

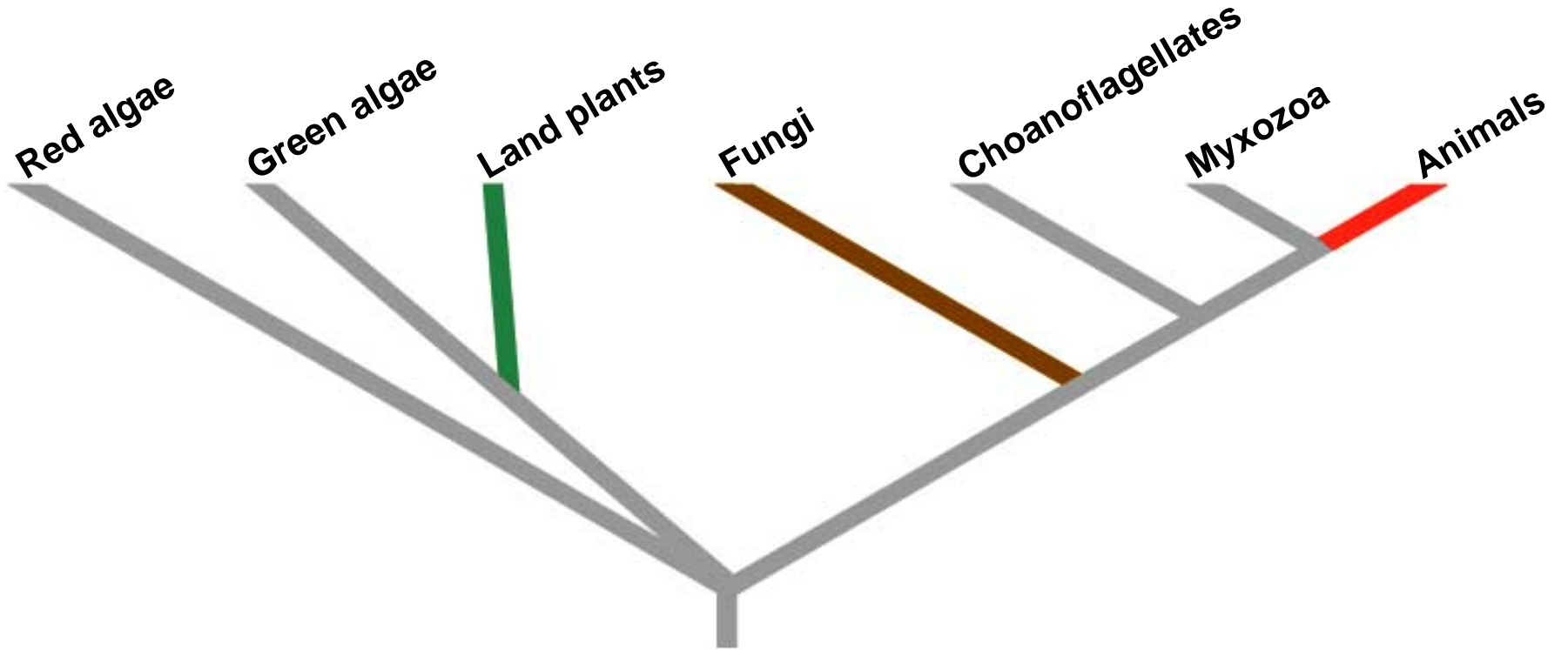


Fungi

The scarlet hood (*Hygrocybe coccinea*)

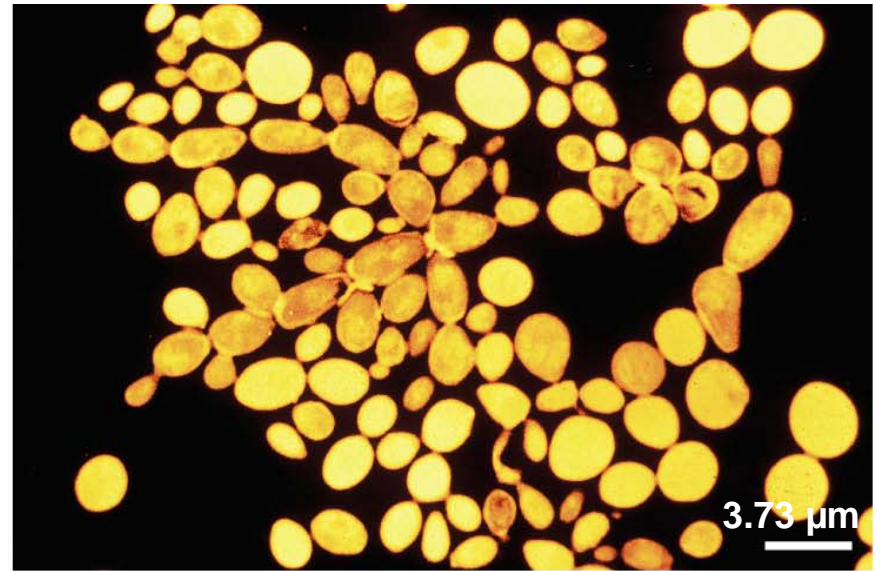
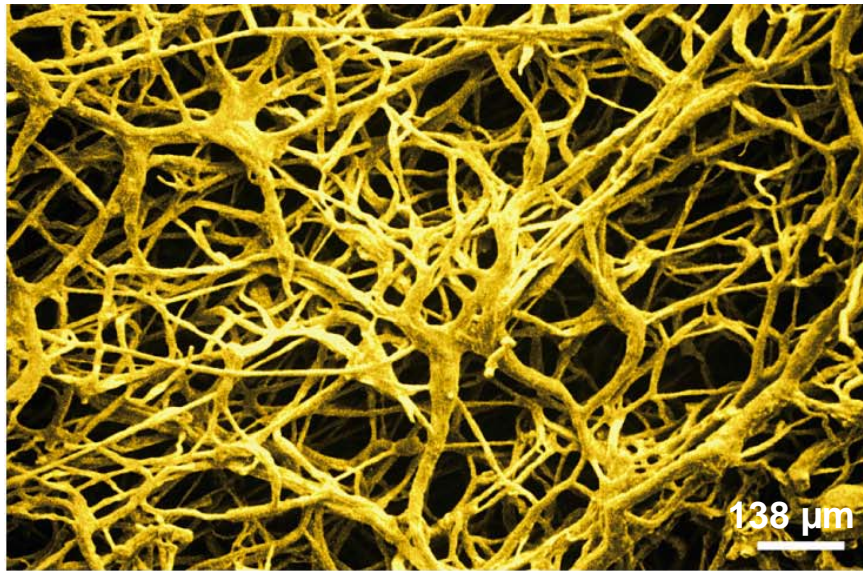


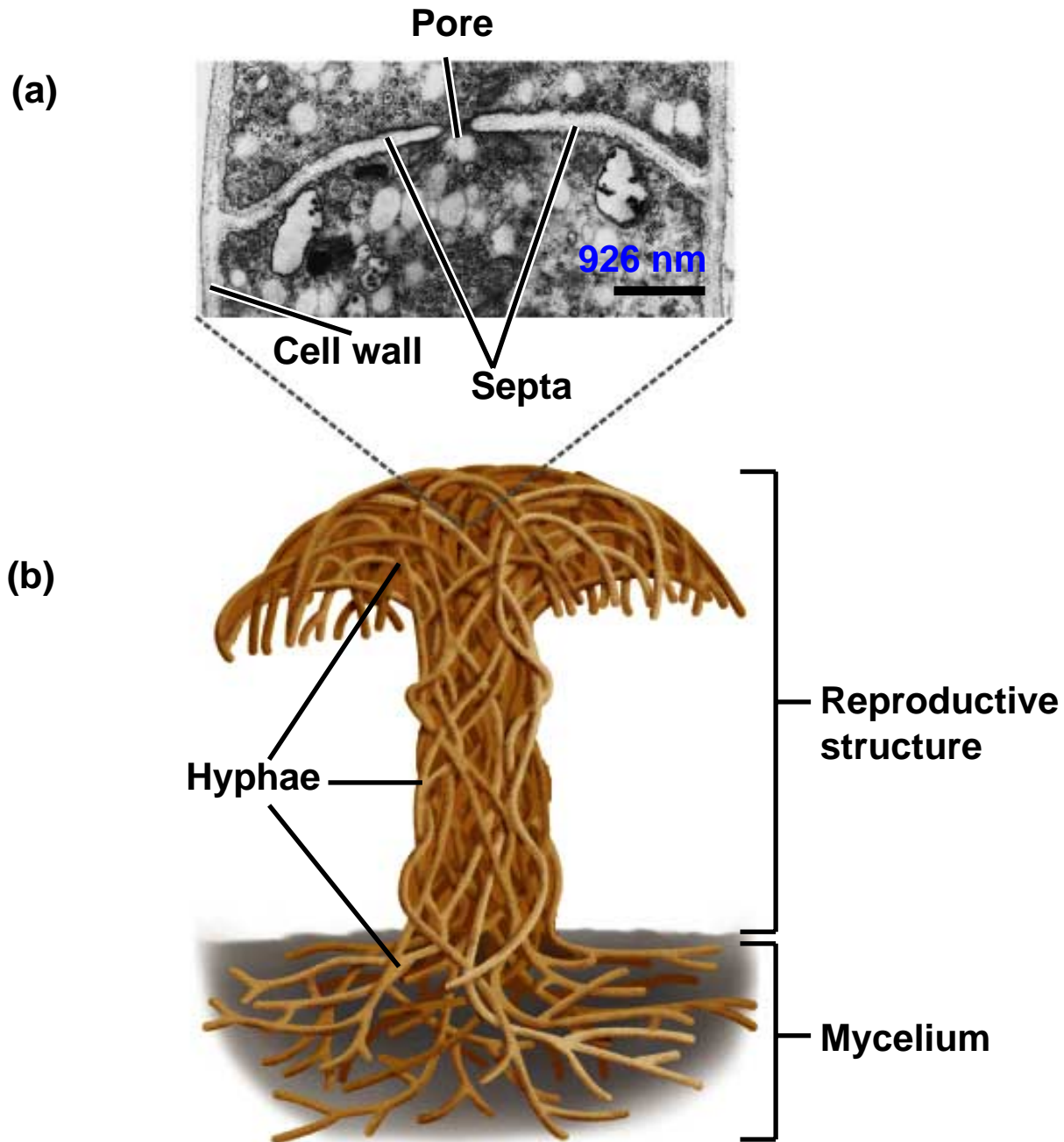
Fungi are absorptive heterotrophs that secrete digestive enzymes and are major decomposers of dead organic material

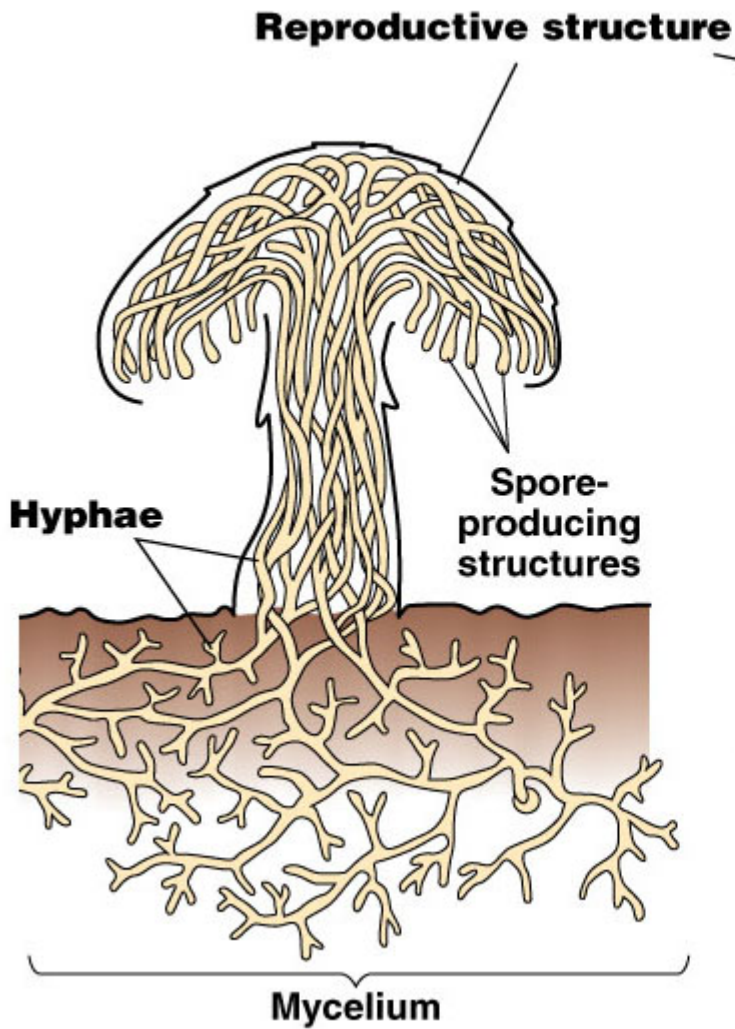


Organization

- Most fungi are haploid
- Some are unicellular (yeasts)
- But most constructed of hyphae that forms an interwoven mat called mycelium
 - Most fungi are multicellular; however some hyphae without septa consist of a continuous cytoplasmic mass with multiple nuclei
- Fungi mycelia can be huge. One giant individual of *Armillaria ostoyae* spreads through 2,200 acres of forest, hundreds of tons of weight and thousands of years old
- Reproductive structures are only thick and fleshy portions; they are not absorptive







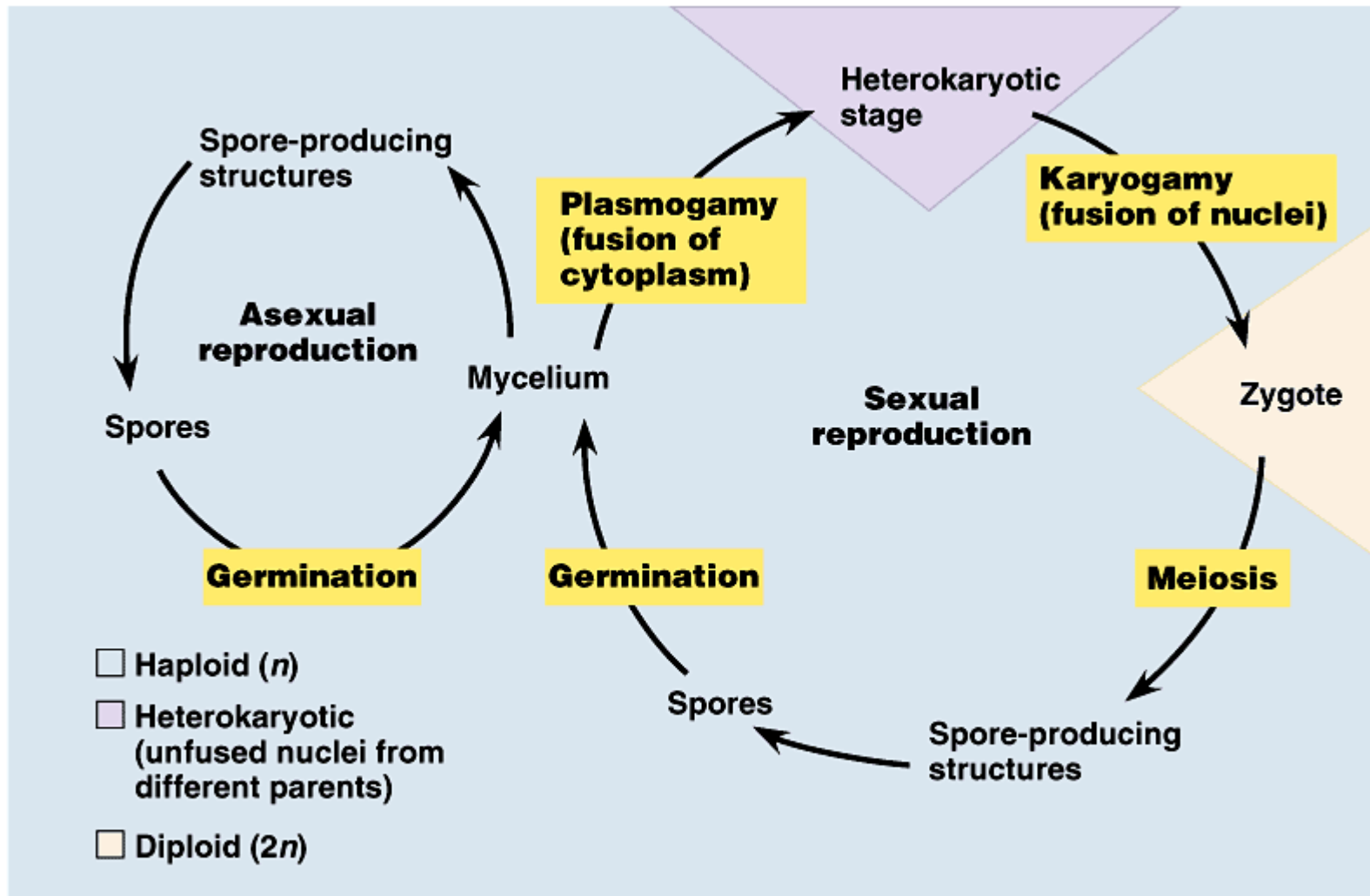
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Homeostasis

- Cell walls mainly of chitin, strong but flexible nitrogen-containing polysaccharide*
- Use of glycogen to store excess carbohydrates*
- Haustoria: hyphal tips in parasitic fungi that penetrate tissues in host
- Filamentous structure of mycelium provides extensive surface area for efficient absorption
- Fungal mycelia are nonmotile
- No flagella on cells; except in species of the phylum Chytridiomycota which have gametes and spores that are flagellated*
- Spores developed when food is lacking; dispersal mechanism

Reproduction and Heredity

- Fungi reproduce by releasing spores produced sexually or asexually
- Nuclei of fungal hyphae haploid
- Transient diploid stages during sexual cycles
- Fungi with sexual cycles go through several stages: plasmogamy (fusion of cytoplasm), heterokaryotic stage, karyogamy (fusion of nuclei), zygote, mycelium



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Growth and development

- Mycelium grows in the direction in which food is more abundant
- It grows rapidly, adding as much as a kilometer per day
- Fast growth possible since proteins and other synthesized materials are channeled by cytoplasmic streaming to tips of hyphae
- Fungi concentrate energy and resources in adding length

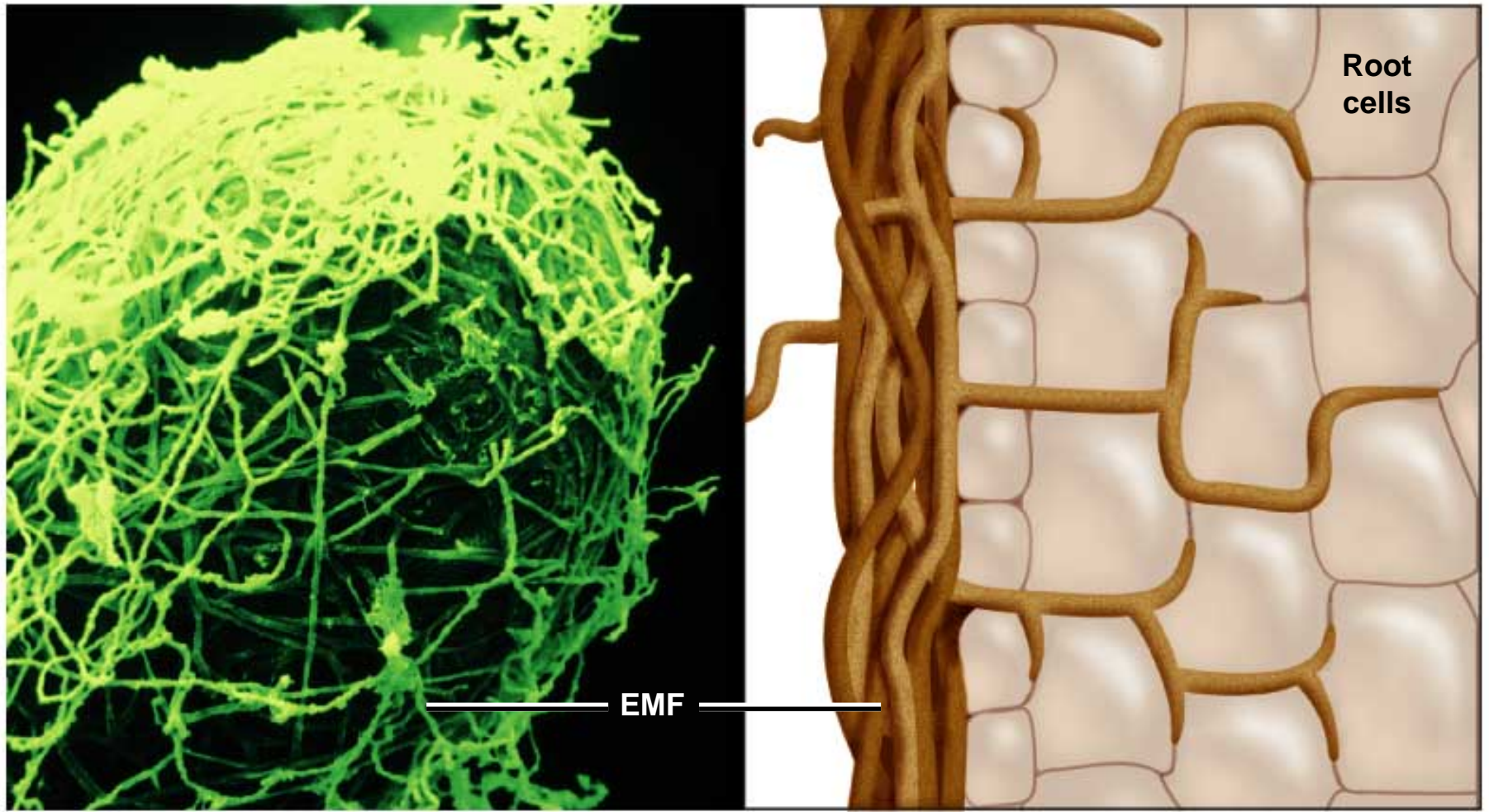
Metabolism

- Fungi are heterotrophs. They obtain energy and carbon from other organisms through absorption
- Diffusion in hyphae is restricted for small molecules, thus fungi secrete digestive enzymes to break down large molecules. Digestion occurs outside the hyphae (extracellularly)
- Fungi can digest lignin, cellulose, many other large and small molecules

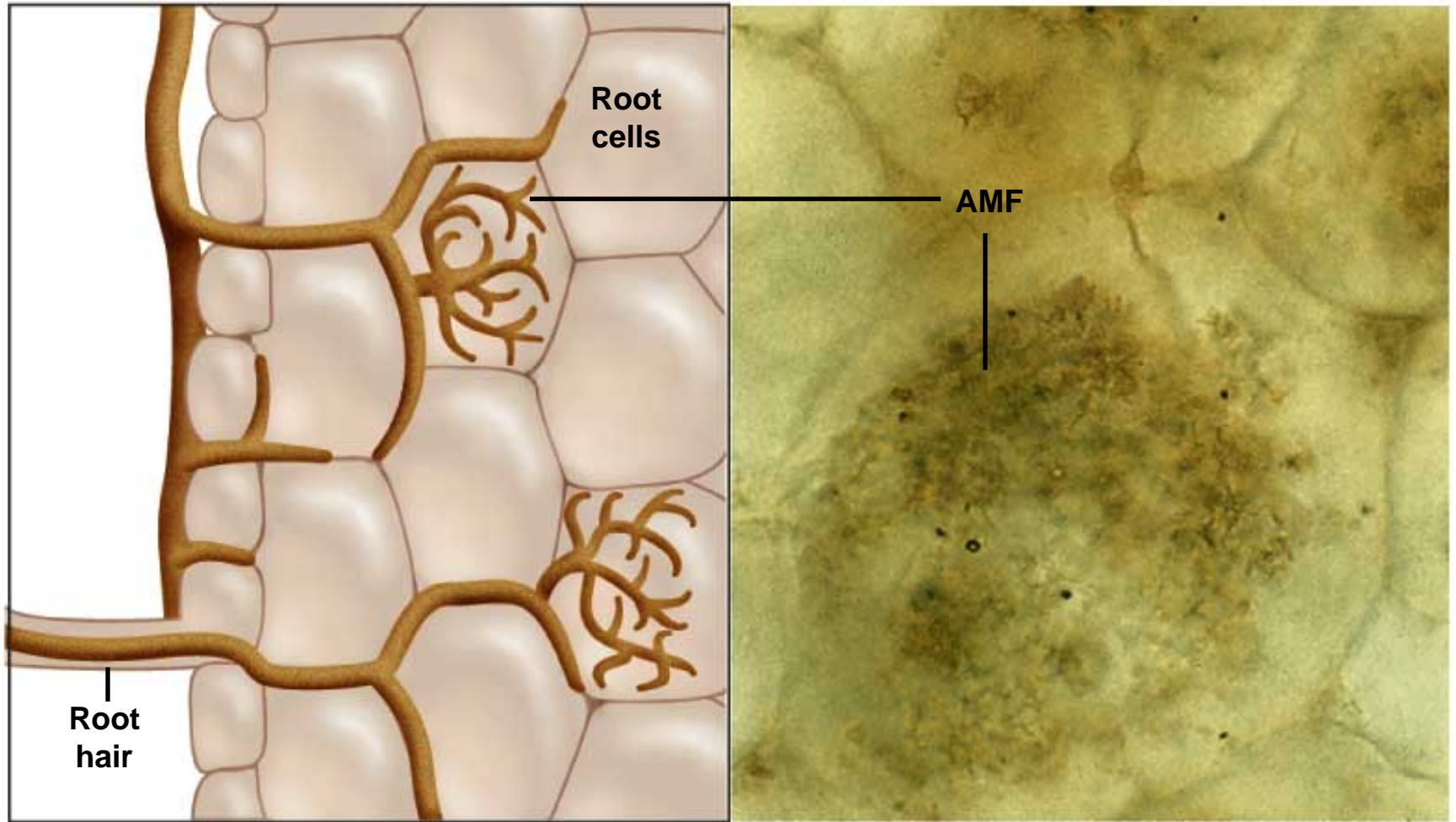
Ecology

- 70,000 species known. Each year 1000 new species are identified. It is estimated that 1.65 million species of fungi may exist
- Mutualism between plants/fungi
 - Mycorrhizae – fungal associations with plant roots; may be the most important cooperative relationships in terms of productivity and richness; plants deliver sugars and other reduced carbon compounds to fungi
 - Ectomycorrhizal fungi (EMF) - dense network of hyphae around plant roots; found in all trees in boreal and temperate forests; abundant in cold, northern habitats with short growing seasons; deliver nitrogen to plants; they are often members of Basidiomycota.
 - Arbuscular mycorrhizal fungi (AMF) – grow into cells of plant root tissue; branching of hyphae is extensive; occur on 80% of all land plant species; dominant in grasslands and warm tropical forests where growing season is long; deliver phosphorus to plants; often members of Zygomycota

Ectomycorrhizal fungi (EMF)



Arbuscular mycorrhizal fungi (AMF)



Ecology cont.

■ Mutualism (cont.)

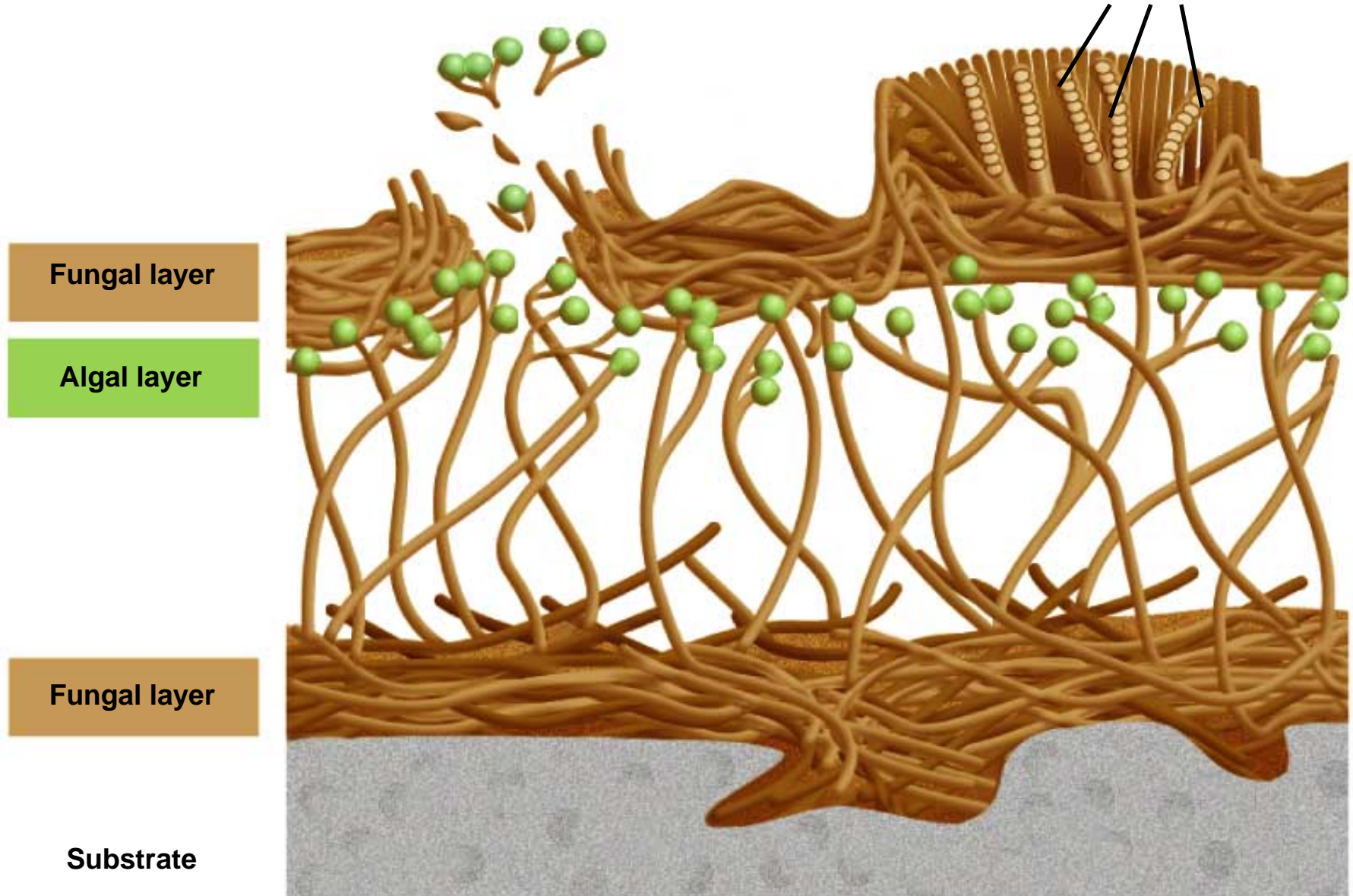
- Lichens – associations of fungi with cyanobacteria or green algae
 - Usually an ascomycete; photosynthetic organisms provide sugars, reduced carbons, and nitrogen (some of them) fungi provide protection through chitin walls; relationship may turn parasitic (fungi kills algal cells)

■ Parasitism

- Some fungi are destructive to plants and animals; yeast infections, athlete's foot, dutch elm disease

Asexual reproduction occurs when “mini-lichens” are produced.

Asci produced by fungus

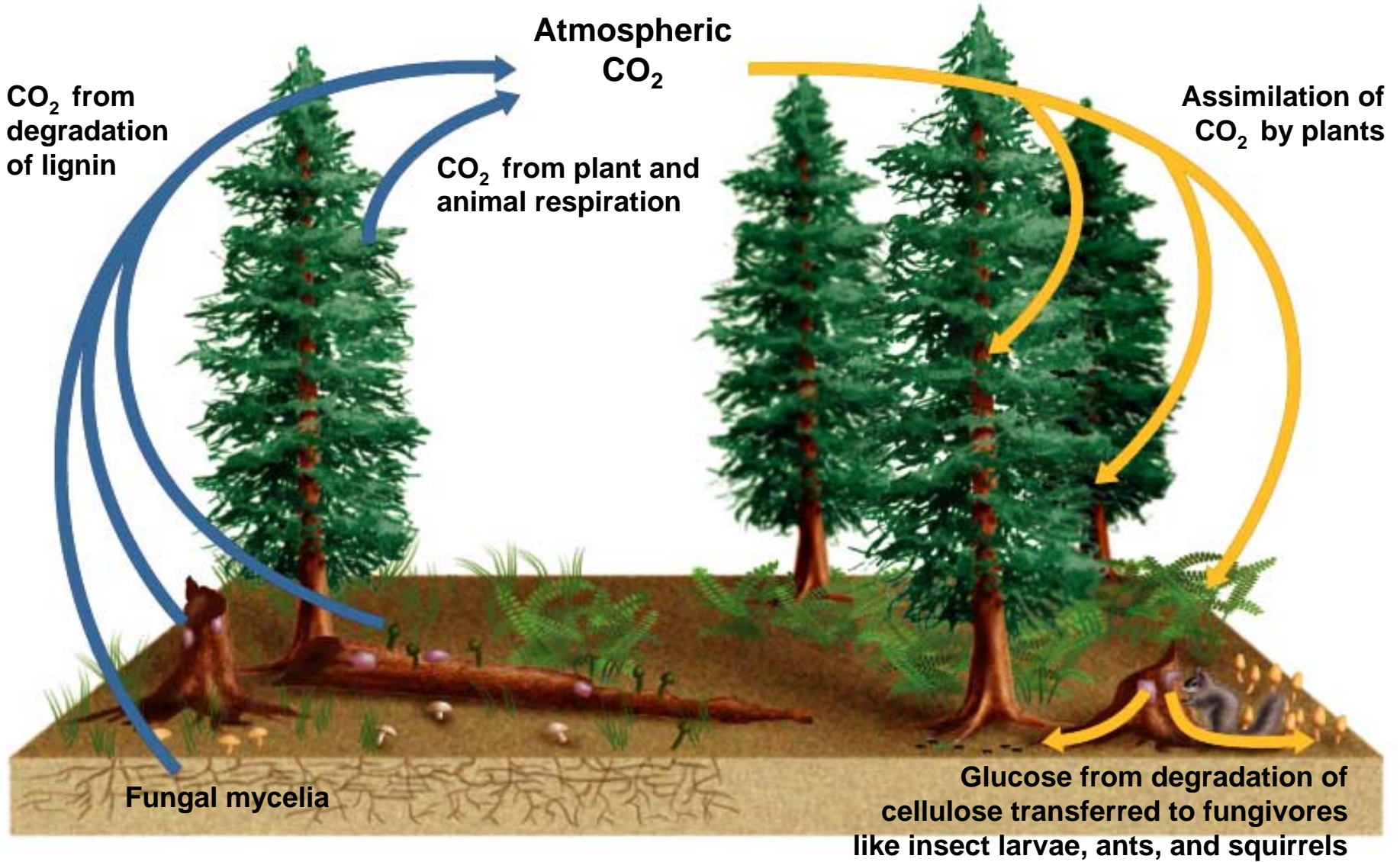


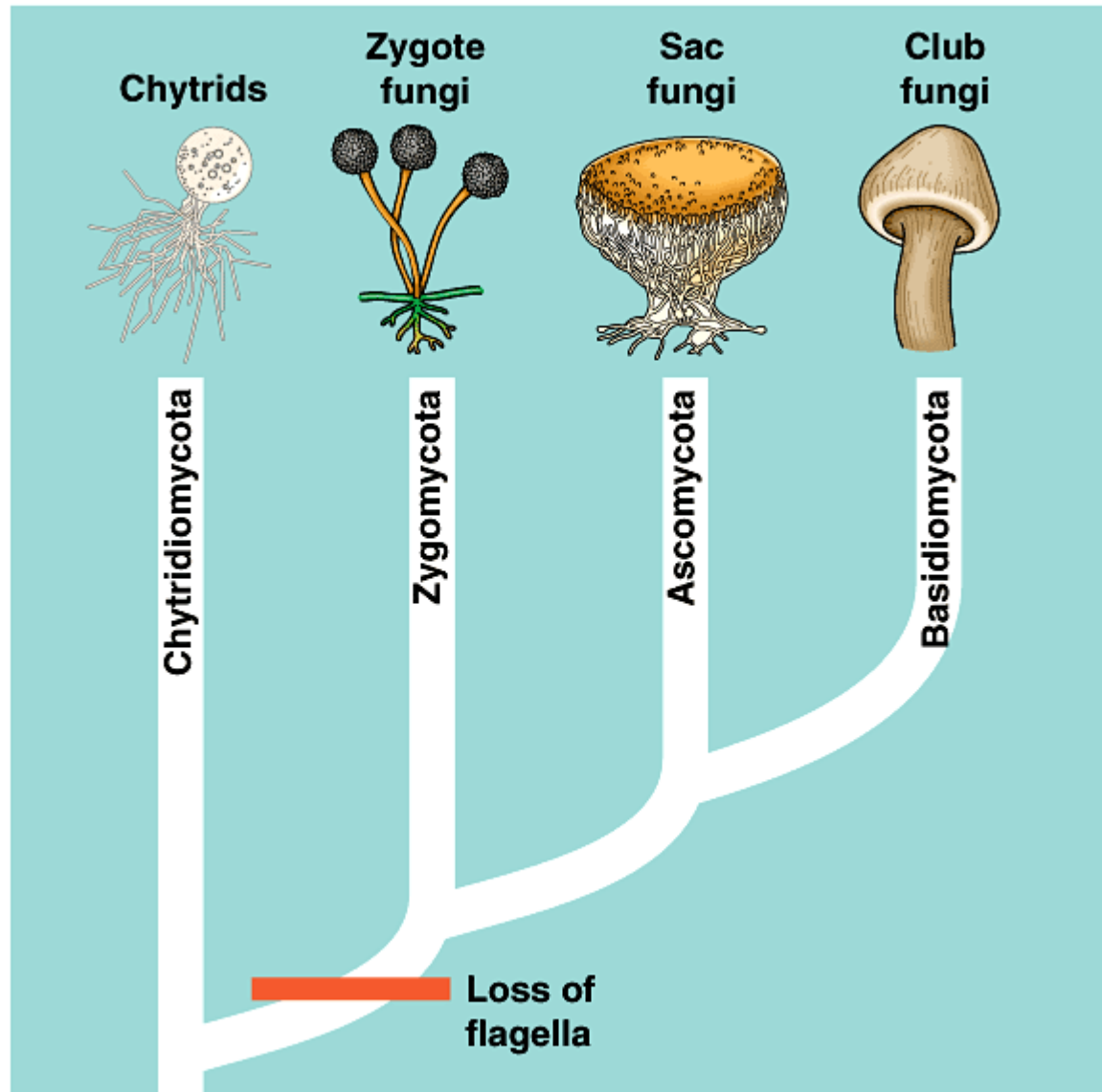


Importance

- Fungi are essential to maintaining global carbon cycle
 - They digest cellulose and lignin (carbon captured by plants) and break into glucose and CO₂, allowing carbon to be recycled to other organisms
- Diversity of mycorrhizal fungi affects diversity and productivity of plant communities
- Fungi can cause important loss of million of dollars through food spoilage, crop losses and habitat destruction
- However they also provide million dollar industries by facilitating bread making (*Saccharomyces cerevisiae*), fermentation to produce beer, wine and spirits (*Saccharomyces spp*), and by production of edible mushrooms
- Yeasts are important research organisms in cell and molecular biology







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Diversity of Fungi

- Fungi can be divided into four major groups based on molecular data and differences in their reproductive structures.
 - Chytridiomycota: aquatic with flagellated spores and gametes. They reproduce sexually and asexually.
 - Zygomycota: mycelia that "yoke together" during reproduction. Most are soil living, many form mutualistic associations with plants. Hyphae are haploid

Chytridium



Rhizopus



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Pilobolus



Diversity of Fungi

- Fungi can be divided into four major groups based on molecular data and differences in their reproductive structures.
 - Basidiomycota:
 - Reproductive structures are mushrooms, puffballs, or bracket fungi.
 - Meiosis and spore formation occurs in basidia, which are like "little pedestals."
 - They have heterokaryotic stage



Diversity of Fungi

- Fungi can be divided into four major groups based on molecular data and differences in their reproductive structures.
 - Ascomycota:
 - Reproductive structures are ascocarps
 - Meiosis and spore formation occurs in asci, which are elongated sacs.
 - Also forms heterokaryotic stage
 - Inhabit variety of marine, freshwater and terrestrial habitats

