

KINGDOM FUNGI



An example of Fungi You know

Autumn Woodlands



www.wildireland.ie

Fungi and leaves on the forest floor

Mushrooms – “Club Like” Fungi or Basidiomycete Fungi



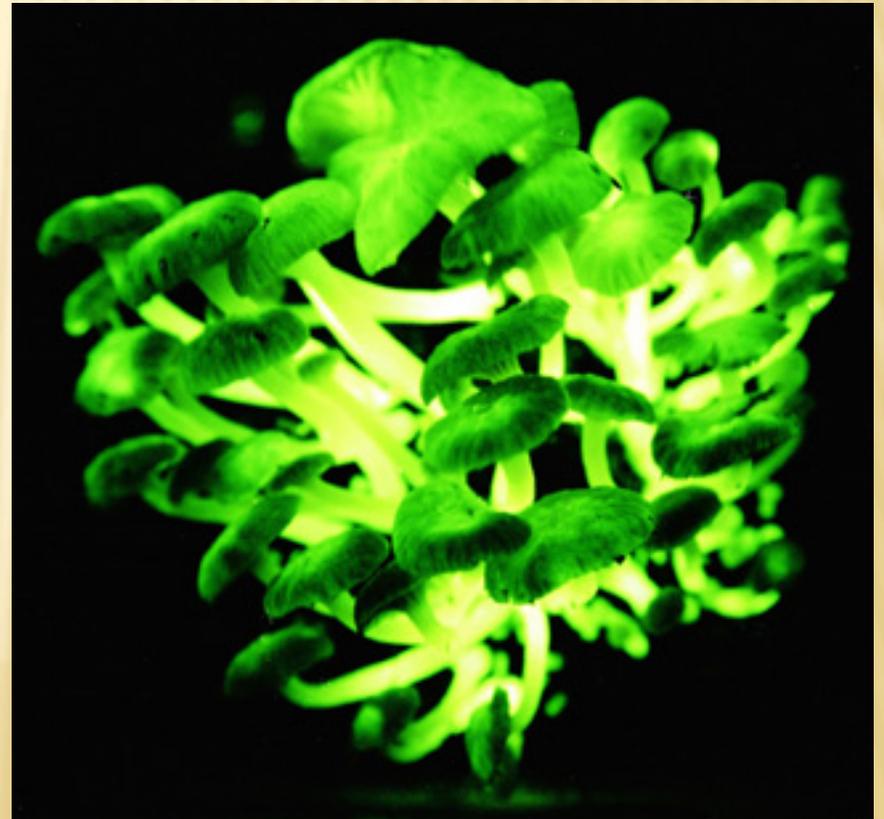
Bracket Fungi – Basidiomycete Fungi





In time, the center of the lesion turns black due to the formation of fungal fruiting bodies















The Deadliest of All!

DEATH ANGEL



Pennicillium Mold







Characteristics

THE CHARACTERISTICS OF FUNGI

- × Fungi are **NOT** plants
- × Nonphotosynthetic
- × Eukaryotes
- × Nonmotile
- × Most are **saprobies** (live on dead organisms)



THE CHARACTERISTICS OF FUNGI

- × **Absorptive heterotrophs**
(digest food first & then absorb it into their bodies)
- × Release **digestive enzymes** to break down organic material or their host
- × Store food energy as **glycogen**

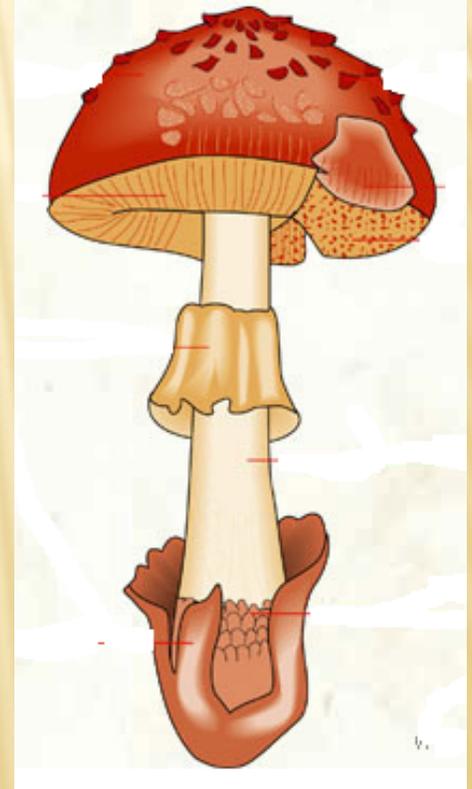
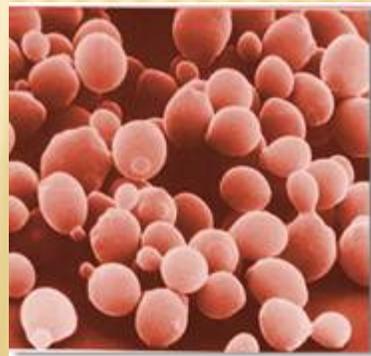


BREAD MOLD

THE CHARACTERISTICS OF FUNGI

- ✘ Important decomposers & recyclers of nutrients in the environment
- ✘ Most are multicellular, except unicellular yeast
- ✘ Lack true roots, stems or leaves

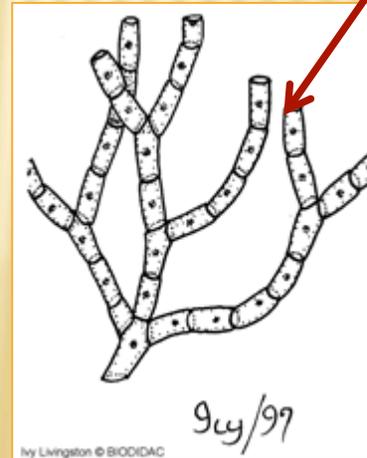
UNICELLULAR YEAST



MULTICELLULAR MUSHROOM

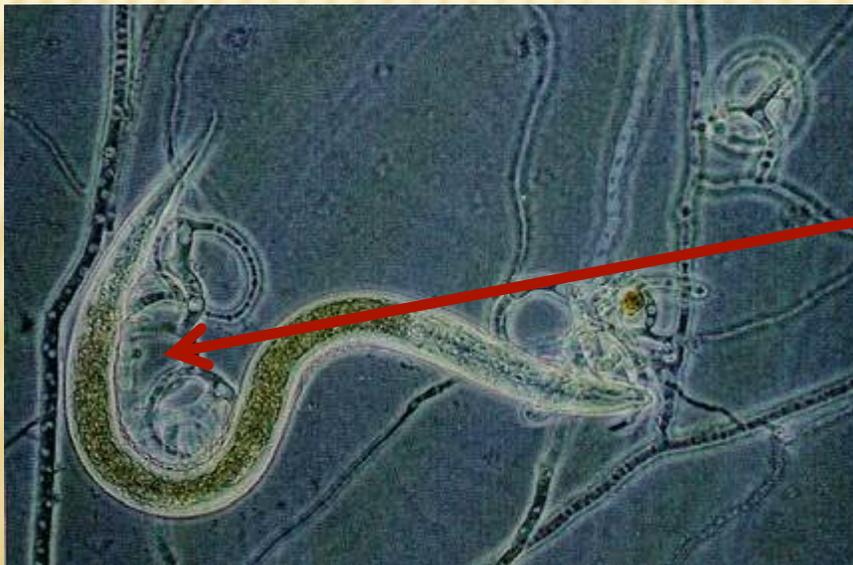
THE CHARACTERISTICS OF FUNGI

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



THE CHARACTERISTICS OF FUNGI

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



Predaceous
Fungi feeding on
a **Nematode**
(roundworm)

THE CHARACTERISTICS OF FUNGI

- × Some are **edible**, while others are **poisonous**



EDIBLE

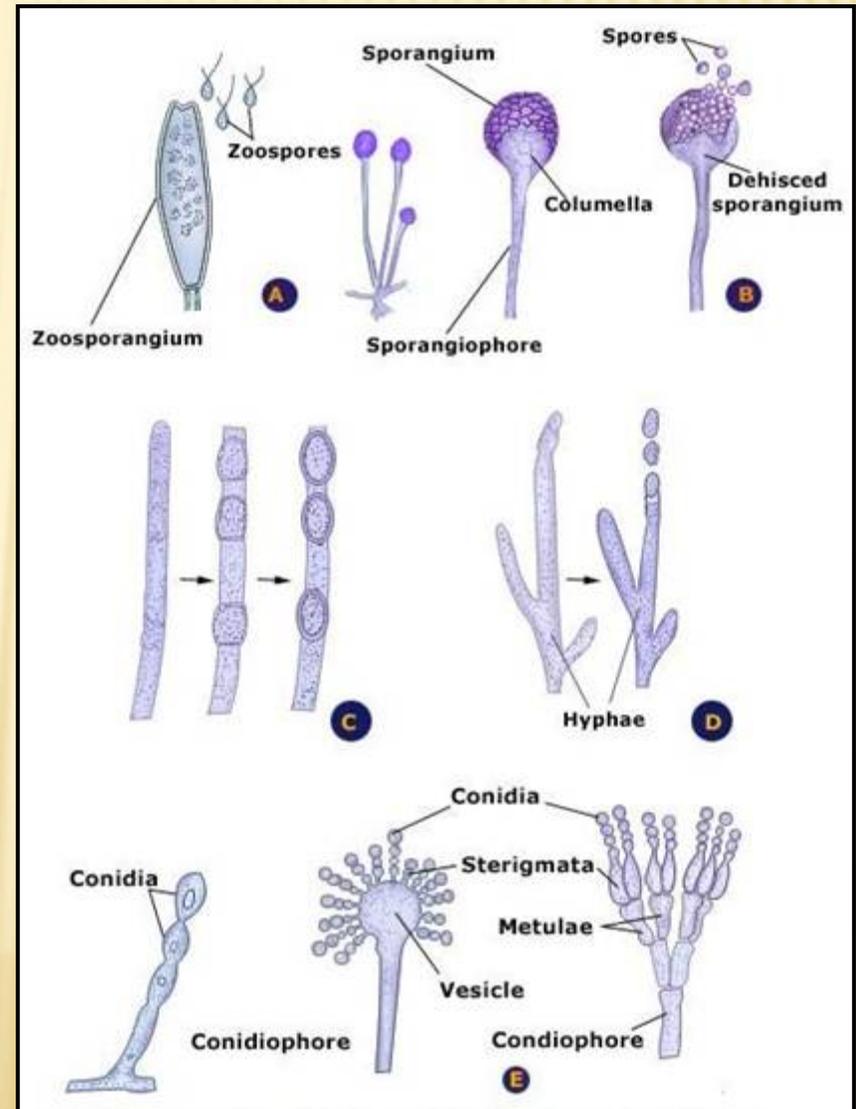
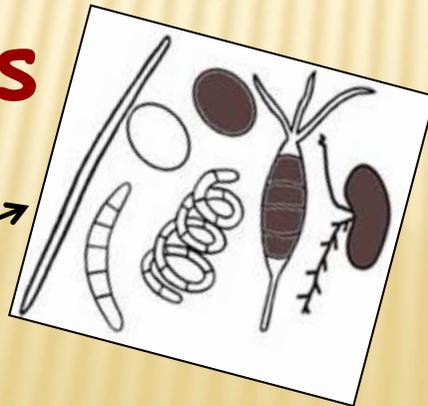


POISONOUS

THE CHARACTERISTICS OF FUNGI

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

Spores come in various shapes



THE CHARACTERISTICS OF FUNGI

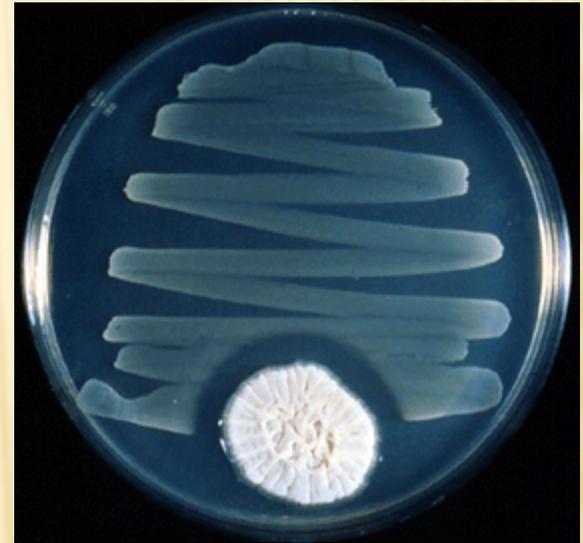
- × Grow best in **warm, moist** environments
- × **Mycology** is the study of fungi
- × **Mycologists** study fungi
- × A **fungicide** is a chemical used to kill fungi

Fungicide
kills leaf
fungus



THE CHARACTERISTICS OF FUNGI

- × Fungi include puffballs, yeasts, mushrooms, toadstools, rusts, smuts, ringworm, and molds
- × The antibiotic penicillin is made by the *Penicillium* mold



Penicillium mold



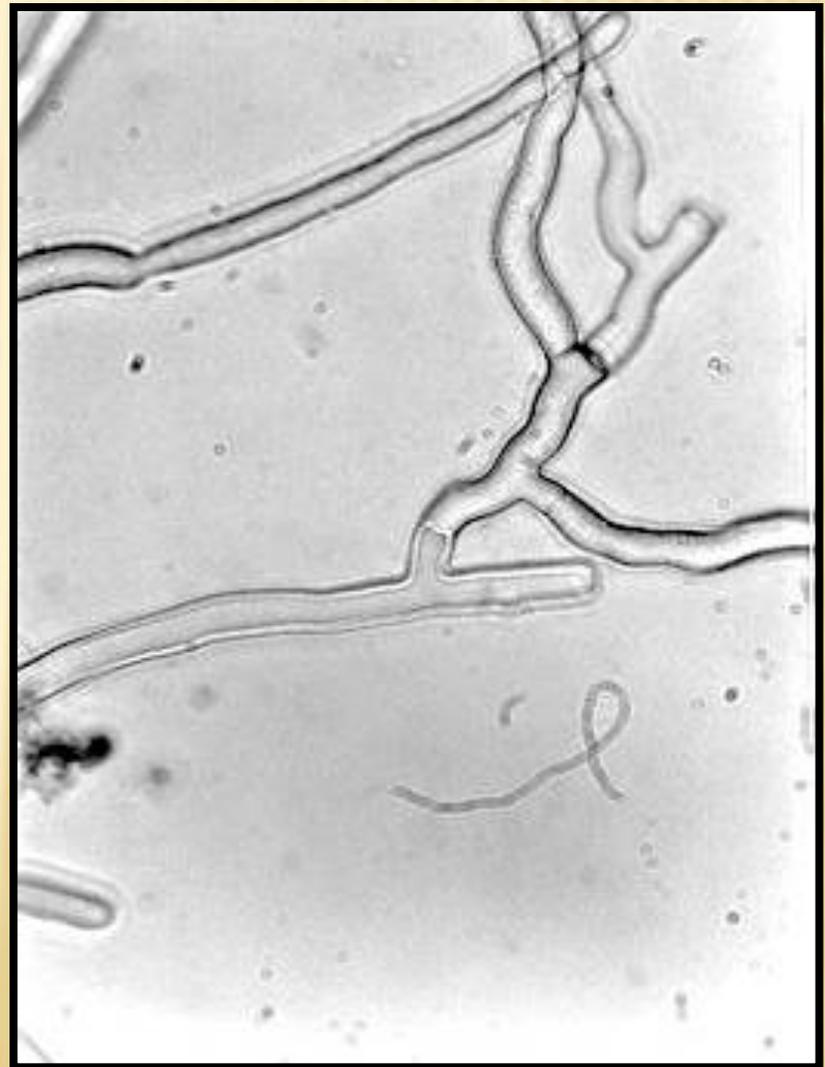
Puffball

Vegetative Structures

NON-REPRODUCTIVE

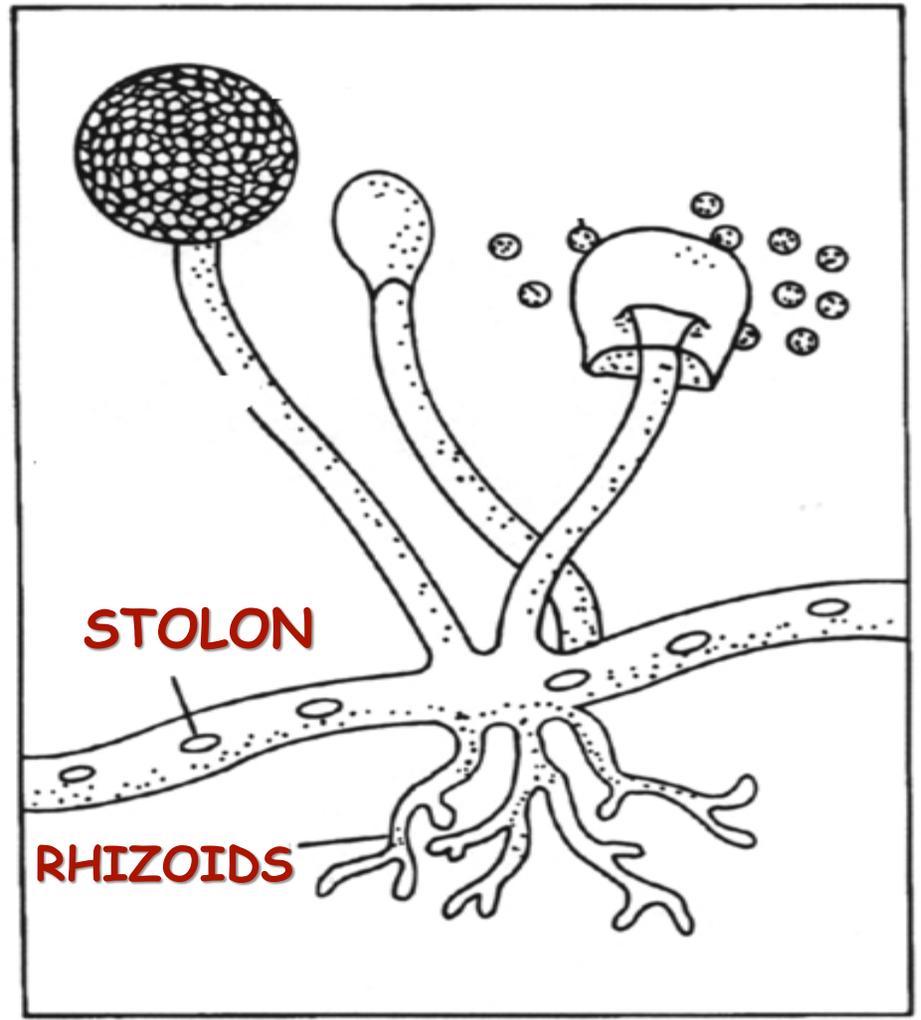
HYPHAE

- × **Tubular** shape
- × **ONE** continuous cell
- × Filled with **cytoplasm & nuclei**
- × **Multinucleate**
- × Hard cell wall of **chitin** also in insect exoskeletons



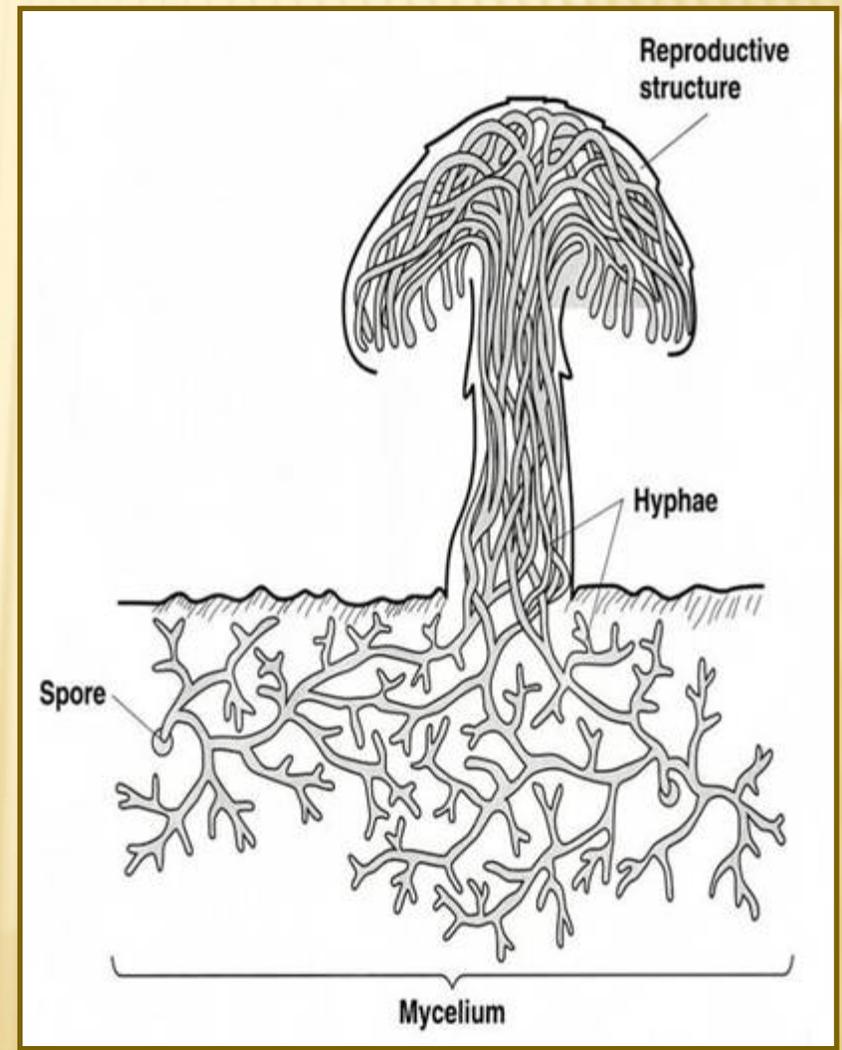
HYPHAE

- × **Stolons** - horizontal hyphae that connect groups of hyphae to each other
- × **Rhizoids** - rootlike parts of hyphae that anchor the fungus



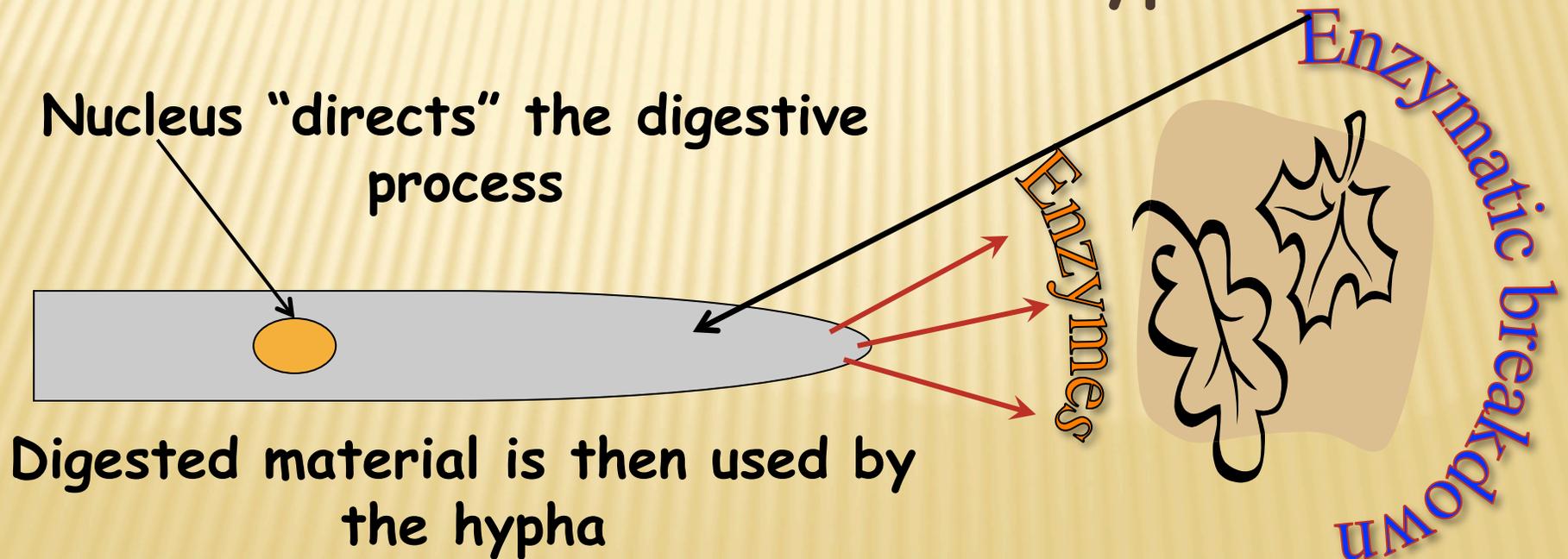
HYPHAE

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



ABSORPTIVE HETEROTROPH

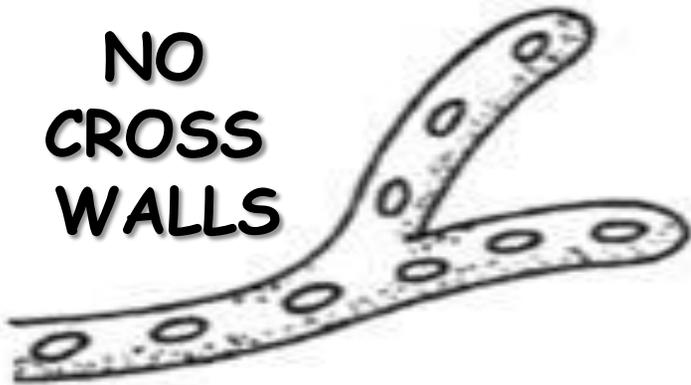
- × Fungi get **carbon** from **organic sources**
- × **Tips** of Hyphae **release enzymes**
- × Enzymatic breakdown of substrate
- × **Products diffuse back** into hyphae



MODIFICATIONS OF HYPHAE

- × Fungi may be classified based on cell division (with or without cytokinesis)
 - + Aseptate or coenocytic (without septa)
 - + Septate (with septa)

NO
CROSS
WALLS



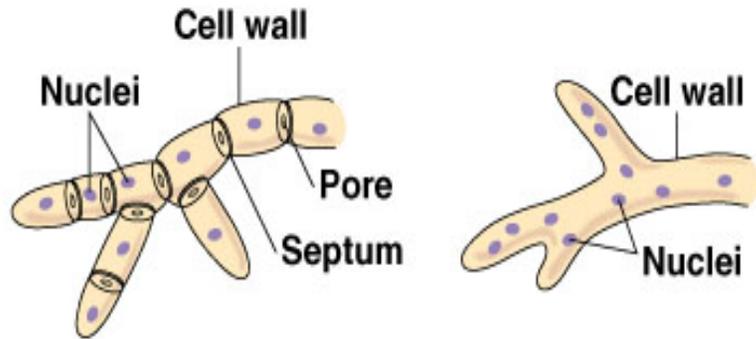
CROSS
WALLS



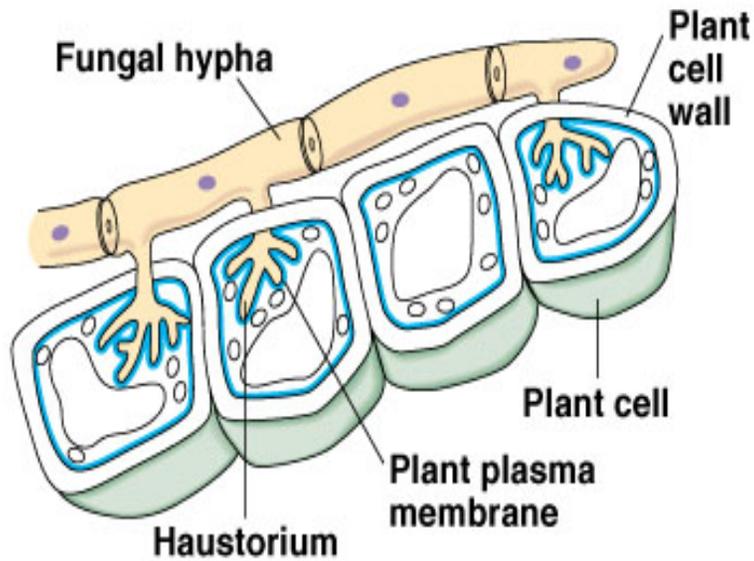




MODIFICATIONS OF HYPHAE



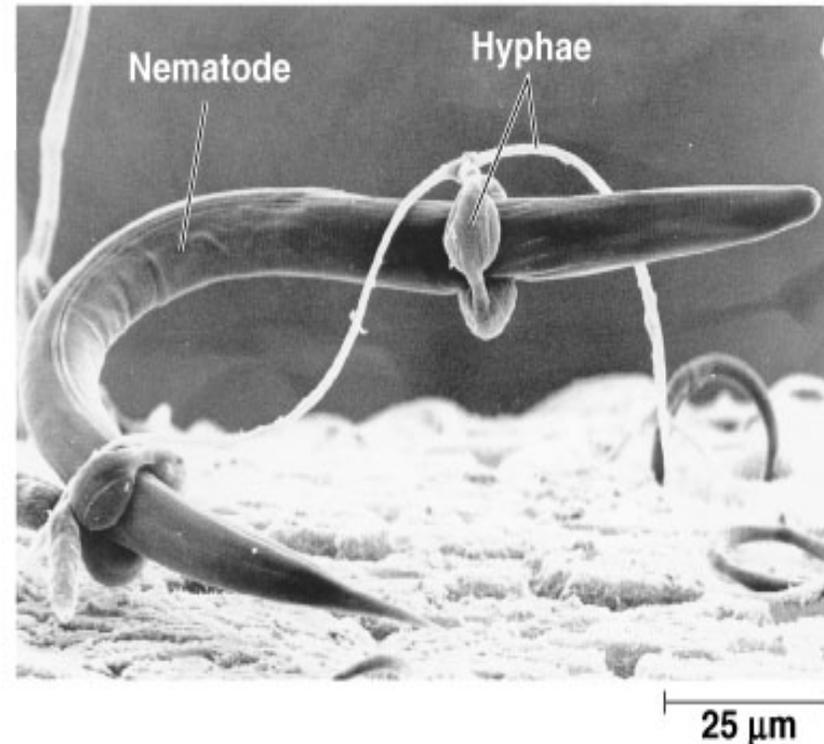
Septate Hyphae Coenocytic Hyphae



(c) Haustoria

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HAUSTORIA - parasitic hyphae on plants & animals



(d) Hyphae adapted for trapping and killing prey

HYPHAL GROWTH

- × Hyphae grow from their tips
- × **Mycelium** is an extensive, feeding web of hyphae
- × Mycelia are the **ecologically active** bodies of fungi

This wall is rigid

Only the tip wall is plastic and stretches



REPRODUCTIVE STRUCTURES

ASEXUAL & SEXUAL SPORES

REPRODUCTION

- × Most fungi reproduce **Asexually** and **Sexually** by spores
- × ASEXUAL reproduction is **most common** method & produces **genetically identical** organisms
- × Fungi reproduce SEXUALLY when **conditions are poor & nutrients scarce**

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**

SEXUAL REPRODUCTION

SEXUAL REPRODUCTION

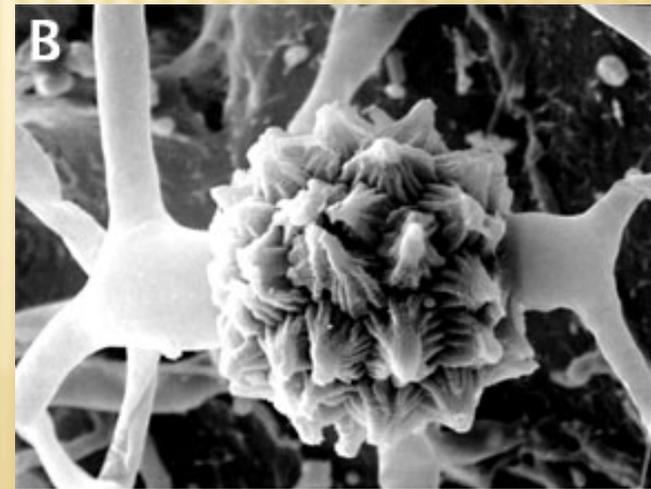
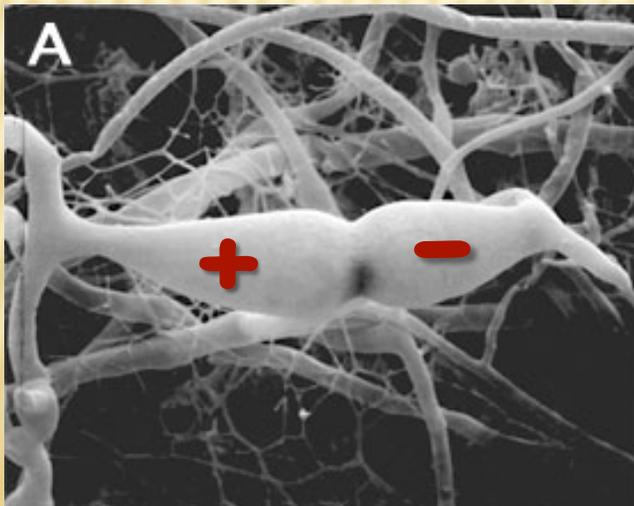
- × Used when environmental conditions are poor (lack of nutrients, space, moisture...)
- × No male or female fungi
- × Some fungi show dimorphism
 - + May grow as **MYCELIA** or a **YEAST -LIKE** state (Filament at 25°C & Round at 37°C)



Dimorphic Fungi

SEXUAL REPRODUCTION

- × Haploid 1n hyphae from 2 mating types (+ and -) FUSE (Fertilization)
- × Forms a hyphae with 2 nuclei that becomes a ZYGOTE
- × The zygote divides to make a SPORE



SPORE FORMS

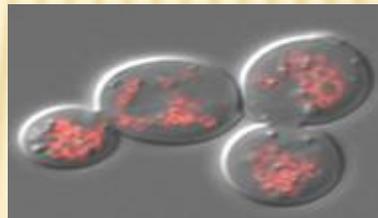
ASEXUAL REPRODUCTION

THREE TYPES OF ASESEXUAL REPRODUCTION

- × **Fragmentation** - part of the mycelium becomes separated & begins a life of its own

- × **Budding** - a small cell forms & gets pinched off as it grows to full size

 - + **Used by yeasts**



- × **Asexual spores** - production of spores by a single mycelium

REPRODUCE BY SPORES

✦ Spores may be Formed:

- + Directly on hyphae
- + Inside sporangia
- + On Fruiting bodies



Amanita fruiting body



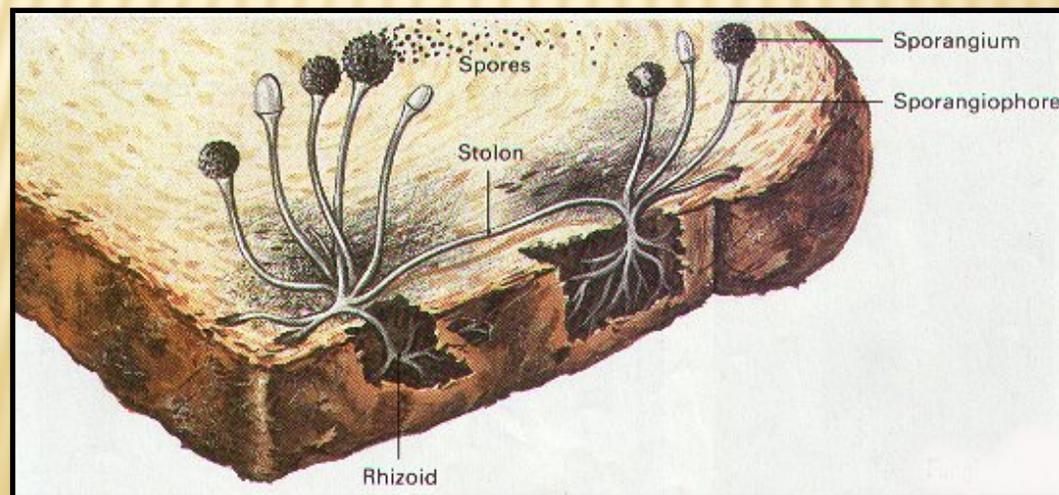
Pilobolus sporangia



Penicillium
hyphae

ASEXUAL REPRODUCTION

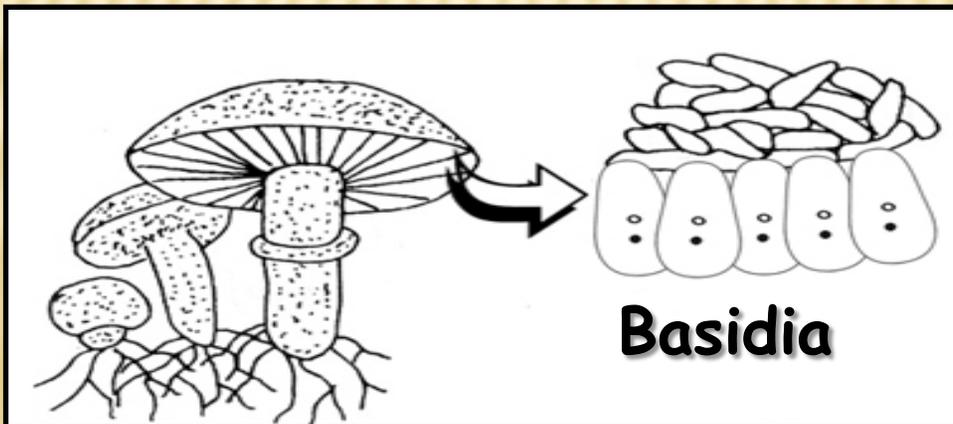
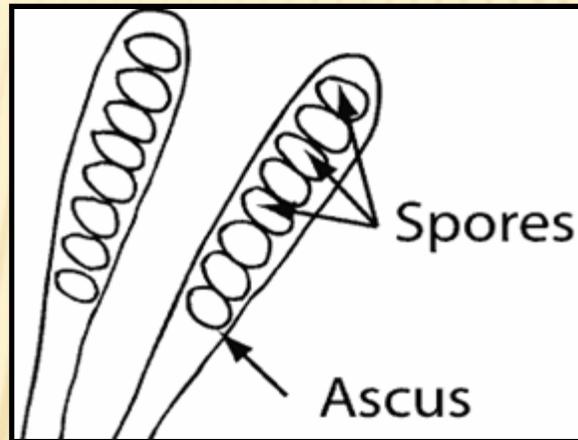
- × **Fruiting Bodies** are modified hyphae that make **asexual** spores
- × An upright stalk called the **Sporangiosphore** supports the spore case or **Sporangium**



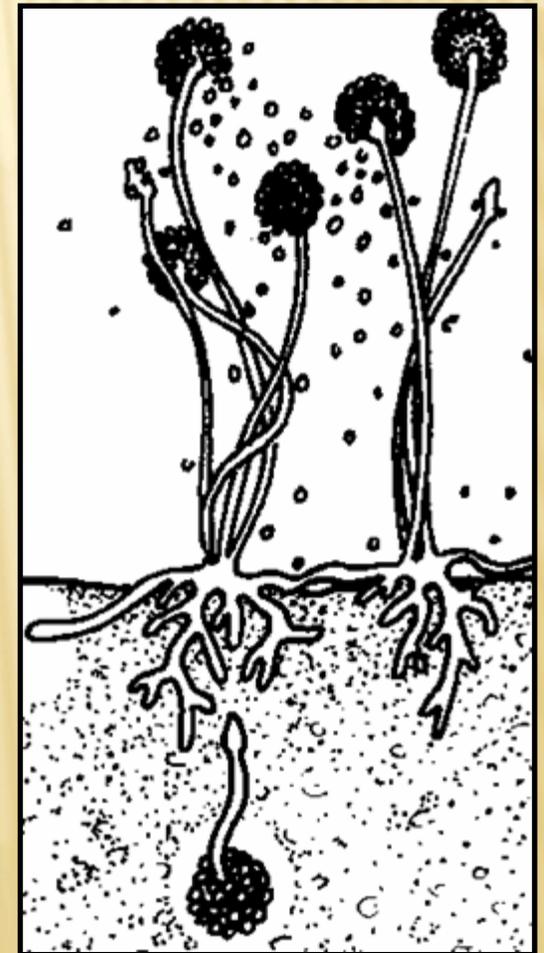
ASEXUAL REPRODUCTION

× Types of Fruiting Bodies:

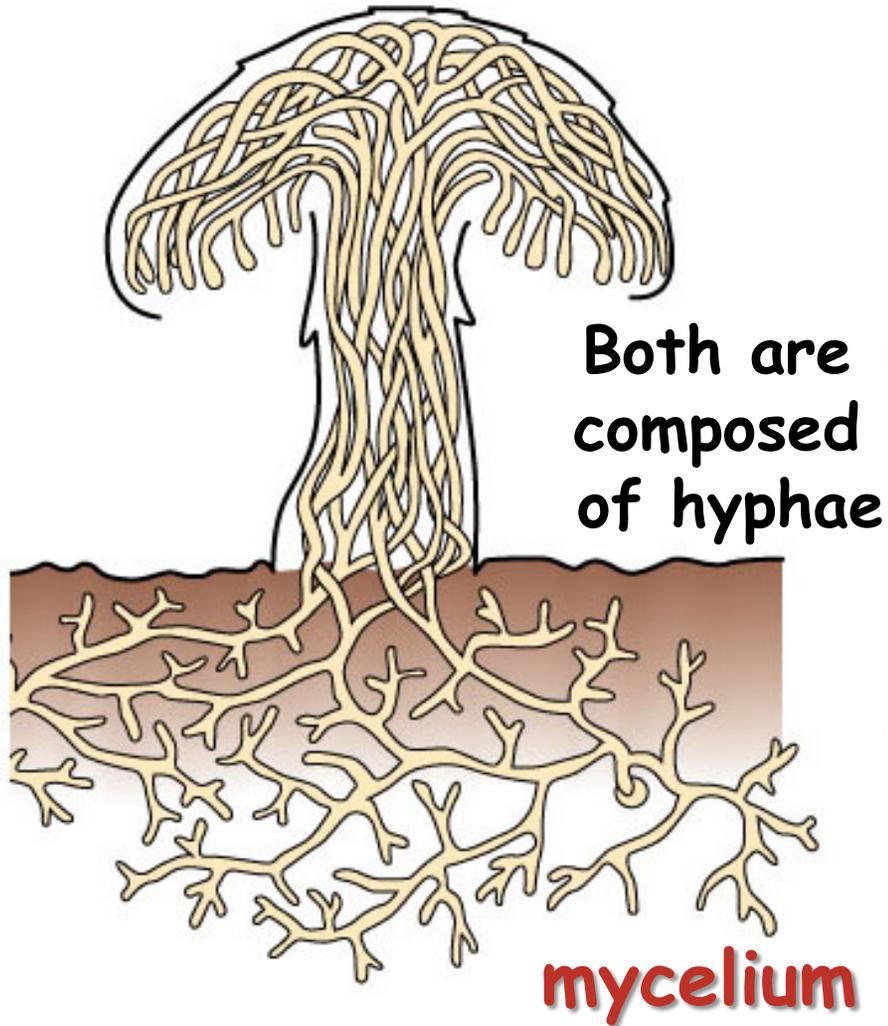
- + Basidia
- + Sporangia
- + Ascus



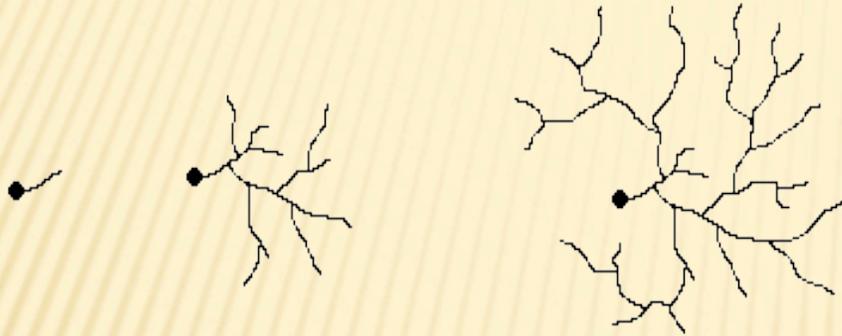
Sporangia



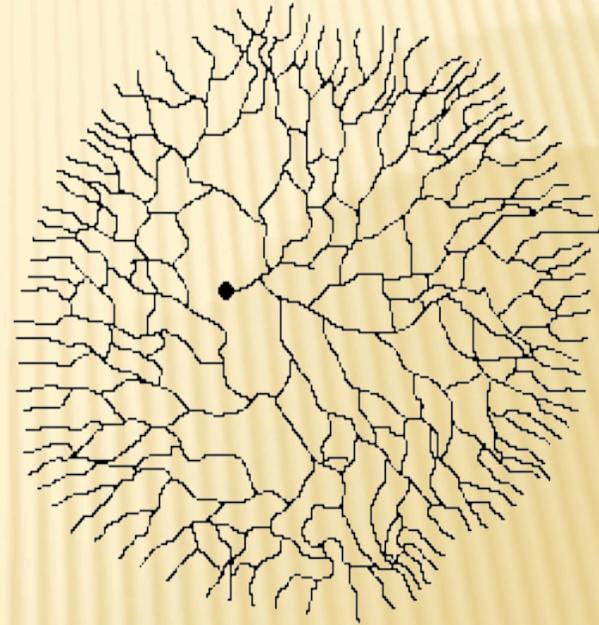
Fruiting Bodies



HYPHAL GROWTH FROM SPORE



Germinating spore



mycelium

- ✘ Mycelia have a huge surface area
- ✘ More surface area aids digestion & absorption of food

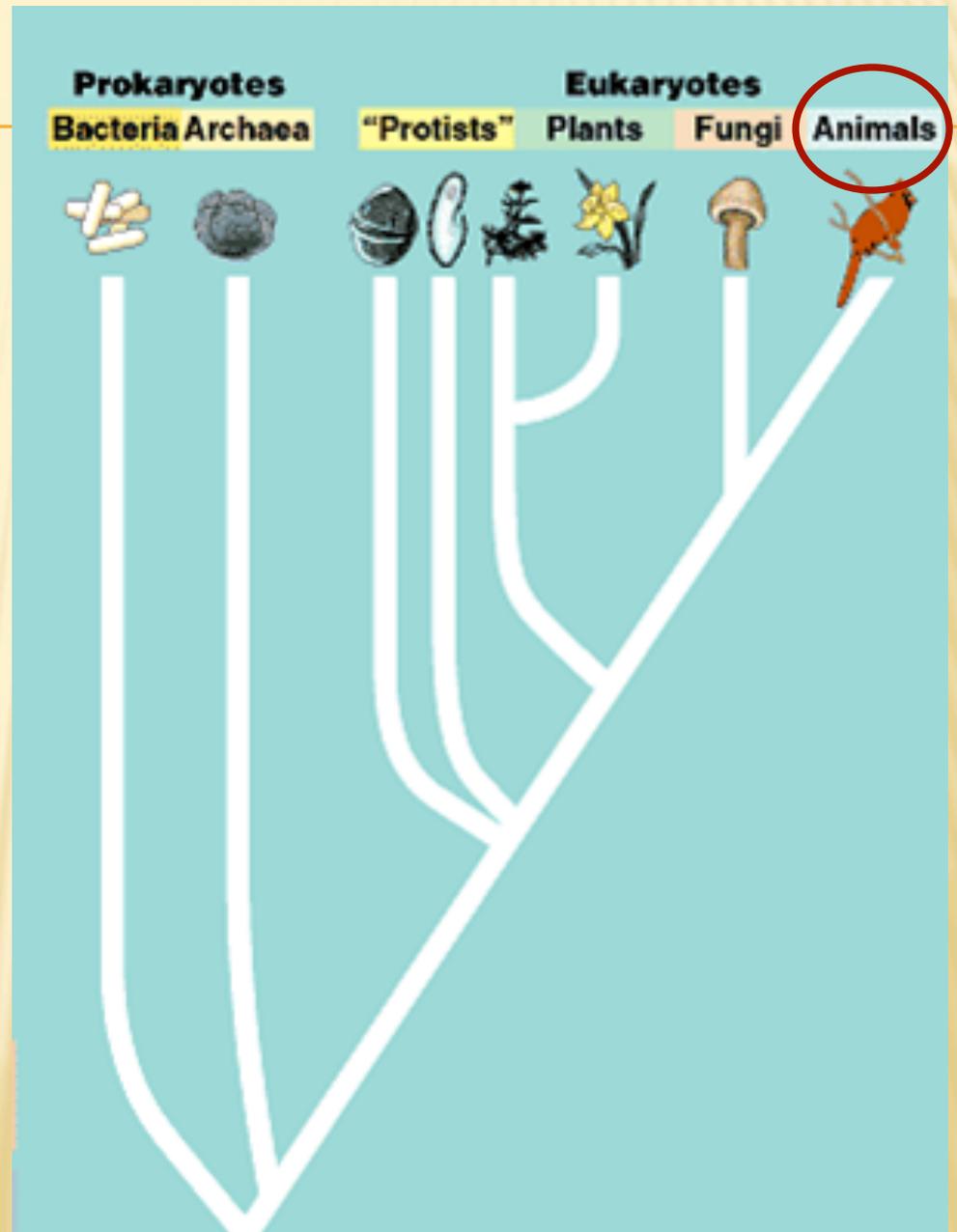
Evolution of Fungi

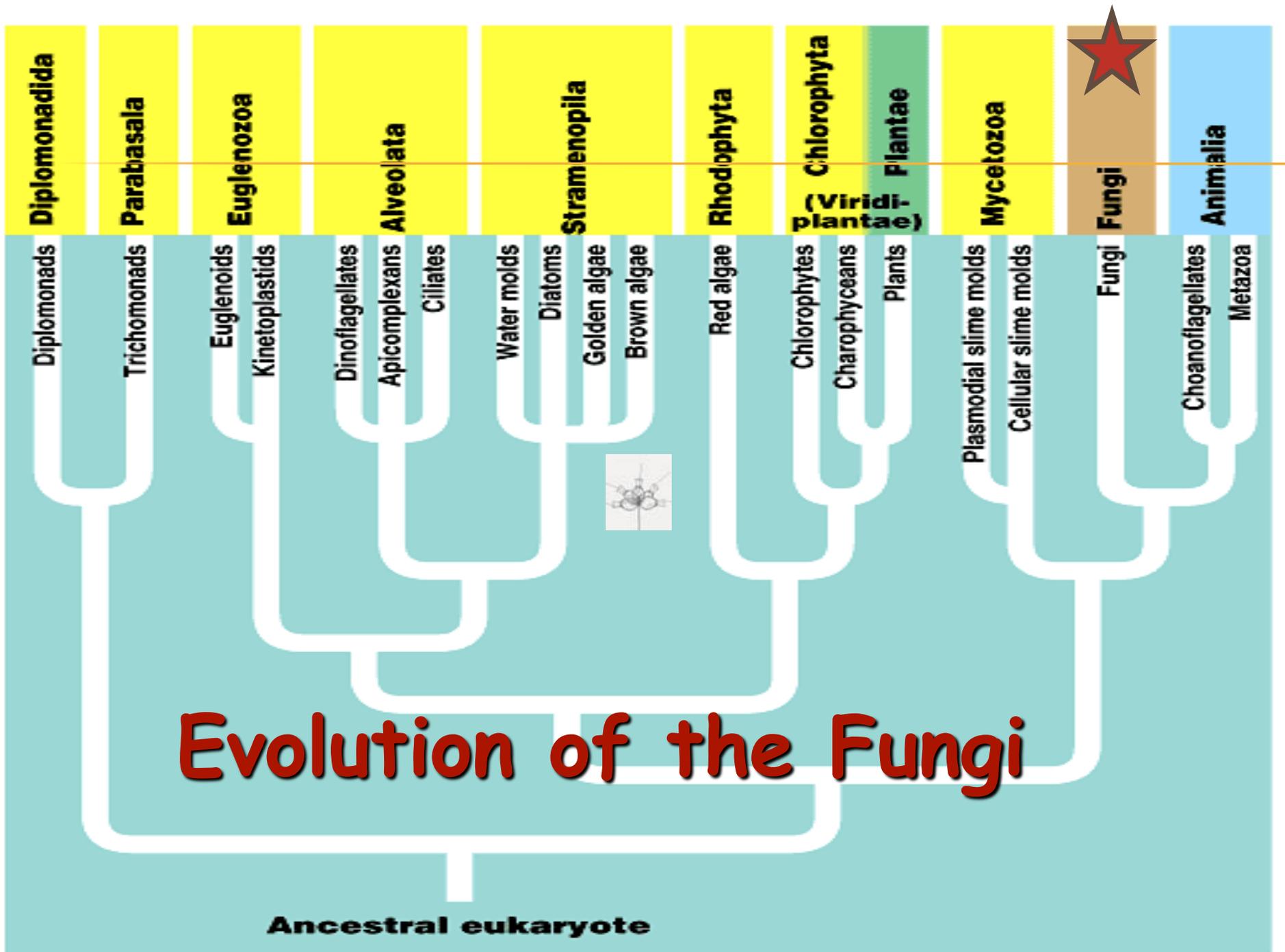
CLADOGRAM

× Which of the following is **most closely related** to a mushroom (fungus)?

× **WHY?**

Recent DNA-based studies show that fungi are more similar to animals than to plants



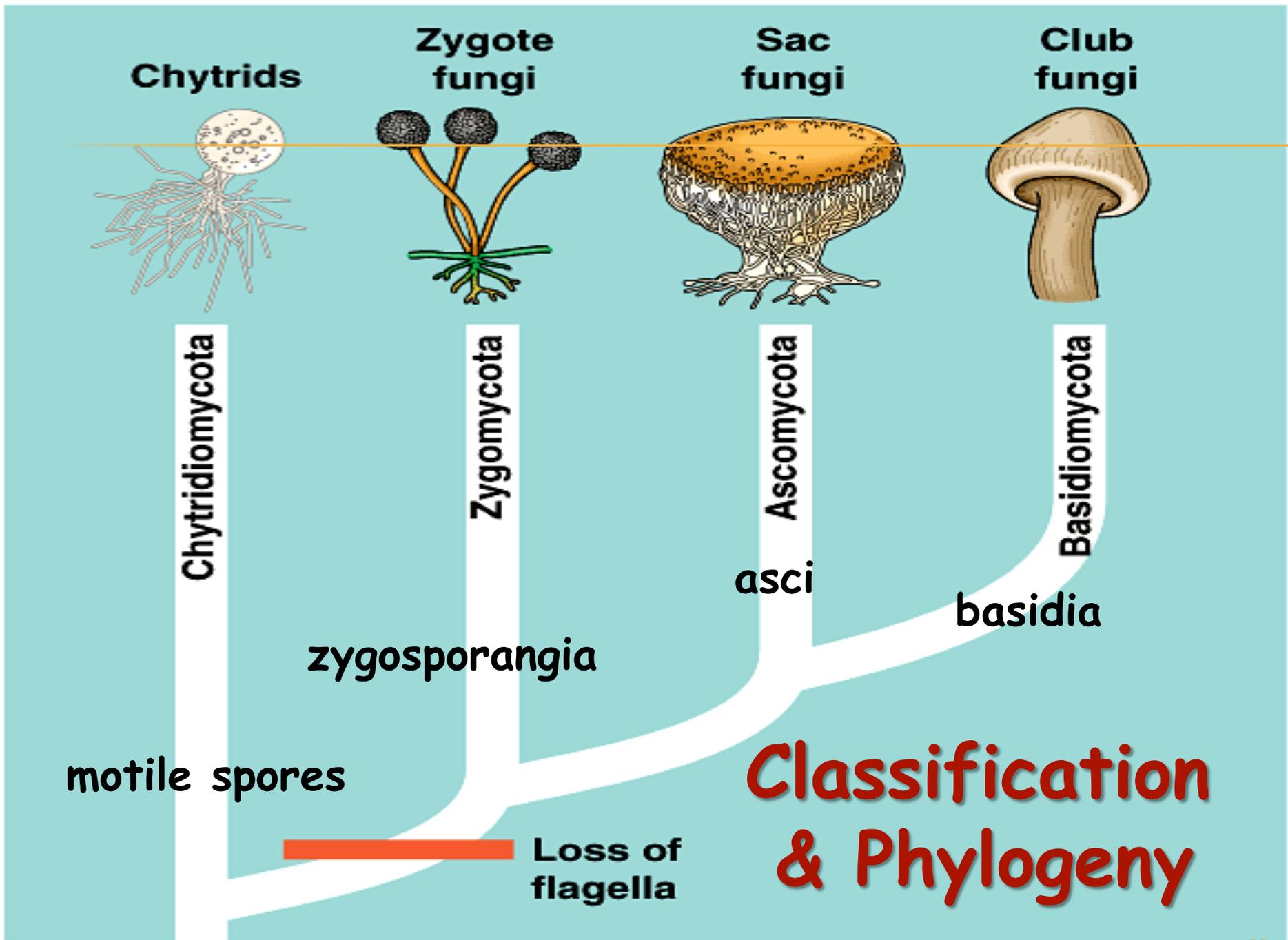


IT'S ALL ABOUT THE SPORES!

- ✘ Fungi are classified by their **REPRODUCTIVE STRUCTURES** and **SPORES**
- ✘ The reproductive structures are:
 - + **BASIDIA** - **BASIDIOMYCOTA**
 - + **SPORANGIA** - **ZYGOSPORANGIA**
 - + **ASCUS** - **ASCOMYCOTA**

IT'S ALL ABOUT THE SPORES!

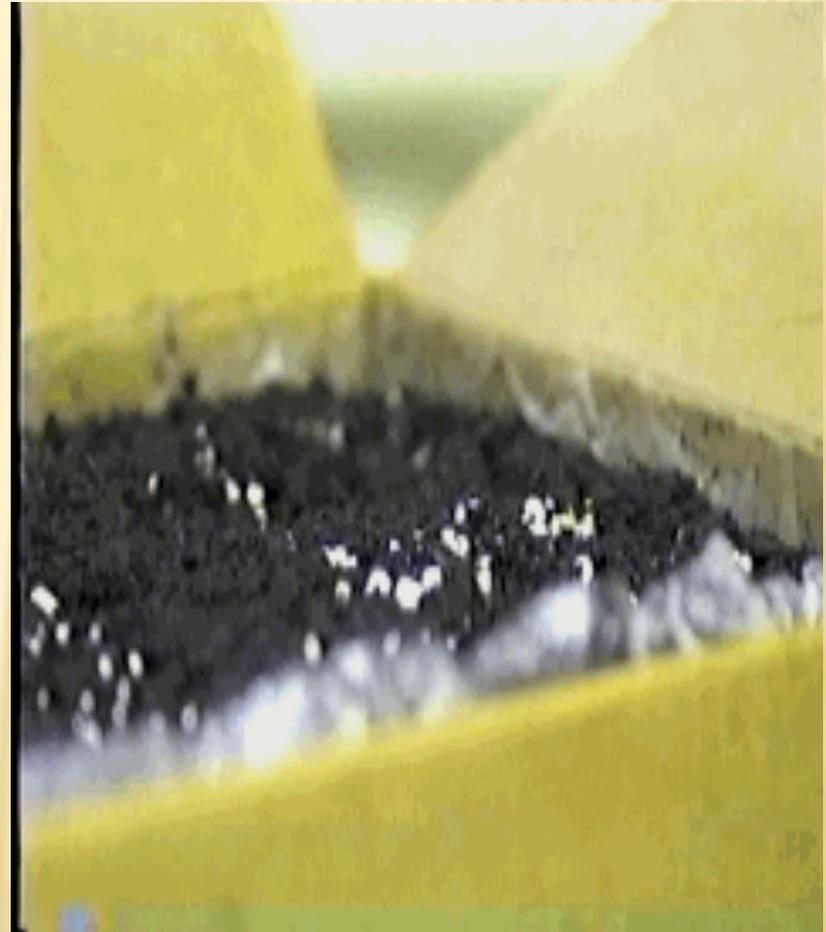
- ✘ **Spores are made of:**
 - + Dehydrated cytoplasm
 - + Protective coat
 - + Haploid cell
- ✘ **Wind, animals, water, & insects spread spores**
- ✘ **Spores germinates when they land on a moist surface (new hyphae form)**



Major Groups of Fungi

MAJOR GROUPS OF FUNGI

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



Classification by Nutrition

× Saprobies

- + Decomposers
- + Molds, mushrooms, etc.

× Parasites

- + Harm host
- + Rusts and smuts (attack plants)

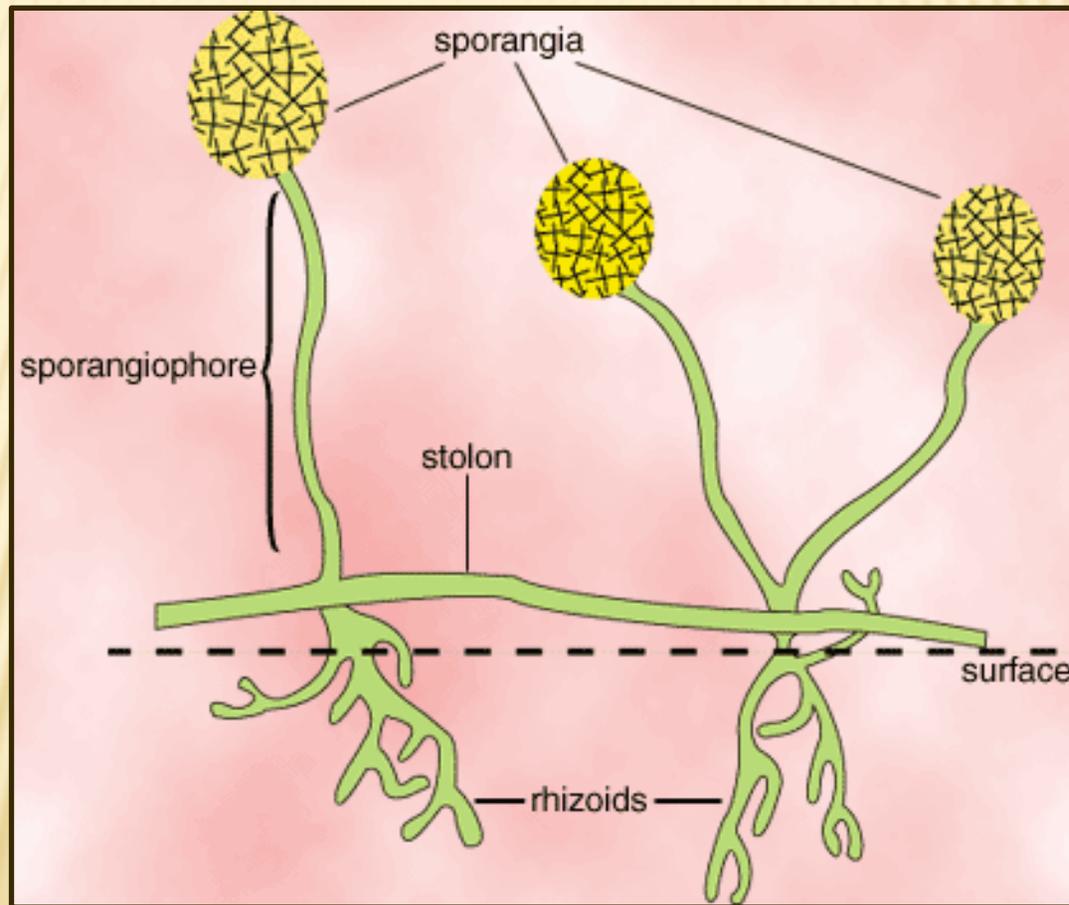
× Mutualists

- + Both benefit
- + Lichens
- + Mycorrhizas

MAJOR GROUPS OF FUNGI

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

ZYGOMYCOTA



ZYGOMYCOTA

- × Called the **sporangium fungi**
- × Commonly called **molds**
- × Also includes **blights**
- × Hyphae have no cross walls (**aseptate**)
- × Grow rapidly
- × Includes bread mold
Rhizopus stolonifer

Rhizopus on strawberries

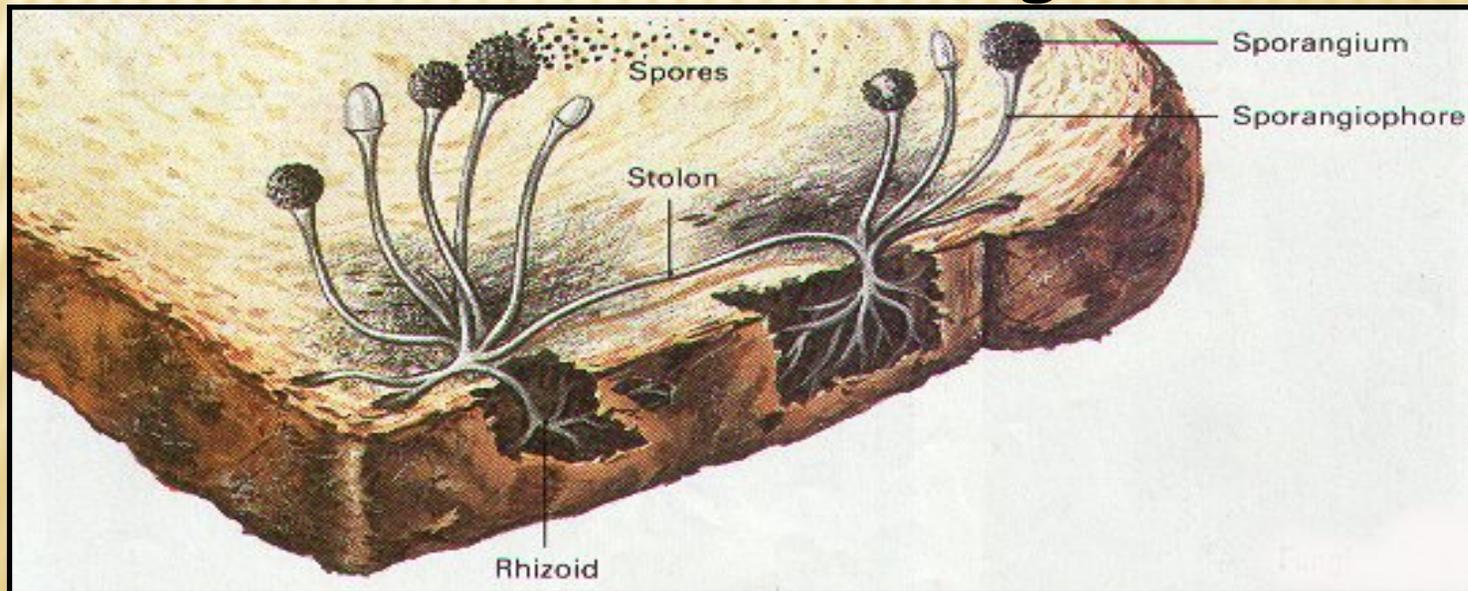


Tomato Blight



ZYGOMYCOTA

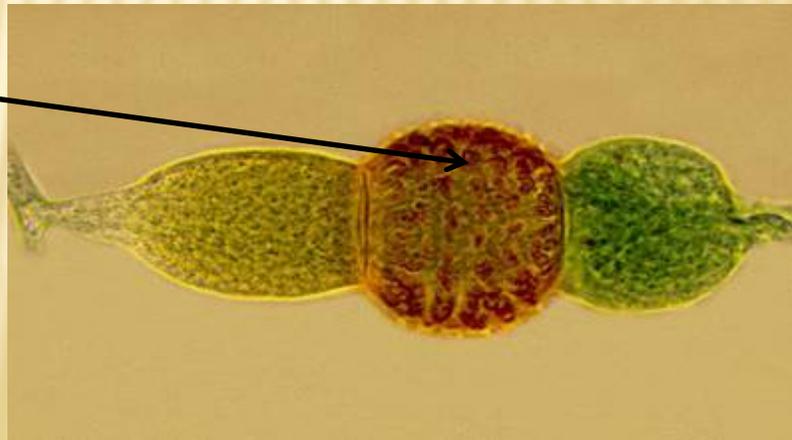
- × Asexual reproductive structure called **sporangium** atop **sporangiophores** make spores
- × **Rhizoids** anchor the mold & release digestive enzymes & absorb food
- × **Stolons** connect the fruiting bodies



ZYGOMYCOTA

- × **Sexual** spores are produced by **conjugation** when (+) hyphae and (-) hyphae fuse
- × Sexual spores are called **ZYGOSPORES**
- × Zygosporangia can **endure harsh environments** until conditions improve

zygospore



BASIDIOMYCOTA



The Death Angel



BASIDIOMYCOTA

- × Called **Club fungi**
- × Includes:
 - × **Mushrooms**
 - × **Toadstools**
 - × **Bracket & Shelf fungi**
 - × **Puffballs**
 - × **Stinkhorns**
 - × **Rusts and smuts**



USES FOR BASIDIOMYCOTA

- ✦ Some are used as food (**mushrooms**)
- ✦ Others damage crops (**rusts & smuts**)



Portobello Mushrooms



Corn Smut



Soybean
Rust

CHARACTERISTICS OF CLUB FUNGI

- × **Seldom** reproduce asexually
- × The visible mushroom is a **fruiting body**
- × **Basidiocarp** (fruiting body) is made of a stalk called the **stipe** and a flattened **cap** with gills called **Basidia** underneath
- × **Basidiospores** are found on basidia
- × **Annulus** is a skirt-like ring around some stipes
- × **Vegetative** structures found below ground

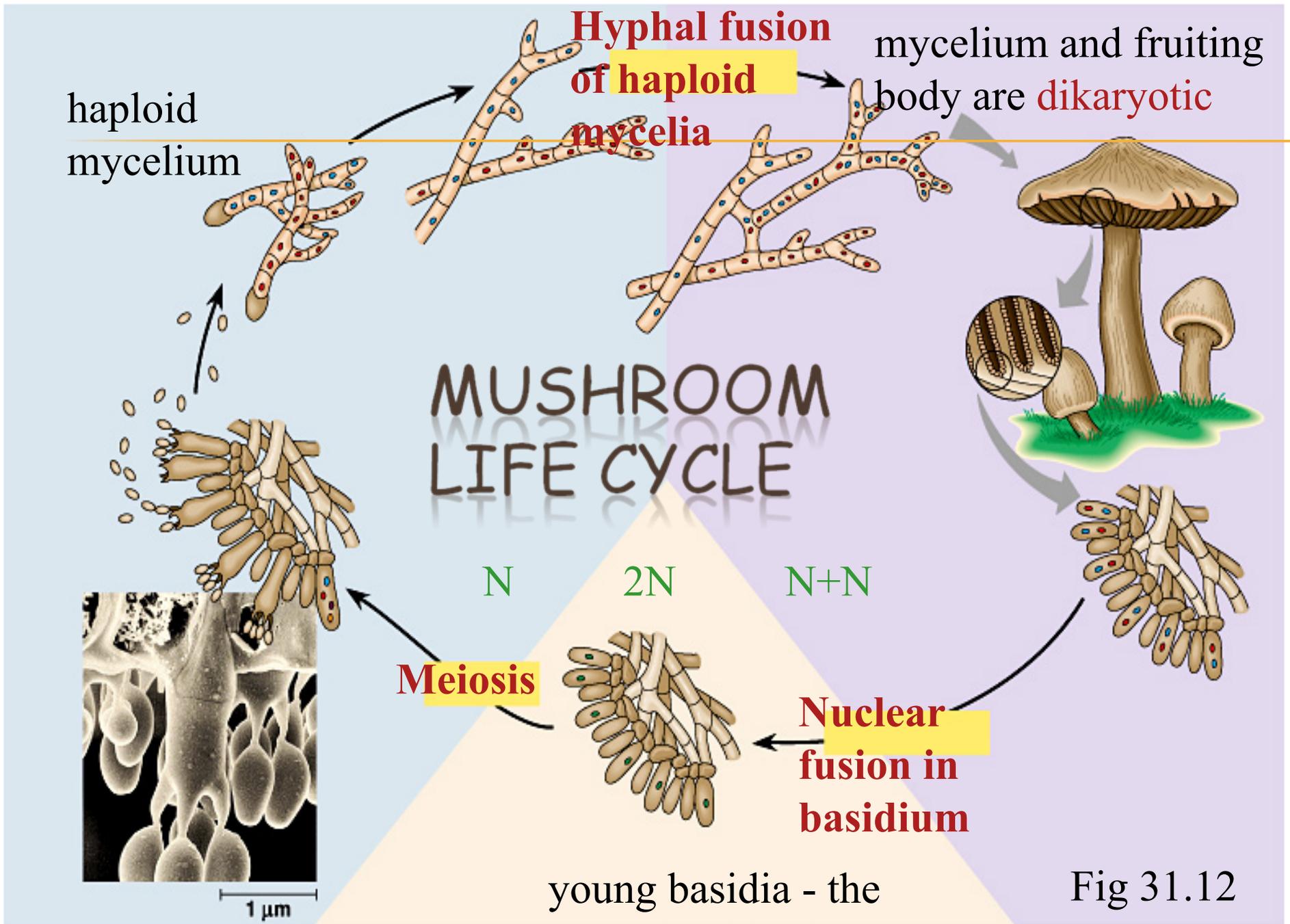


Fig 31.12

ASCOMYCOTA

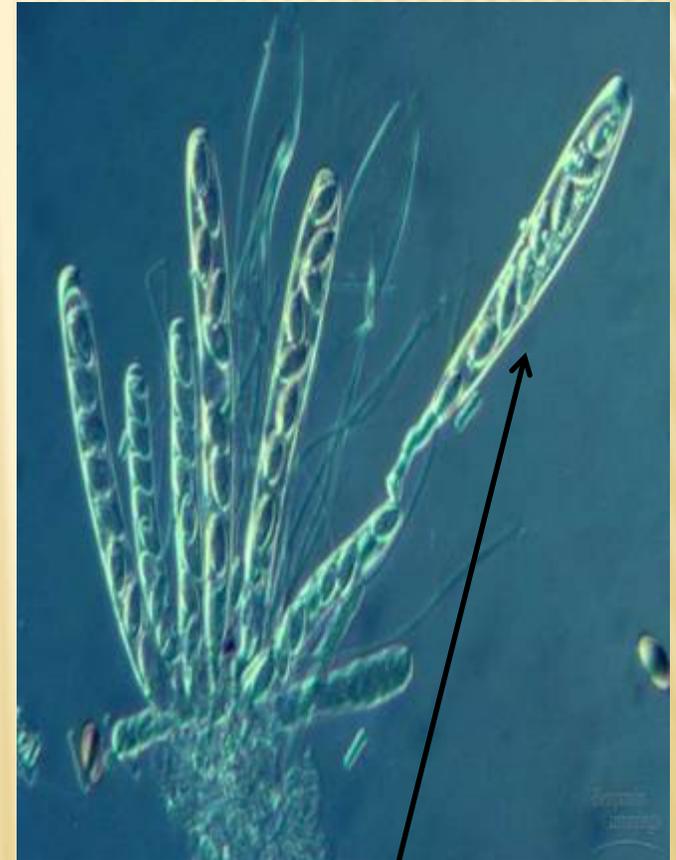


CHARACTERISTICS

- × Called **Sac fungi**
- × Includes **Cup fungi, morels, truffles, yeasts, and mildew**
- × May be plant parasites (**Dutch elm disease and Chestnut blight**)
- × Reproduce sexually & asexually
- × **Ascus** - sac that makes **ascospores** in sexual reproduction
- × Specialized hyphae known as **Ascocarps** contain the asci

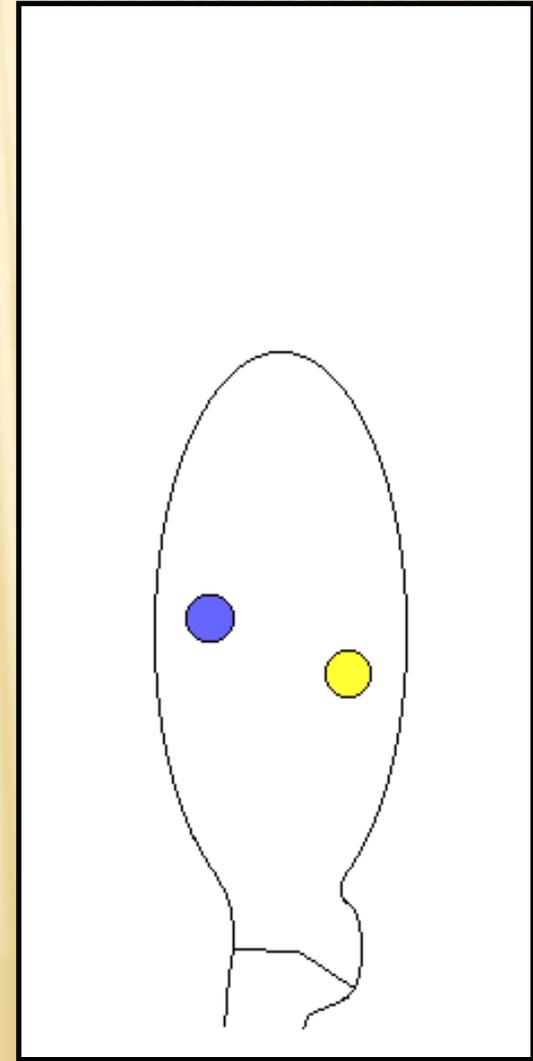
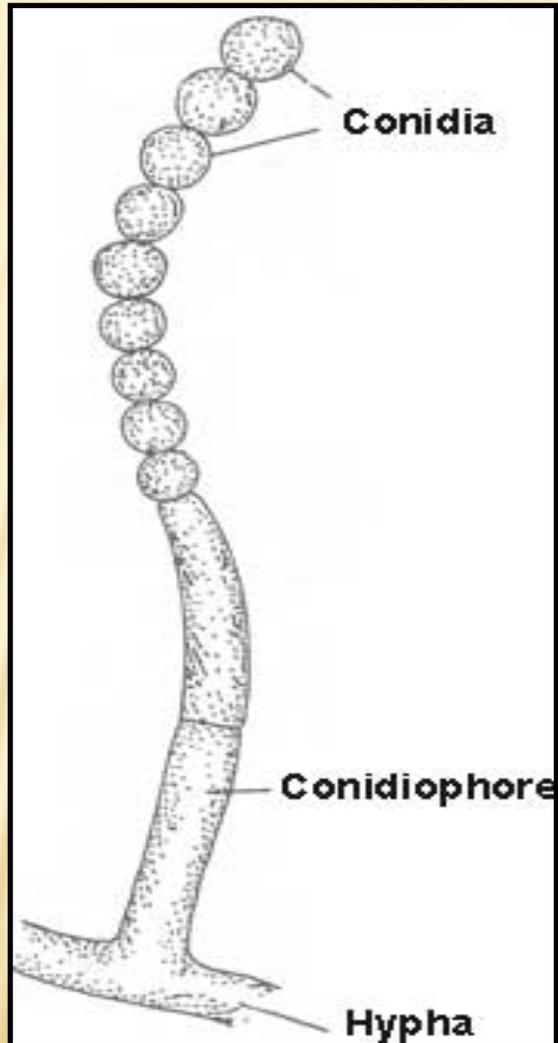
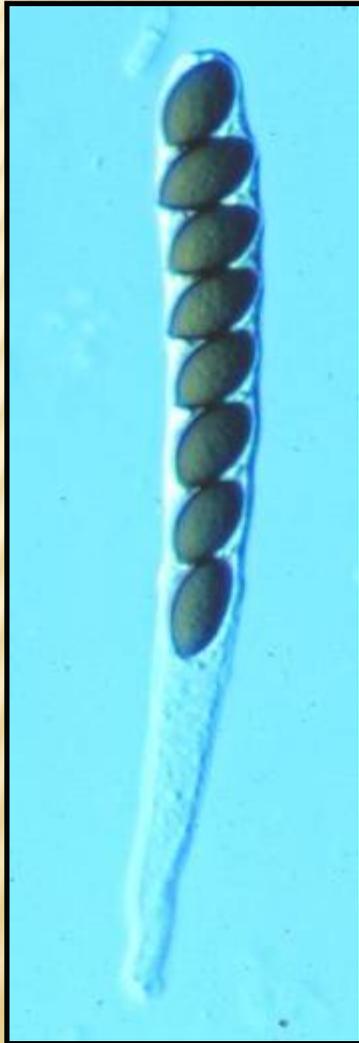
CHARACTERISTICS

- × Yeasts reproduce asexually by **budding** (buds break off to make more yeast cells)
- × **Asexual** spores called **conidia** form on the tips of special hyphae called **conidiophores**

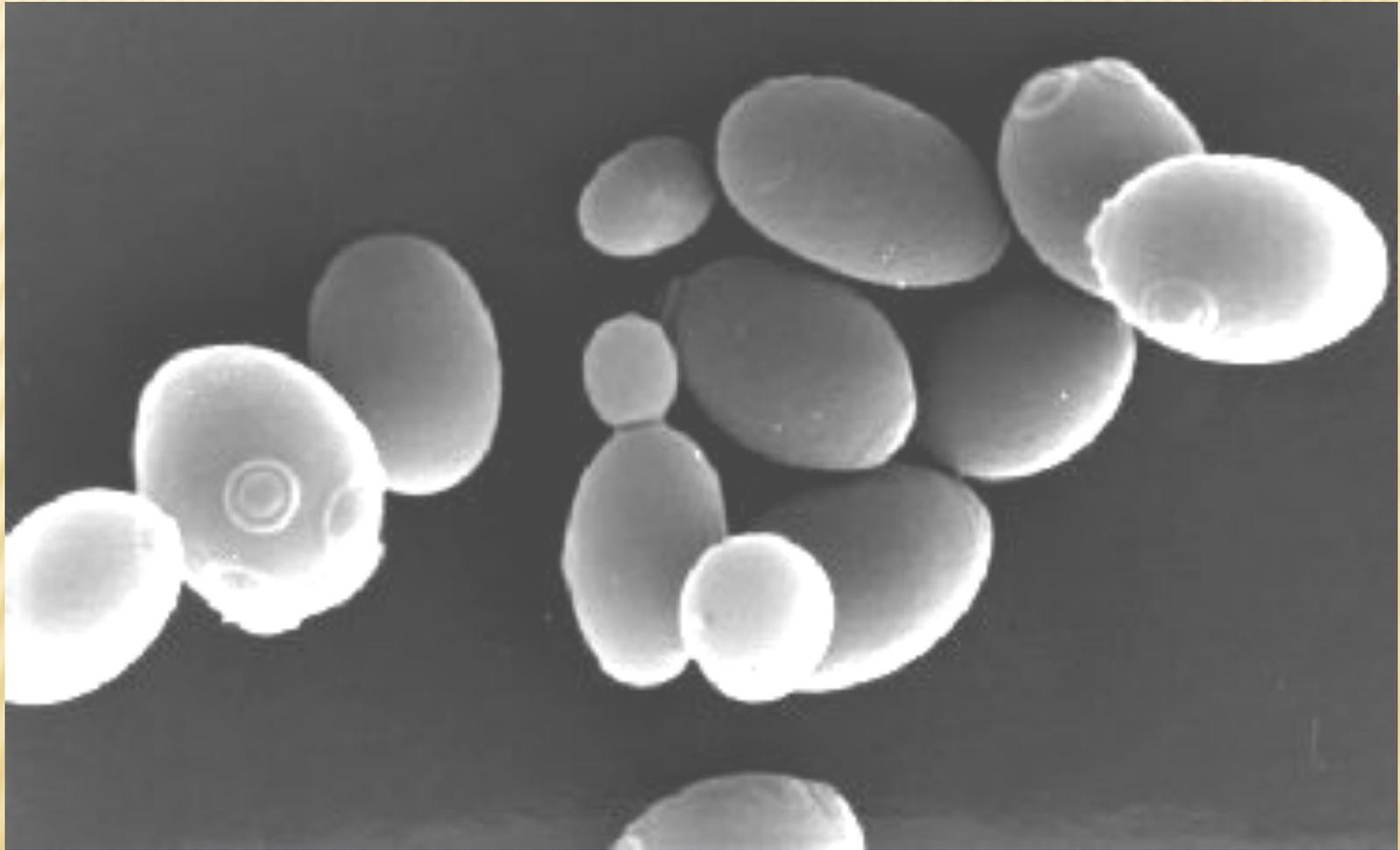


CONIDIA

CONIDIA FORMATION



YEASTS BUDDING



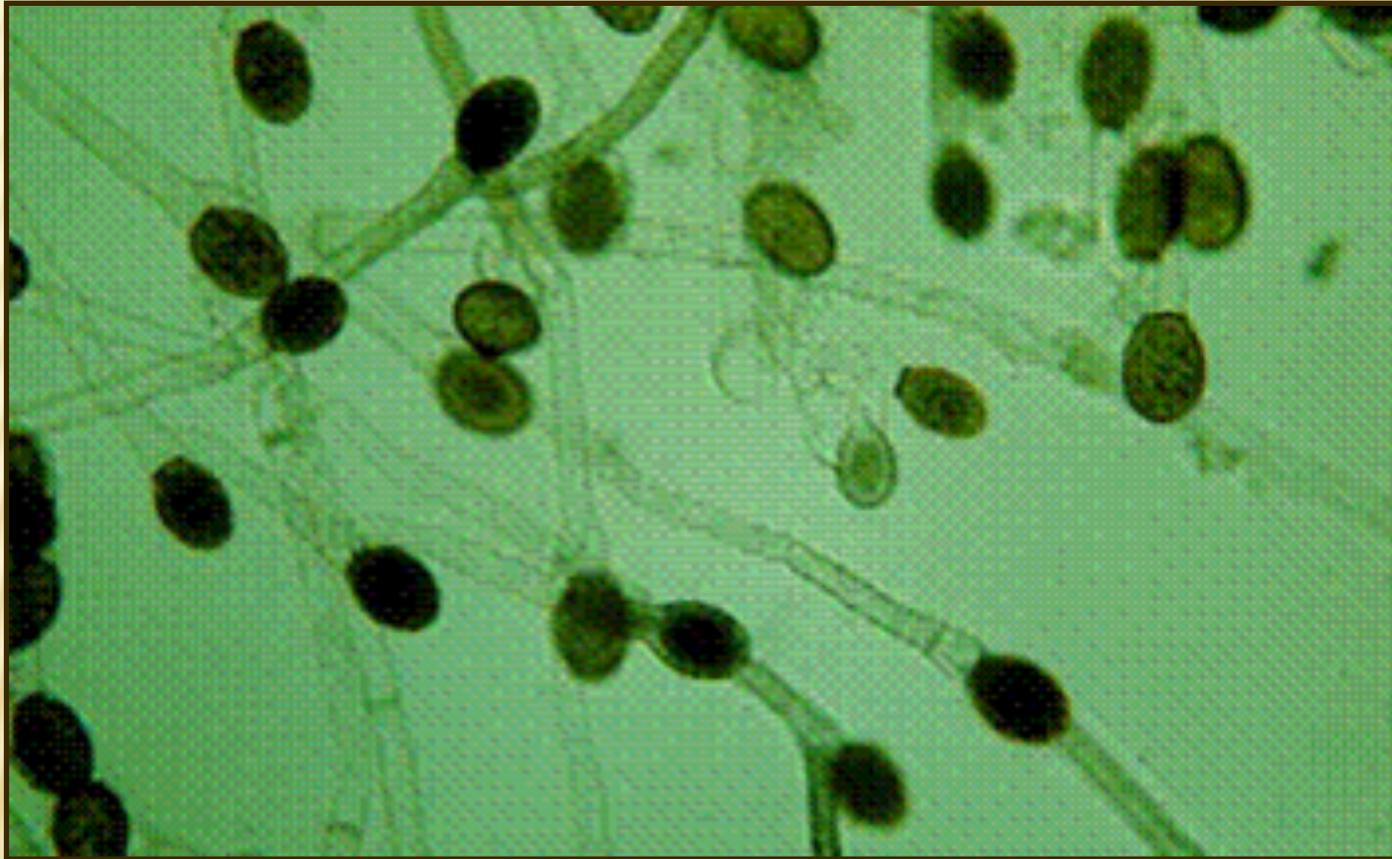
Saccharomyces

USES OF ASCOMYCETES

- ✦ **Truffles** and **morels** are good examples of edible ascomycetes
- ✦ **Penicillium mold** makes the antibiotic penicillin.
- ✦ Some ascomycetes also gives **flavor to certain cheeses**.
- ✦ ***Saccharomyces cerevesiae*** (yeast) is used to make bread rise and to ferment beer & wine.



CHYTRIDIOMYCOTA

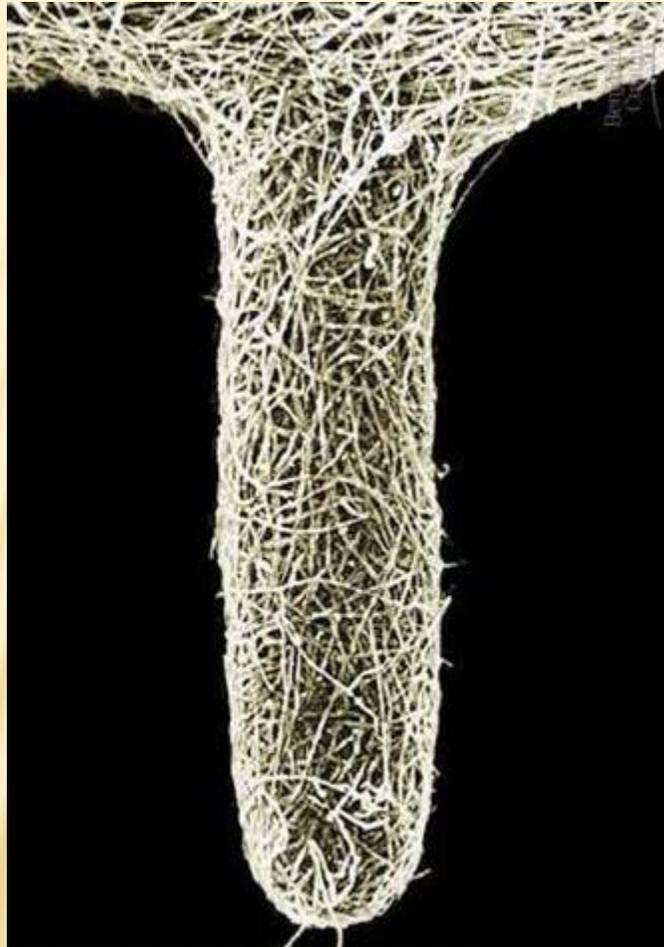


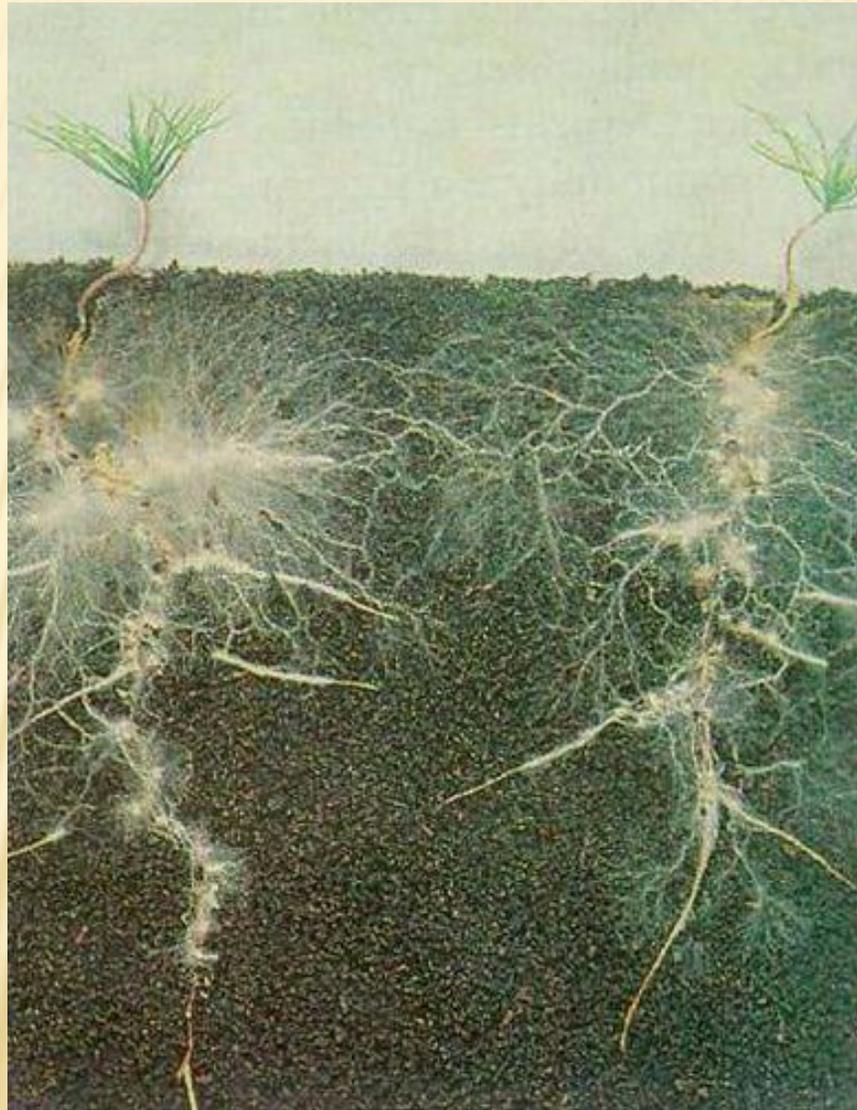
CHYTRIDIOMYCOTA

- × Called **chytrids**
- × Produce **motile spores**
- × Mostly **saprobies** and **parasites** in aquatic habitats
- × **Biodegrade and recycle** nutrients



Chytrid that attacks Potatoes



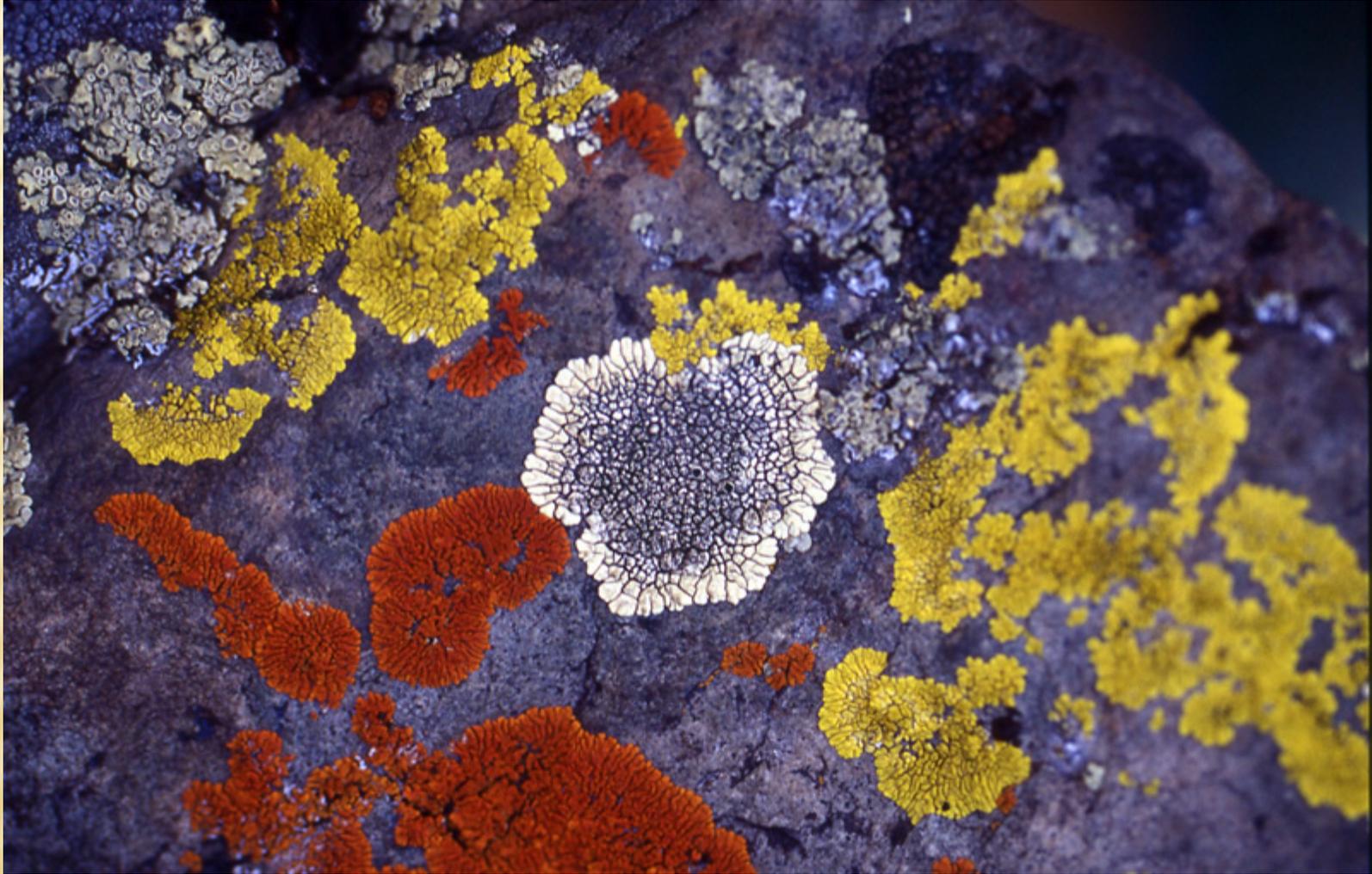




MYCORRHIZA

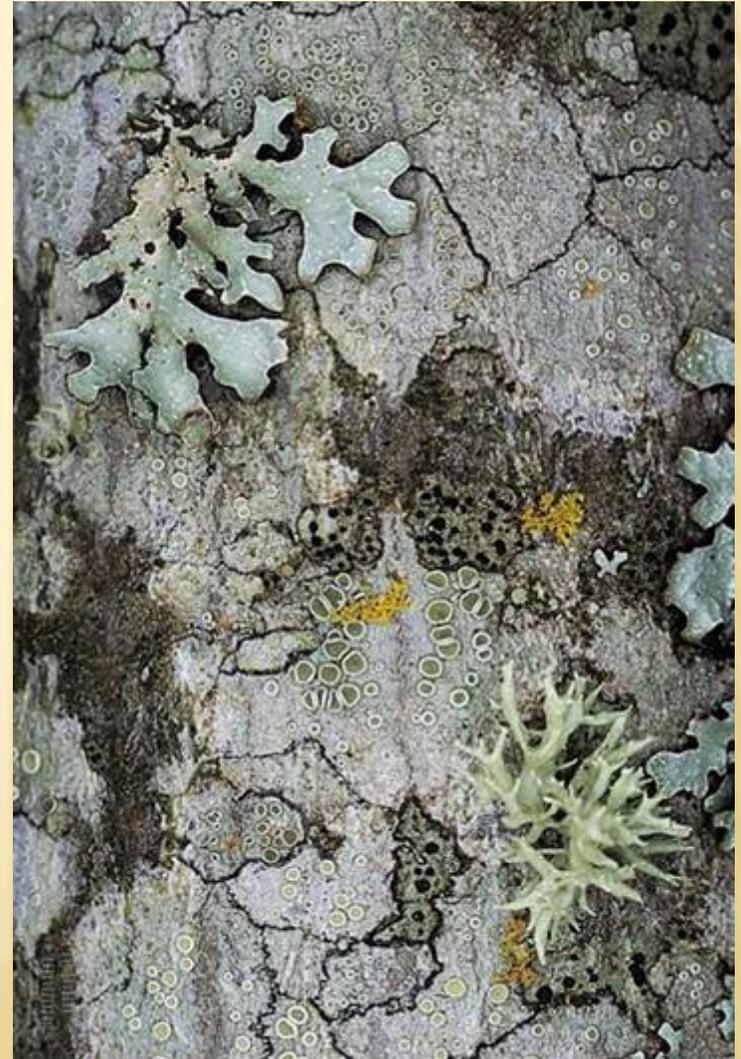


LICHENS

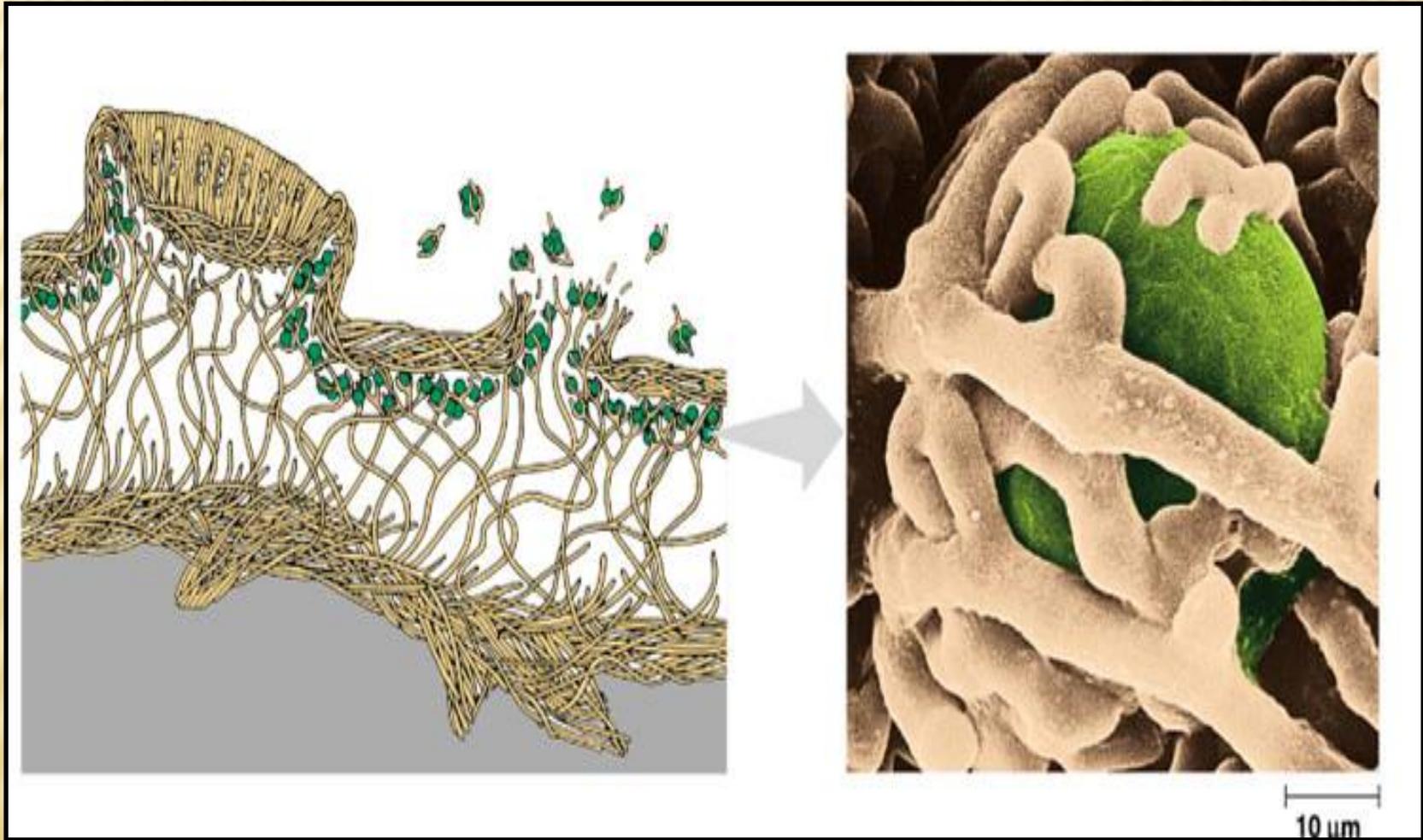


LICHENS

- × Mutualism between:
 - + **Fungus** (structure)
 - + **Algae or cyanobacteria** (provides food)
- × Form a thallus (body)
 - + **Folioiose**
 - + **Fruticose**
 - + **Crustose**



LICHEN STRUCTURE



LICHENS AS BIOMONITORS

- × Thalli **act like sponges**
- × Some species more **sensitive** than others **to pollutants**
- × Which species are present can indicate **air quality**
- × Most resistant species can also be analyzed for **pollutants**

MYCORRHIZAS

- × Fungus associated with plant roots
- × Mutualism between:
 - + Fungus (nutrient & water uptake for plant)
 - + Plant (carbohydrate for fungus)
- × Several kinds:
 - + Zygomycota - hyphae invade root cells
 - + Ascomycota & Basidiomycota - hyphae invade root but don't penetrate cells
- × Extremely important ecologically

