Mushrooms!

Catherine Creech (she/her)

Boletus edulis

Craterellus tubaeformis

Cantharellus formosus

What even is a mushroom?

Mycena epipterygia

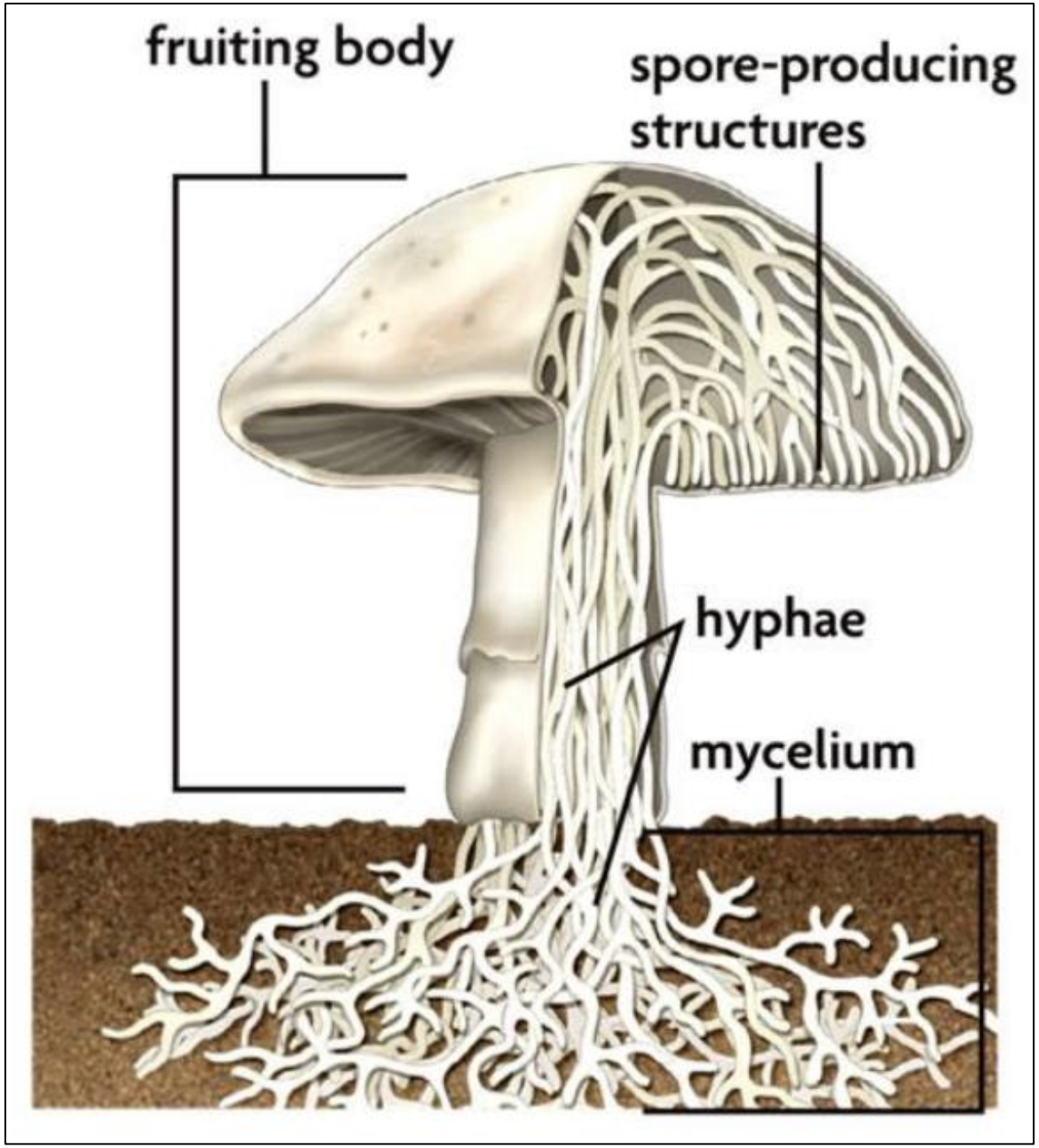


Image: Kyle Martens, Nebraska Forest Service

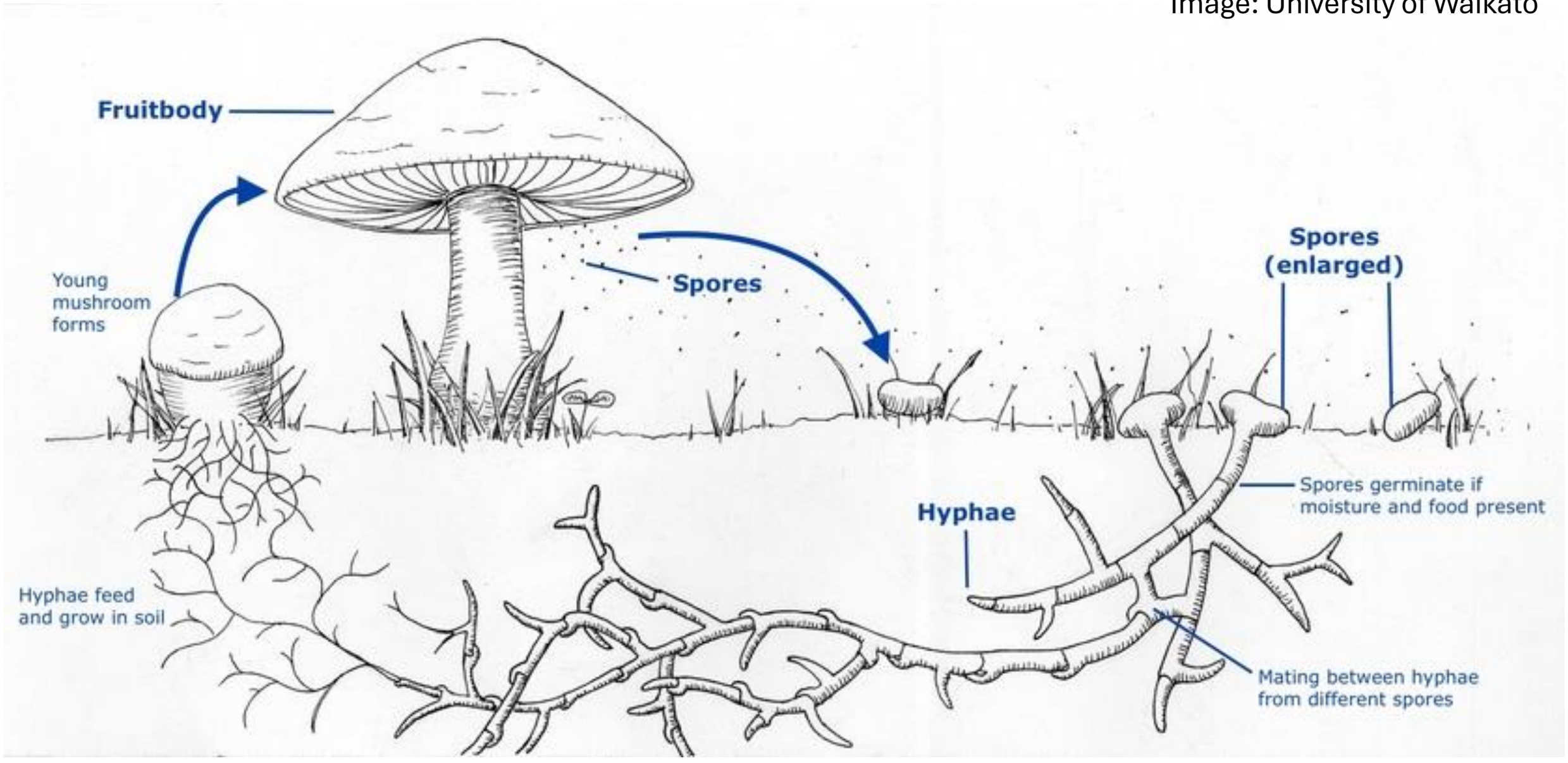
Fungi Characteristics:

1. Eukaryotic
2. Filamentous (mostly)
3. Heterotrophic
4. Cell walls of chitin
5. Intranuclear division
6. Store extra carbs as glycogen & lipids
7. UGA is used for tryptophan

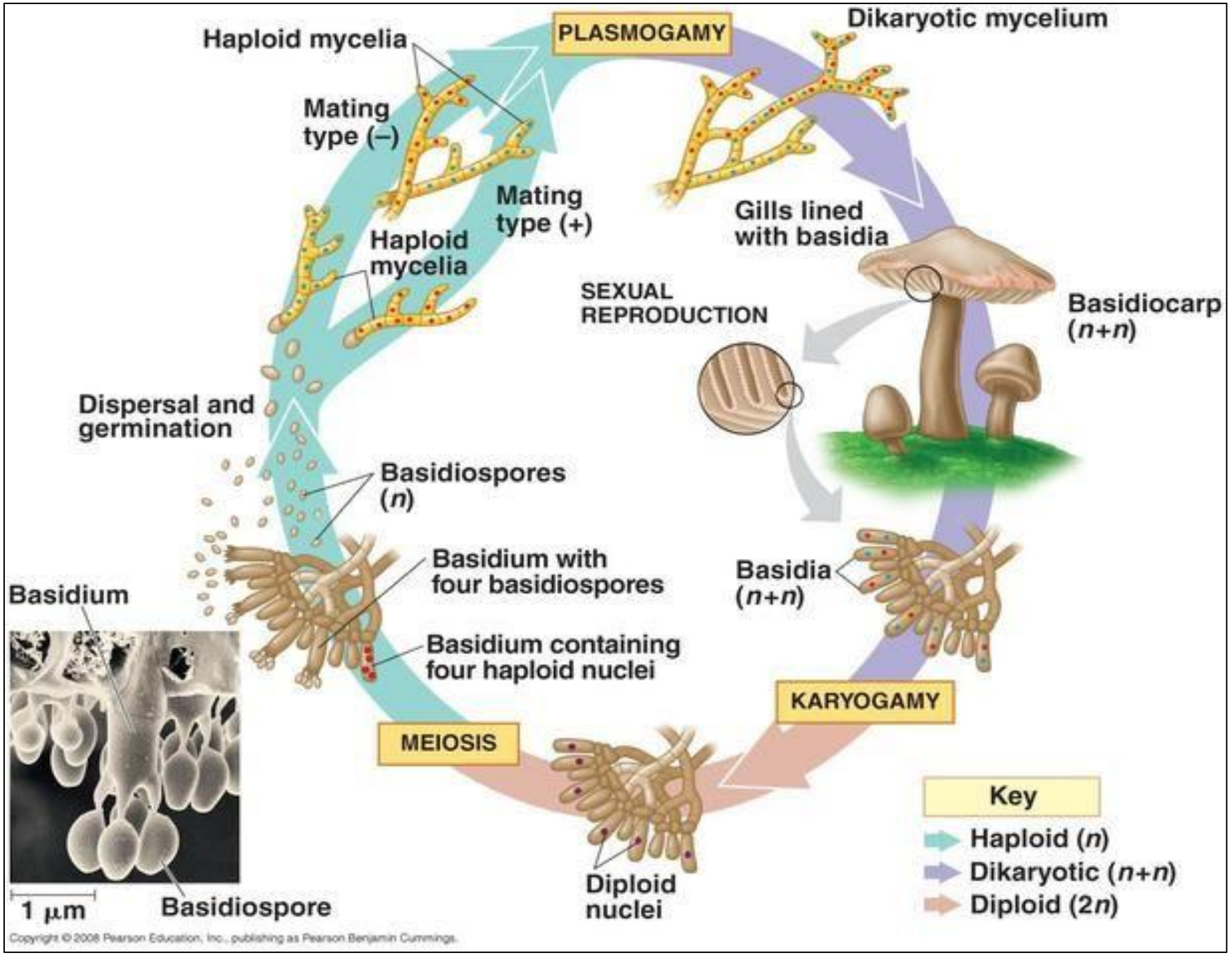
Laetiporus conifericola

The Mushroom Lifecycle

Image: University of Waikato



Schizophyllum commune
23,328 distinct sexes



Fungal Classification

- An estimated 1.5-5 million different species exist
- ~120,000 species have been described (as of 2018) … only 5%!
- ~20,000 of those are mushroom forming

Amanita smithiana

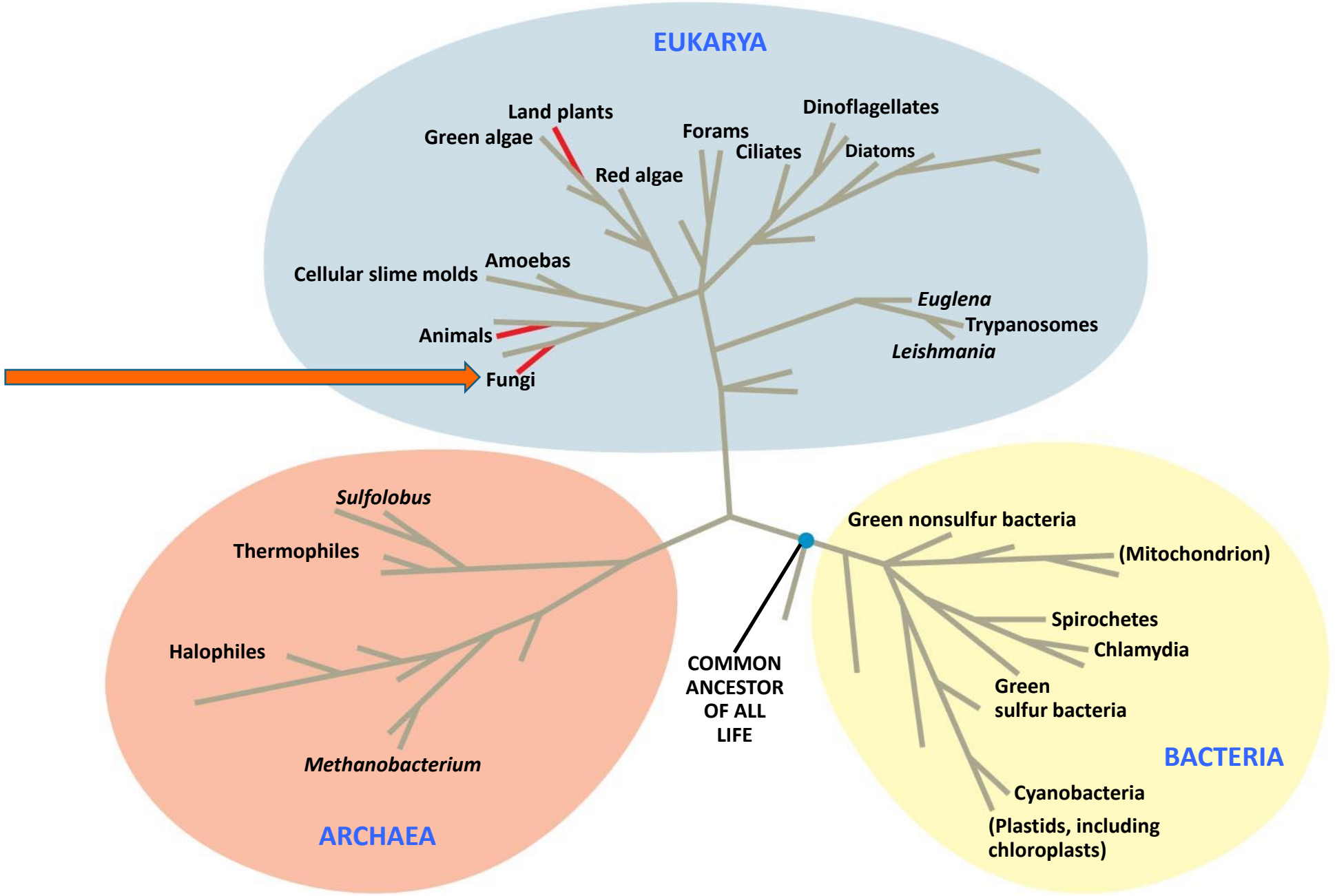
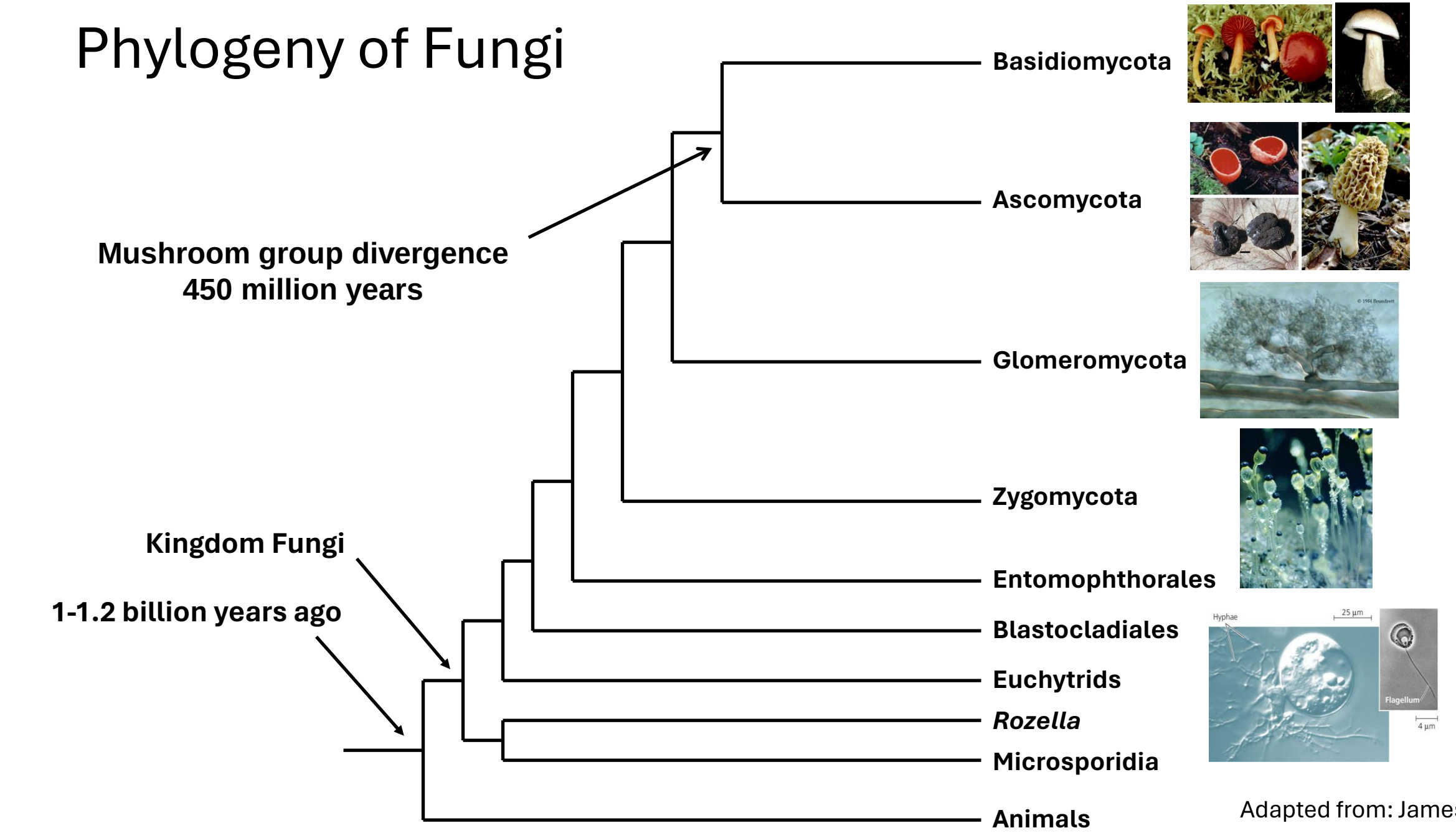


Image: Dennis Desjardin, SFSU

Phylogeny of Fungi



Adapted from: James et al.
Nature 443: 818-822. 2006

Fungal Ecology: Saprotrophs or Biotrophs

Pleurotus ostreatus

Russula cyanoxantha

Saprotrophic Fungi

Decomposers and recyclers: break down the complex carbohydrates, proteins, lipids, alcohols, and lignin

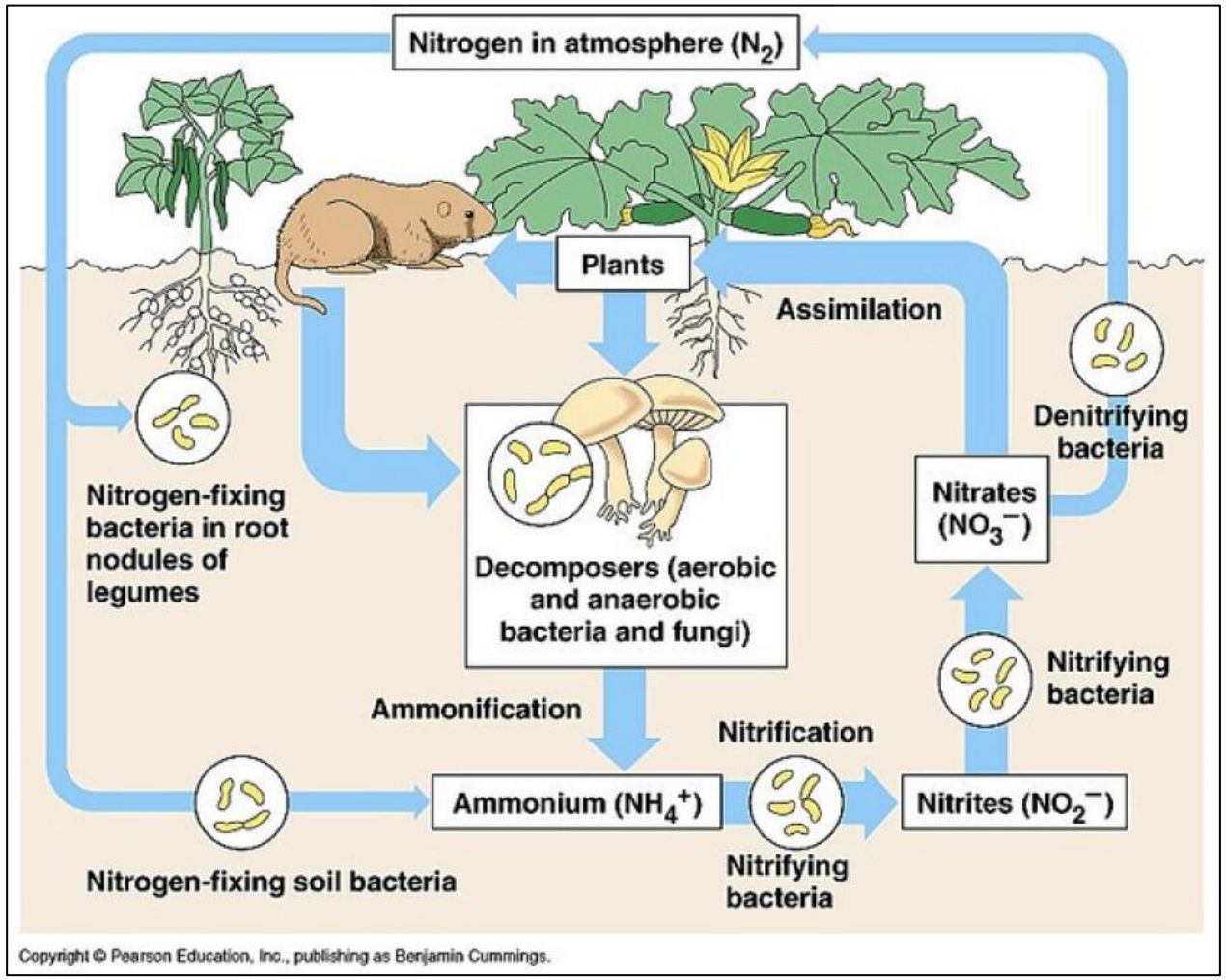
Piviotal role in nutrient (C, N, P) and water cycle

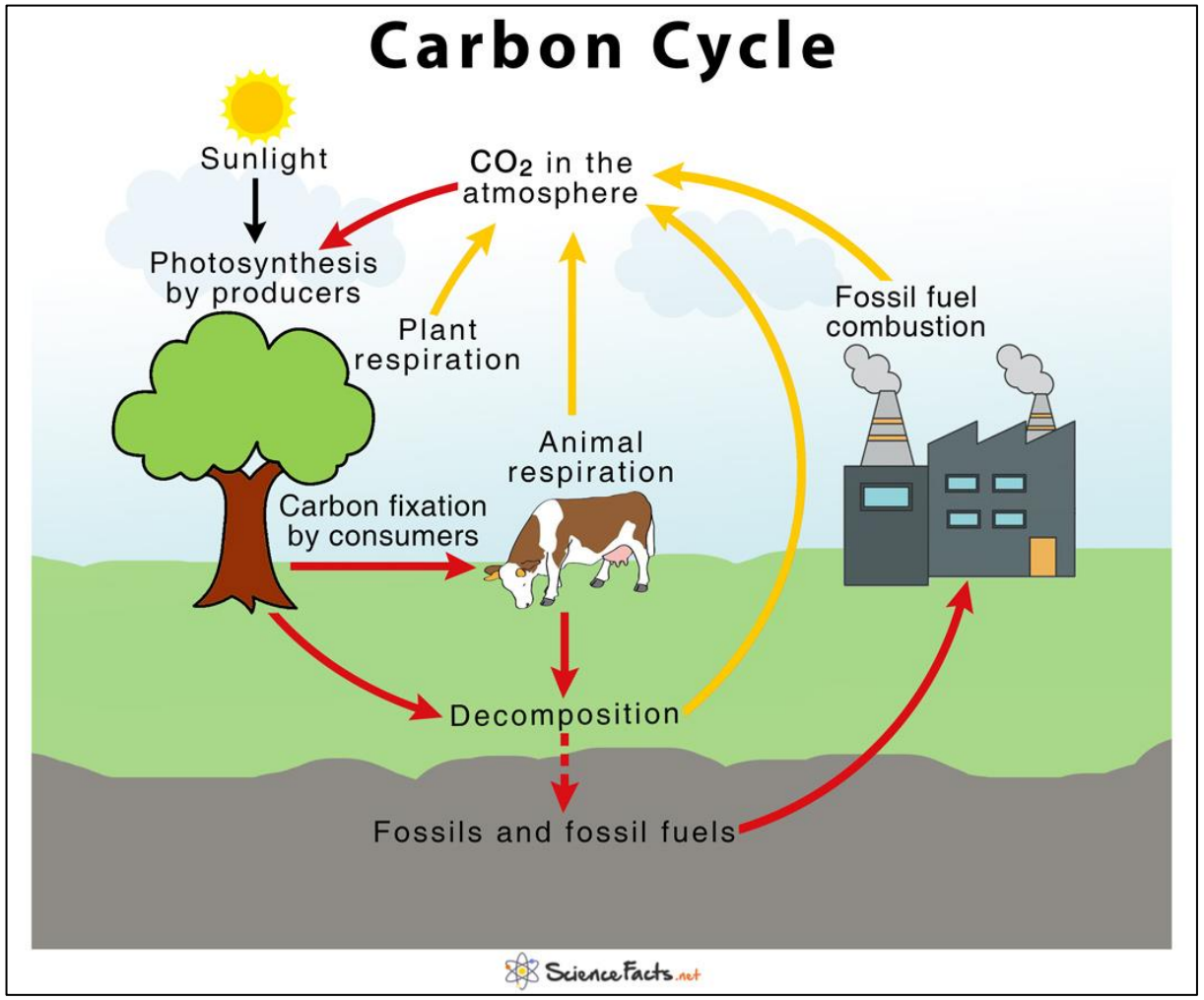
Release 85 billion tons of carbon per year

~100,000 species of "molds"

Penicillium sp. on an orange
Image: Wikicommons

Nutrient Cycling





Saprotrophic Fungi

How diverse are they?

5 gram quantities of leaf litter from a Costa Rican forest yielded on average 100 different species of saprotrophic fungi

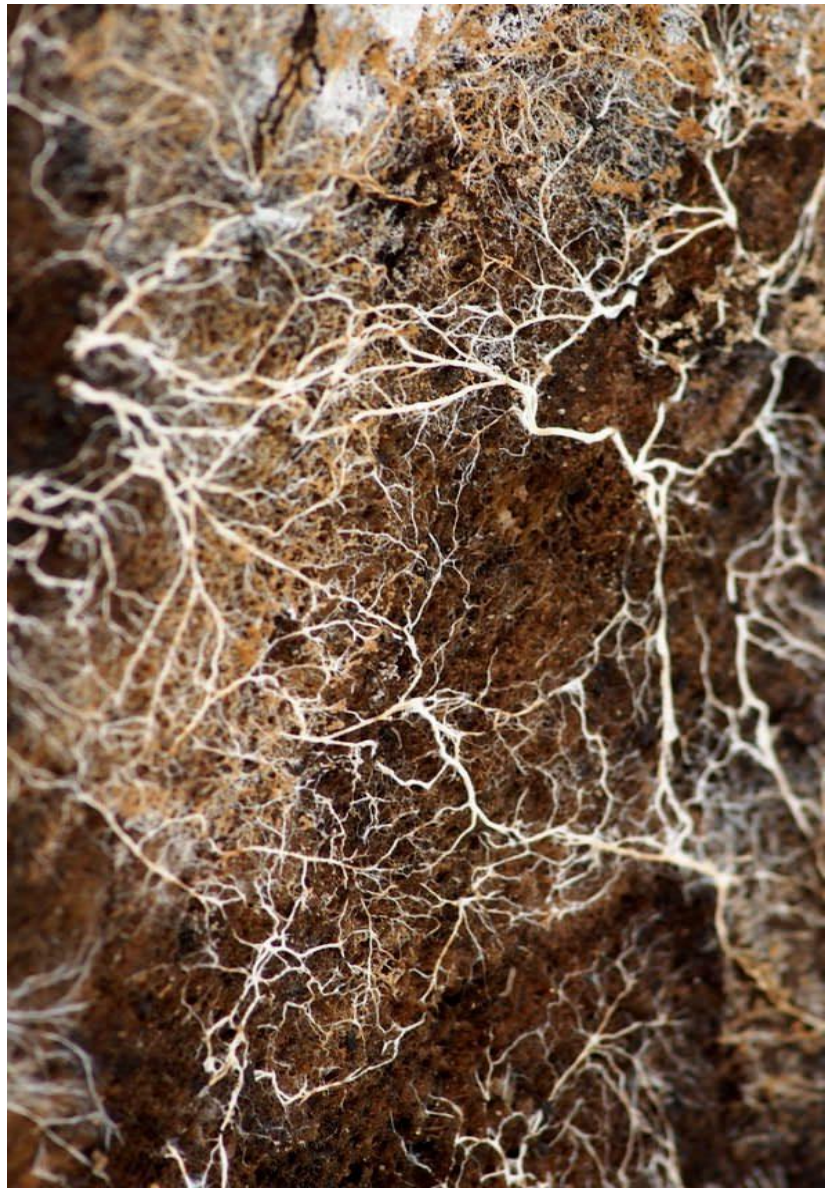
Over 2,000 species of saprotrophic mushrooms reported from California alone

Various fungi in wood chips
Image: James Young, Permaculture Research Institute

Saprotrophic Fungi

Dense mycelium like this may harbor hundreds of species of saprotrophic fungi

They inhibit erosion, retain beneficial nutrients, and feed arthropods



Mycelium on leaf litter
Image: Mogu.Bio

Saprotrophic Fungi

Fungi can store Ca as calcium oxalate crystals, then solubilize the crystals when needed for growth and development

Crystals protect hyphae from predation and can convert to oxalic acid to break down rock particles and aid in soil genesis

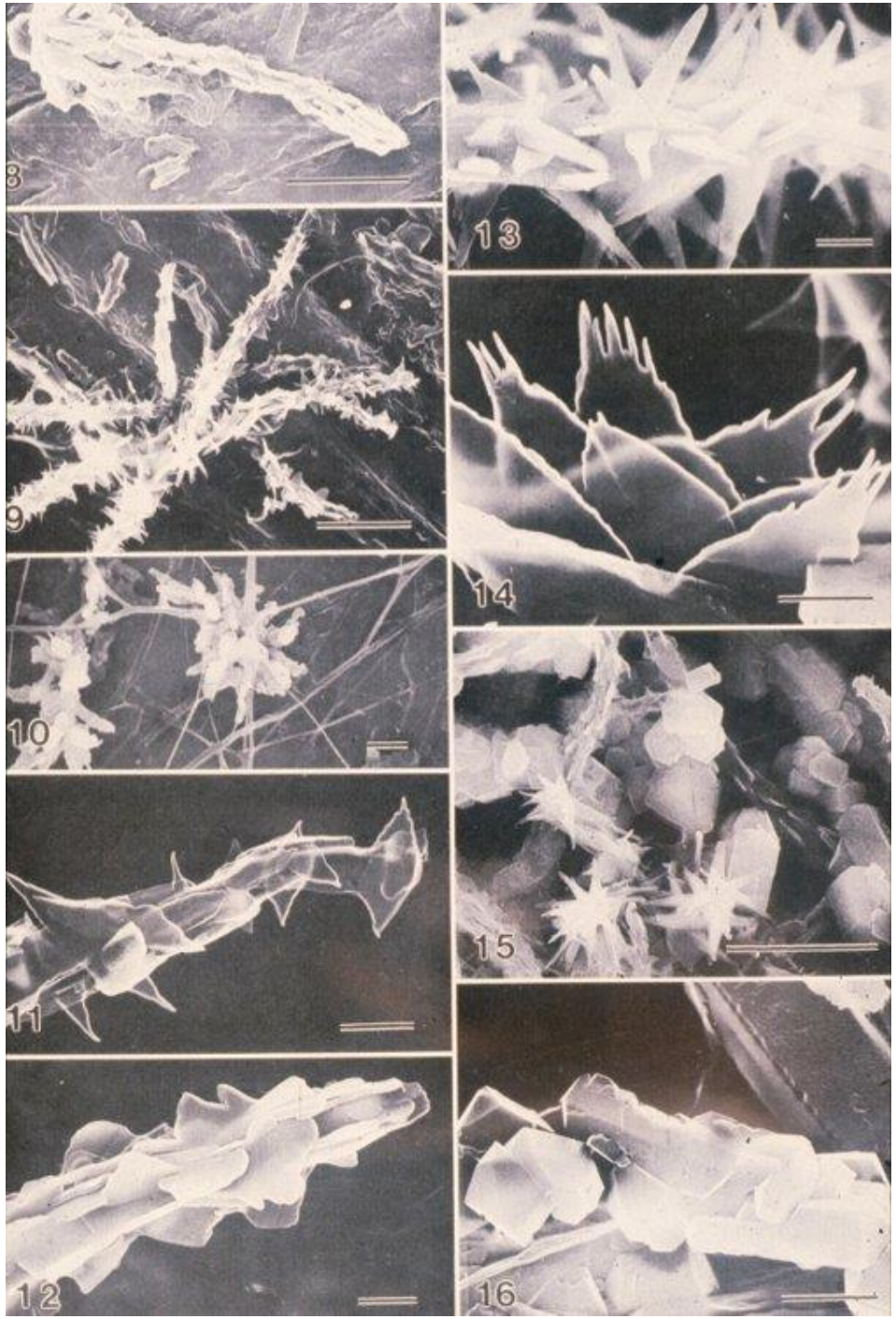


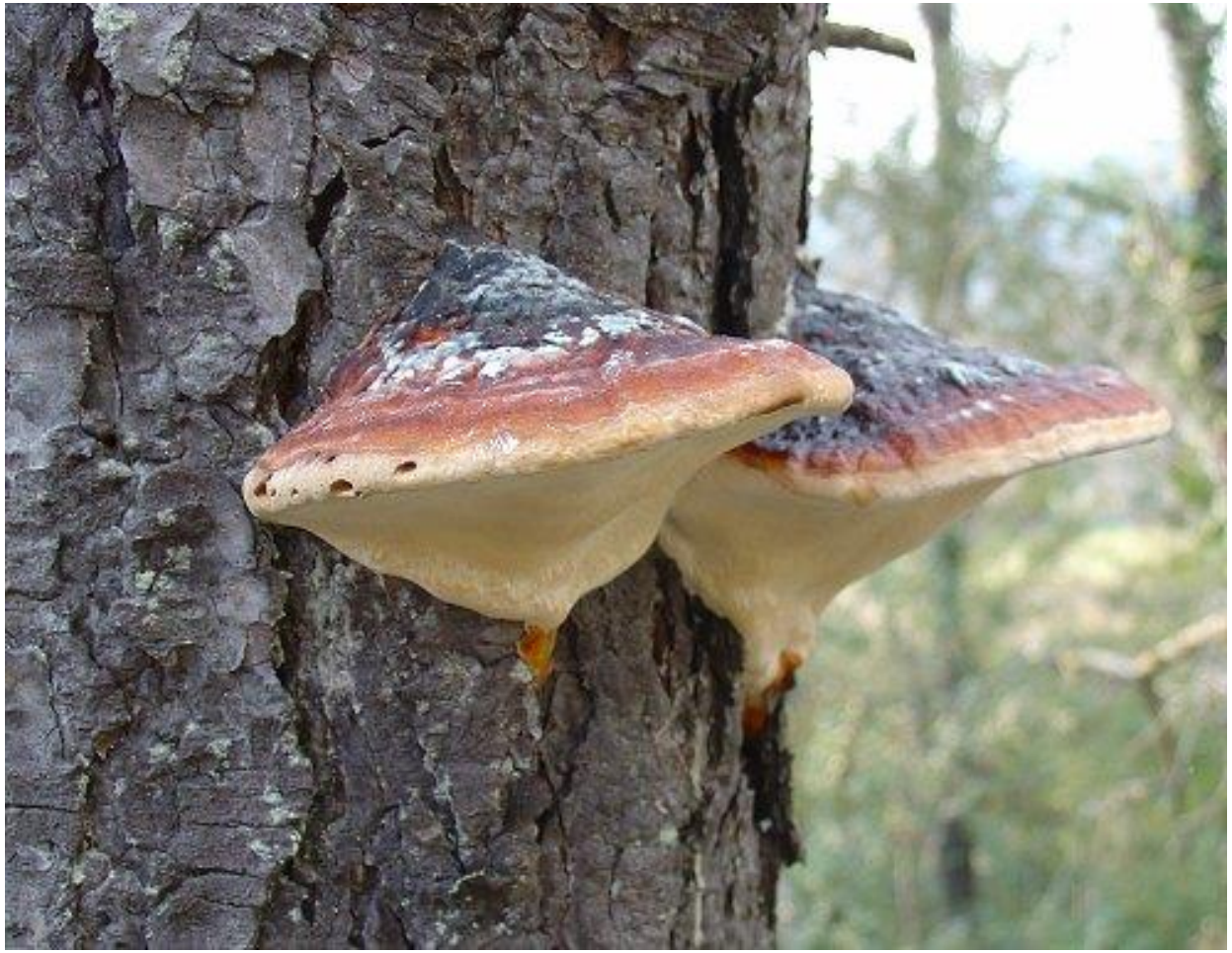
Image: Horner et al.1995

Saprotrophic Fungi

Endophytes live in tissues and transition to decomposers as leaves fall or tissue breaks off, which gives the fungi a competitive edge over other decomposers

Lophodermium sp. on pine needle
Image: R.S. Byther, WSU

Saprotrophic Wood Specialists



Fomitopsis pinicola

Dacrymyces chrysospermus on conifer wood

Saprotrophic Wood Specialists

Mycena haematopus

Nidula candida

Saprotrophic Wood Specialists

Coprinopsis lagopus

Leratiomyces ceres

Saprotrophic Leaf Litter Specialists

Clitocybe albirhiza

Mycena aurantiadisca

Photos: Mike Wood

Saprotrophic Leaf Litter Specialists

Clavaria fragilis

Fuligo septica

Saprotrophic Bark Specialists

Marasmiellus candidus

Mycena purpureofusca on pine cones

Photos: Wikicommons

Saprotrophic Wood Rots

Brown-rot (cubical brown rot)

White-rot

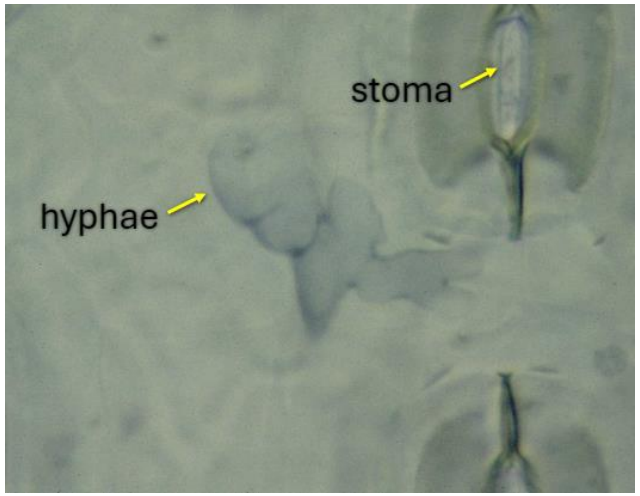
Photos: Wikicommons

Biotrophic Fungi

Pathogens

(*Pholiota squarrosa*)

Commensalisms
& endophytic fungi



(*Phyllosticta abietis*)

Image: George Carroll, UO

Mutralists

(*Boletus edulis*)

Biotrophic Fungi: Commensalisms

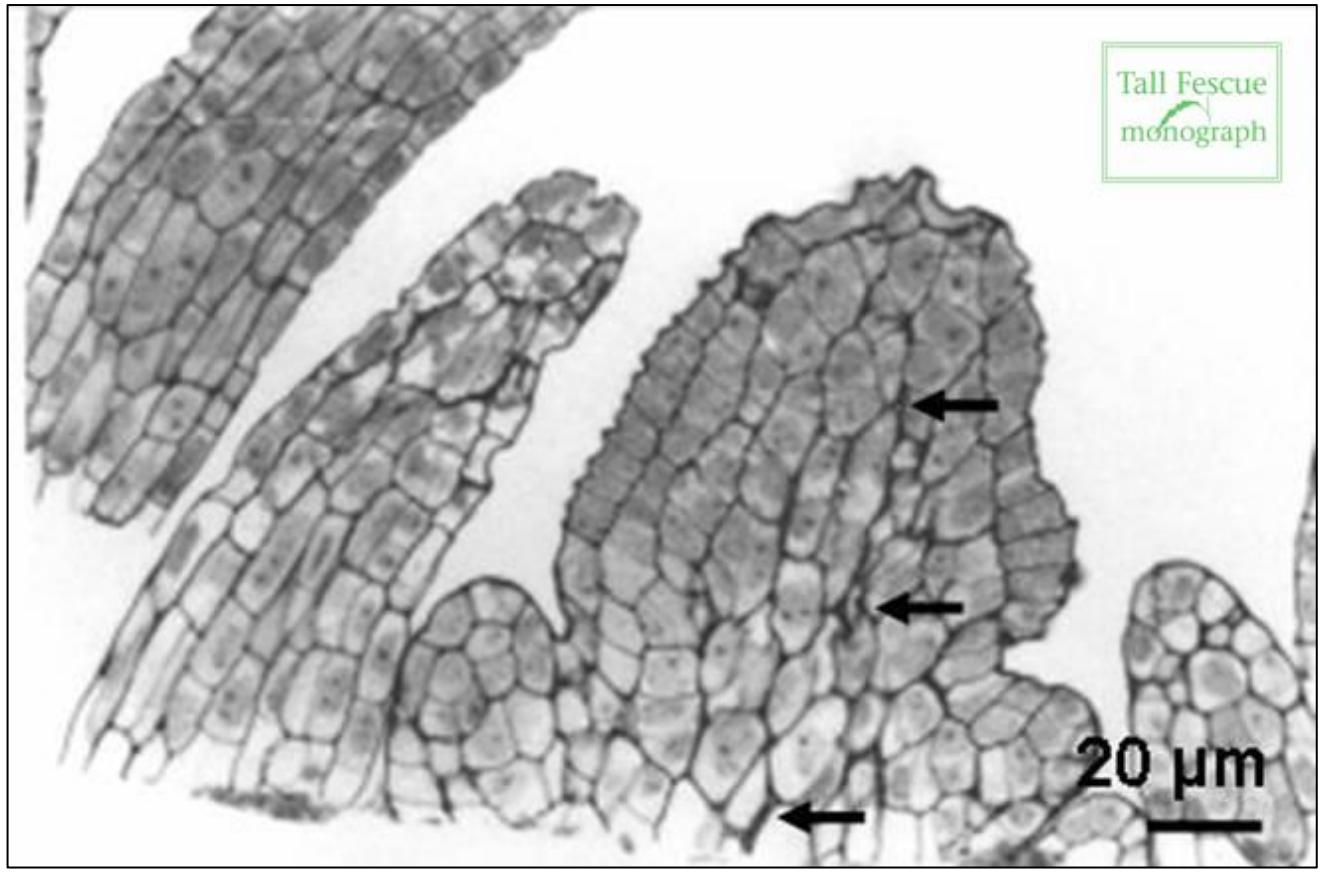


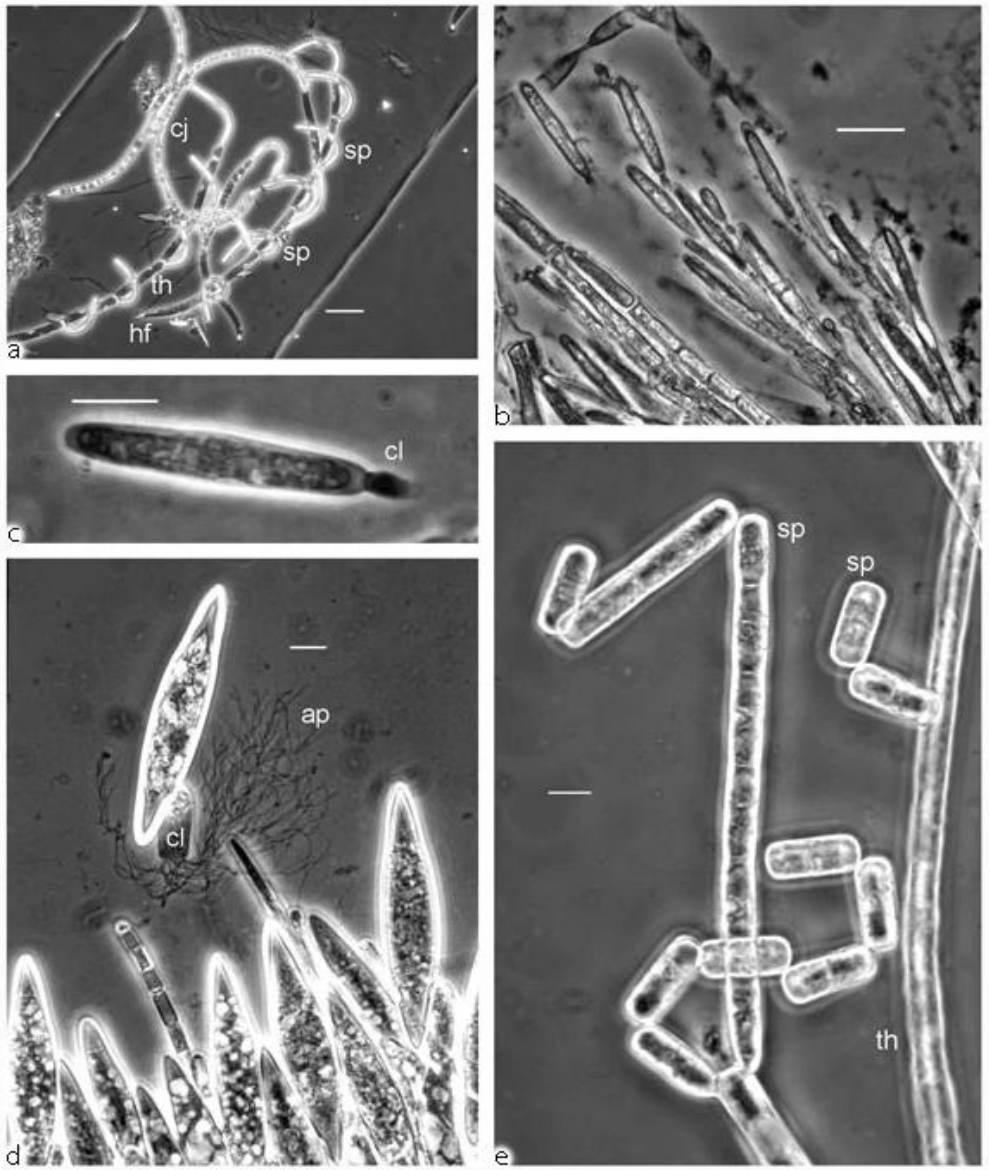
Image: Tall Fescue the Twenty-first Century monograph. OSU, 2009.

Endophytes have been found in almost every plant tissue observed.

Longitudinal section of the shoot apical meristem of a plant infected with *Neotyphodium coenophialum*

Biotrophic Fungi: Commensalisms

Trichomycetes, Figure 101



Trichomycetes: (**a**) Fresh dissection of *Harpella melusinae* from *Simulium innoxium*. Asexual spores and conjugating thalli are shown. cj = conjugating thalli, hf = holdfast, sp = asexual spore, th = vegetative thallus. Scale bar is 30 μm....

Endophytes have been found in 5% of all arthropods so far - both marine and terrestrial

Image: CE Beard, 2008

Biotrophic Fungi: Plant Pathogens

Rusts obligately specialize on specific plant species. Often with more than one host.

Cause significant economic loss and are often opportunistic on damaged trees

Western Gall Rust (*Endocronartium harknessii)*

Photo: Wikicommons

Biotrophic Fungi: Plant Pathogens

Common rust like pathogens in our area:

Rhododendron rusts (*Chrysomyxa sp*)
Photo: Ralph S. Byther, OSU Extension Plant Pathology

tar spot on big leaf maples (*Rhytisma punctatum*

Biotrophic Fungi: Plant Pathogens

Common root pathogens in our area:

Armillaria sp

Phaeolus schweinitzii

Biotrophic Fungi: Plant Pathogens

Common shoot pathogens in our area:

Hericium erinaceum
Image: Wikicommons

Laetiporus conifericola

Biotrophic Fungi: Plant Pathogens

Powdery mildew is caused by several different genera of fungi. Weakens the plant but doesn't kill it.

How to treat it?

- Don't crowd plants
- Practice rotations every 2-3 years
- Give up/buy resistant varieties

Photo: Cynthia M. Ocamb, PNW Plant Disease Management Handbook

Biotrophic Fungi: Mycorrhizae

Arguably the most important symbiosis on Earth

92% of all plants, including

- Rice
- Potato
- Sugar cane
- Coffee
- Cotton
- Doug fir

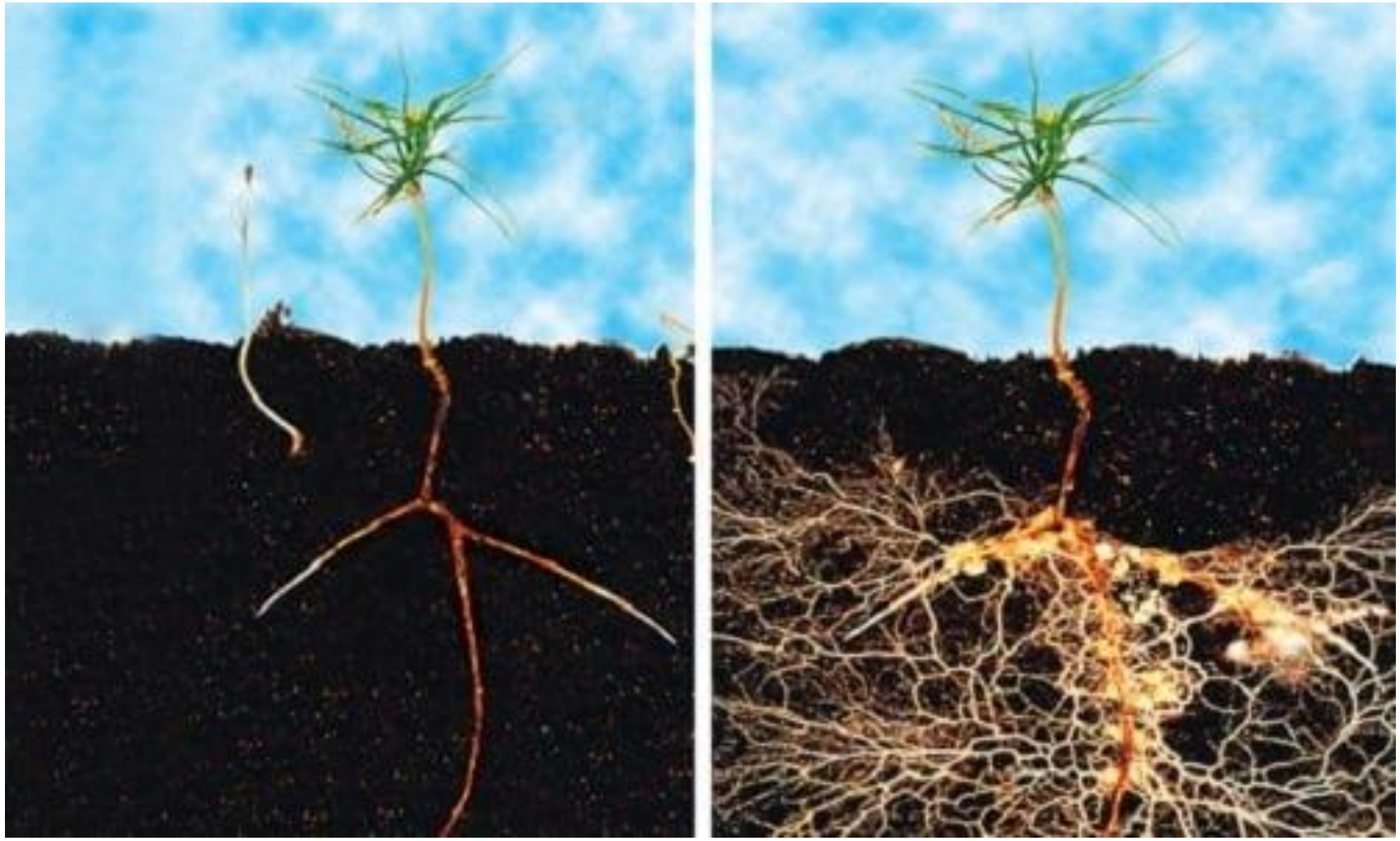


Image: Reed & Smith, Mycorrhizal Symbiosis

Biotrophic Fungi: Mycorrhizae

Fungi exchange water, N, P, K, and antibiotics for photosynthetic products

80% of plants are endomycorrhizal (arbuscular mycorrhizal)

12% are ectomycorrhizal

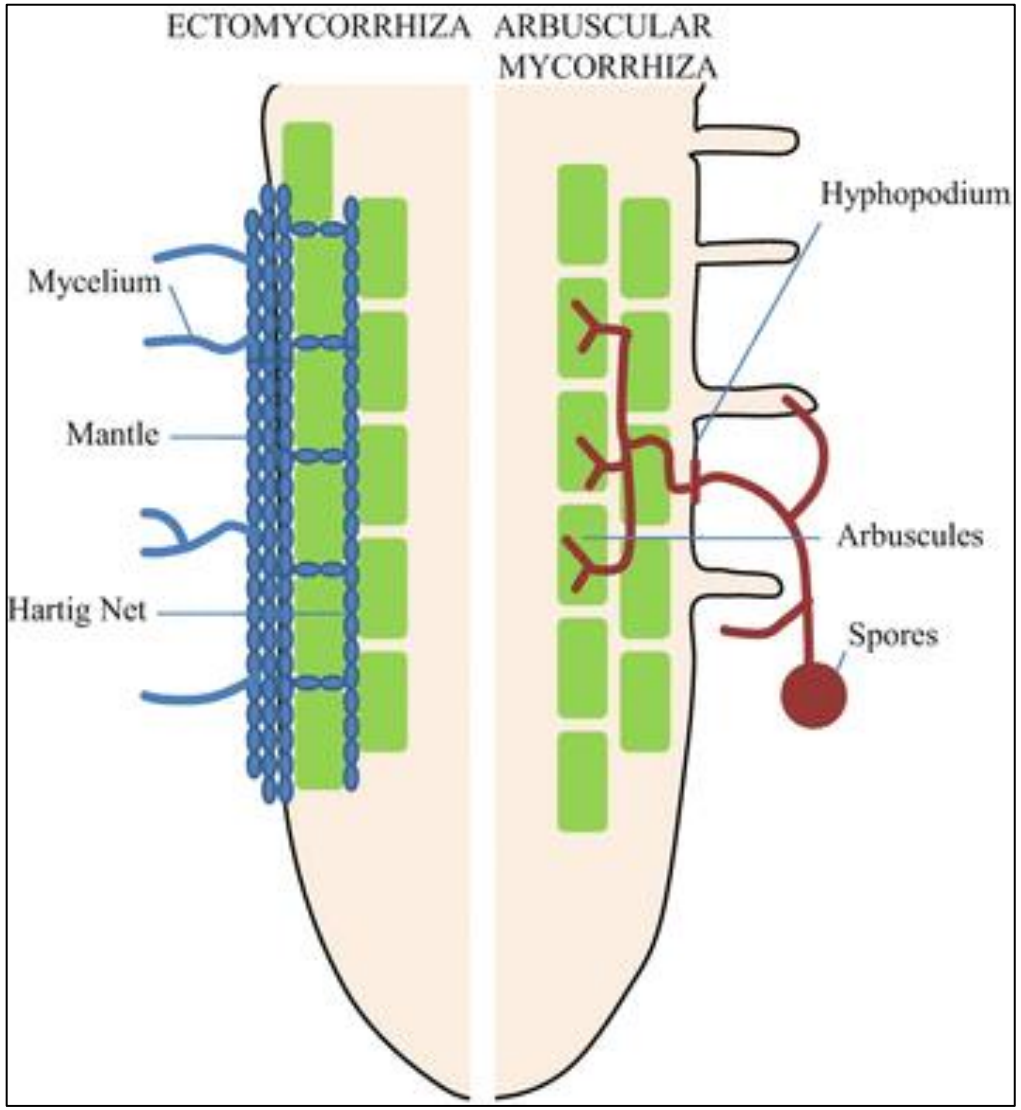


Image: Bonfante & Genre, Nature 2010

Biotrophic Fungi: Mycorrhizae

Benefits:

- Increased nutrient uptake, decreased phosphate stress
- Increased stress tolerance (drought, salt, heavy metals)
- Increased pathogen resistance
- Increased water uptake
- Increased growth rate
- Increased community communication (alarm calls)

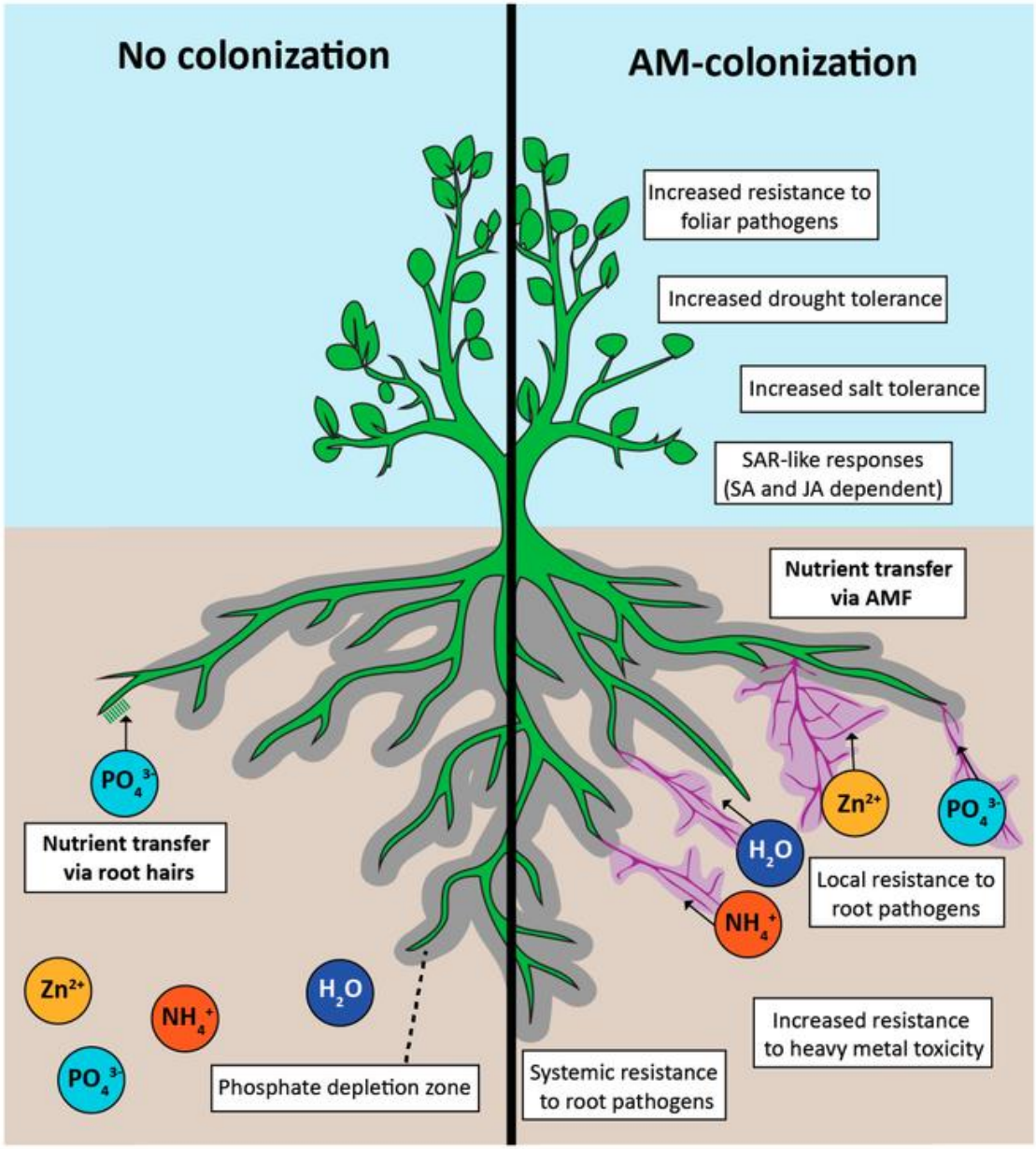


Image: Jacott et al. 2017

Biotrophic Fungi: Mycorrhizae

May cause early growth depression in some species

Direct cellular contact for nutrient and water exchange

Fossil evidence from 400 MYA

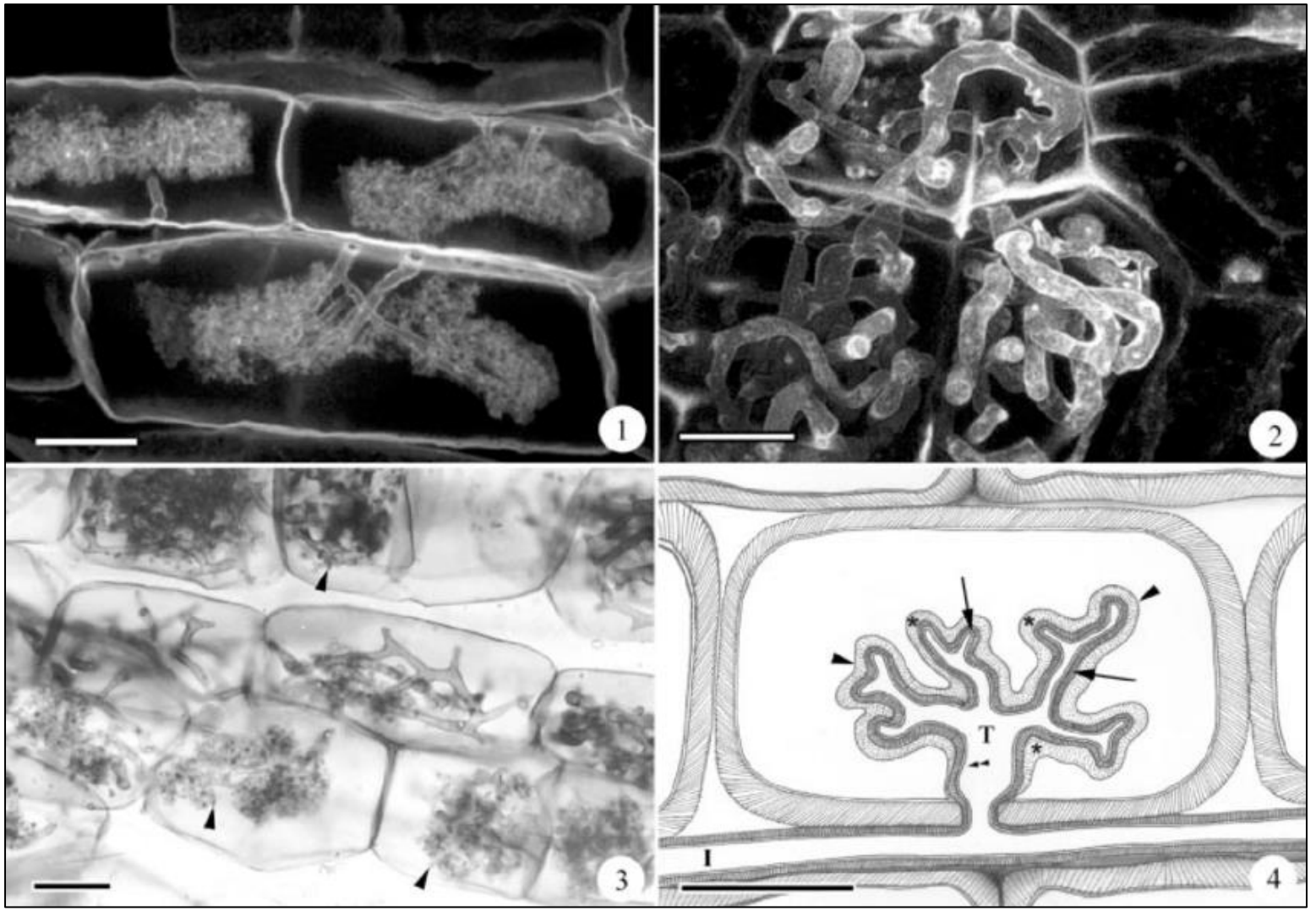


Image: Peterson & Massicotte, 2004. Scale bar = 25 µm

Mycorrhizal-obligates and Myco-heterotrophs

Calypso bulbosa

Allotropa virgata (Wikicommons)

Monotropa uniflora

Common Garden Mushrooms

Amanita "fly agarics" or "toad stools"

Agaricus "meadow mushrooms"

Common Garden Mushrooms

Mycena "fairy bonnets"

Coprinopsis, Coprinellus, and Coprinus "inky caps"

Common Garden Mushrooms

Conocybe "cone caps"

Hypholoma "sulfur tufts"

Laccaria "deceivers"

Want to know more? Join a group!

iNaturalist

Oregon Mycological Society

The Pacific Chanterelle
Cantharellus formosus

https://www.wildmushrooms.org/