

Fungi

- Eukaryotic organisms, heterotrophs, characterized by chitin and B-glucans in the cell wall, feeding through absorption, reproducing by spores and producing a vegetative structure made up of tubular structures, branched, irregular, and indefinite in growth (modified from B. Kendrick 1992)

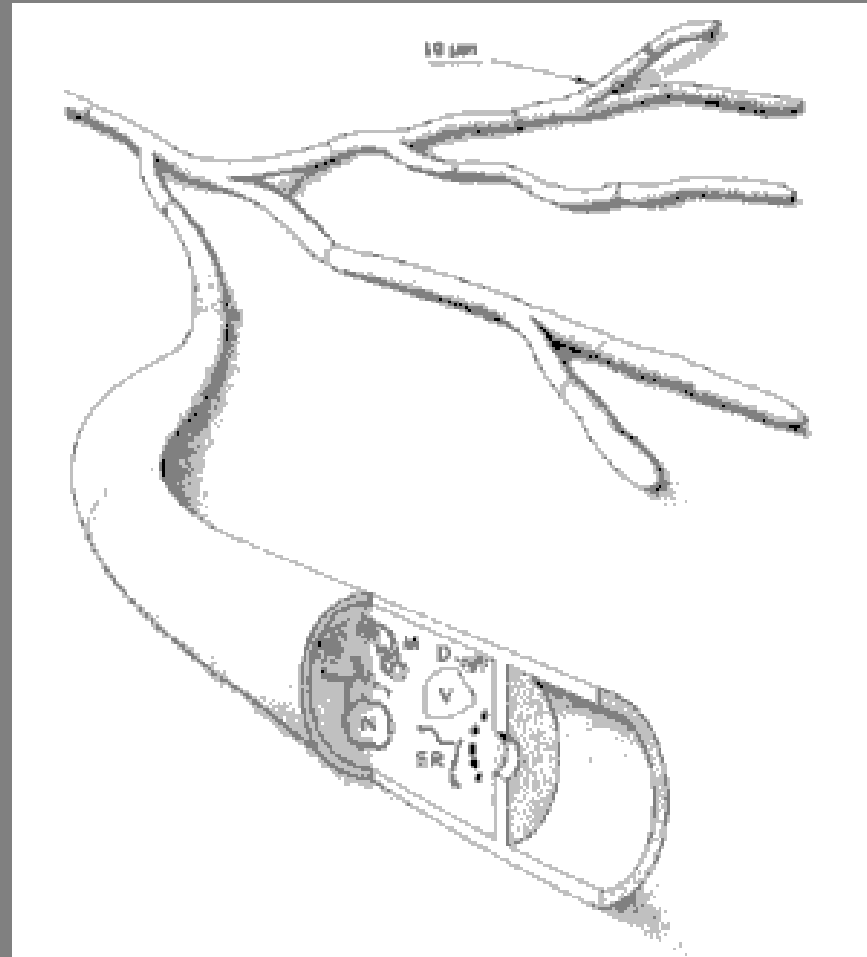
Diversity of fungi, but all have ideal structure for plant infection:

- hypha/cord/rhizomorph/infection peg/appressorium
- Sexual vs. asexual reproduction: can do both
- Do not photosynthesize
- Chitin in cell wall
- Exogenous digestion
- Indefinite growth
- Phenotypic plasticity and pleomorphisms

Fungi do not photosynthesize

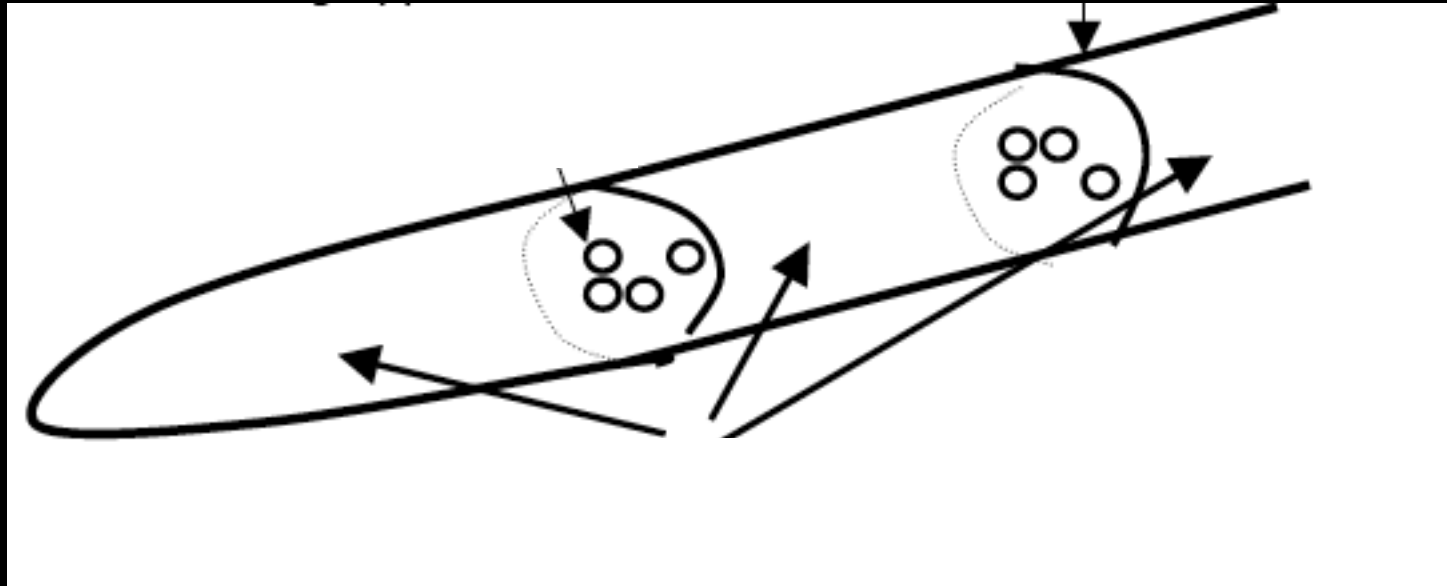
- Biotrophic: mycorrhizae, rusts
- Endophytes: clavicipetaceae,
- Necrotrophic; most pathogens
- Saprobies: primary (involved in litter decomposition)

Fungal hyphae and mycelium



Pores

Septa



CELLS

Thanks to their web-like indefinite growth in soil and plant substrates and their way of digesting nutrients fungi play a critical role in recycling nutrients which can then be reutilized by plants



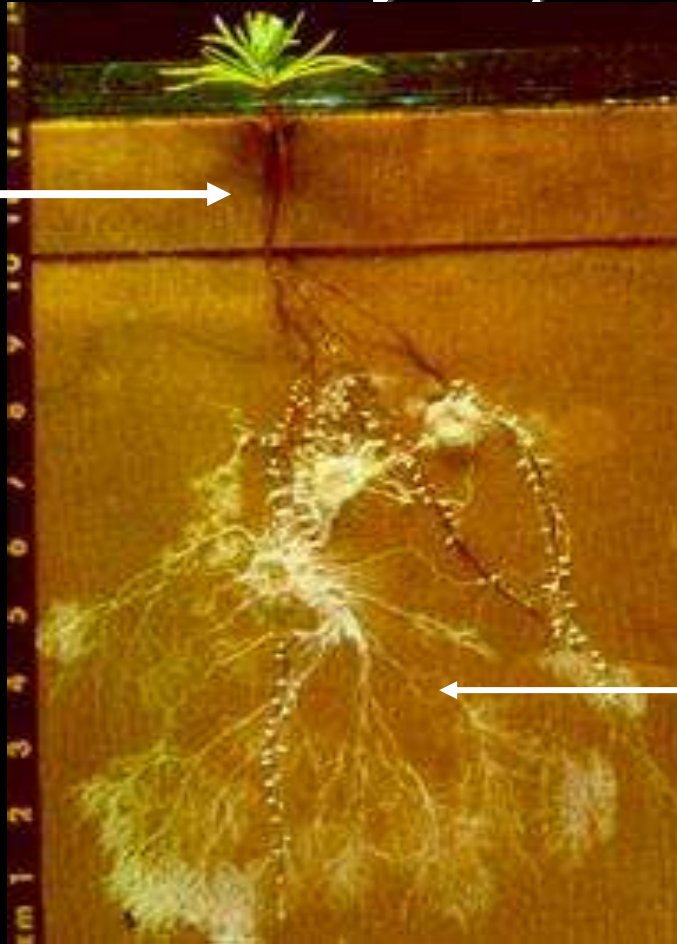
- Fungi like this one will actually decay the woody matter and physically free space for new generations of trees, besides recycling the nutrients



The weblike structure of fungi, usually immersed in the soil or in plant matter is involved in an essential symbiosis that greatly enhances the ability of plants to grow

•plant

Carbon sequestration?



•fungus

The visible part of root tips of most trees is actually a mantle of fungal hyphae fused with the plant tissue



What is the deal of this mutualism?

- Fungus absorbs nutrients for plants
- Plant gives fungus carbohydrates it produces via photosynthesis
- Side effects: protection of plant against pathogens and drought
- Diseased plants: mycorrhizal hyphal network in soil highly reduced

There are no differentiated structures in fungi, but hyphae can generate...



mycelia



stroma



rhizomorphs

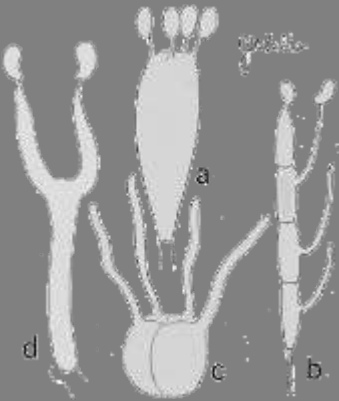


Left: mycelia (felt, fans)
Bottom: hyphae



There are no differentiated structures in fungi, but hyphae can generate...

Asco- or basidio-spores

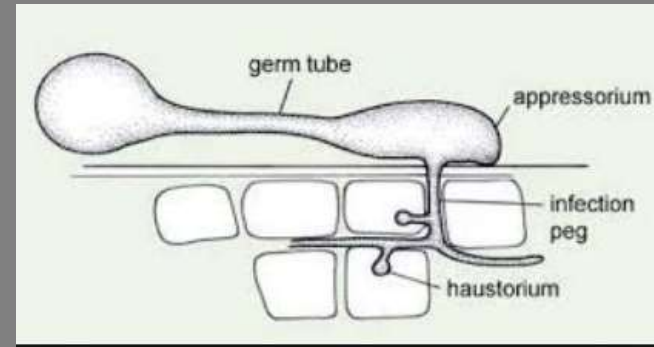


Sexually generated spores (meiospores)

Conidia



Asexually or clonally generated spores (mitospores)



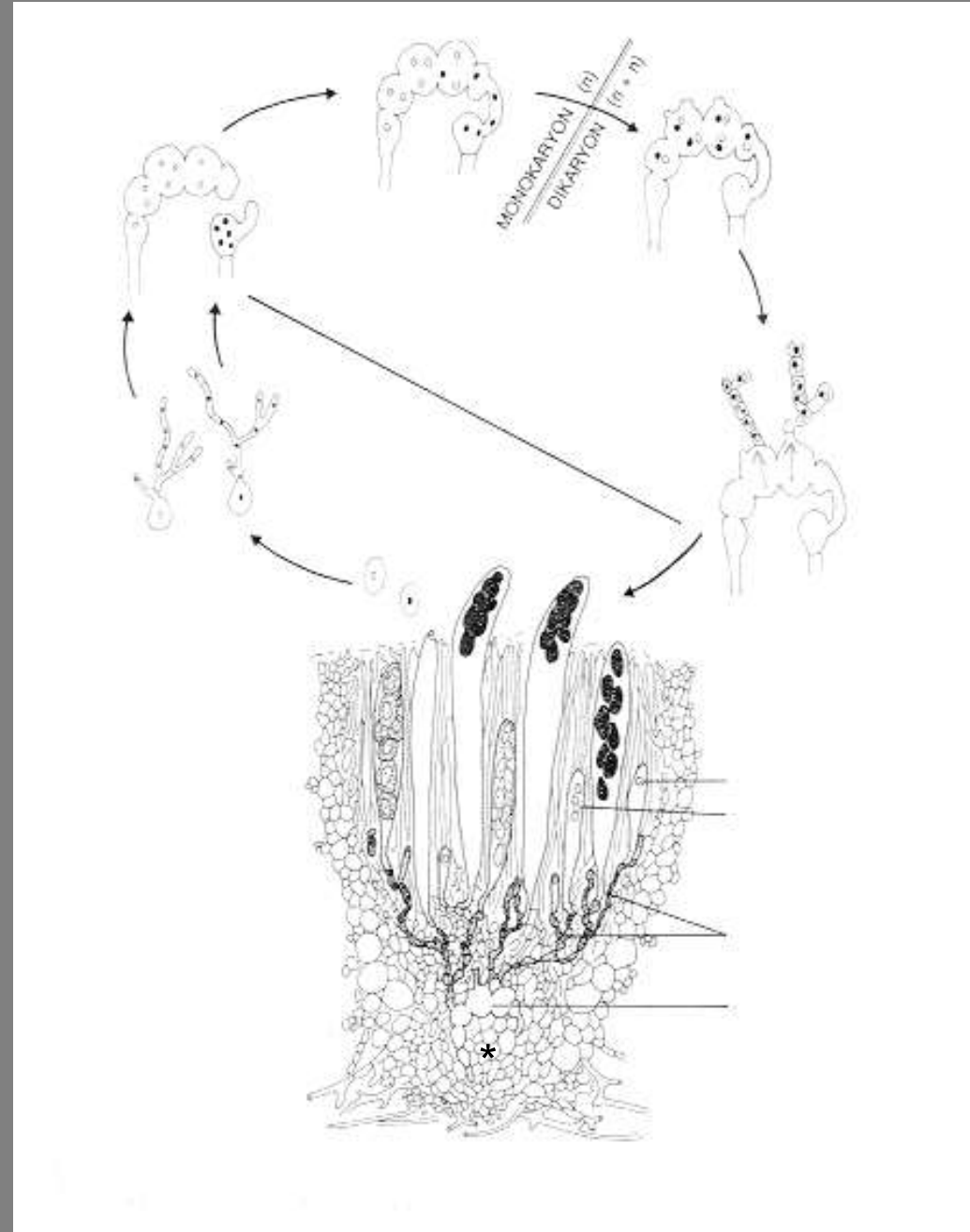
Infection structures

Ascomycetes (predominance of n in life cycle)



Ascus

Sexual spores (ascospores)
are generated within “sacks”
called asci

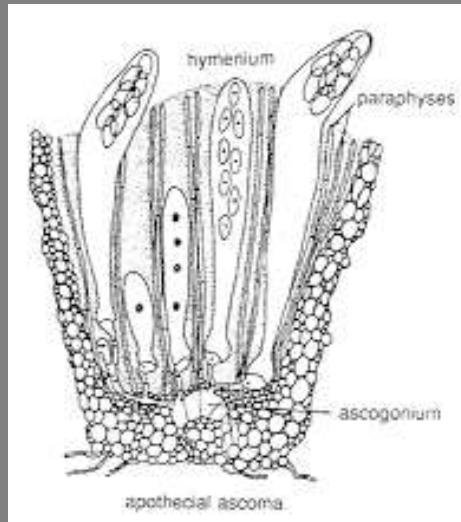


Ascomycota

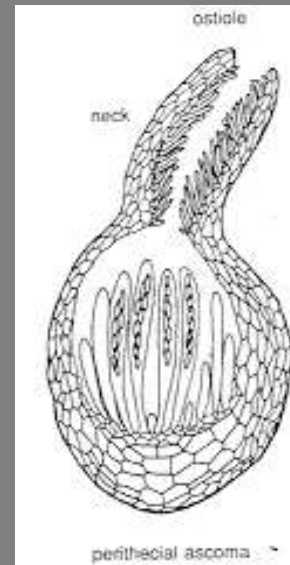


Ascomata

apothecium



perithecium

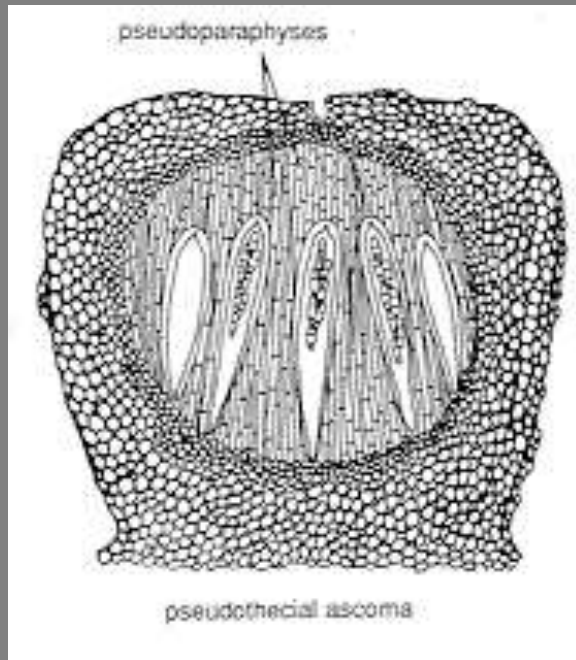


cleistothecium



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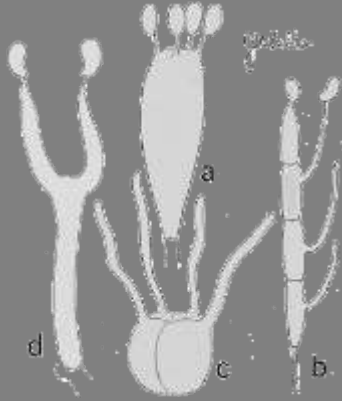


pseudothecium

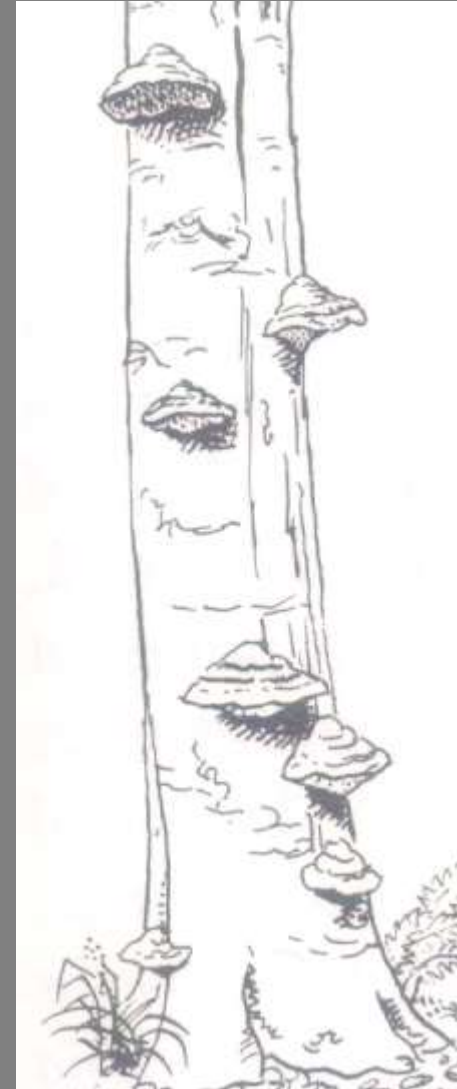
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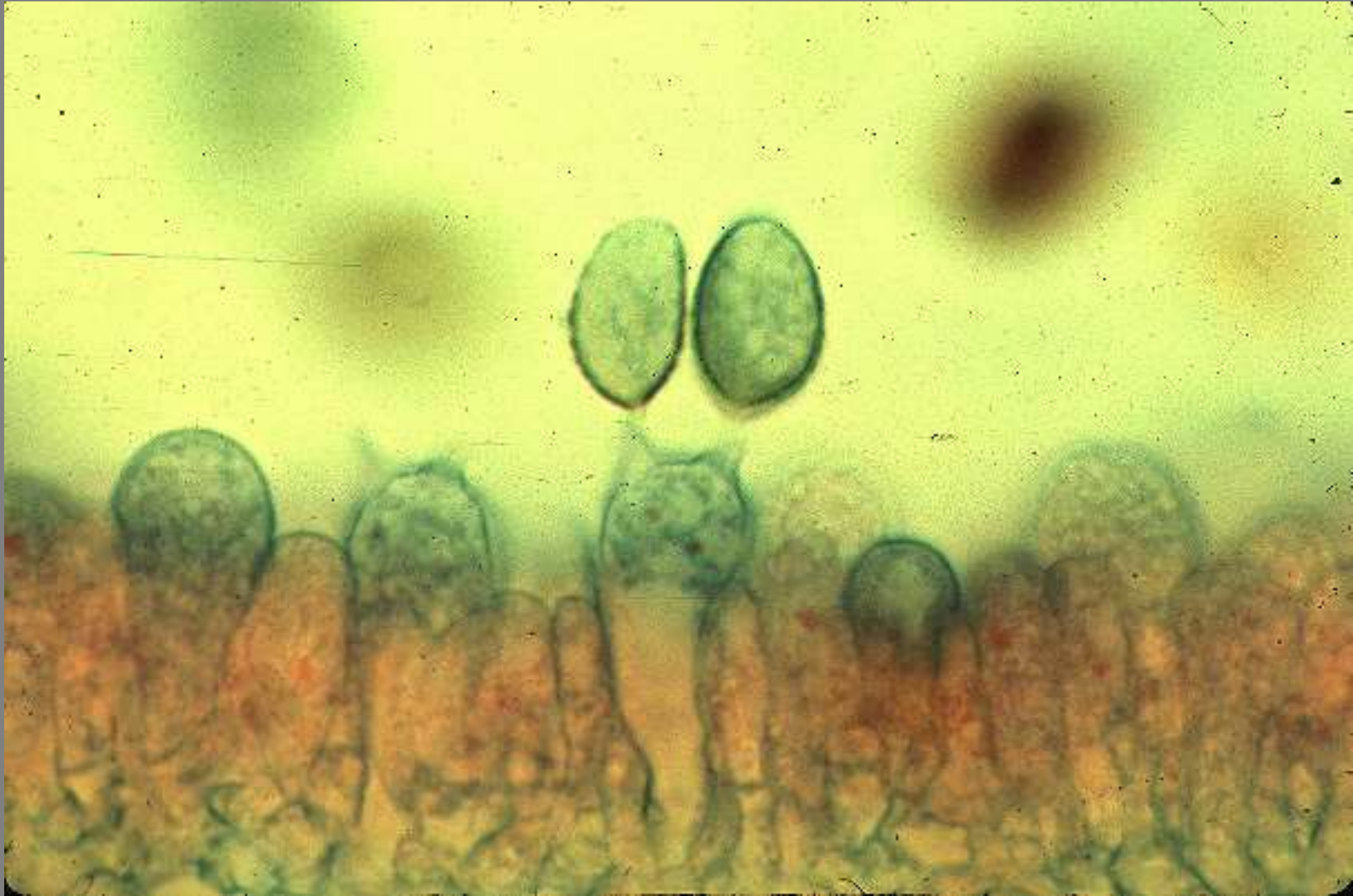
Basidiomycetes (Div. Basidiomycota) $n+n$ or rarely $2n$ is predominant in life cycle

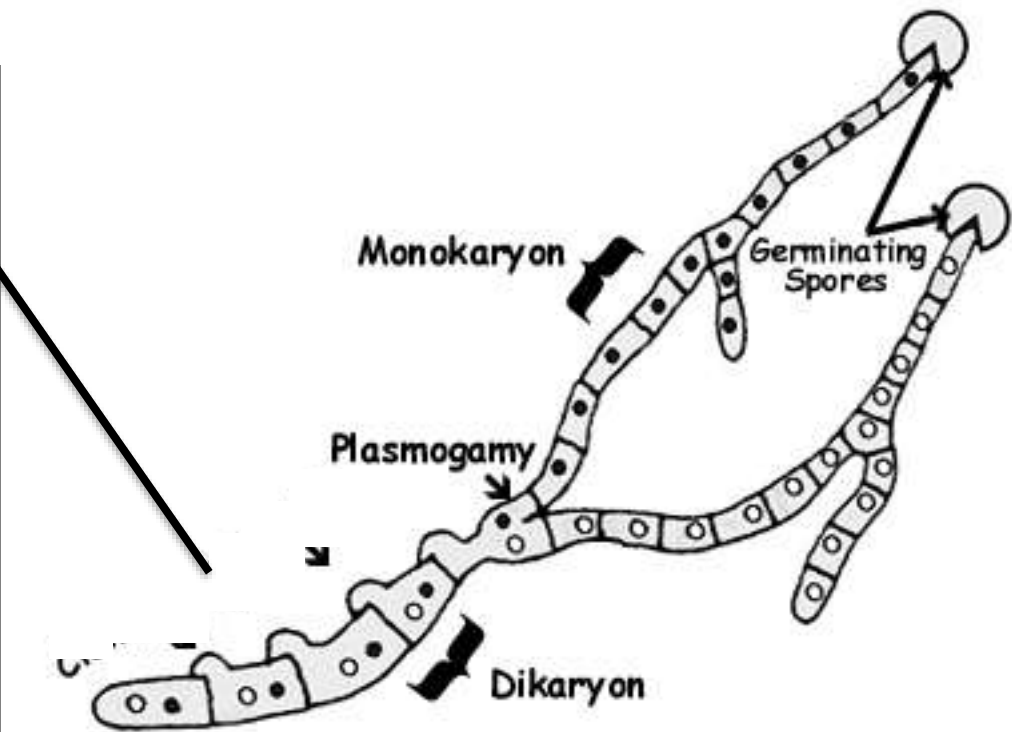
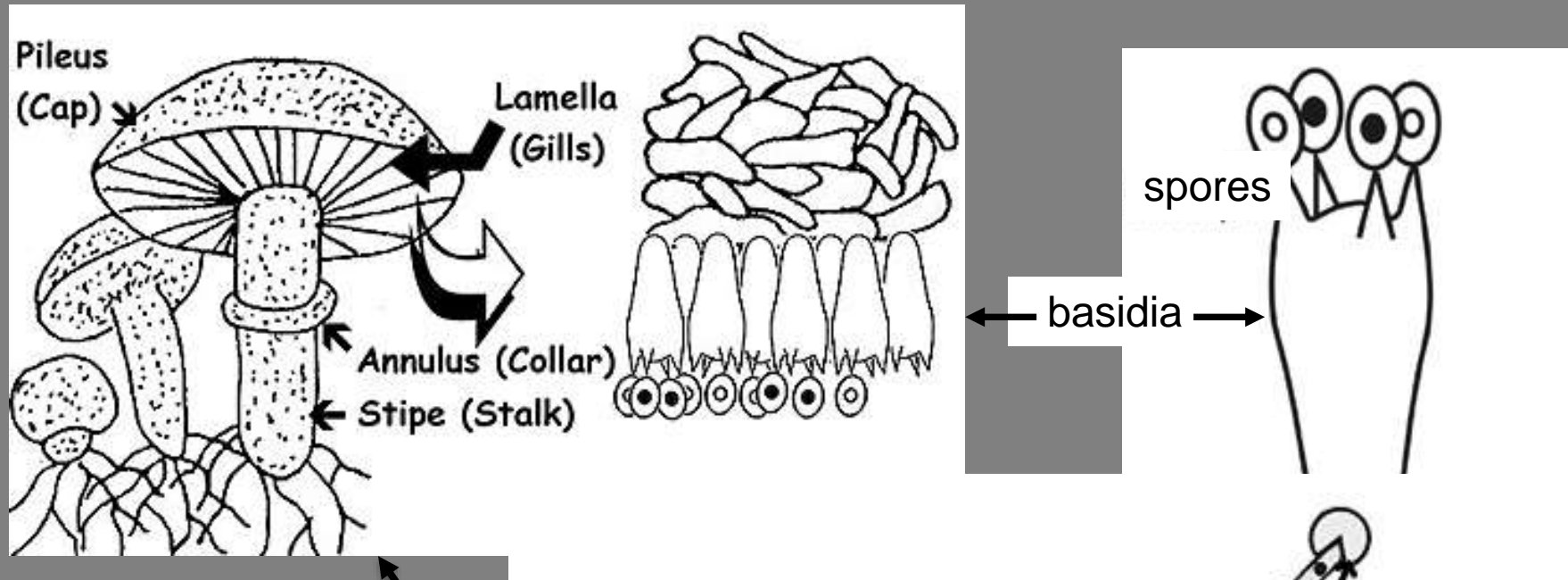


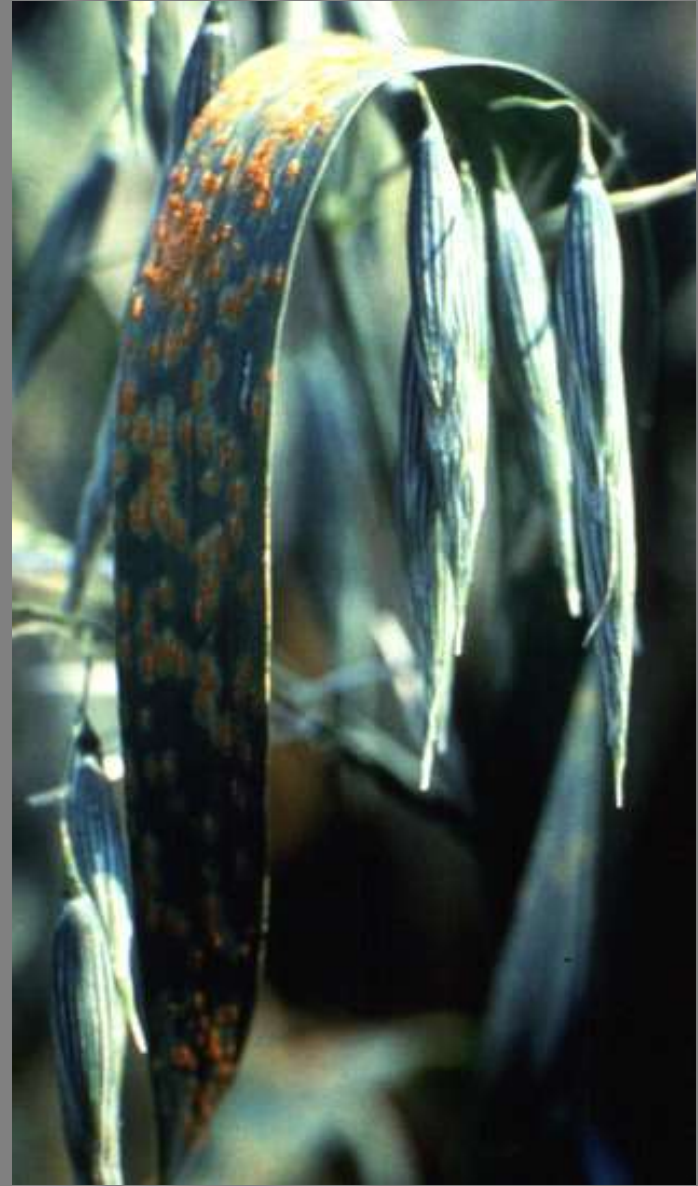
Sexual spores, basidiospores, are carried naked on surface of “clubs” called basidia



Basidiomycota



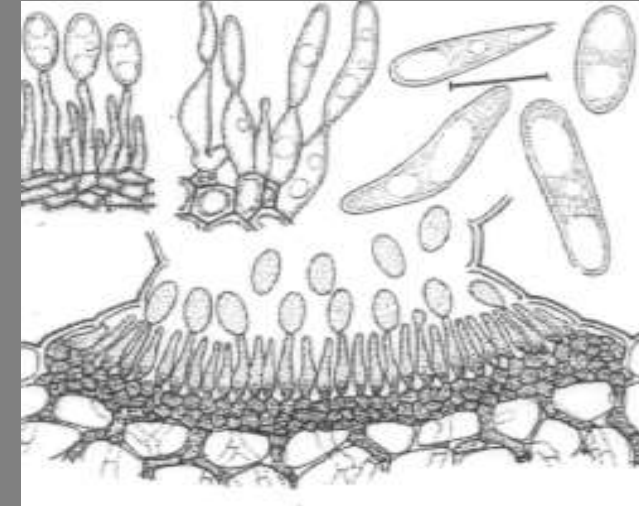
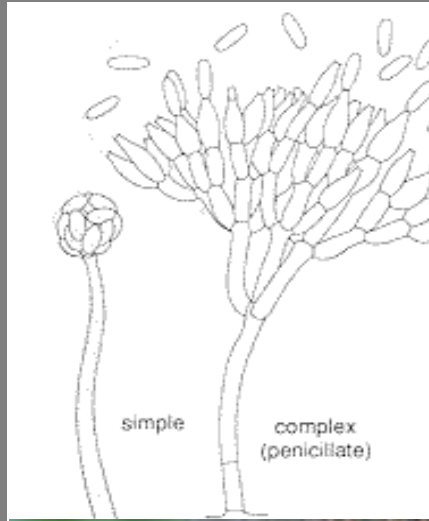






anamorphic fungi, no sexual stage

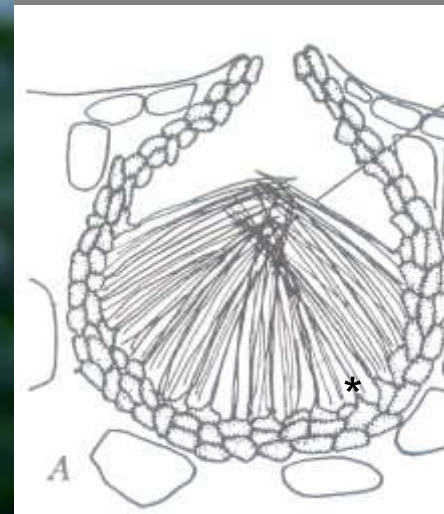
coidiophores



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acervulum



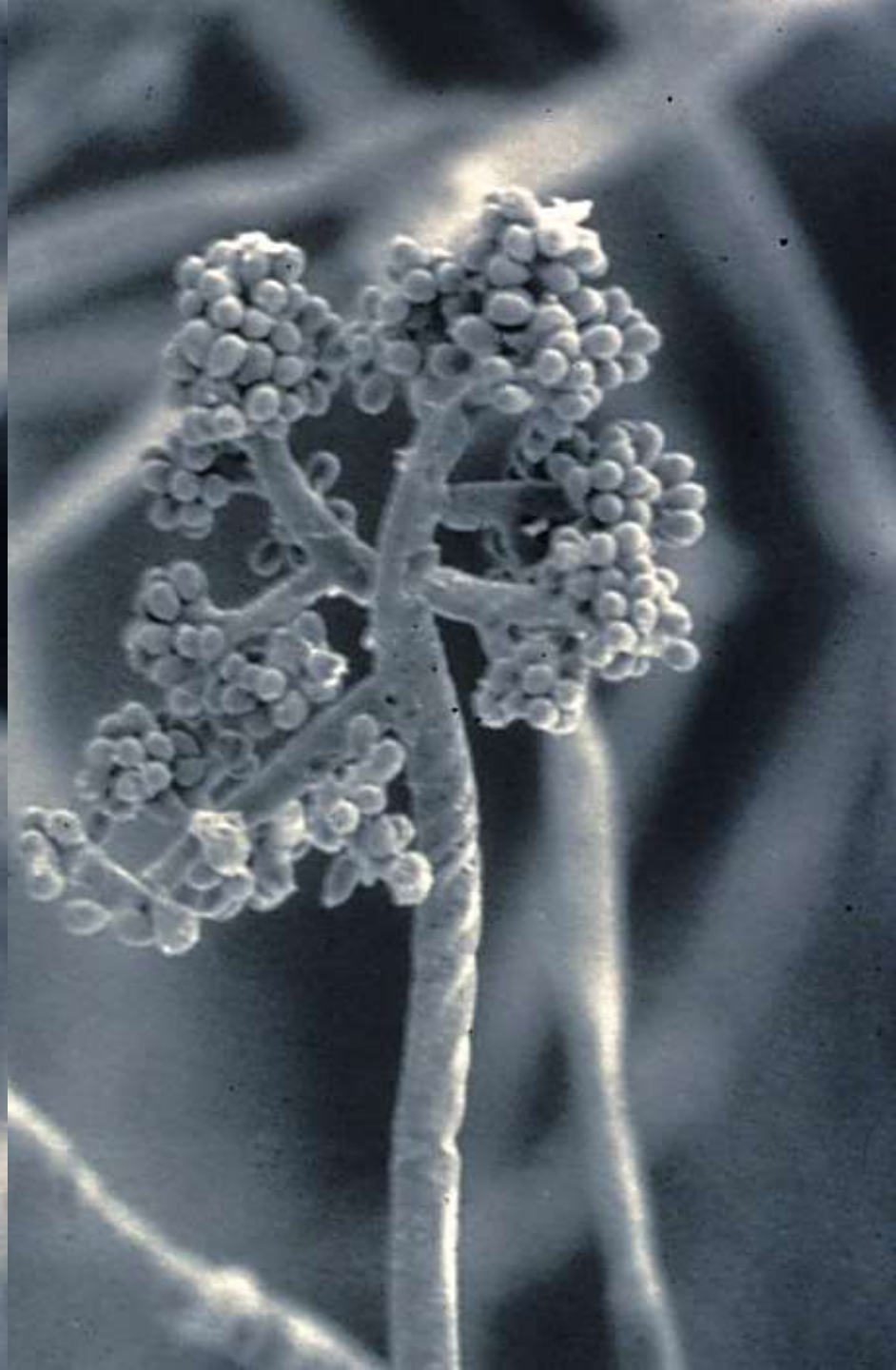
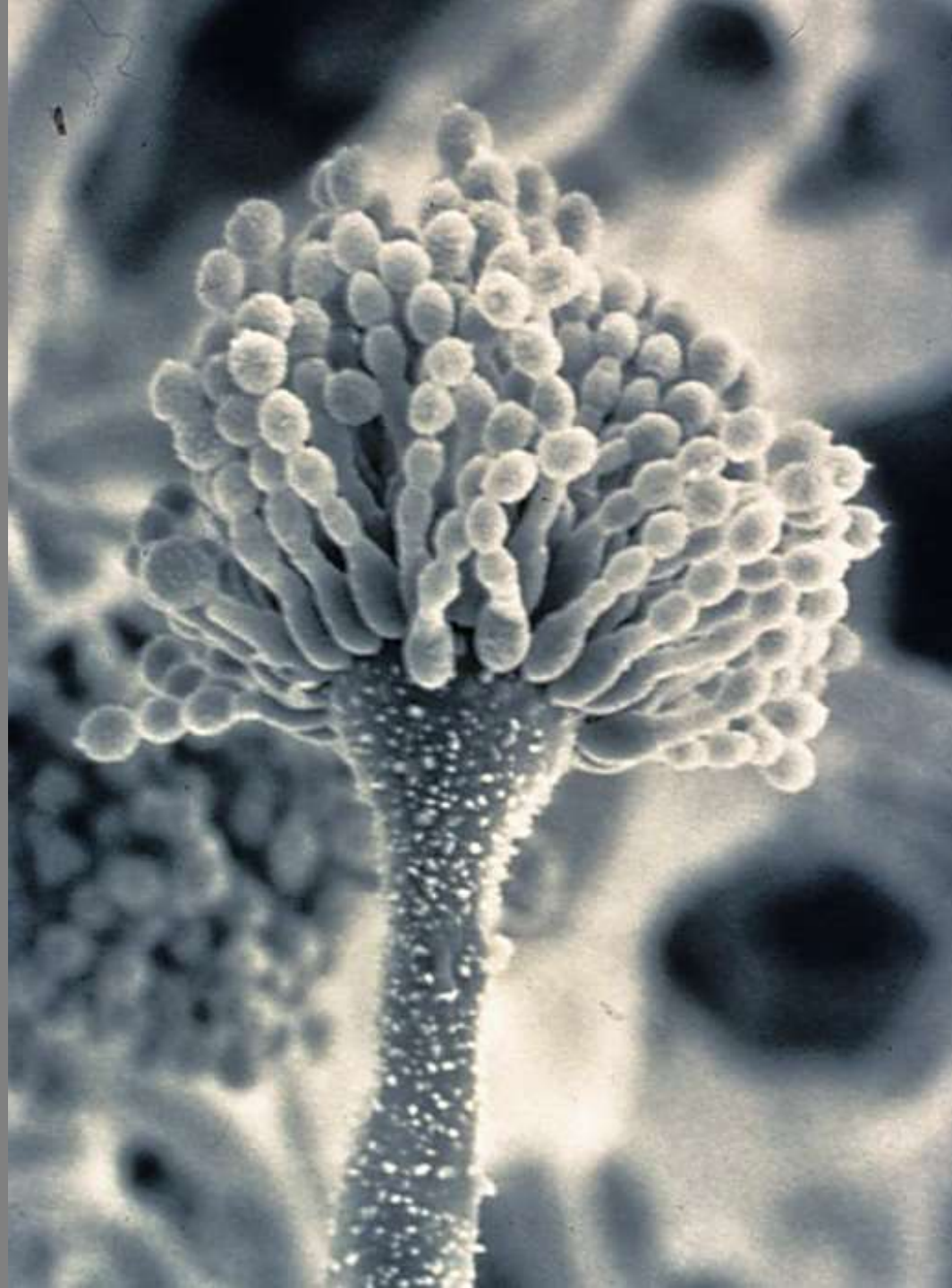
Cryphonectria sp.



pycnidium



Marssonina betulae



Fitness of Fungi as Plant Pathogens

1- HYPHAE CAN DIFFERENTIATE INTO MANY STRUCTURES

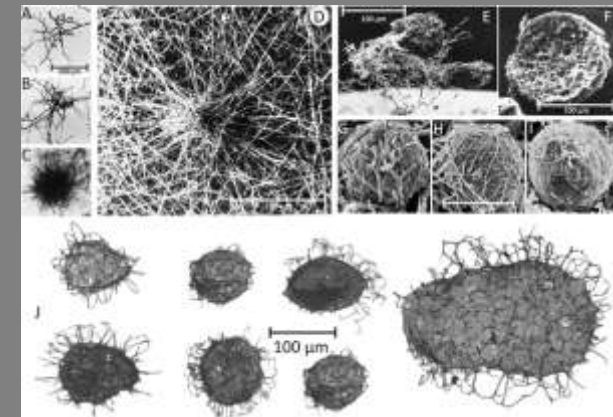
2-HYPHAE CAN HAVE INDEFINITE GROWTH (LIMITED BY OTHER FUNGI, BY AVAILABILITY OF RESOURCES, AND BY ENVIRONMENT)

3-SEXUALLY REPRODUCING FUNGI CAN ADAPT FAST

4-HOWEVER THANKS TO CLONAL REPRODUCTION THROUGH CONIDIA, AN AGGRESSIVE STRAIN CAN BE REPLICATED IN TRILLIONS OF COPIES. IF SUPER SUCCESSFUL MAYBE SEX WILL BE LOST. Given huge reproductive potential clonal reproduction can generate significant variability

5- SOME SPORES CAN BE SURVIVAL STRUCTURES WHEN CONDITIONS ARE UNFAVORABLE

SCLEROTIA WITH MELANIZED OUTER CELL WALL



Fitness of Fungi as Plant Pathogens

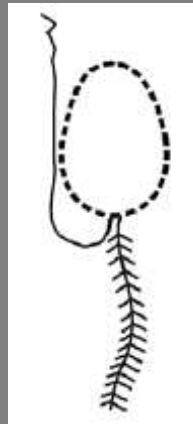
- Fungi can switch from one life-style to another
 - From Endophytic to Pathogenic
 - From Pathogenic to Saprotrroph
 - From Saprotrroph to either Pathogenic or Endophytic

Oomycetes (Div. Oomycota) Kingdom: straminopila (prev. Chromista)

Important group of forest pathogens, includes the genera *Pithyum* and *Phytophthora*

Although apparently similar to the fungi, oomycetes are an example of convergence, basically the same morphology was selected because of their lifestyle similar to that of the fungi. they all have a water dependant phase, they have cellulose in the cell wall, and are mostly 2n

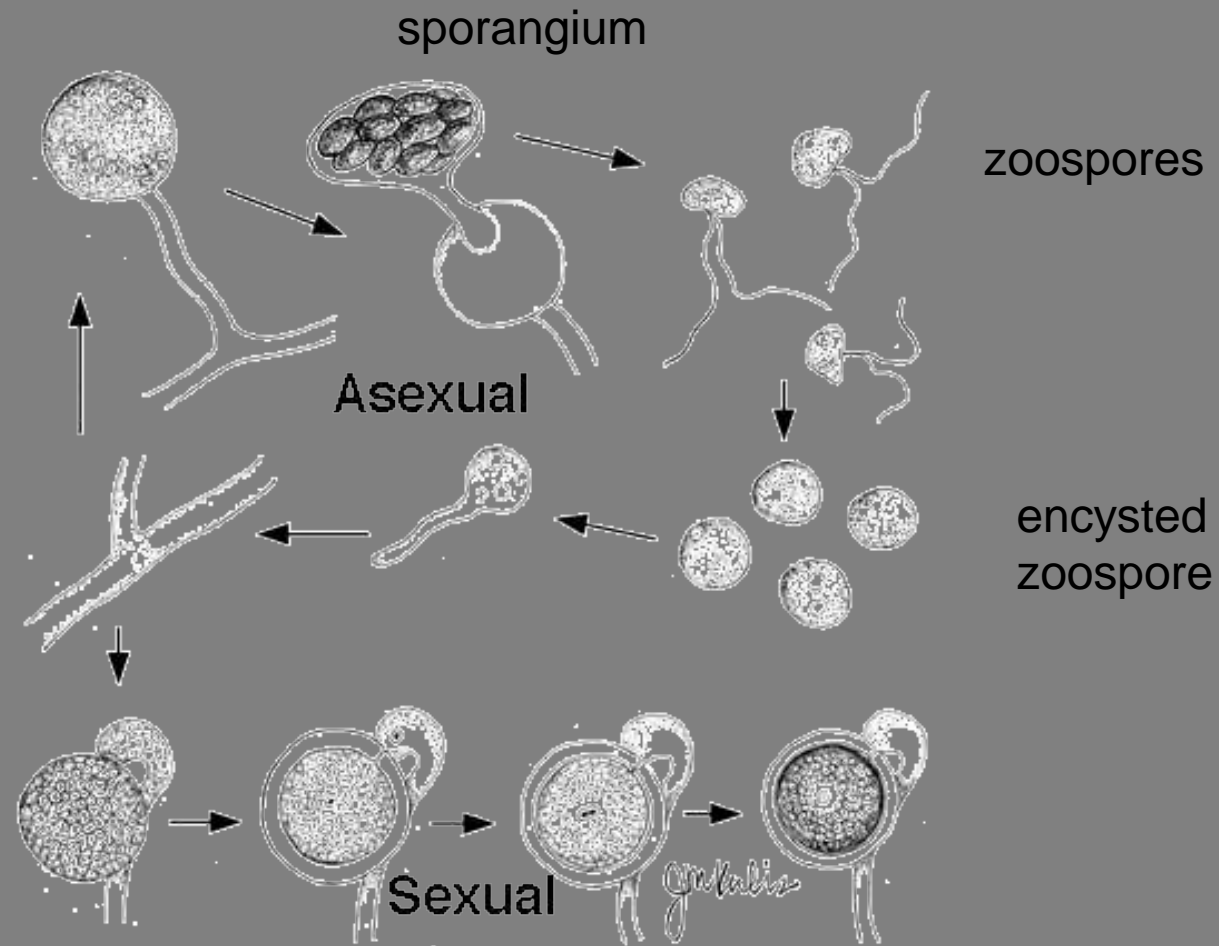
They have a motile phase



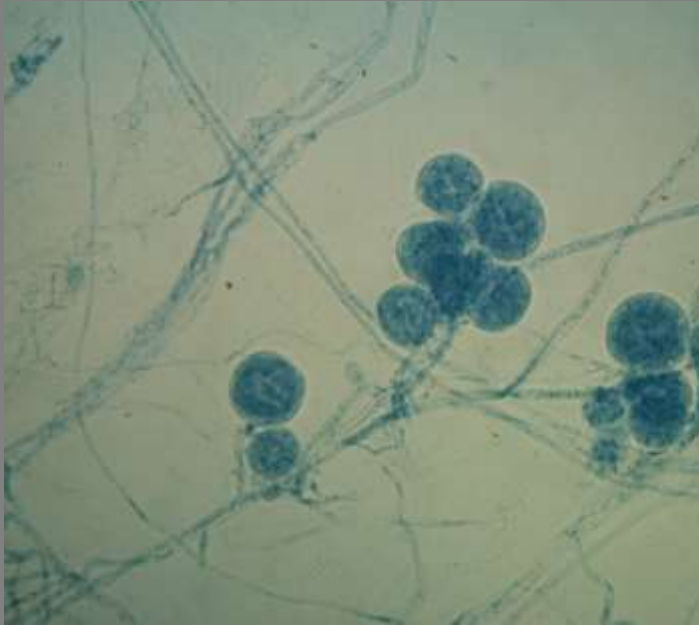
zoospore

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Oomycetes life cycle



Phytophthoras in their asexual life cycle can produce both sporangia and chlamydospores



Chlamydospores: survival structures thanks to thick cell wall. Can survive in unfavorable environments. Also float and can disperse long distance in water



Sporangia: oblong (ovoid to pyriform). Can germinate directly and infect plant or the tip will dissolve and release zoospores