



Kingdom Fungi



People do not like fungi, especially athletes.

People who like fungi and study them are called mycologists.

The study of fungus is called **mycology**.

Usually all we want to know about a fungus is what is it and how do you kill it.

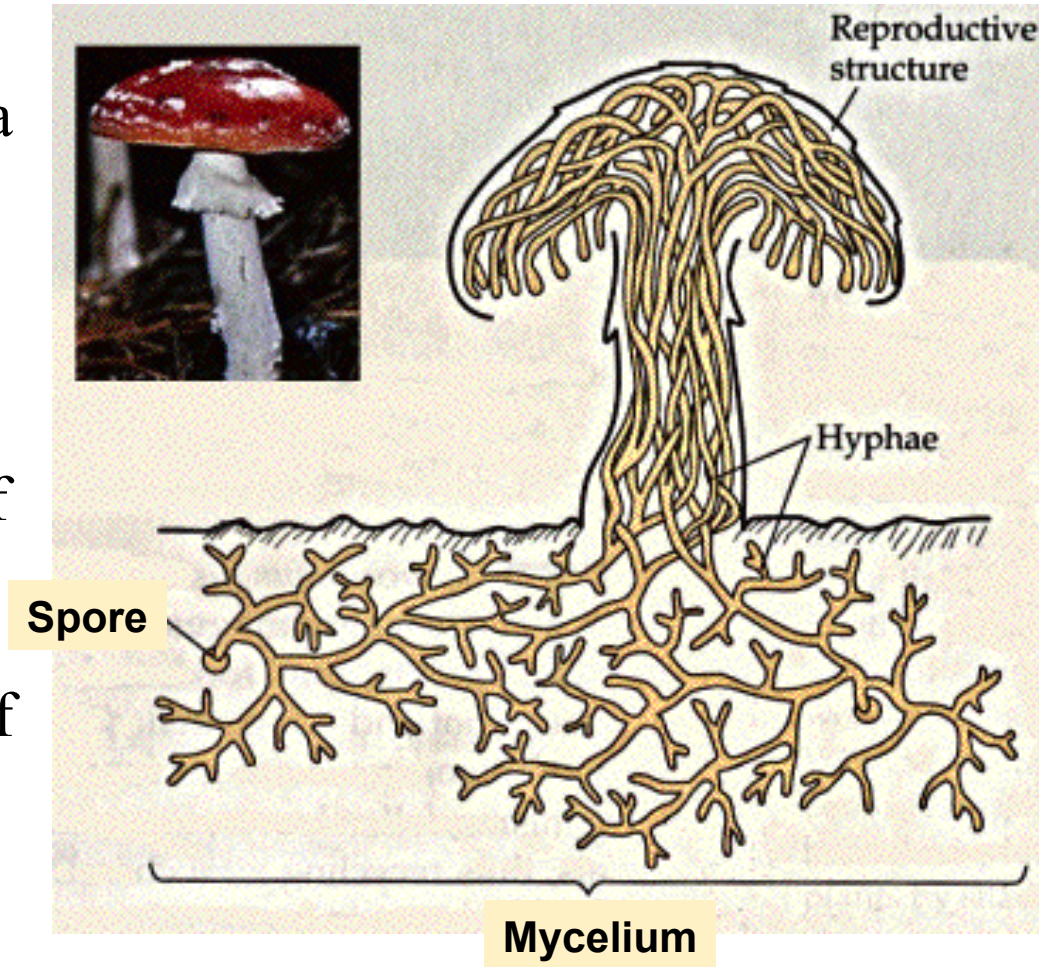
Fungi are eukaryotic, have chitinous cell walls, are generally multicellular, and are heterotrophic. In general, they spend most of their life cycle as **haploid** individuals.



Hyphae

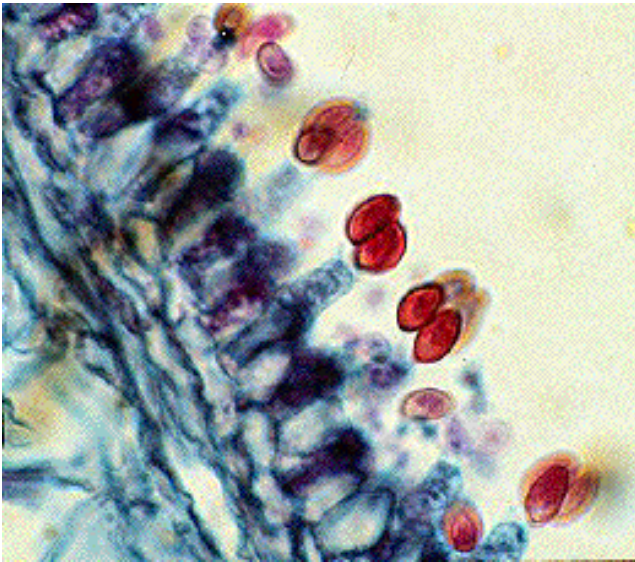
The vegetative (non-reproductive) part of a fungus (except for yeasts), is called the **hyphae**. It is composed of filamentous strands of cells.

Collectively, a mass of hyphae is referred to as **mycelium** and can be quite extensive.

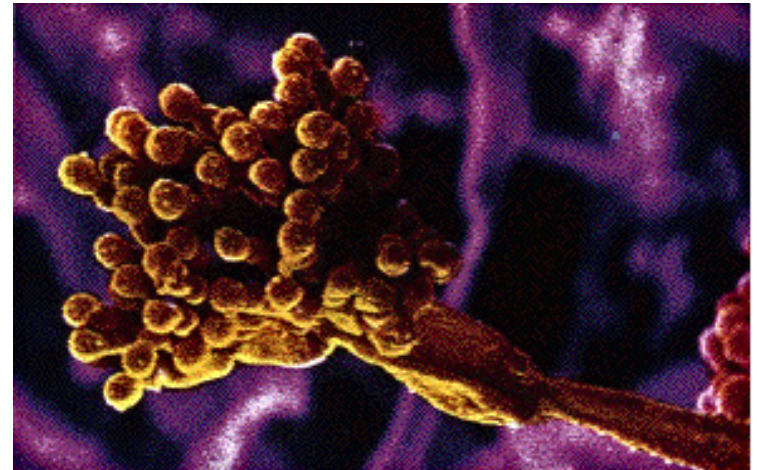


Sample sporangia

The reproductive structure of the fungus consists of mycelia modified to form **sporangia** (spore bearing structures). The different classes of fungi are organized based on the type of spore bearing structure they produce.



Basidium



Conidia



Fungi are important

Fungi form an integral part of any ecosystem and have an enormous importance to humans directly both economically and medically.

Ecological roles

Saprophytes (Decomposers, Recyclers)

Saprobic fungi absorb nutrients from *non-living* organic material, such as fallen logs, animal corpses, or the wastes of live organisms, and in the process, the fungi decompose this material.



Parasites

Parasitic fungi absorb nutrients from the cells of *living* hosts. Many of these fungi, such as certain species which infect human lungs, are pathogenic.

Ecological roles

Symbiotic (*mutualism*)

mycorrhizae (fungal roots)

Fungi form what are called mycorrhizal associations with the roots of over 90% of the existing plant families today.

The fungus supplies the plant with an **increased surface area** for **water absorption** and the **absorption of phosphorous**.

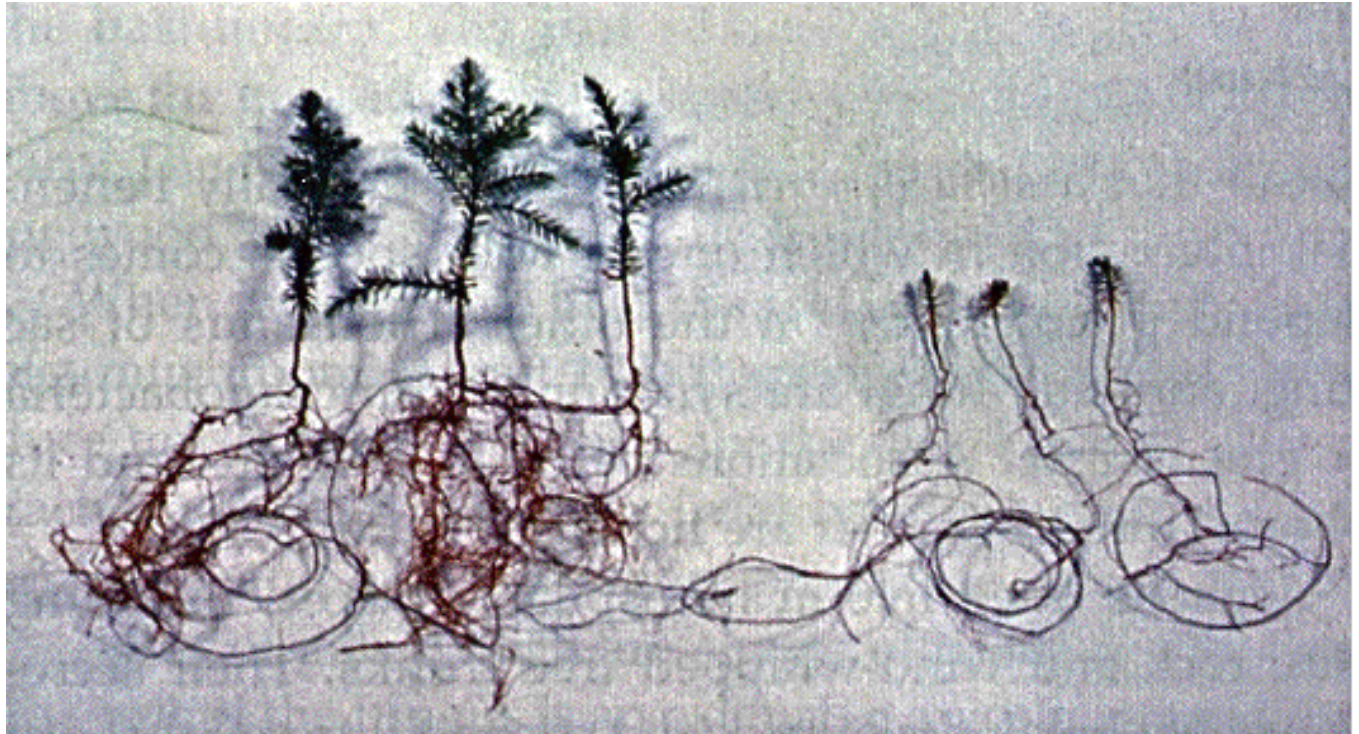
In return, the plants supply the fungus with a ready **carbohydrate** source with products from photosynthesis.

These mycorrhizae help trees obtain nutrients from the soil and grow at a faster rate, foresters make sure the tree roots are exposed to the fungus before they are planted.

Ecological roles

Symbiotic (*mutualism*)

mycorrhizae (fungal roots)



These are six-week old hemlock seedlings grown in soil with fungi and without. Most conifers will not survive without mycorrhizae.

Ecological roles

Symbiotic (*mutualism*)

lichens

Fungi, usually a *sac fungi*, also form symbiotic associations with algae, usually a *green algae*, to form lichens.

The alga provides the fungus with carbohydrates and the fungus gives the alga protection in potentially harsh environments.

Lichens can live on bare rock or in poor soil, and they are able to survive great temperature extremes and dryness in all areas of the world.

Lichens have been used as **indicator species of pollution and they create soil.**

Ecological roles

Symbiotic (*mutualism*)

lichens

Lichens are part of the food chain in the arctic tundra. Lichens are the first colonizers to grow on barren terrain such as bare rock, volcanic ash, or burned-over forests.

They help prepare the soil for other plants by penetrating the substrate with hyphae from the fungi component of the lichen and chemically breaking down the rock or ash into *usable soil*.

Ecological roles

Symbiotic (*mutualism*) lichens



Crustose is a flat lichen that clings tightly to a tree trunk, rock, or other host. It looks like the host has been spray painted.

Ex) Pale Shield

Ecological roles

Symbiotic (*mutualism*)

lichens

Foliose is leaf-like though still relatively flat. The edges are curled up and ruffled. These are the most common form of lichens and usually occur on rocks.



Ecological roles

Symbiotic (*mutualism*)

lichens

Fruticose is a branched or stem-like variety. These lichens are often branched and may occur on trees, soil and rocks.

Ex) Reindeer moss is actually a fruticose lichen, not a moss.



Medicinal roles

Diseases

Many fungi are responsible for causing both minor and serious diseases in humans. Some of the diseases you are probably familiar with include athlete's foot, jock itch, yeast infections, ringworm, and various allergies. More serious diseases are Cryptococcosis which affects the central nervous system, and Aspergillosis which affects the lungs and brain.

athletes foot



Antibiotics

Several antibiotics are produced by fungi; one you are all familiar with is **penicillin**.

Medicinal roles

Wild mushrooms

There are several wild mushroom species which can induce hallucinations, illness, or death. The best known is a mushroom known as the Death Cap Mushroom. This particular mushroom is fatal if eaten.

NEVER eat anything that has not been identified by a knowledgeable mycologist!



Amanita muscaria

Economic roles

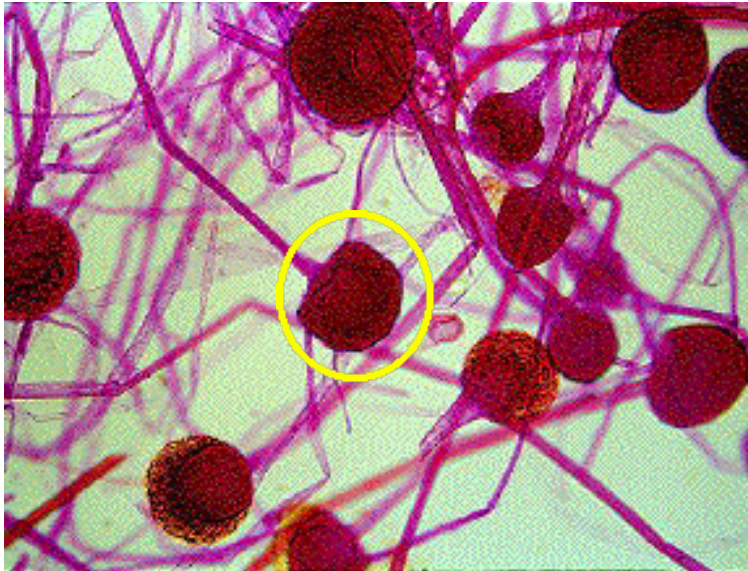
Beer, wine, bread: these are all the result of fungi. Yeast, a single celled fungus, undergoes fermentation. In the case of beer and wine, the alcohol produced by fermentation is the desired product. However, in the case of bread, the CO_2 is desired.

The “blue” in Bleu Cheese, and its characteristic flavor, is the result of the fungus Penicillium roquefortii. Brie and Camembert are also flavored by fungi.

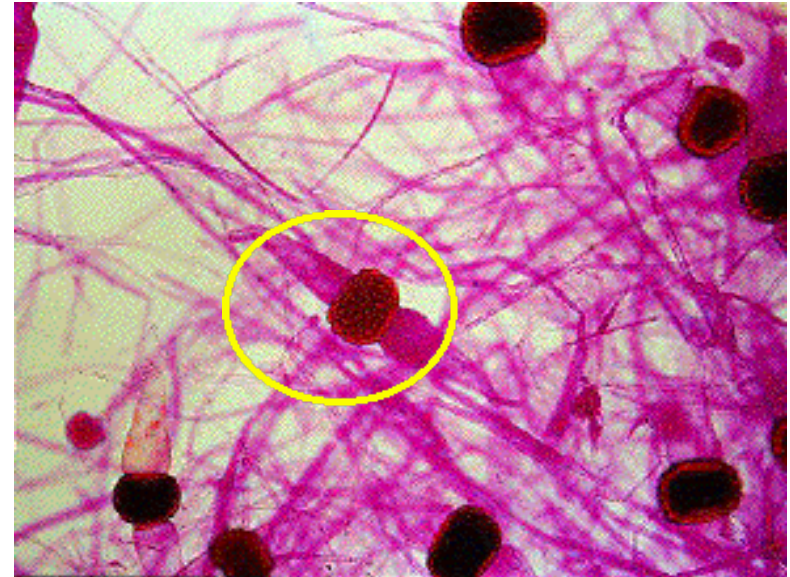
Fungi classification

- **Phylum Mastigomycota – water molds**
- **Phylum Amastigomycota – 3 classes:**
 - **Zygomycetes**--sexual (uses a zygosporangium) and asexual reproduction
 - **Ascomycetes**--*sac fungi*, sexual reproduction with an ascus
 - **Basidiomycetes**--*club fungi*, sexual reproduction with a basidium
- **Phylum Deuteromycota--*imperfect fungi***, no known sexual stage or asexual stage of Ascomycetes

Zygomycetes



This is the asexual reproductive structure called the **sporangium**



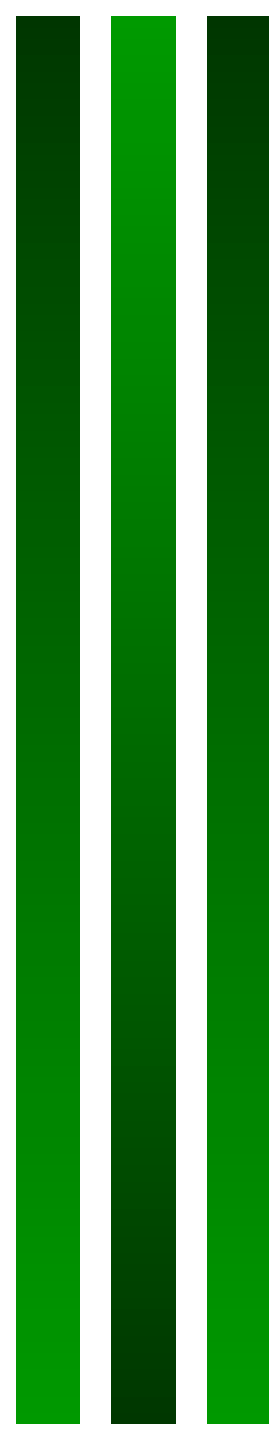
This is the sexual reproductive structure called the **zygospore**.

Zygomycetes

Pilobolus



This saprophyte on animal dung is able to aim its spores.

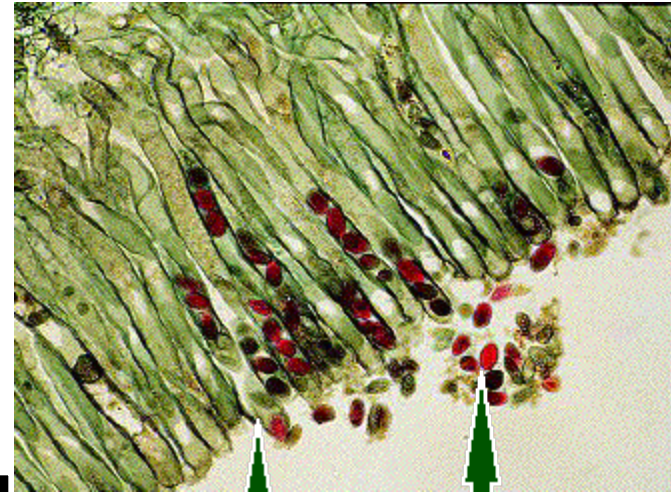


Ascomycetes: “yeasts”, morels, truffles, sac or cup fungi

They range in size and complexity from unicellular yeasts to morels and truffles. All produce haploid sexual spores in pouch-like cells called **asci** (singular, ascus).

Ascomycetes

This is a morel. Inside the pits are several asci with their ascospores.

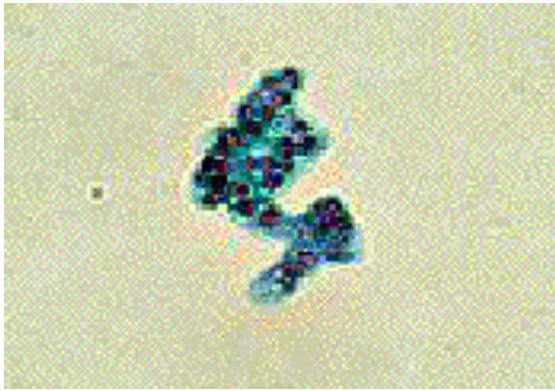


Asci

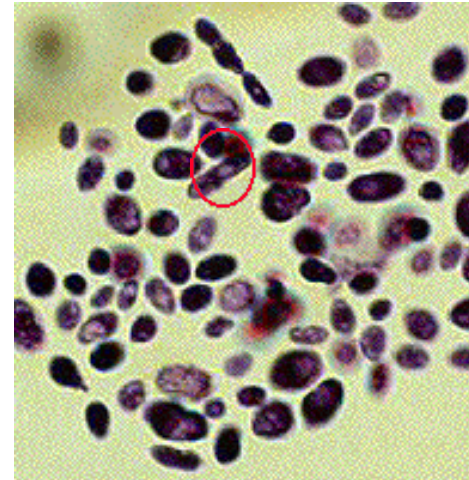
Ascospore

Ascomycetes

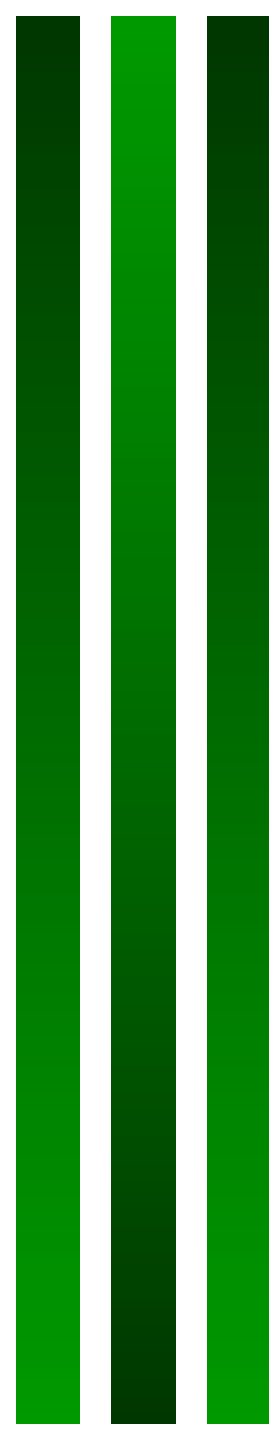
These are microscope slides of yeast.



The little dark red balls are the **ascospores**. The yeast itself forms the **ascus**.



These are **budding** yeasts. They are going to split into two parts.

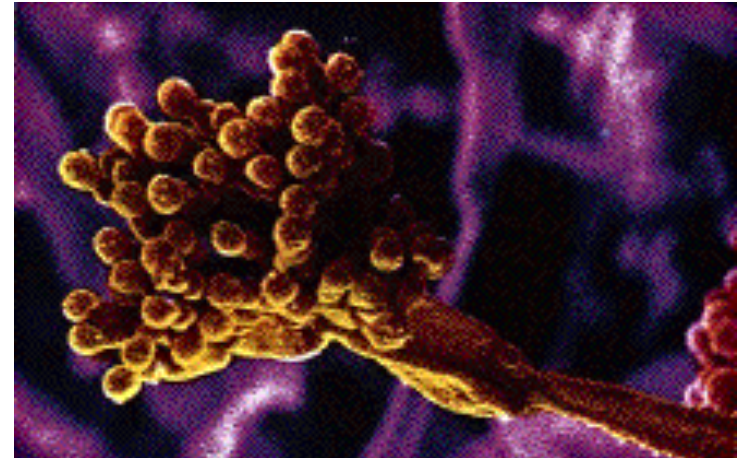
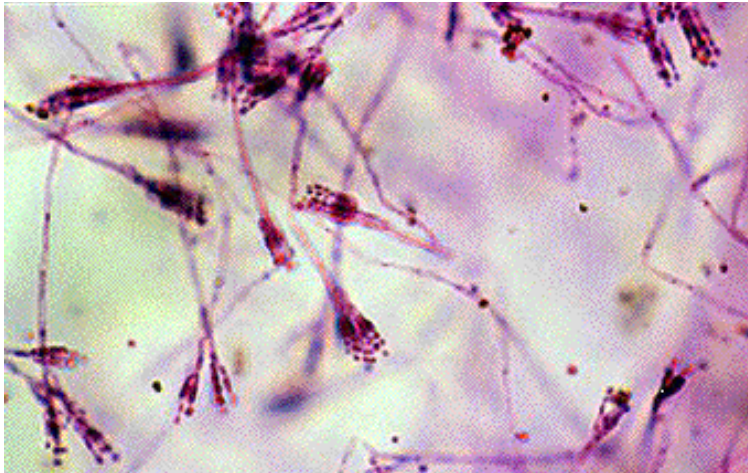


Deuteromycota: “blue-green” molds and others --the “virgin” fungi

These are fungi that have no sexual stage; they are said to be “**imperfect**” resembling both sac and club fungi.

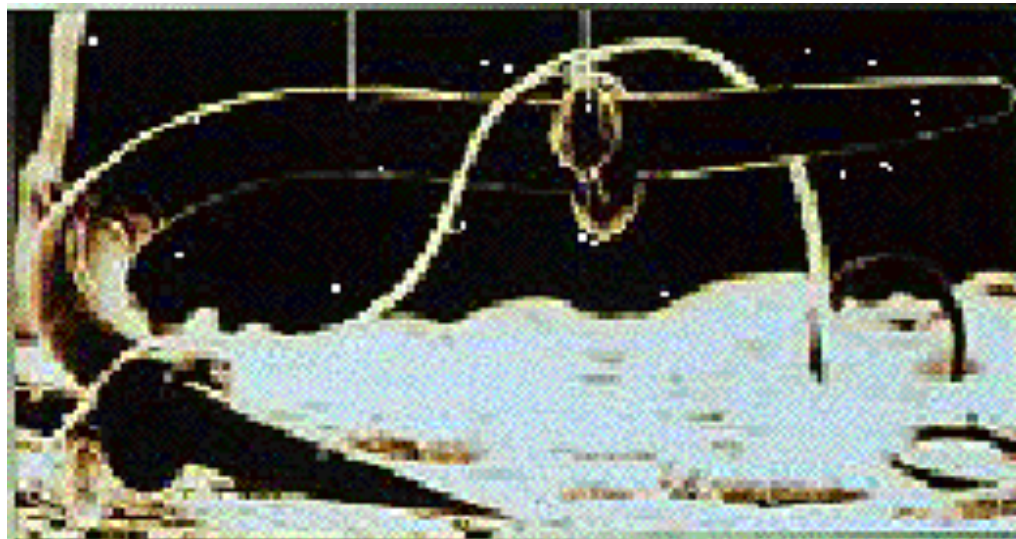
Deuteromycota

Since Deuteromycota do not have a sexual stage they must reproduce asexually. This is accomplished with a structure called a **conidia**. These are Penicillium conidia:



Deuteromycota

Arthrobotrys is a predatory fungus of nematodes (roundworms). The hyphae of the fungus form noose-like rings that swell rapidly with incoming water when stimulated (rubbed). The increased turgor pressure shrinks the “hole” in the noose and captures the nematode. Once it is trapped, the fungus produces additional hyphae that penetrate the body of the nematode, releasing digestive enzymes. It then digests and absorbs its contents.



Basidiomycetes: “mushrooms”, shelf fungi, conks

Members of this group include the mushrooms, shelf fungi, coral fungi, stinkhorns, and puffballs. Some club fungi are **saprobies** that are important decomposers of plant debris.

Many form **mycorrhizal** associations with the roots of conifers.

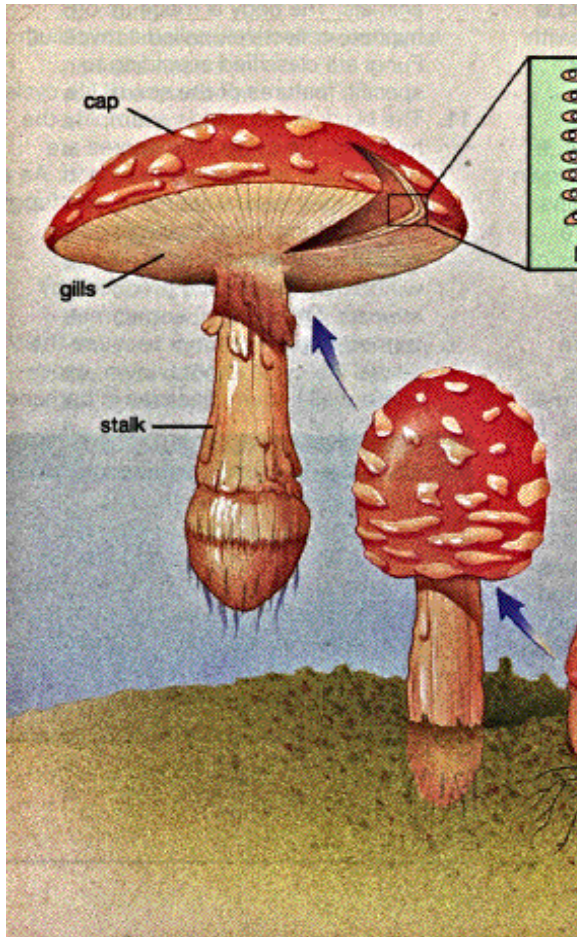
Others, including the rust and smut fungi are **parasitic** fungi that attack grains, resulting in great economic loss and necessitating expensive control measures.

Some species are **edible**; in fact, it is a multimillion-dollar business.

Basidiomycetes



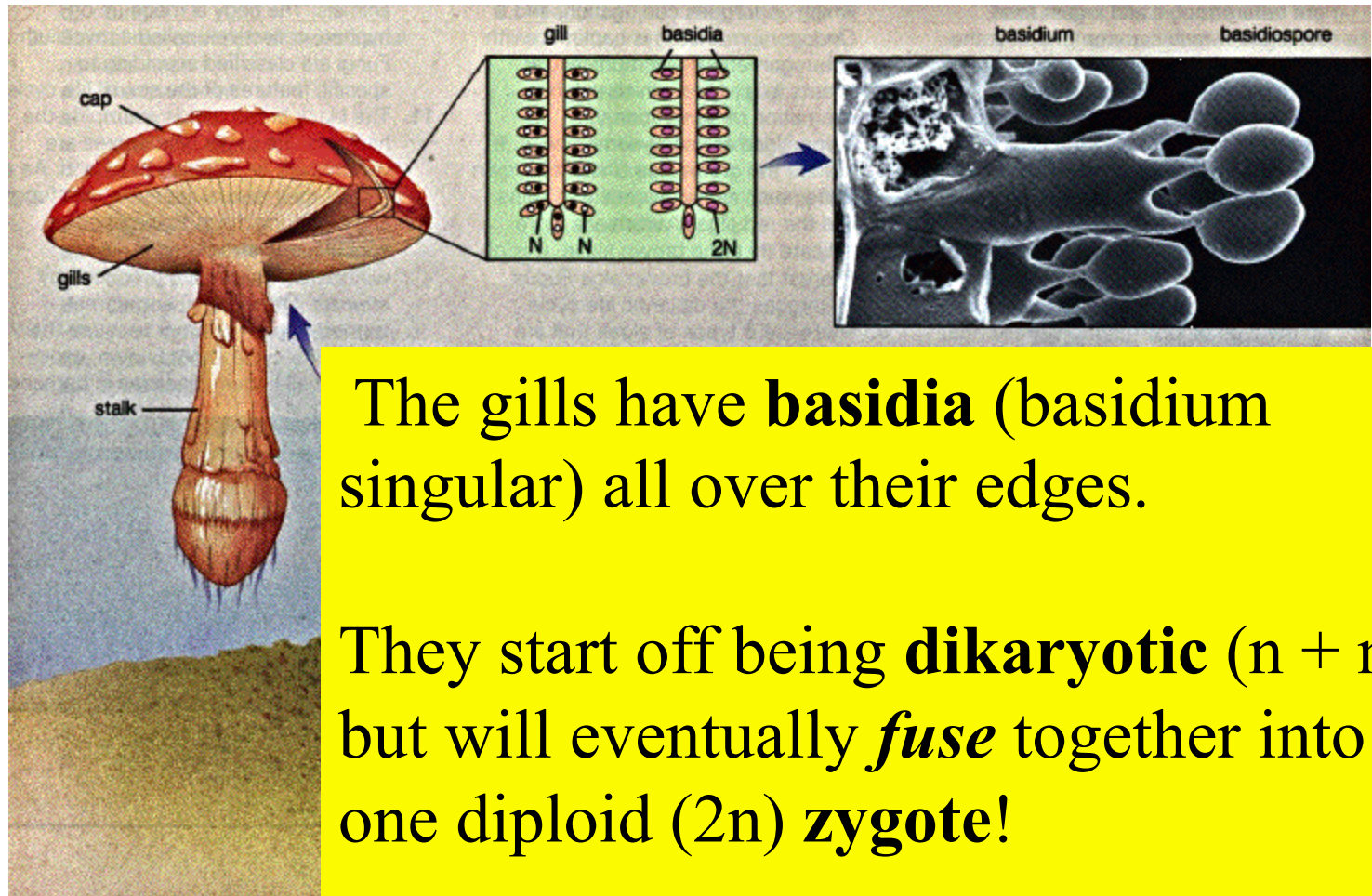
Basidiomycetes life cycle



The mushroom is **dikaryotic**, meaning that it is made up of cells that have two nuclei each ($n + n$).

One other part of the mushroom that is not in this picture is the **mycelium**.

Basidiomycetes life cycle



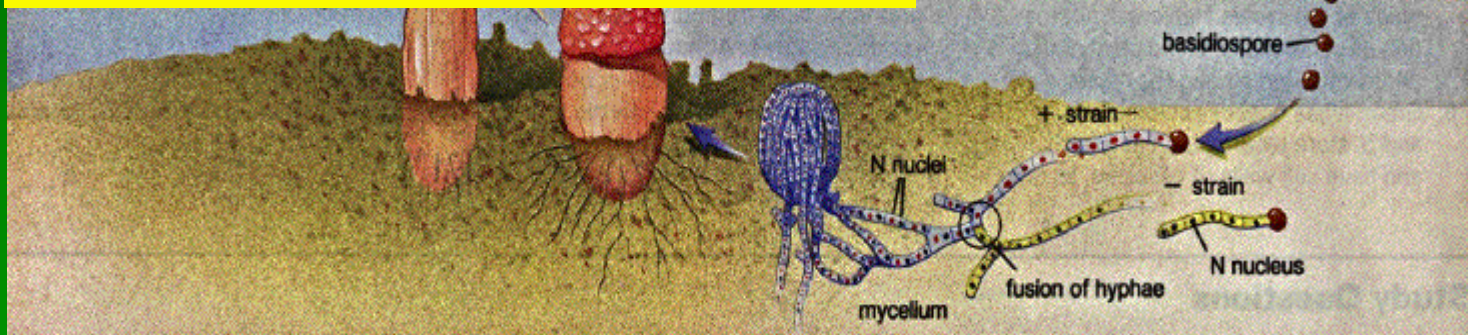
The gills have **basidia** (basidium singular) all over their edges.

They start off being **dikaryotic** ($n + n$), but will eventually ***fuse*** together into one diploid ($2n$) **zygote**!

Basidiomycetes life cycle

Each of these is a basidiospore.. When the conditions are right the basidiospore will germinate and start growing hyphae.

Spores can be of different strains indicated by + **or** - symbols.



Basidiomycetes life cycle

