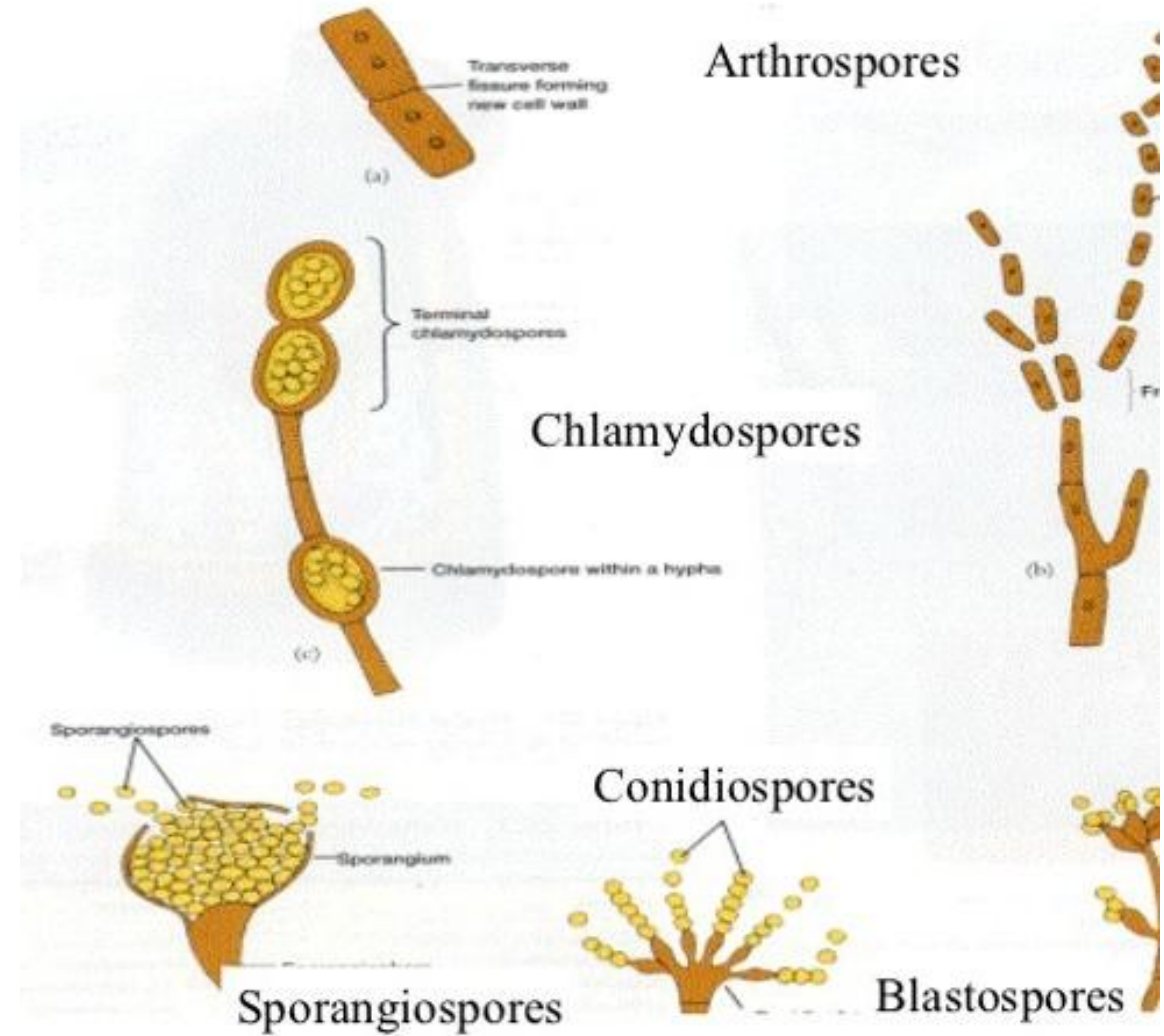
- **Fragmentation:** Part of the mycelium becomes separated and begins a life of its own
- **Budding:** A small cell form and gets pinched off as it grows to full size. Used by yeasts
- **Asexual spores:** production of spores by a single mycelium

Types of Asexual spores

- **Sporangiospores:** single cell spores are formed within sacs called sporangia at the end of special hyphae
- **Conidiospores or conidia:** This is formed at the tip or side of a hyphae
- **Oidia or arthrospores,** This single cell are formed by disjoining of hyphal cell
- **Chlamydospores:** this is thick-walled single celled spores are highly resistant to adverse condition. They are formed from the cells of the vegetative hyphae
- **Blastospores:** These spores are formed by budding

Asexual Spores

- Spores are an **adaptation to life on land**
- **Ensure that the species will disperse to new locations**
- Each spore contains a reproductive cell that forms a new organism
- **Nonmotile**
- **Dispersed by wind**



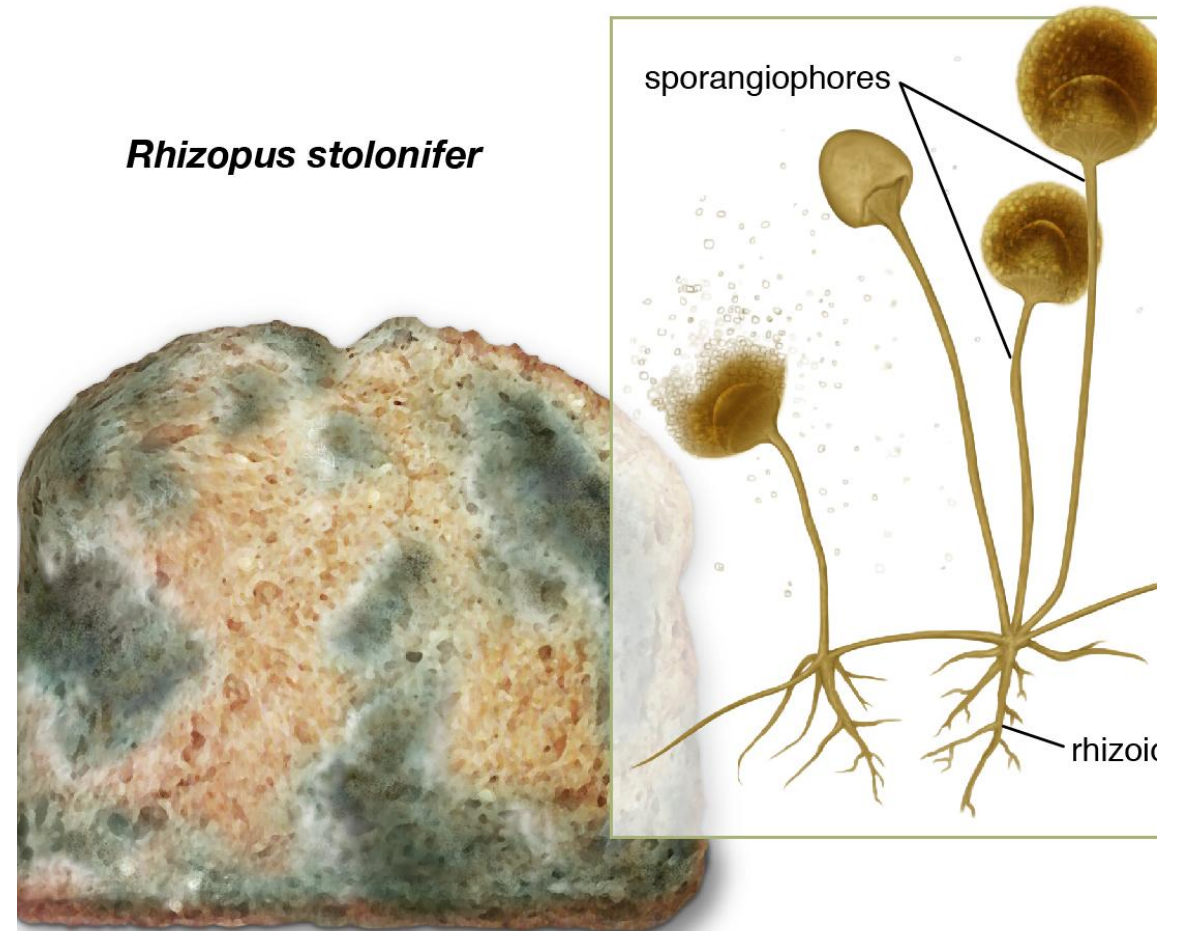


Asexual Spores

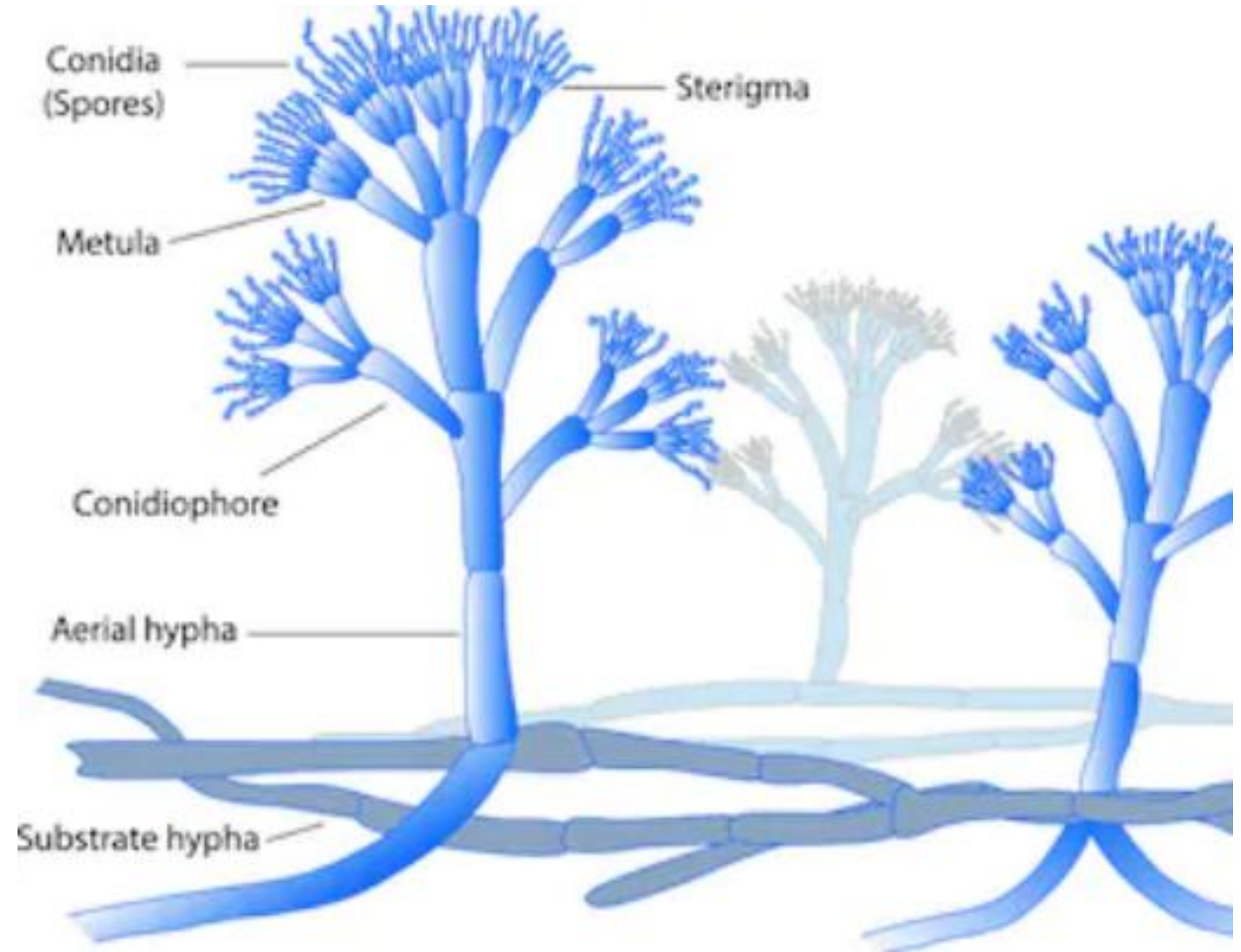
- Spores may be Formed
- Directly on hyphae
- Inside sporangia
- On Fruiting bodies

Asexual spores

- **Fruiting Bodies** are modified hyphae that make asexual spores
- An upright stalk called the **Sporangiospore** supports the spore case or Sporangium

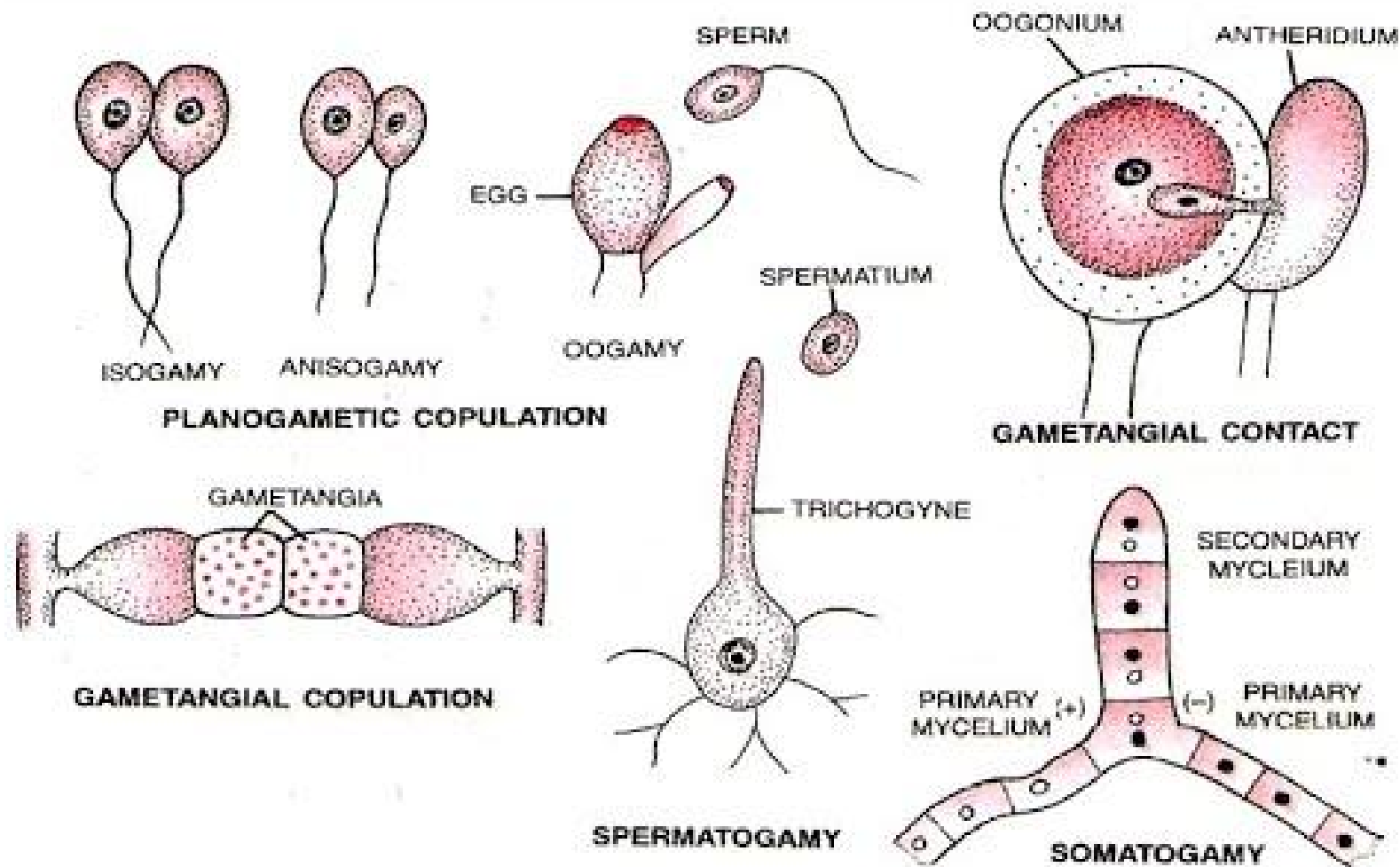


Asexual Spores



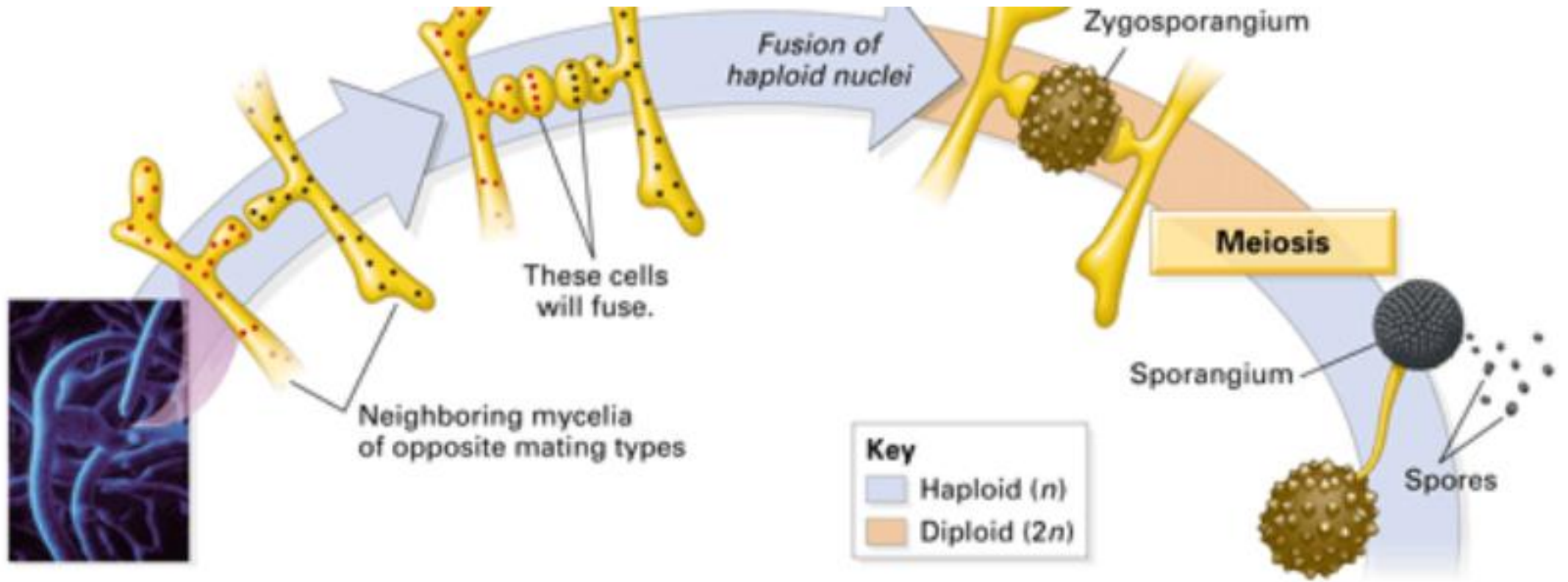
Sexual Reproduction

- Sexual reproduction are carried out by **fusion of the compatible nuclei of two parent cells.**
- Sex organelles of fungi if they are present, are called **gametangia**
- **Male gametangia:** Antheridia
- **Female gametangia:** Oogonia



Types of sexual reproduction in fungi

Sexual Reproductive Structure

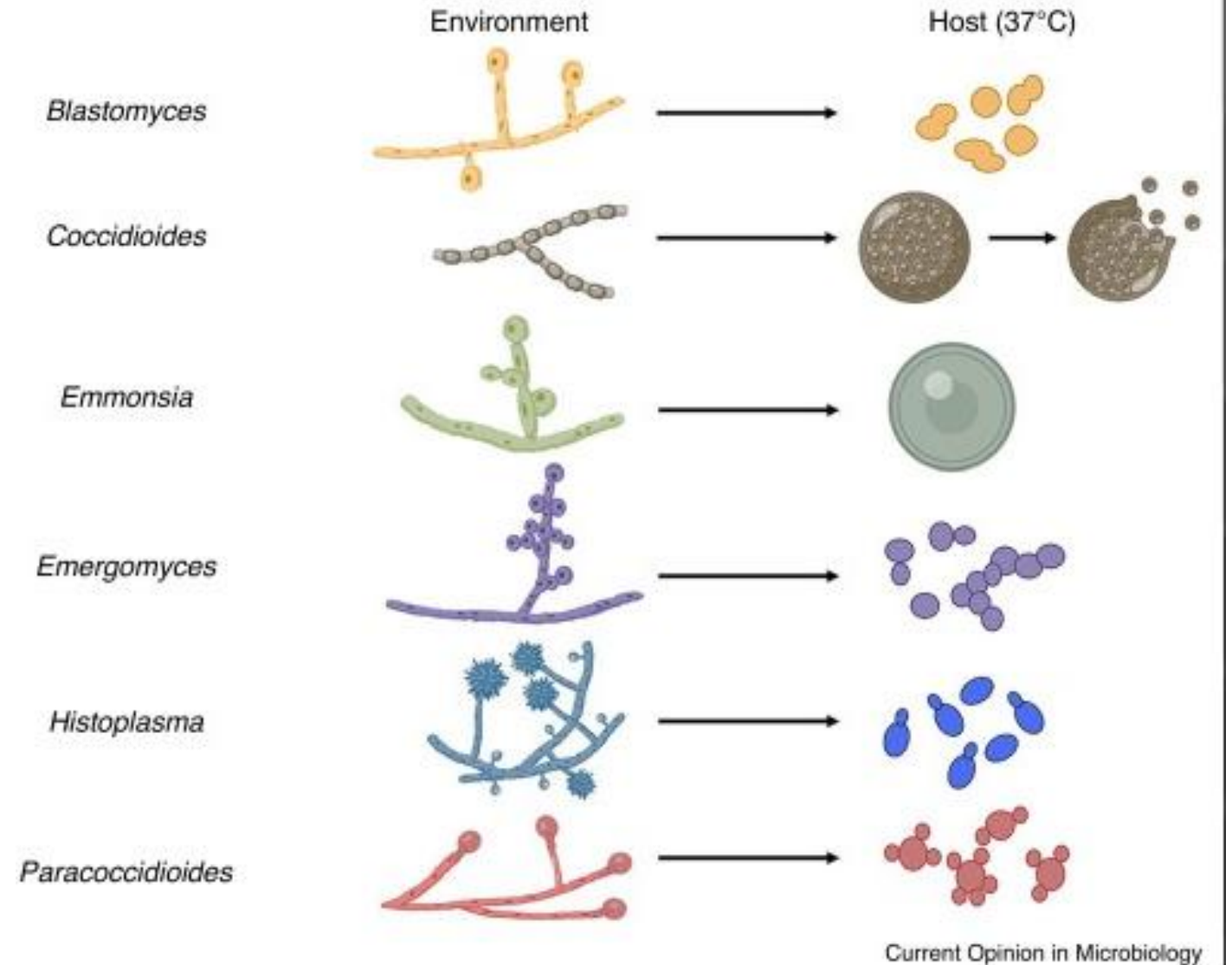


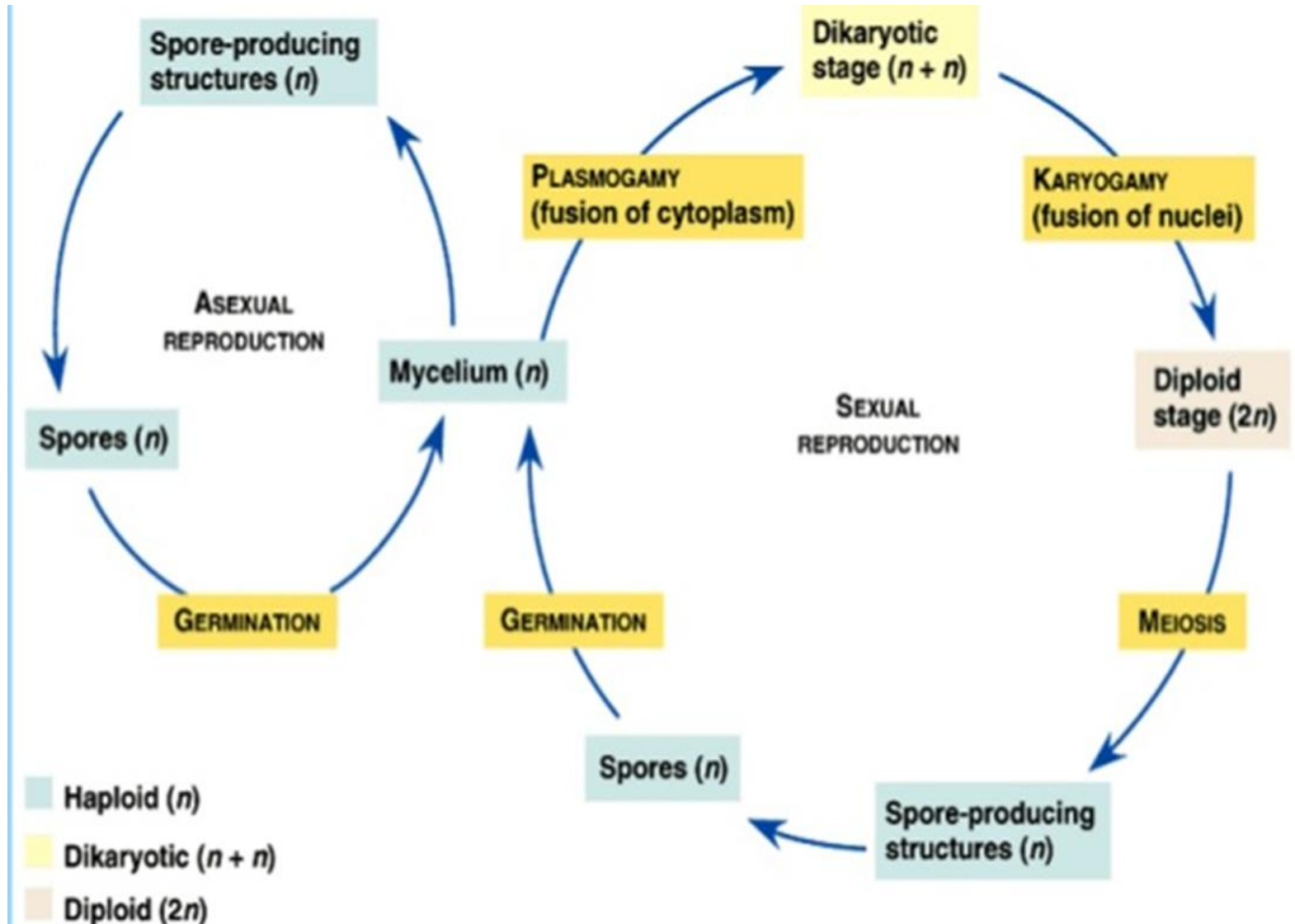
Sexual Reproduction

- Haploid $1n$ hyphae from 2 mating types (+ and -) Fuse (**Fertilization**)
- Forms a hyphae with **2 nuclei** that becomes a **Zygotes**
- The zygote divides to make a spore

Sexual Reproduction Dimorphism

- Used when **environmental conditions are poor** (lack of nutrients, space, moisture)
- No male or female fungi
- **Some fungi show dimorphism**
- May grow as Mycelia or a yeast-like state (Filament at 25°C and Round at 37°C)

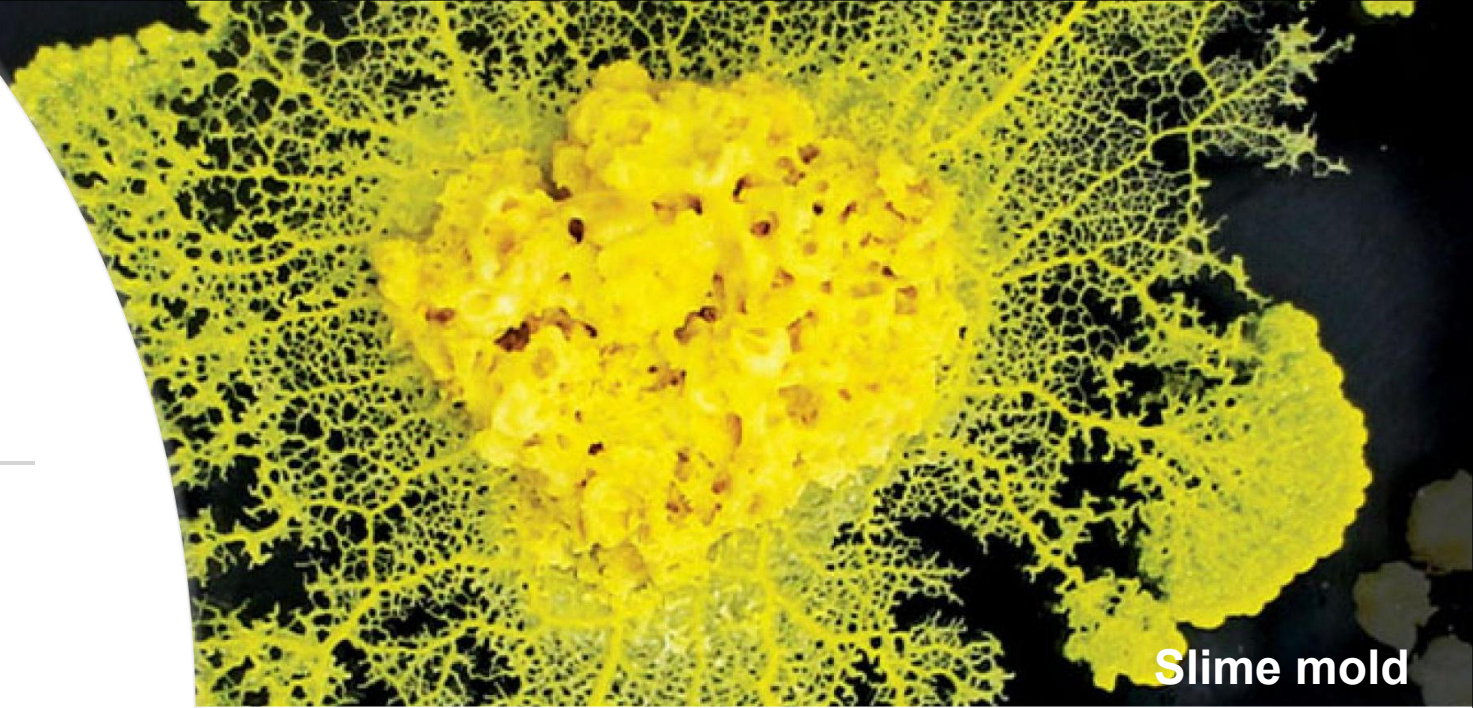




Generalized Life cycle of a Fungus

Major Groups of Fungi

- Within the past few years, several groups have been reclassified into the **protists**
- Two of these groups are the **slime molds** and **water molds**



Slime mold



Water mold

Mode of Nutrition

- **Saprobies:**
 - i. Decomposers
 - ii. Molds, Mushrooms etc
- **Parasites**
 - i. Harm host
 - ii Rust and smuts (attack plants)
- **Mutualists**
 - i. Both Benefit
 - ii Lichens
 - iii Mycorrhizas



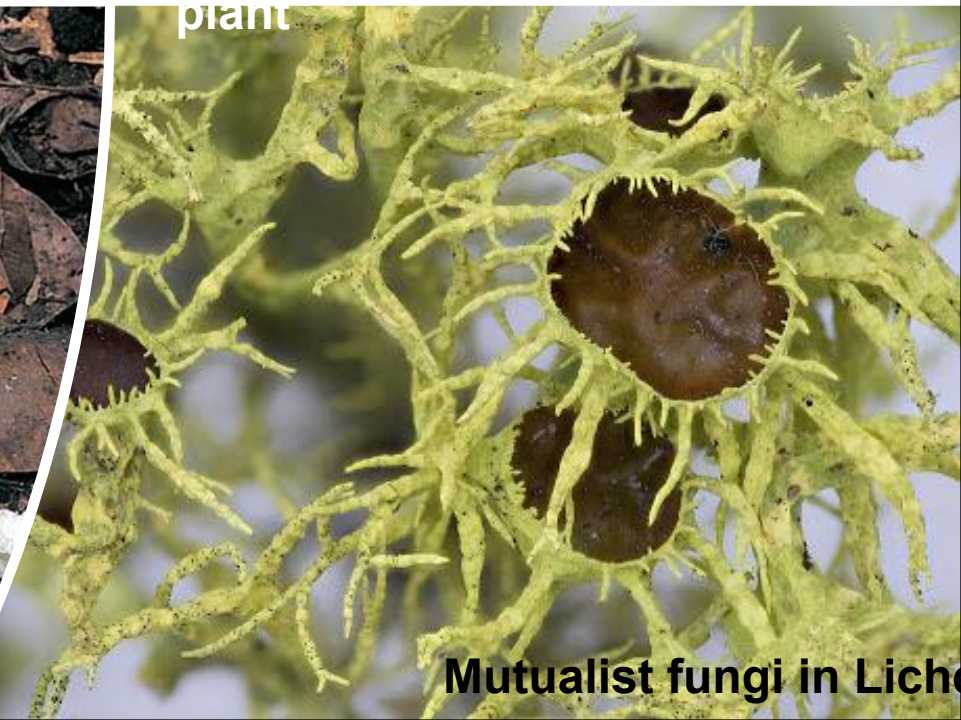
Parasitic fungi on animals



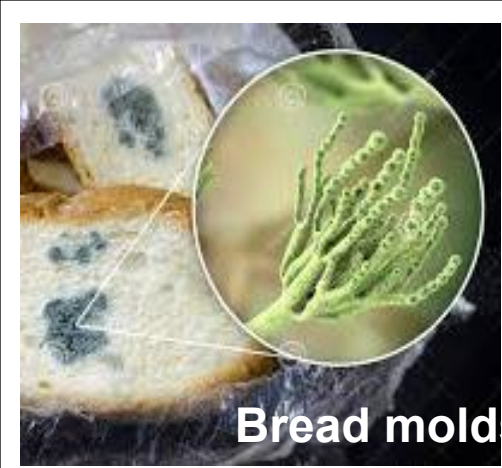
Parasitic fungi rust on plant



Decomposer



Mutualist fungi in Lichen



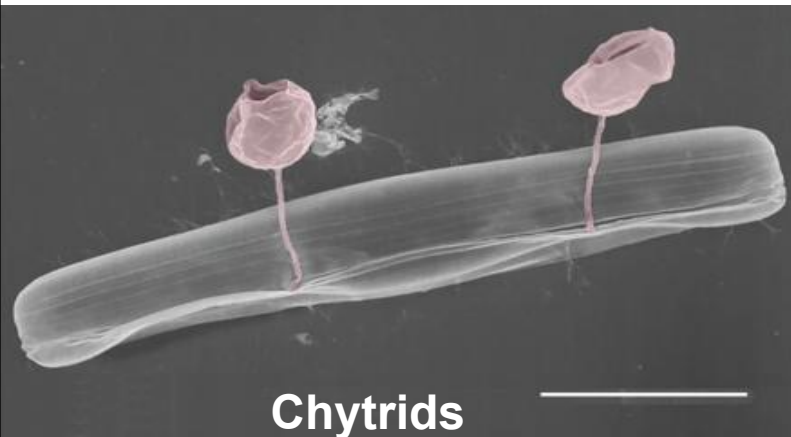
Bread mold



Liche



Sac fungi



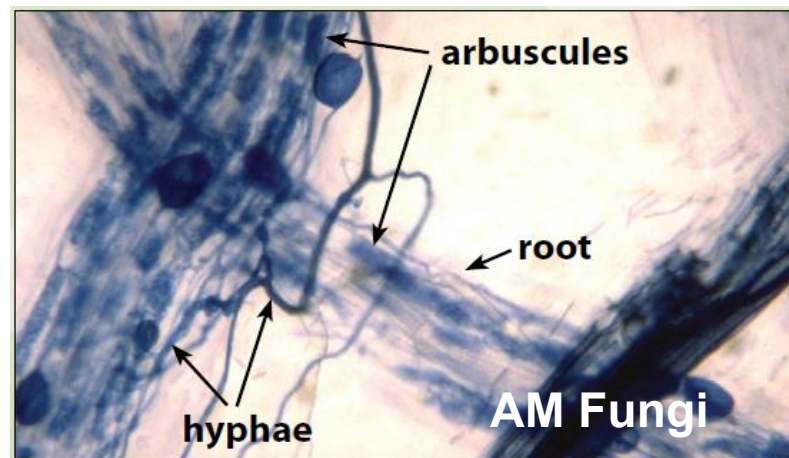
Chytrids



Club Fungi



Mycorrhizas



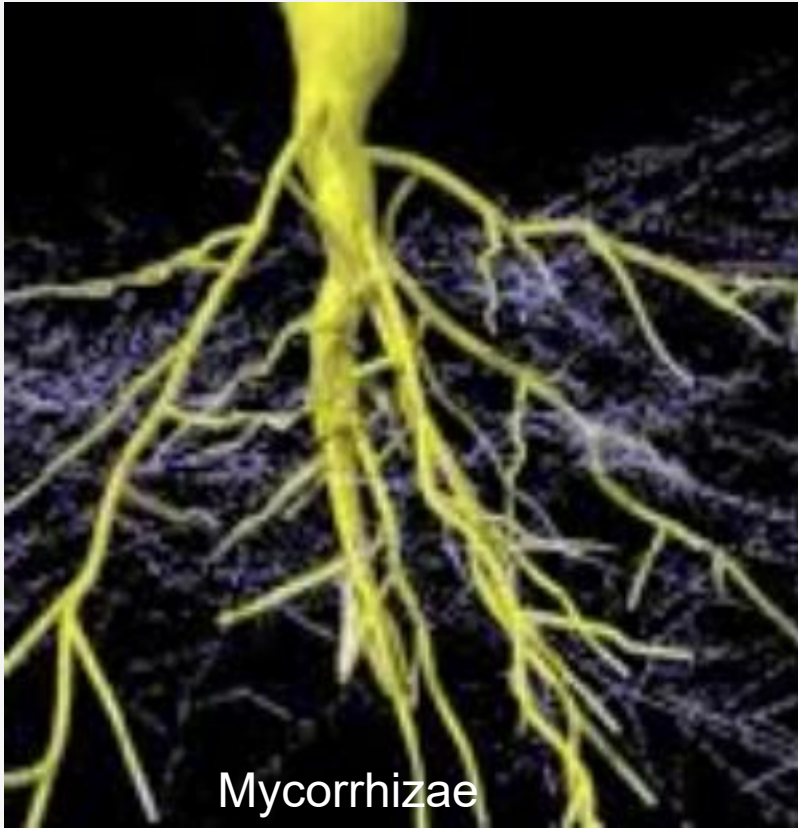
AM Fungi

Major Groups of Fungi

- **Basidiomycota:** Club Fungi
- **Zygomycota:** Bread Molds
- **Chytridiomycota:** Chytrids
- **AM Fungi:** Mycorrhizas
- **Ascomycota:** Sac Fungi
- **Lichens:** Symbiosis (algae and Fungi)

Economic Importance of Fungi

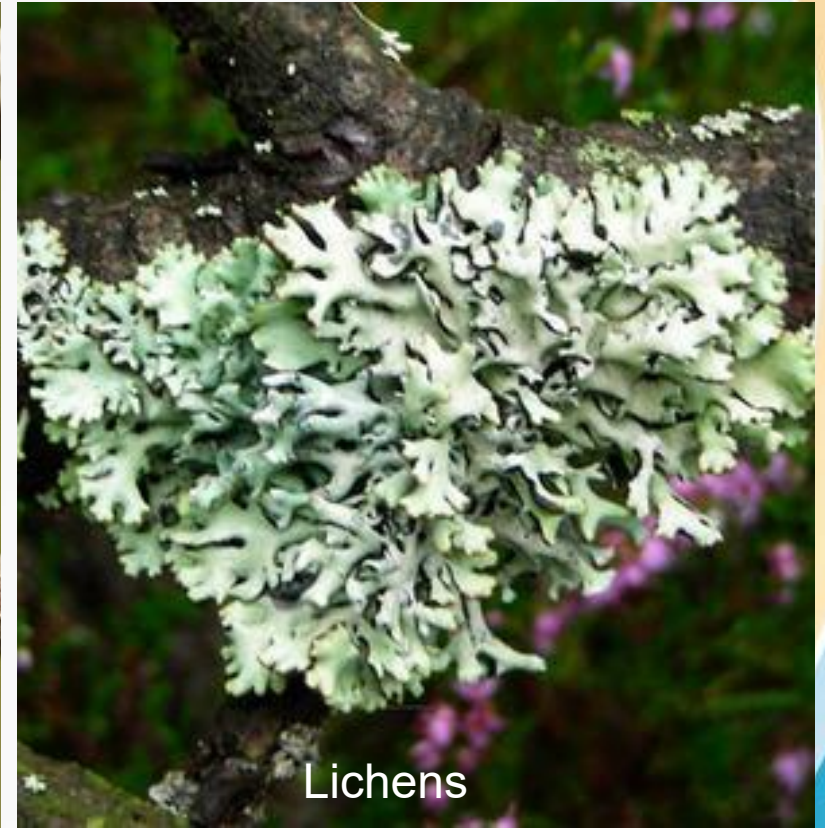
- **Beneficial Effects of Fungi**
- **Decomposition** : Nutrient and carbon recycling
- Biosynthetic factories can be used to produce drugs, antibiotics, alcohol, acids, food(e.g., fermented products, Mushrooms)
- Model organisms for biochemical and genetic studies
- Production of vitamins
- Hormone production
- Edible fungi
- Production of insecticides



Mycorrhizae



Lichens



Lichens

Fungi form beneficial partnerships (Symbiosis) with other organisms such as Trees and Flowering plants

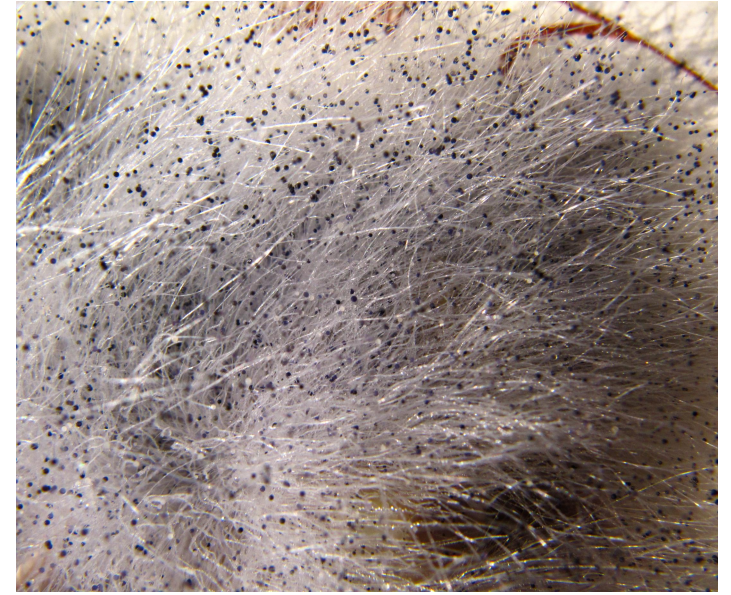
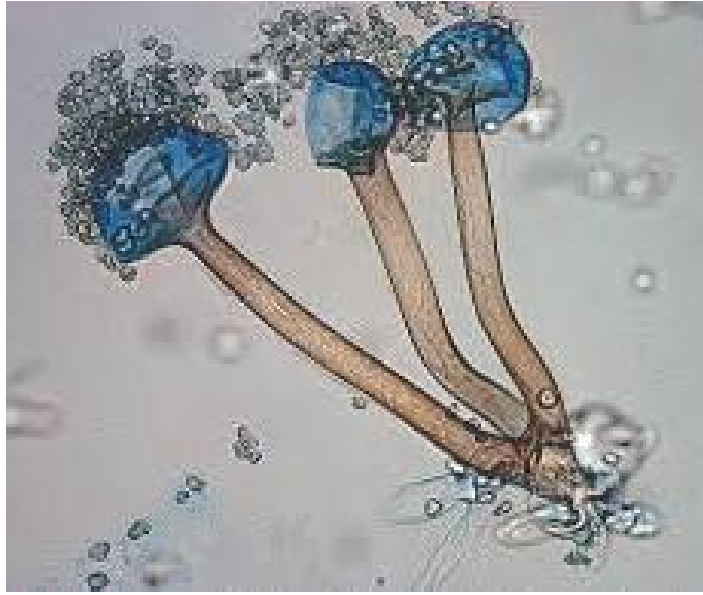


Harmful effects of fungi



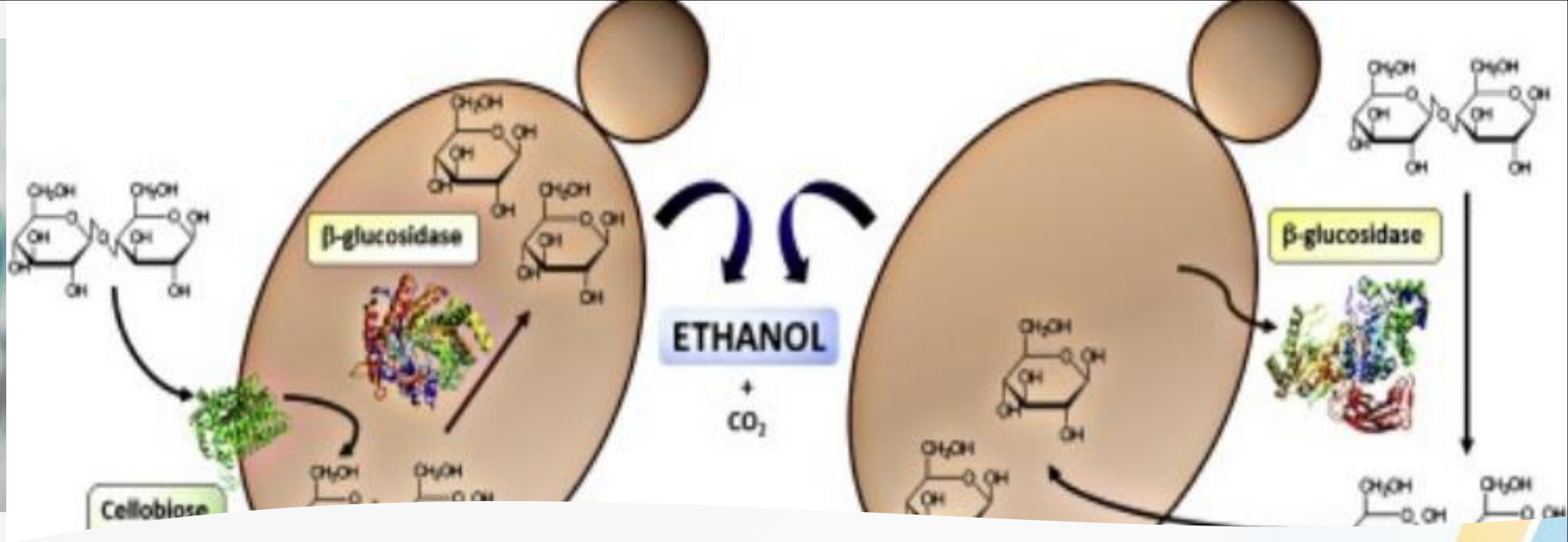
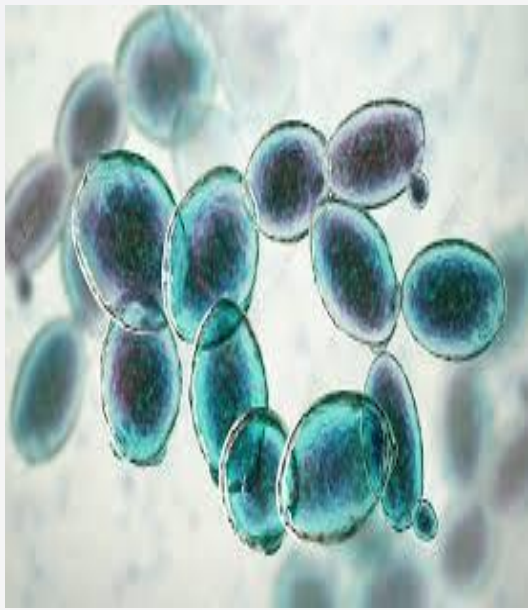
- Destruction of food, lumber, paper and cloth
- Plant disease
- Animal diseases
- Human disease including allergies
- Toxins produced by poisonous mushrooms and within food(e.g. grain, cheese etc)





Rhizopus

- The **common bread mold** which cause food spoilage is Rhizopus.
- They grow on bread, vegetables, fruits and other food products.

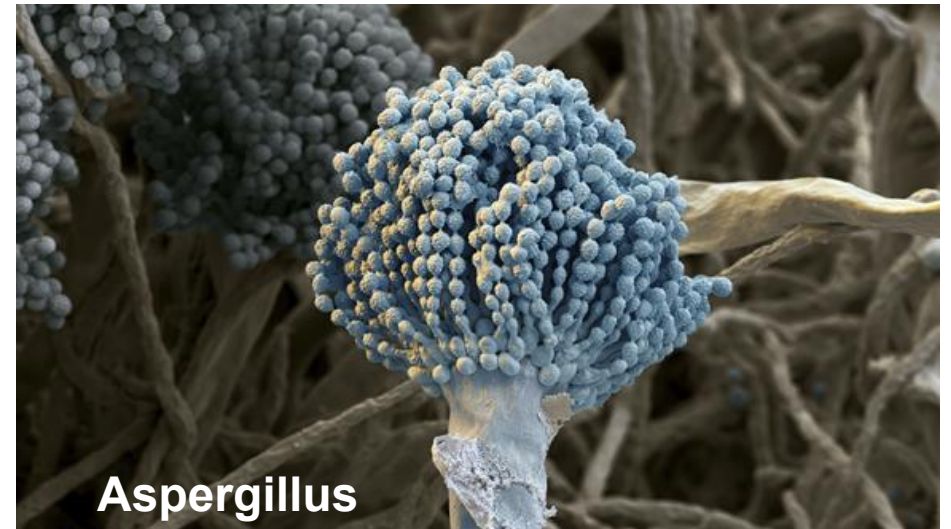


Saccharomyc es cerevisiae

- *Saccharomyces cerevisiae*, strain is used in fermentation of beer and wine and in baking.
- It is found in nature on ripe fruit.
- *S. cerevisiae* is a yeast of great economic importance.

Aspergillus

- *Aspergillus* is widespread in nature and other substrates.
- Some species are involved in food spoilage.
- Used in several **Industrial fermentations** including production of citric acid and gluconic acid by *A. niger*.



Penicillium

- Some species cause spoilage of fruits, vegetables, preserves, grains and grasses. Some are used in **industrial fermentations**.
- One of the best-known antibiotics are produced by *Penicillium notatum* and *Penicillium chrysogenum*.

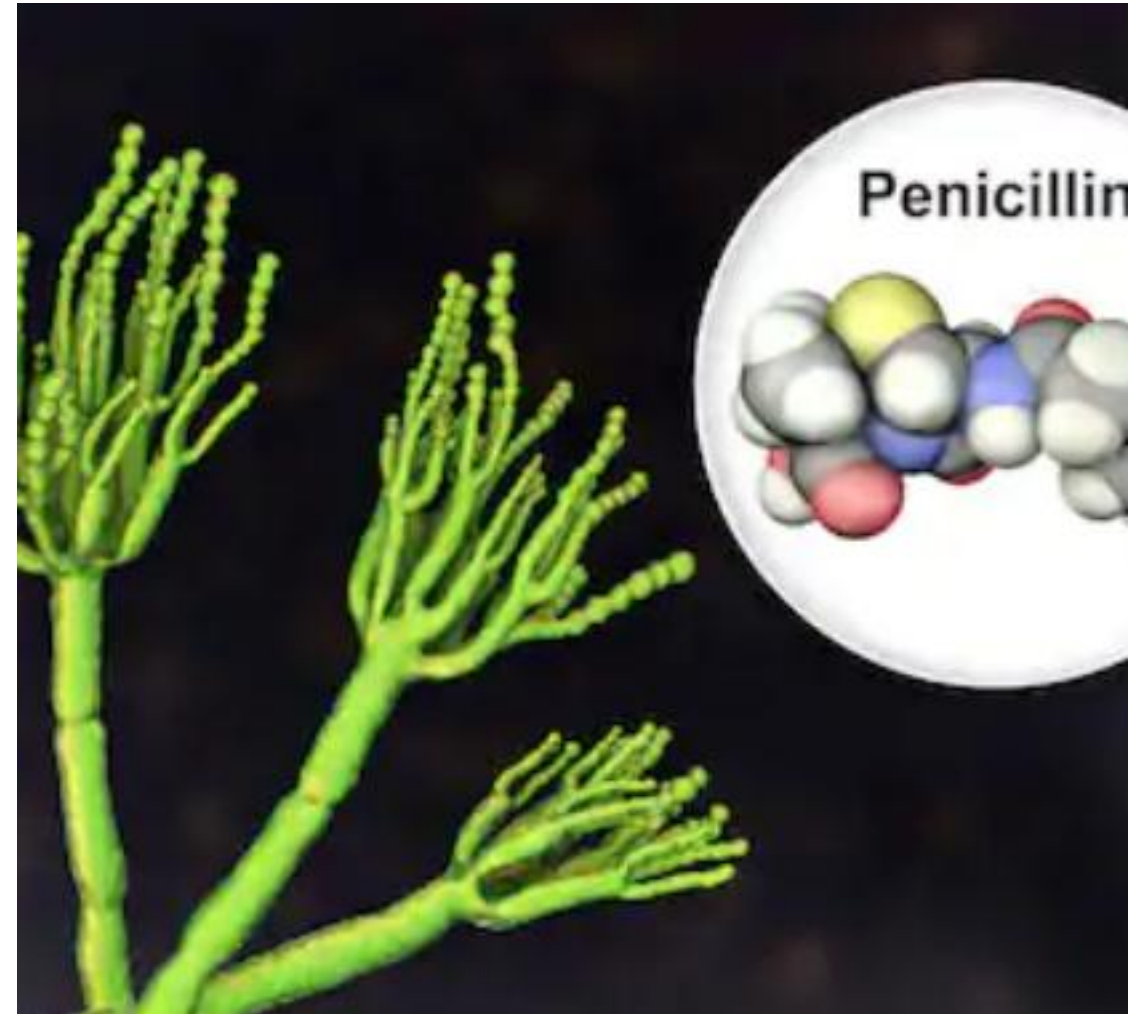




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Candida albicans

- *Candida albicans* is often isolated from warm blooded animals including humans
- Sometimes this fungus may become pathogenic, causing **candidias**, a **disease of the mucus membrane of the mouth**, vagina and alimentary tract.
- It is an **opportunistic pathogen**

Fungi: some new changes

Fungus, plural fungi, any of about 144,000 known species of organisms of the kingdom Fungi, which includes the yeasts, rusts, smuts, mildews, molds, and mushrooms.

There are also many **funguslike organisms, including slime molds and oomycetes (water molds), that do not belong to kingdom Fungi but were included in fungi previously.**

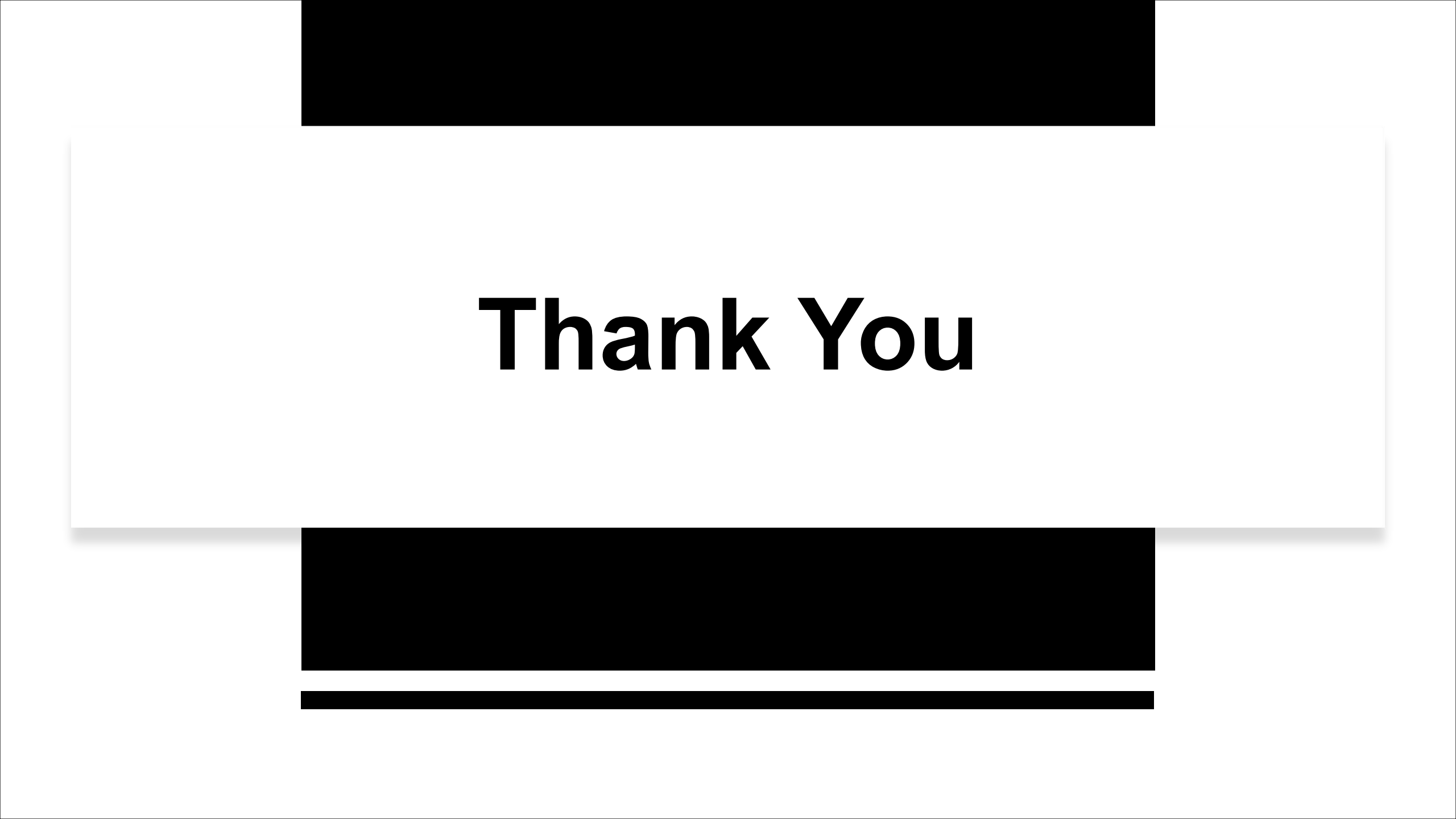
Many of these funguslike organisms are included in the kingdom **Chromista**.

Fungi are among the most widely distributed organisms on Earth and are of great environmental and medical importance. Many fungi are free-living in soil or water; others form parasitic or symbiotic relationships with plants or animals.



References

- B.R. Vashishta “Fungi”
 - H.C.Dubey “ An Introduction to fungi”
 - C.J.Alexopolous “Introductory Mycology
-



Thank You