

Fundamentals of Small-Scale Mushroom Production



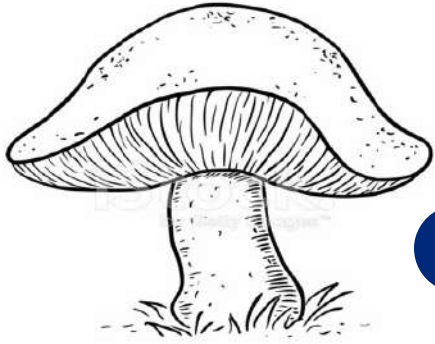
COLLEGE OF AGRICULTURE
AND LIFE SCIENCES
COOPERATIVE EXTENSION

presented by

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&
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Establishing mushroom production in Arizona



Arizona Mushroom Growers Association

- ✓ **Funded by the Arizona Department of Agriculture Specialty Crops Block Grant program, 2015 and 2017**
- ✓ **Providing cultures, resources, research, expertise, and training to assist small businesses integrate mushroom production into diversified farming systems**
- ✓ **Currently 115 members representing production in 12 of the 14 counties**
- ✓ **Everyone can join!! <http://www.azmushroomgrowers.org/>**

Arizona Mushroom Growers Association Workshop

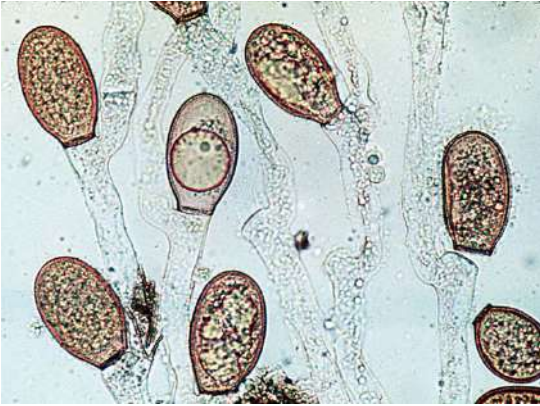
Phoenix, AZ 6/20/18

Schedule/Itinerary

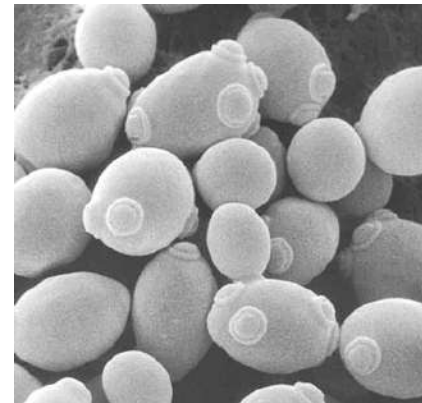
- 11:30 - 11:45 - Introductions and Backgrounds
- 11:45 - 12:00 - Introductory Mycology
- 12:00 - 12:15 - The Mushroom Market
- 12:15 - 12:30 - The Nutritional Value of Fungi
- 12:30 - 1:00 - The Specialty Mushroom Growing Process
- 1:00 - 1:15 - Short Break
- 1:15 - 2:00 - Hands-on: Culture Transfers and Inoculation
- 2:00 - 2:30 - Entry Points for the Small-Scale Grower
- 2:30 - 2:45 - Mobile Mushroom Shed
- 2:45 - 3:15 Questions and Answers
- 3:15 - 3:30 - Distribution of Grow Bags, Wrap-up

A mycology primer...

what are fungi??



Achlorophyllous, typically **filamentous** organisms that reproduce via **spores**, have **chitin** in their cell walls, are **haploid** for most of their life cycle, and obtain nutrients through **absorption processes**



The Old Tree of Life – Whittaker's Five Kingdoms

- Monera
- Protista
- Plantae
- Fungi
- Animalia

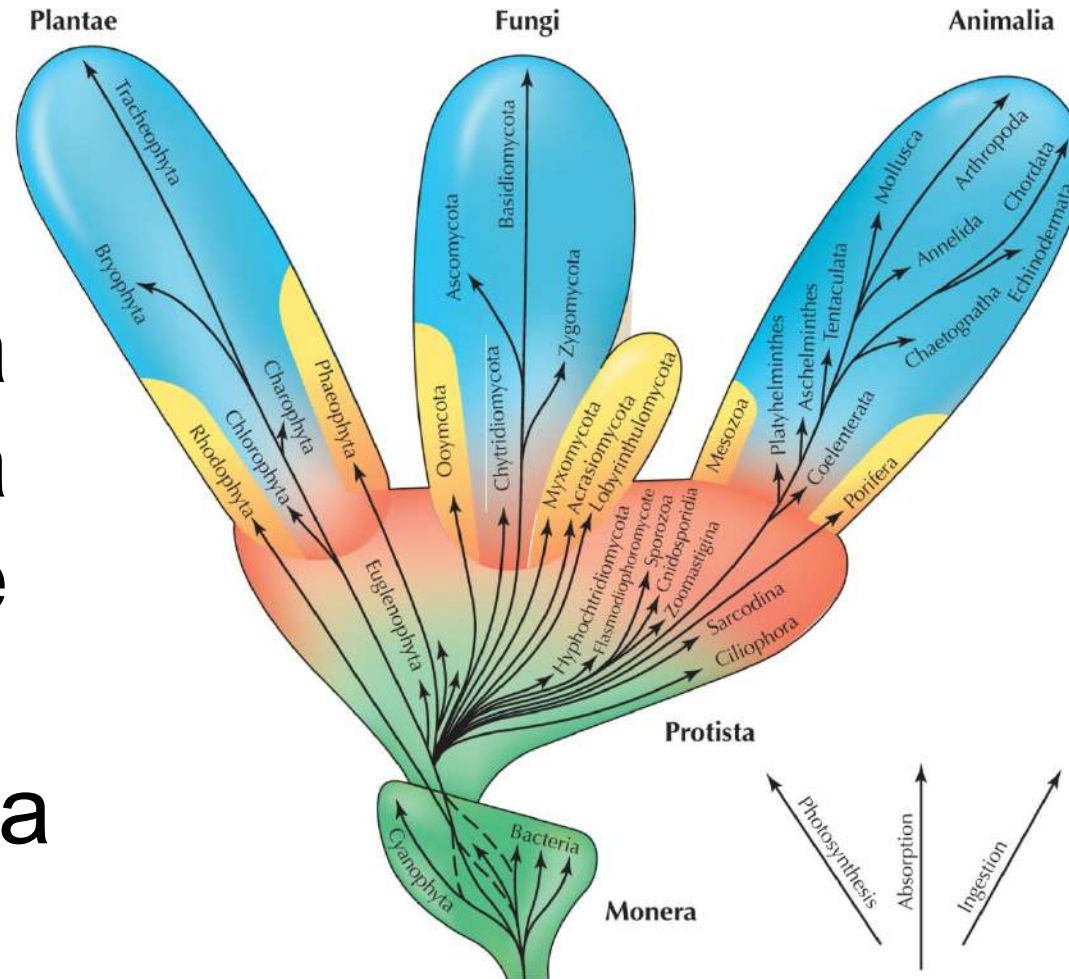
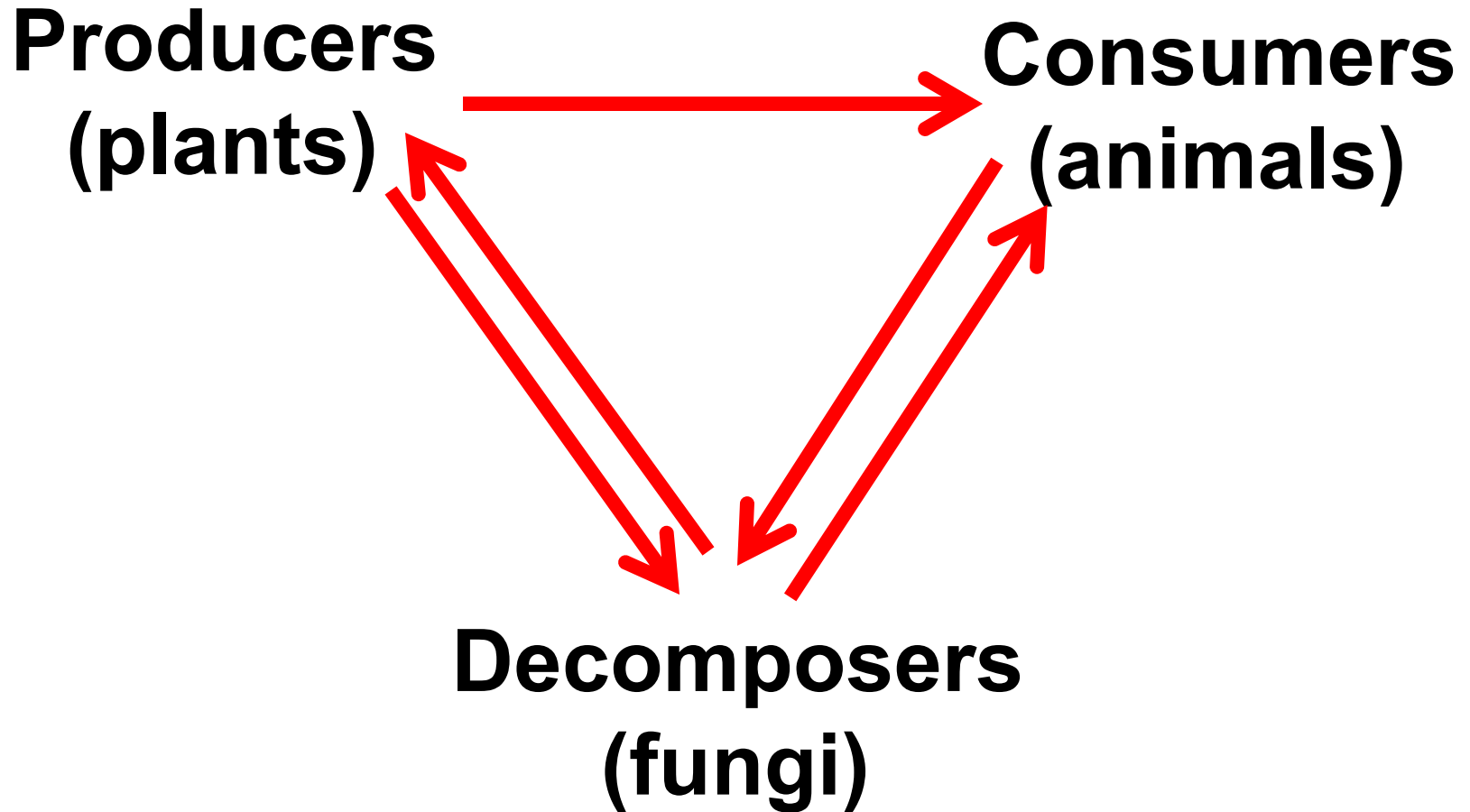


FIGURE 5.15. Whittaker's five-kingdom tree. This system contains five kingdoms based on three levels of organization: prokaryotic (kingdom Monera), eukaryotic unicellular (kingdom Protista), and eukaryotic multicellular and multinucleate (kingdoms Fungi, Animalia, and Plantae). The three kingdoms at the top of the figure are distinguished mainly by differences in nutrition (see the *inset*).

5.15, redrawn from Whittaker R.H., *Science* 163: 150–160, © 1969 American Association for the Advancement of Science

Energy and resource cycling: fungi are the 3rd critical component



Ecologically, fungi are the single most important **decomposers** in all ecosystems.



of both natural products.....

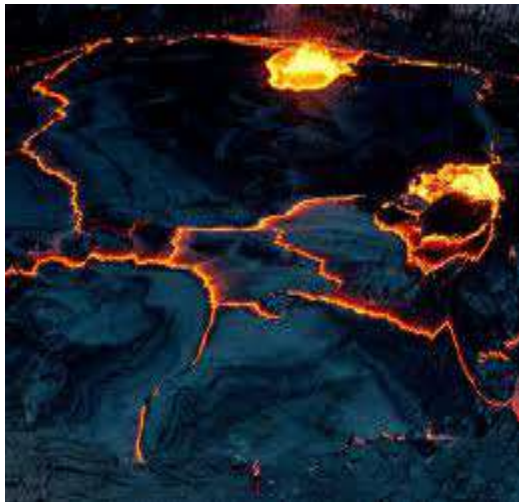


and man-made products!

They can even breakdown stone buildings and monuments!

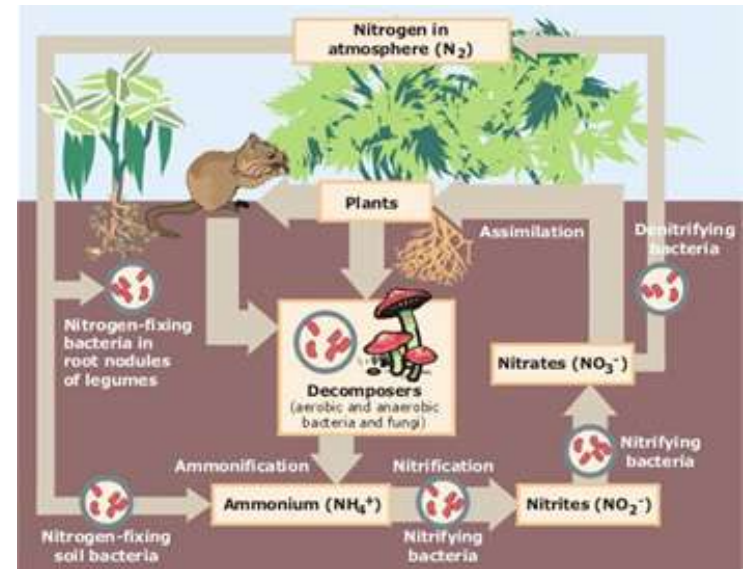
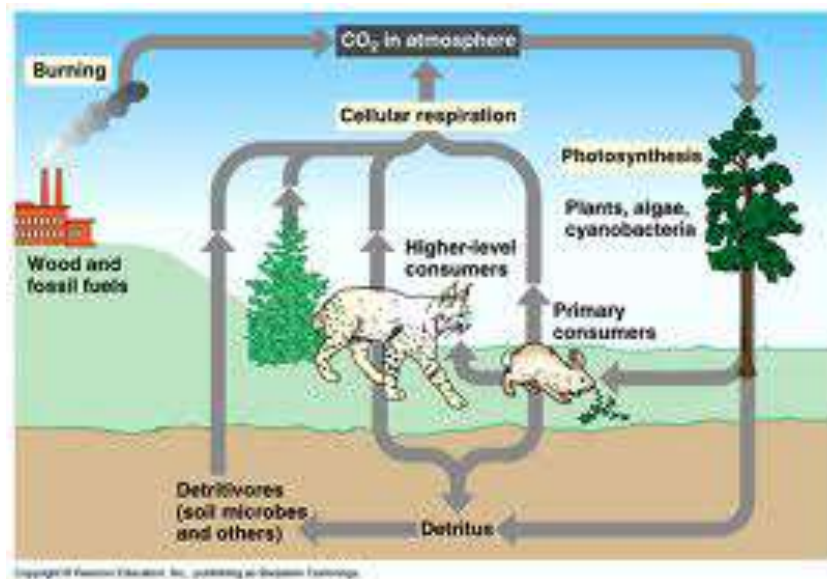


And fungi are also the first colonizers of bare rock and new land



In the process of decomposition, fungi are critical for the **recycling** of nutrients in our ecosystem

- They often perform the first critical step in the recycling process.....
breaking down big pieces of matter into little pieces.
-structural decomposition.



Most important nutrients recycled are **carbon** and **nitrogen**.
-molecular decomposition.

- Other important nutrients that are recycled include **phosphorus, potassium, calcium, sulfur, and manganese**. Essential elements for plants.
- Minor nutrients recycled include boron, copper, iron, manganese, molybdenum, and zinc

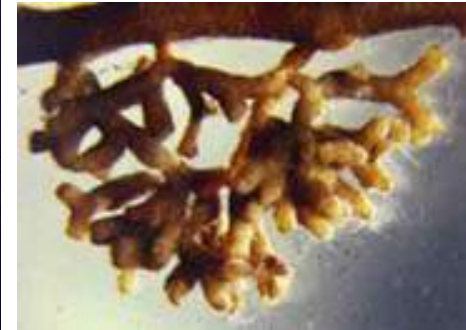
More specifically, fungi are the great **PROMOTERS** and **RECYCLERS** of plants!!

Primary colonizers of rock surfaces



Lichen – fungus – algal symbiosis
<http://www.nybg.org/bsci/lichens/>

Primary symbionts of plant roots



Mycorrhizal fungi
<http://sciweb.nybg.org/science2/hcol/mycorrhizae.asp>

Primary pathogens and decomposers of plants



Armillaria – the humungous fungus!
<http://www.scientificamerican.com/article.cfm?id=strange-but-true-largest-organism-is-fungus>

The five (or eight??) divisions of fungi

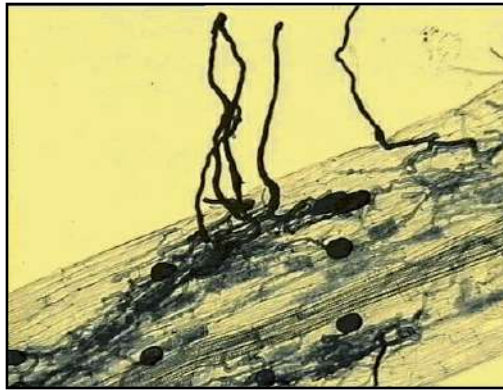
Chytridiomycetes **

Strange little water molds



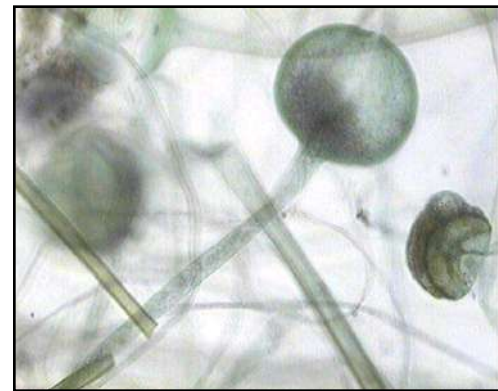
Glomeromycetes

Endomycorrhizal fungi



Zygomycetes**

Black bread molds and other oddities



Ascomycetes

Most molds and the yeasts
The biggest group of fungi!!



spores

Basidiomycetes

The “charismatic” fungi and the rusts



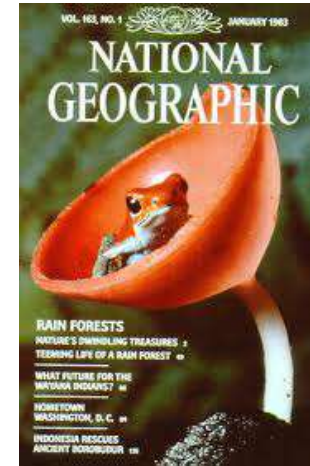
** these 2 groups have been broken up into many smaller groups by modern mycologists

Ascocarp (fruiting structures) diversity!

Perhaps not as great as in the Basidiomycetes



Jelly cups



Truffles!



Morels!!



Basidiocarp diversity!!

Mushrooms, brackets, conks, puffballs, earthstars, stinkhorns, bearded fungi, jelly fungi, rusts, smuts, and more..

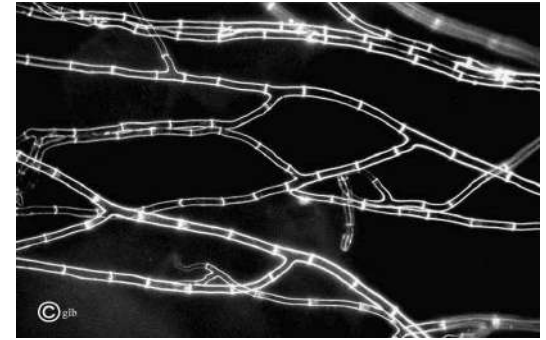


Mycological terms to remember

Fungi grow by one-cell thick filaments called **hyphae**. Collectively, a colony of hyphae is referred to as **mycelium**

Spores are how fungi get around. They are small, generally 5-50 μm diameter.

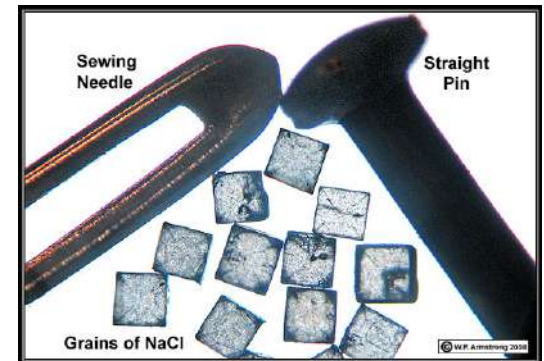
Most are forcibly discharged and wind blown, and are fairly tolerant of **desiccation** and **UV**, but too much will kill them!



Smut teleospores from infected wheat



Denver dust storm!
Lots of spores!



A salt crystal is about 300 μm

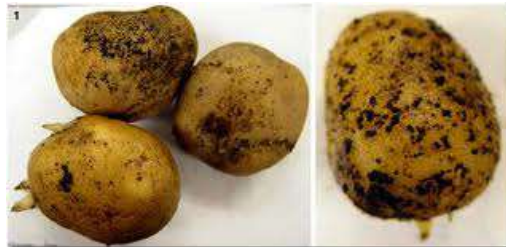
Do all fungi produce spores???

NO! (but most do....)

Mycelia Sterilia (sterile mycelia)
propagate by the production of
sclerotia and/or **hyphal fragmentation**



In culture



On potatoes



On peanut stems



On rye

**Hyphal fragment
propagation makes for
easy artificial culture
and research**



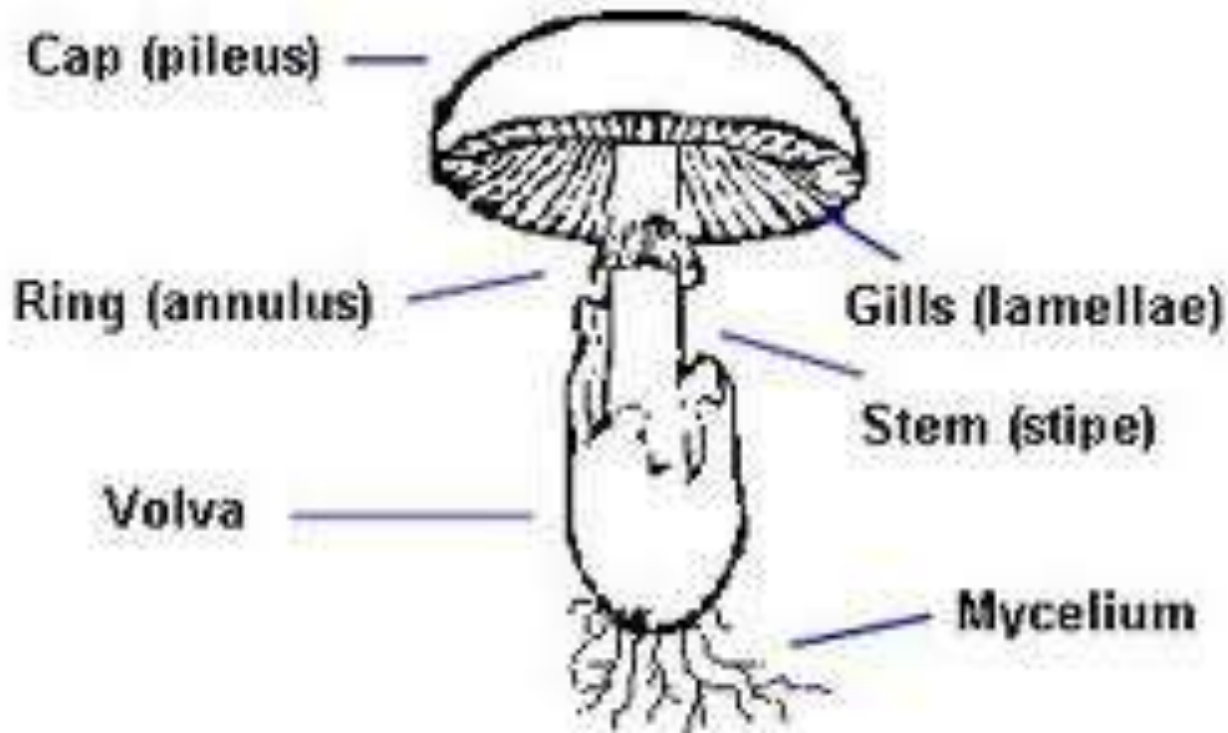
And easy commercial production



The parts of a "mushroom"

Remember, there are two uses for the term "mushroom"

One is used for a specific type of basidiocarp and one is general for all fungal fruiting structures



Not all mushrooms have all
of these parts...
but poisonous *Amanita* do!!!!



Amanita phalloides

Where do fungi live??

Almost everywhere!

Most are terrestrial

Most are found in temperate or tropical areas

Most are found in association with soil or leaf litter

The Great Decomposers!!



However.....

Some are aquatic

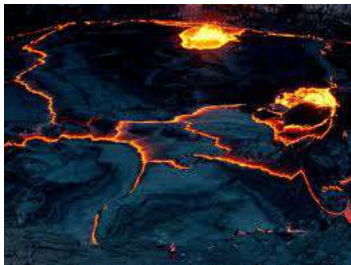
Some are found in alpine and polar regions

Some are found on the tree tops,

deep within the earth, or inside animal hosts

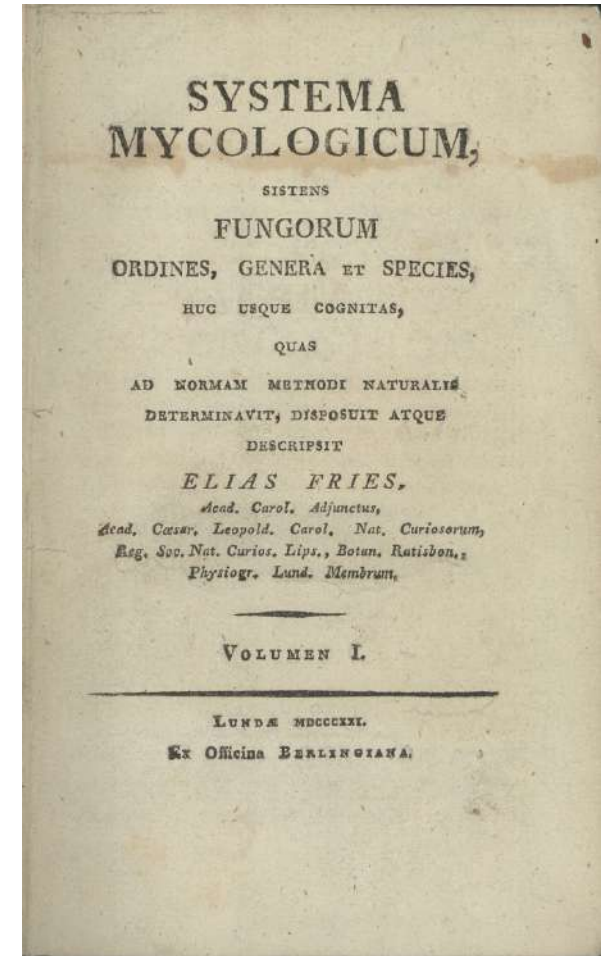
Some are found on bare rock

The Great Colonizers!!



Founder of Mycology

Elias Fries (1794-1878)



Systema Mycologicum
3 volumes (1821-1832)

The 19th century was an amazing time for microbiology!!