

MUSHROOM HUNTING AND AMATEUR MYCOLOGY: AN INTRODUCTION IN TWO PARTS

We forage for Mushrooms

We Study Fungi!

Bill Yule 2019

So Remember....

ALL
MUSHROOMS ARE
FUNGI...

...BUT NOT ALL
FUNGI PRODUCE
MUSHROOMS.



PART 1 - MUSHROOM HUNTING

The Feast in the Forest

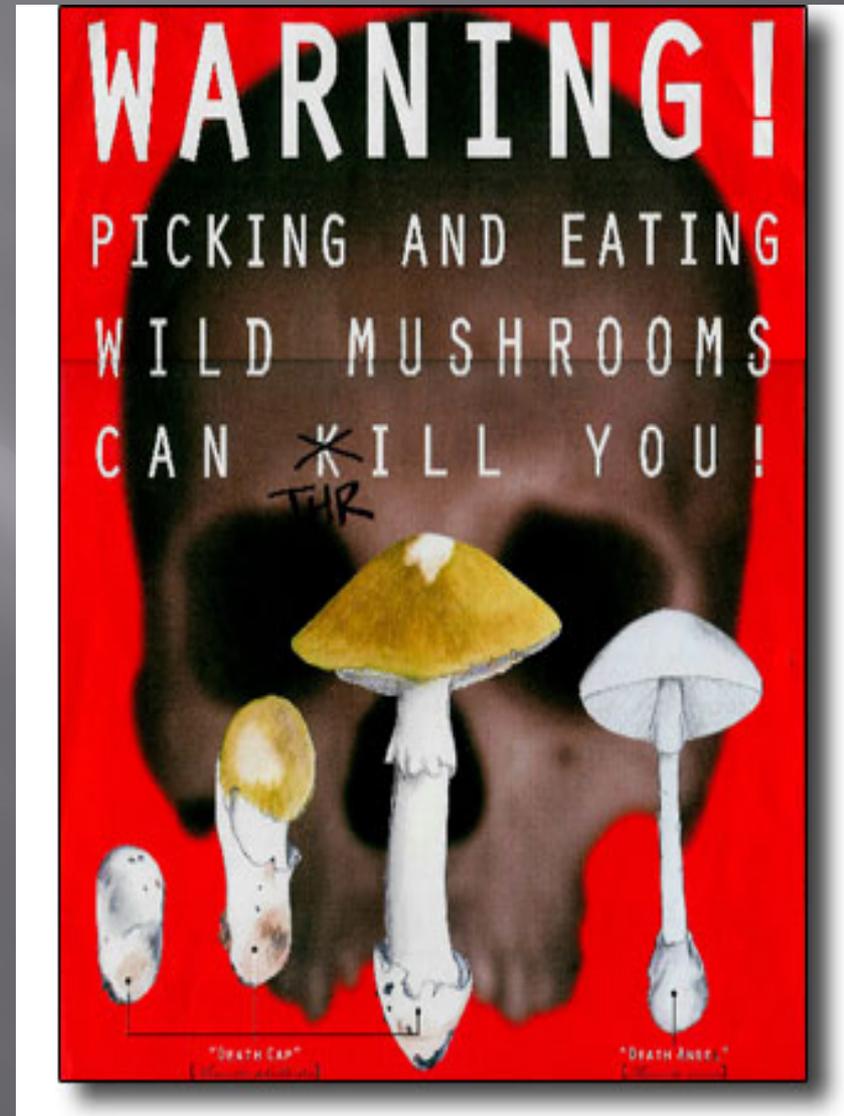
How to safely forage wild Mushrooms

Wild Edible Mushrooms



TOP MUSHROOM JOKE

- Newbie- “What’s that Mushroom?”
- Old Timer- “That’s a Bolete”.
- Newbie- “Is it edible?”
- Old Timer- “All mushrooms are edible....
- At least ONCE!”



Mushroom Identification Skills and Tools

1. Learn the forms of various mushrooms-gilled, puffball, coral, cup, jelly, shelf, pored, etc.
2. Gilled mushrooms- learn the parts of the mushroom-cap, stem, gills.
3. Observe how the mushroom is put together. Gill spacing and attachment. Is the cap smooth or hairy, etc.
4. Taste the mushroom. Taste, chew and spit.
5. Smell the mushroom.
6. Cut the mushroom, does it bruise a color?
7. Growth-on wood, grass, leaf or needle litter?
8. Note the nearest trees and habitat.

ID skills #2

- ▣ Spore color and sporeprints
- ▣ How to make a sporeprint.

- ▣ Mushroom identification is an acquired skill that comes with practice and paying attention to details. What you're trying to do is create a series of filters that eliminate features that don't fit and leave you with a probable close identification.
- ▣ Expect frustration and failure. Persistence pays off!

Forms Mushrooms can Take



gill fungus



bolete type



bracket type



club fungus



stinkhorn



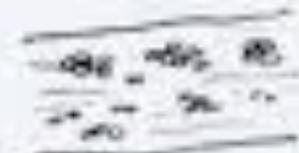
trumpet type



puffball type



cup fungi



blubs on wood

Forms of mushrooms

GILLED SHELF MUSHROOM



REGULAR FLESHY GILLED MUSHROOM



Forms of mushrooms

BOLETES OR FLESHY
PORED MUSHROOMS



POLYPORES OR SHELF
FUNGI



Forms of mushrooms

CUP FUNGI



CORAL MUSHROOMS



Forms Mushrooms can take

JELLY MUSHROOMS



STINKHORNS



Forms of mushrooms

PUFFBALL



STALKED PUFFBALLS



Mushroom + Mycelium = the Whole Fungus

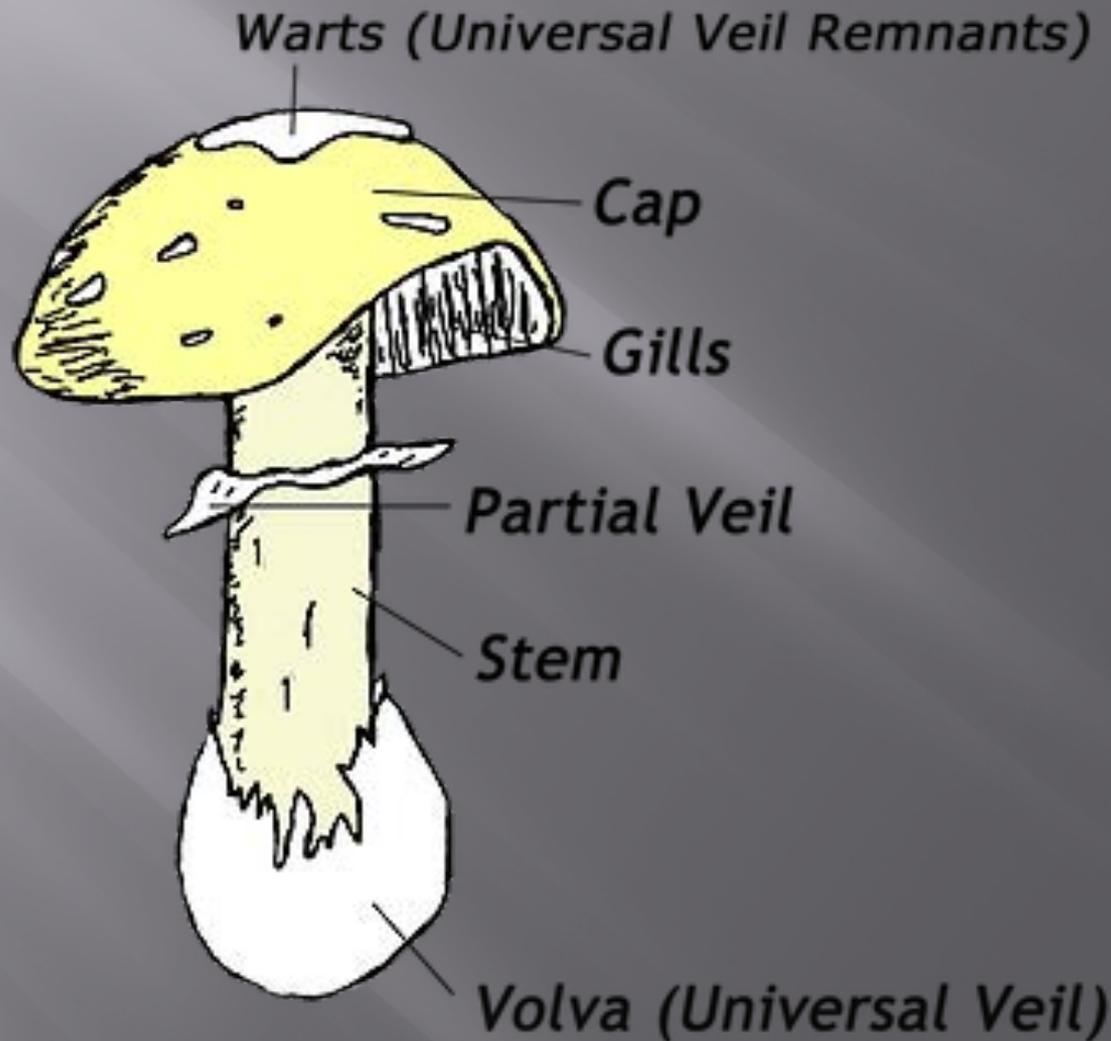
WHAT IS A FUNGUS?

Fungi have two parts:

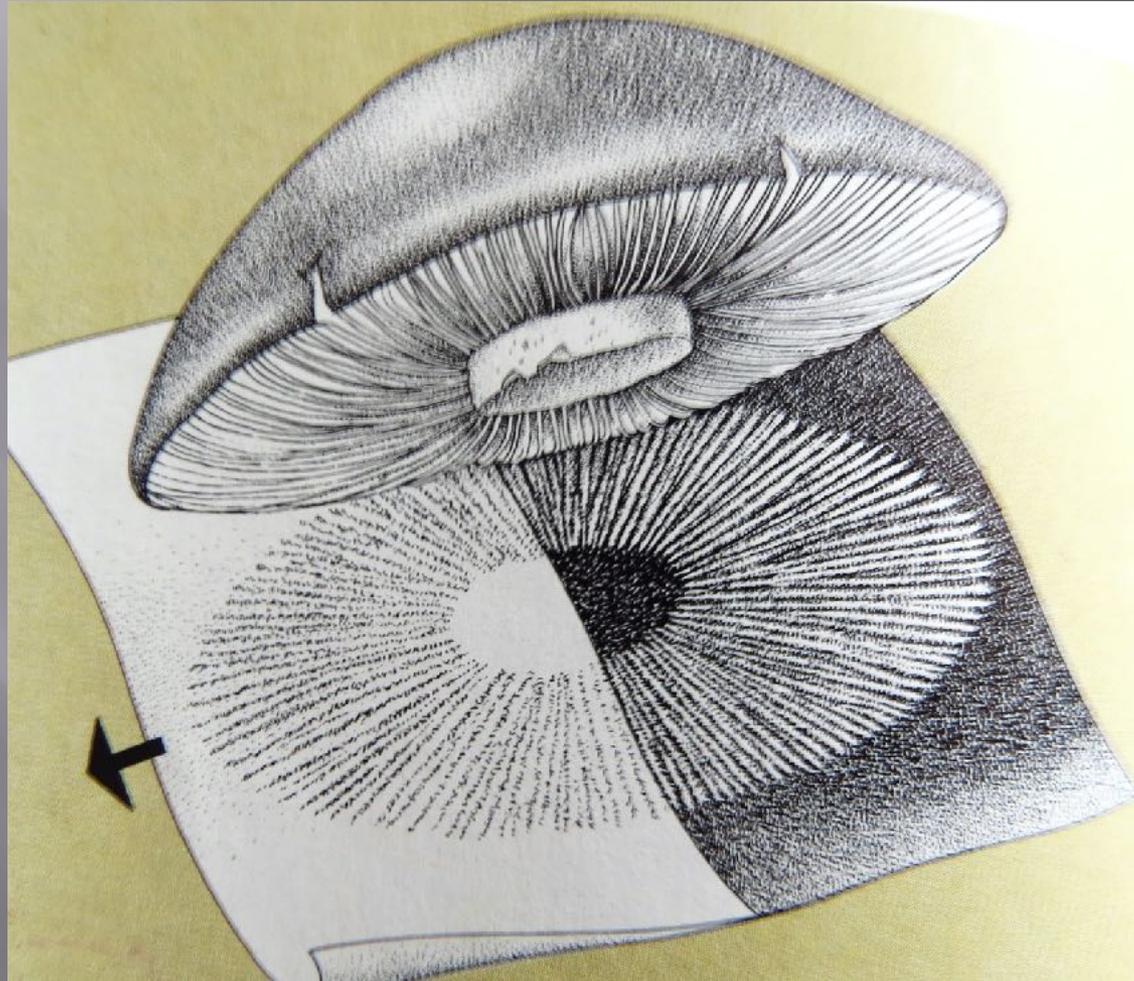
- 1. Mycelium; Vegetative-body.*
- 2. Mushroom; Fruit-body.*



Parts of a mushroom



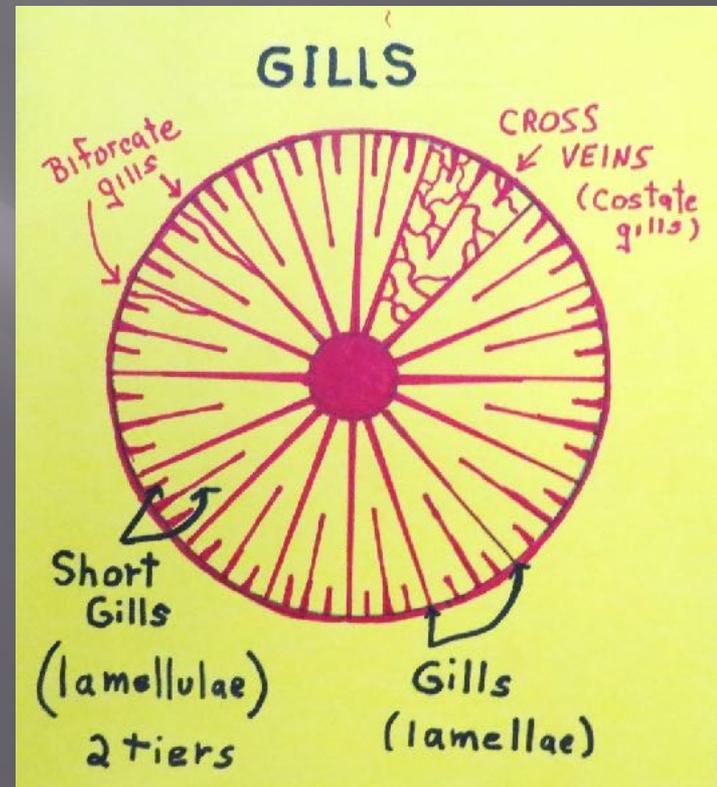
Spore color is a critical step in identification



GILL ATTACHMENT



GILL SPACING AND SHORT GILLS



Looking at gills closely



Gill Spacing- distant



Tools of the Mushroom Hunter

- ▣ A picnic basket for carrying mushrooms.
- ▣ Wax paper bags. Egg cartons, tackle box.
- ▣ A knife and a brush for cleaning.
- ▣ A hand lens or loupe.
- ▣ A camera for pictures in situ.
- ▣ A pen and notebook for taking notes.
- ▣ Insect repellent and a hat.
- ▣ Compass.
- ▣ Water bottle
- ▣ Your five senses

Tools for Foraging



Deadly Poisonous Mushrooms: Amanita



- ▣ Amanita poisoning is serious and can result in death. So we learn the **KILLERS** first!
- ▣ First symptoms are nausea, vomiting, dehydration and food poisoning like symptoms.
- ▣ Then there is a **FALSE** recovery for one to two days, and then liver and kidney failure occur.
- ▣ You **MUST** go to the hospital.

The Deadliest Mushroom

AMANITA PHALLOIDES-
THE "DEATH CAP"

HOW TO KNOW THE
DEATH CAP



The Destroying Angel

AMANITA VIROSA



AMANITA "EGG"



Another Deadly Mushroom

GALERINA MARGINATA

THIS CAN LOOK LIKE A
“HONEY MUSHROOM”



Amanita that are NOT deadly

AMANITA JACKSONII-THE
AMERICAN CAESAR



AMANITA MUSCARIA- THE
FLY AGARIC



Top 10 Edible Mushrooms

CHICKEN MUSHROOM-
LAETIPORUS SULPHUREUS



WHITE CHICKEN- LAETIPORUS
CININNATUS



#9

HONEY MUSHROOM
ARMILLARIA GALLICA



A LOOKALIKE
MUSHROOM- *GALERINA*



#8

AGARICUS ARVENSIS-
HORSE MUSHROOMS



DANGEROUS LOOKALIKE
DESTROYING ANGEL



#7

MATSUTAKE- TRICHOLOMA
MAGNEVELARIS



TRICHOLOMA CALGATUM



#6

GRIFOLA FRONDOSA- HEN
OF THE WOODS



BERKLEY'S AND BLACK
STAINING POLYPORES



#5

PUFFBALLS- CALVATIA
CYATHIFORMIS

SMOOTH ALL THE WAY
INSIDE



Beware of this



Poison Pigskin Puffball *Scleroderma citrina*



#4

KING BOLETE- PORCINI



BOLETUS EDULIS



King Bolete lookalike



#3-other boletes

XANTHOCONIUM
PURPUREUM



ORANGE-TOP; LECCINUM
VULPINUM



One Toxic Bolete



#2

MORELS- SPONGE
MUSHROOMS- YELLOW FORM



MORCHELLA AMERICANA-
GREY FORM



False Chanterelle- *Hygrophoropsis aurantiacum*



#1 top mushroom...Real Chanterelles

GOLDEN CHANTERELLE



WINTER CHANTERELLE



Chanterelle lookalike is the Jack-o-lantern- *Omphalotus olearis*



...and the greatest of all chanterelles
is...

BLACK TRUMPET-
CRATERELLUS FALLAX



DEVIL'S URN- URNULA
CRATERELLUM



Medicinal Mushrooms

REISHI, GANODERMA
TSUGAE



CHAGA, INONOTUS
OBLIQUIS



Medicinal Mushrooms

TURKEYTAIL, TRAMETES
VERISICOLOR



FOMES FOMENTARIUS, AN
“ICEMAN” FUNGUS



Grow your own mushrooms- you can grow wood decay fungi!

SHIITAKE



OYSTERS, PLEUROTUS SPECIES



Break Time Big Laughing Gym Psilococybin mushrooms



PART 2- AMATEUR MYCOLOGY

The Study of Fungi and Citizen
Science

What are Fungi?

- ▣ Learning to ID and forage wild mushrooms (without killing yourself) leads you into learning the habits and lifestyle of fungi.
- ▣ The mushrooms we hunt are simply the fruiting bodies of SOME kind of fungi.
- ▣ In the next section we'll take a beginning look into the biology and ecology of fungi.

Fungi Defined

1. Eukaryotes- DNA in nucleus and organelles.
2. Heterotrophs- they have to get food from the environment.. Can't make their own like plants.
3. Absorptive nutrition- they digest food outside their body by exporting enzymes that break down organic molecules; then they absorb the digested food through their cell walls. Animals eat first, then digest. Fungi digest first, then eat.
4. Cell walls are made of chitin.
5. Fungal bodies are filamentous- made of hollow thread-like strands (hyphae) that form a mass called the mycelium.

Mycelium is the vegetative body of all fungi. The “THALLUS”

- Mycelium branches and grows through its substrate (soil, wood, leaves, dung, etc.) and explores the environment for resources. Some mycelium is 1,000's years old and cover 1,000's of acres.



Three Multicellular Kingdoms



PLANTS are multi-cellular organisms that have a cell wall made of cellulose and make their own food by a chemical process called photosynthesis.

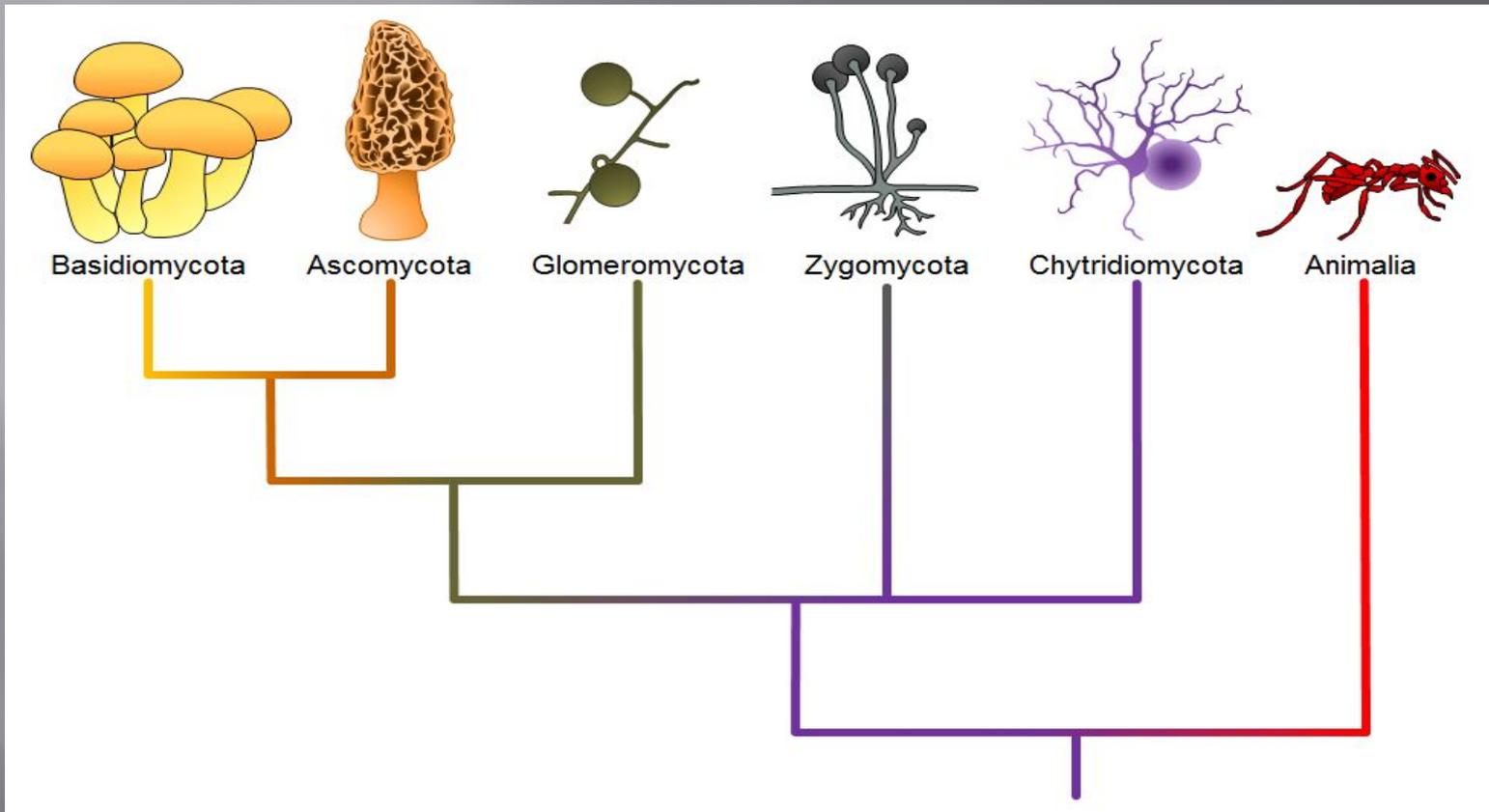


Animals are multi-cellular organisms that have no cell wall and obtain nutrition by ingesting food food particles.

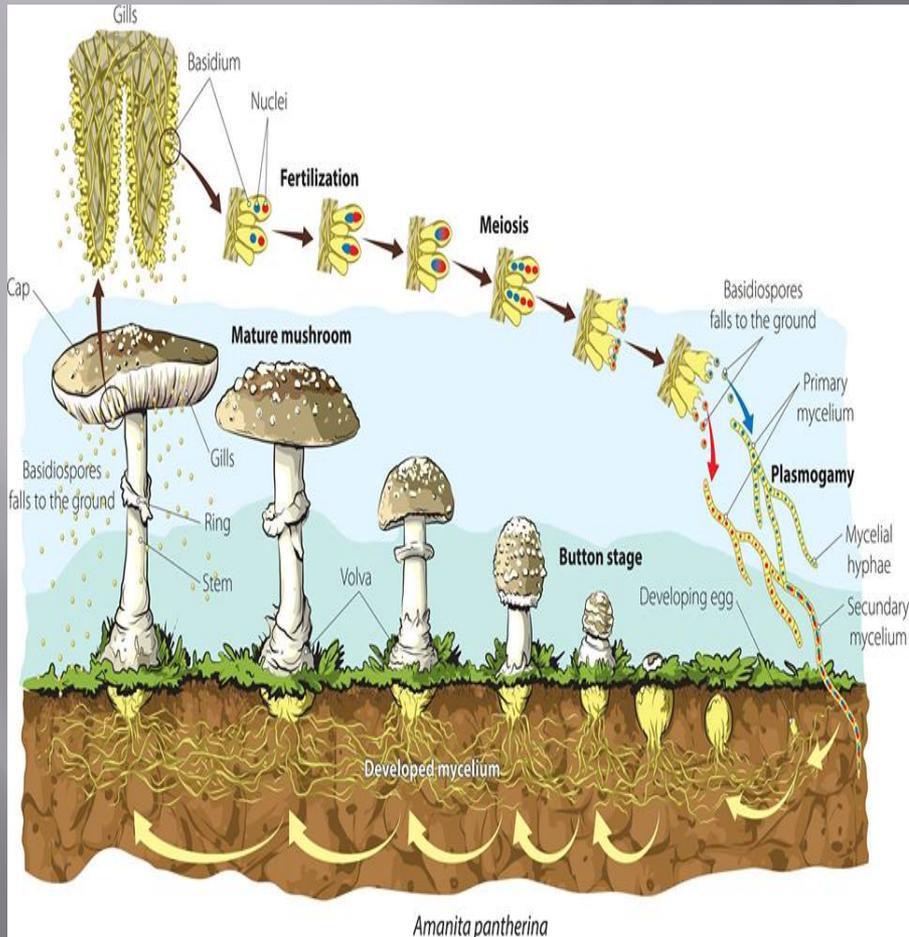


Fungi are multi-cellular organisms that have cell walls made of chitin and obtain nutrition by excreting enzymes outside their body that dissolves food particles and then they absorb the dissolved food through their cell walls.

Fungal Classification

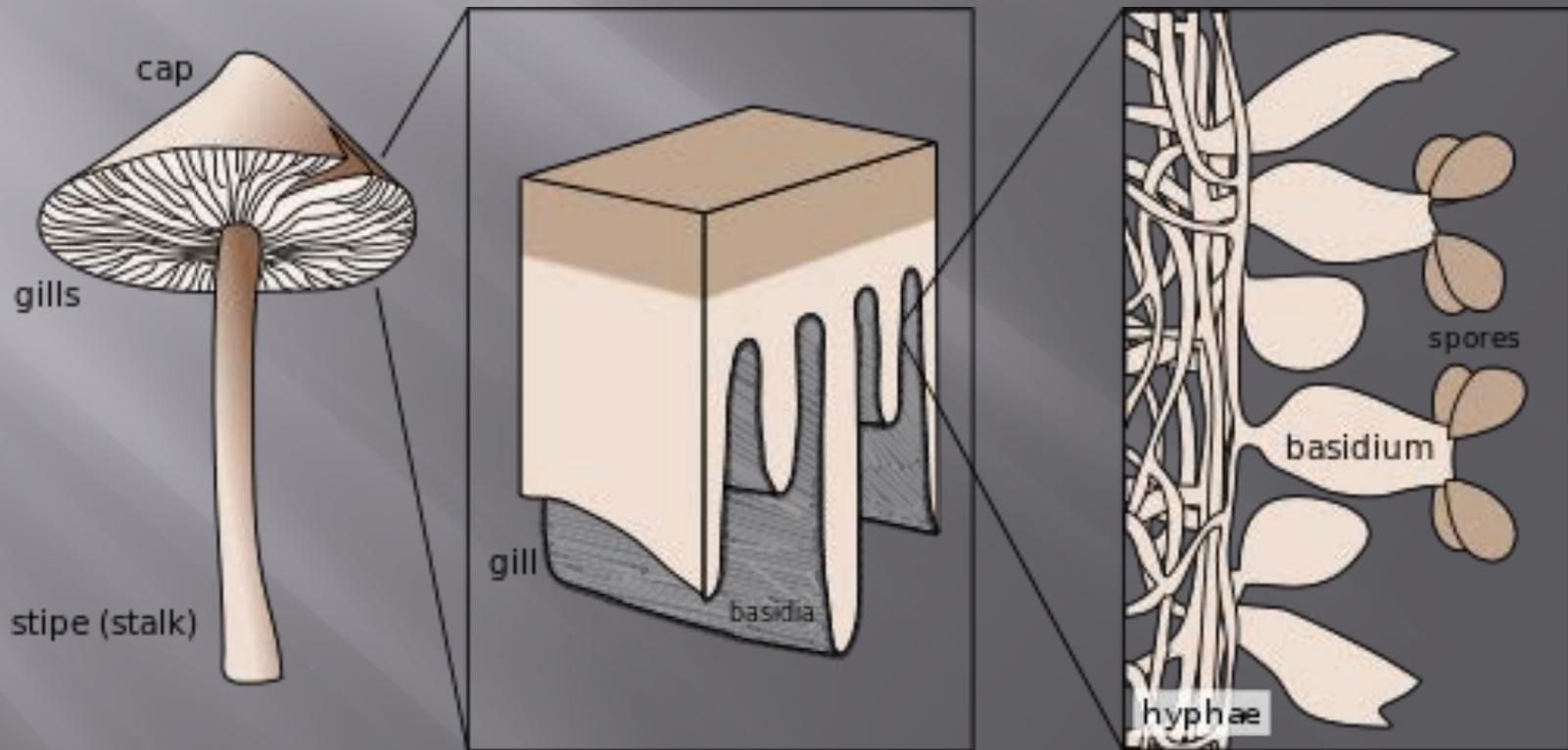


Fungal Lifecycle in Mushroom Producing Fungi

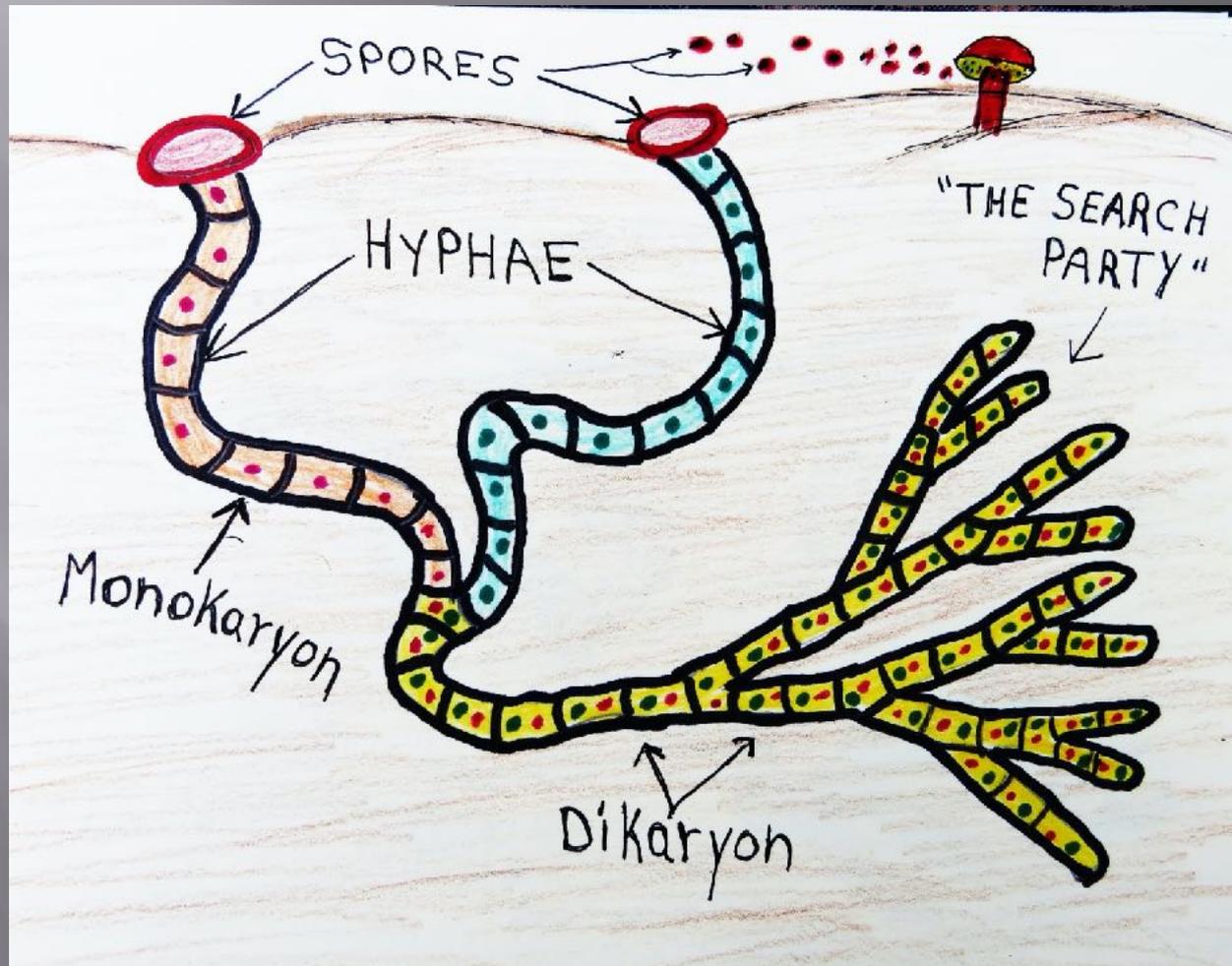


- In its simplest form, fungal life starts with a spore.
- Spores germinate into hyphal strands called mycelium. Two compatible mycelium meet, fuse, and grow.
- When conditions are right the mass of mycelium come to the surface and form a mushroom. The mushroom producers spores.

Reproduction in Basidiomycete fungi



Compatible hyphae fuse to form fertile or dikaryotic hyphae



Mycelium, the vegetative mass of hyphae in fungi are foragers

- ▣ Some mycelium forages through the soil looking for a plant or tree partner, a mycorrhizal association.
- ▣ Some mycelium forages through the soil and forest floor litter looking for wood, leaves, needles or other organic carbon compound to degrade.
- ▣ Some mycelium attacks living trees, insects or other animals and micro-organisms.
- ▣ When mycelium finds what it needs the strands of hyphae mass together in cords called rhizomorphs that function like a pipeline that can interconnect as a network throughout the forest.

Ecology or Fungal Lifestyles

- ▣ Fungi have three main ecological modes.
- ▣ 1. SAPROTROPHS- they are the recyclers. They degrade organic material like wood, leaves and conifer needles, grass, dung, dead animals, etc. As they degrade organics they free up biochemical nutrients for other organisms.
- ▣ Wood Decay fungi recycle the forest. They are of two types- White rot fungi decay lignin and cellulose. *Ganoderma tsugae*, or Reishi. Brown rot degrade cellulose and hemicellulose but not lignin. *Piptoporus betulina* or Birch polypore,

Fungal Lifestyles continued

- ▣ 2. Parasites- these fungi attack living organisms, mostly plants and trees but also animals.
- ▣ 3. Symbiotes- these fungi live in some kind of partnership with another organism, usually a plant or tree. Lichens, Endophytes and Mycorrhizal fungi.

2. Parasitic Fungi can destroy whole forest ecosystems

- ▣ Beginning around 1903 the Chestnut Blight fungus destroyed ALL the American Chesnut trees in North America, forever changing the composition of eastern forests.
- ▣ Since the mid 1900's Dutch Elm Disease fungus has killed millions of American Elm trees, a favorite shade tree of cities and towns.
- ▣ One kind of "Honey Mushroom", *Armillaria mellea* infects 1,000's of acres of forest trees in northern latitudes.

3. Symbionts- Lichens are a relationship between a fungus and an algae or cyanobacteria.



Symbionts- Endophytes

- ▣ Enophytes are tiny free living fungi found inside the leaves of plants and trees that protect the plant from microbial attacks.
- ▣ Little is known about endophytes and science is just beginning to investigate them and their role in ecosystems.

Symbionts- Mycorrhizal fungi

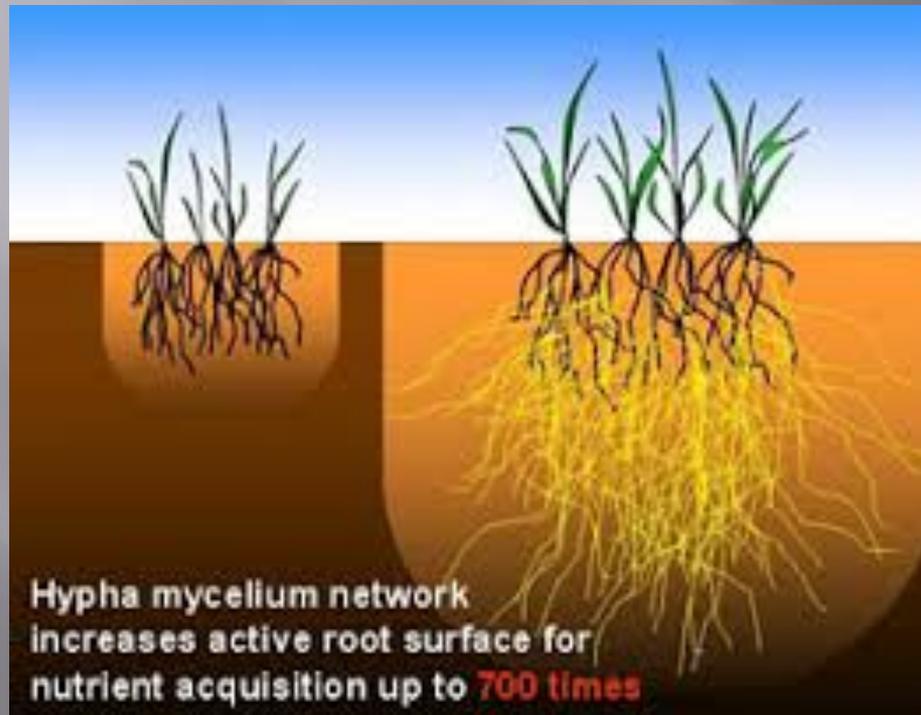
- ▣ Mycorrhizal fungi are currently the superstars of the fungal kingdom.
- ▣ IT HAS BECOME KNOWN AS THE “FUNGAL INTERNET” OR THE WOOD WIDE WEB. It seems that forests can communicate through fungi with other trees and plants and everything in the forest is connected for the benefit OF THE WHOLE FOREST!!
- ▣ There are several kinds of mycorrhizal fungi.
- ▣ Mycorrhizae means “fungus/root”. The fungus and the roots of plants and trees bond together and the plant gives the fungus sugars and the fungus gives the [plant, water, biochemical nutrients (N,P,K) and helps the plant fight disease. This symbiosis is termed mutualism.
- ▣ We will look at the two main types of mycorrhizae.

Mycorrhizal Symbiosis- The Fungus/ Plant Connection

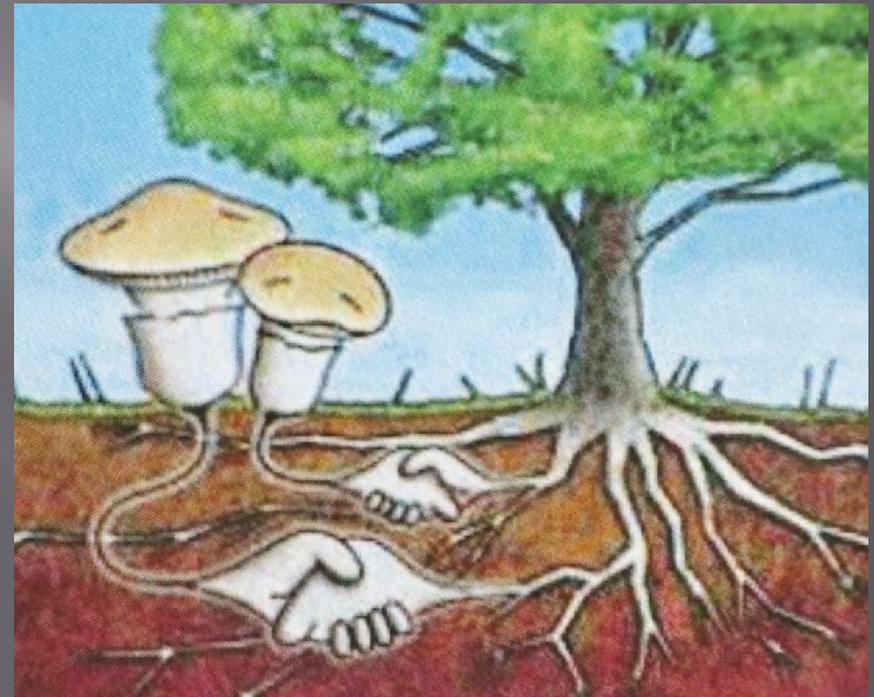
- ▣ More than 90% of all plants are involved in a mycorrhizal relationship with Fungi.
- ▣ Mycorrhizae helped plants colonize land more than a half a billion years ago.
- ▣ Mycorrhizal symbiosis allows fungi to get photosynthates (sugars) from plants and in return they give the plant water, nutrient minerals (N, K, P, S) AND they allow plants to communicate with other plants through a **COMMON MYCELIAL NETWORK!**

Main types of Mycorrhizae: AM and EM

ARBUSCULAR MYCORRHIZAE (ALSO VAM OR ENDOMYCORRHIZAE)



ECTOMYCORRHIZAE EM



Arbuscular Mycorrhizae (AM)

- ▣ AM fungi are asexual soil fungi. They don't form mushrooms.
- ▣ 200 different species
- ▣ All AM are Glomeromycota
- ▣ Obligate biotrophs
- ▣ 460-500 MYO, colonized land with plants
- ▣ Grass, food crops, shrubs, trees, 80%

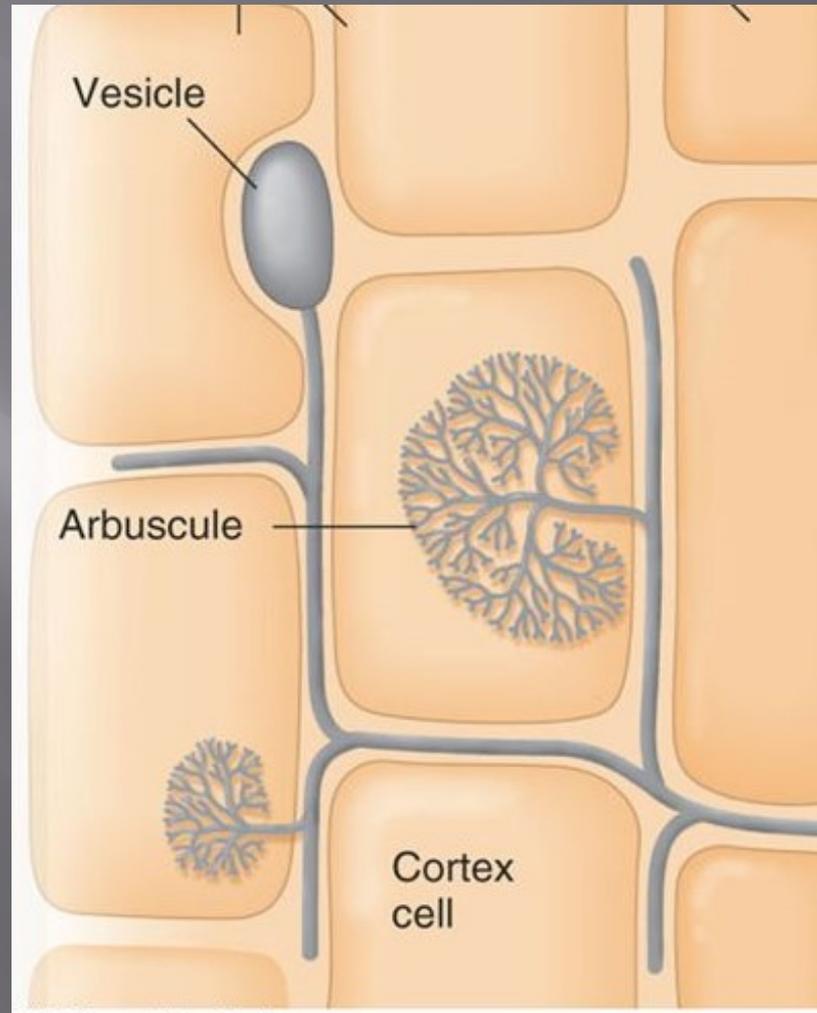


ARBUSCLES

AM fungi, the Glomeromycota, evolved only once and so..

They are a clade, a single monophyletic lineage

They are united by arbuscules



Fun Facts about AM Fungi

Although there's only about 200 species they may associate with 40,000 plant species or 85-90% of land plants

They are ancient, more than a half a billion years old, yet little changed.

They are supposed to be responsible for plants ability to colonize the land.

AM fungi are “keystone species” of the microbial soil food web.

They assist in the uptake of ALL plant nutrients.

They are essential to restorative agriculture

Mycorrhizial Forest Fungi

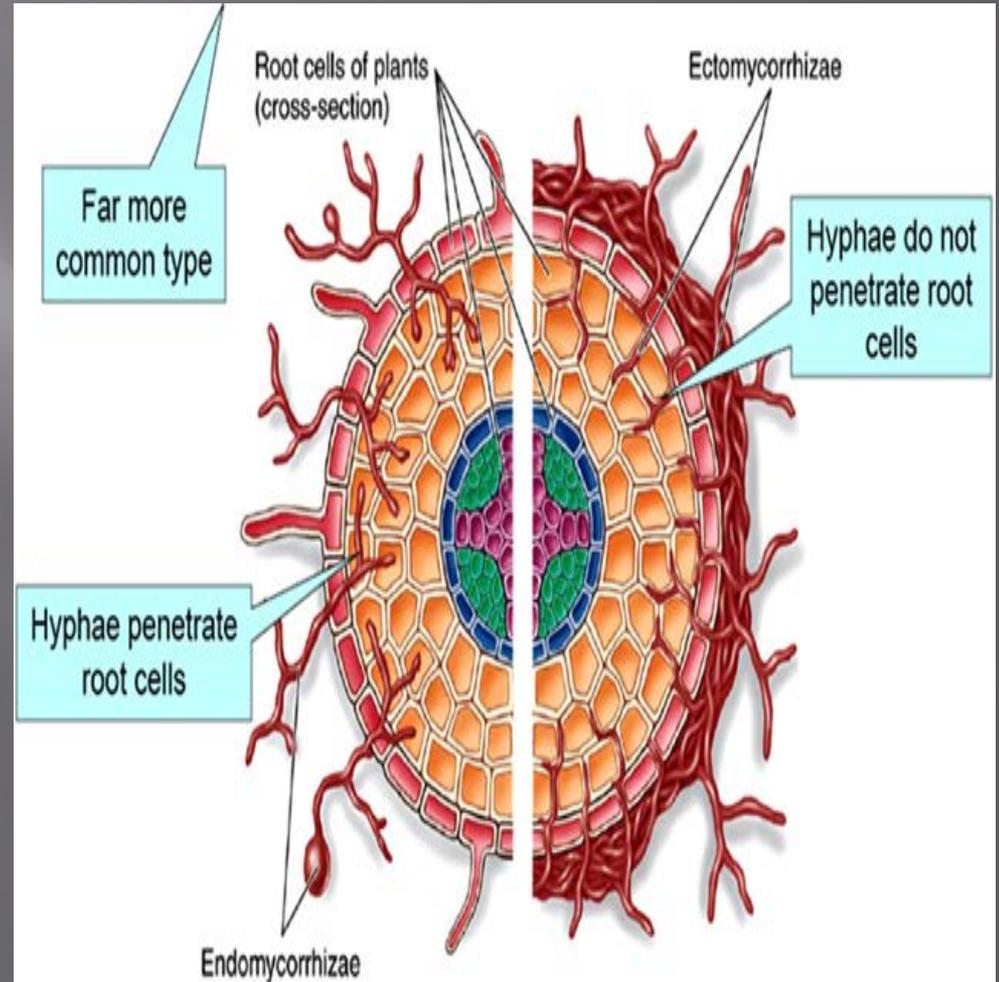
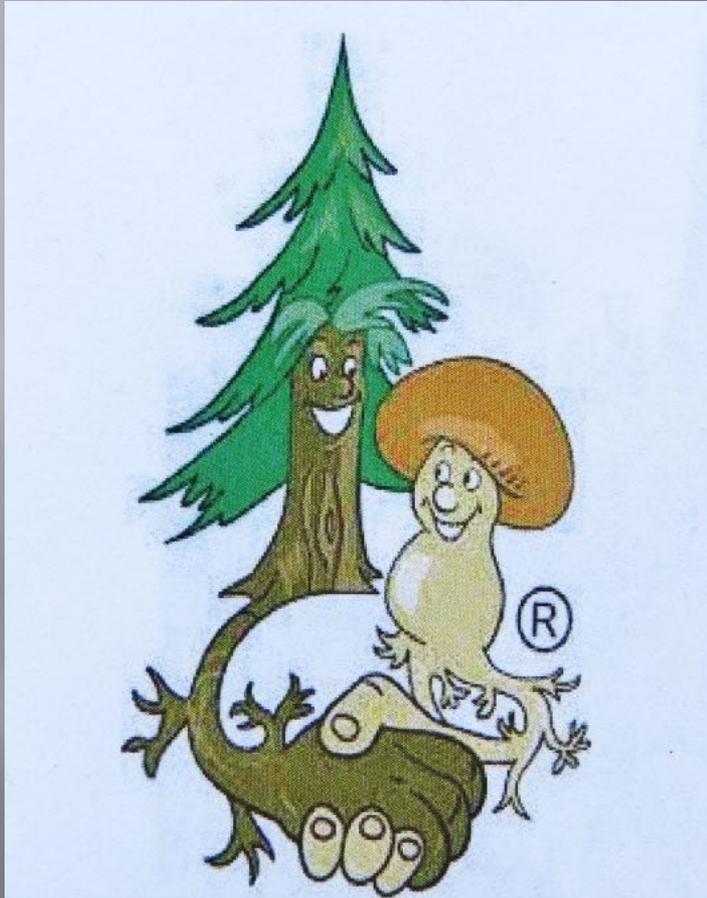
EM, Ectomycorrhizial fungi are the mushroom producing fungi of temperate and boreal forests.

EM fungi are our familiar *Russula*, *Amanita*, boletes, *Lactarius*, *Tricholoma*, *Scleroderma*, Chanterelles, truffles, *Porcini*, *Matsutake* and others.

EM fungi associate with tree roots but the hyphae do NOT penetrate the root cells.

Three characters unite EM fungi- the mantle, the Hartig net, and extraradical mycelium. More about these later.

Ectomycorrhizae(EM)



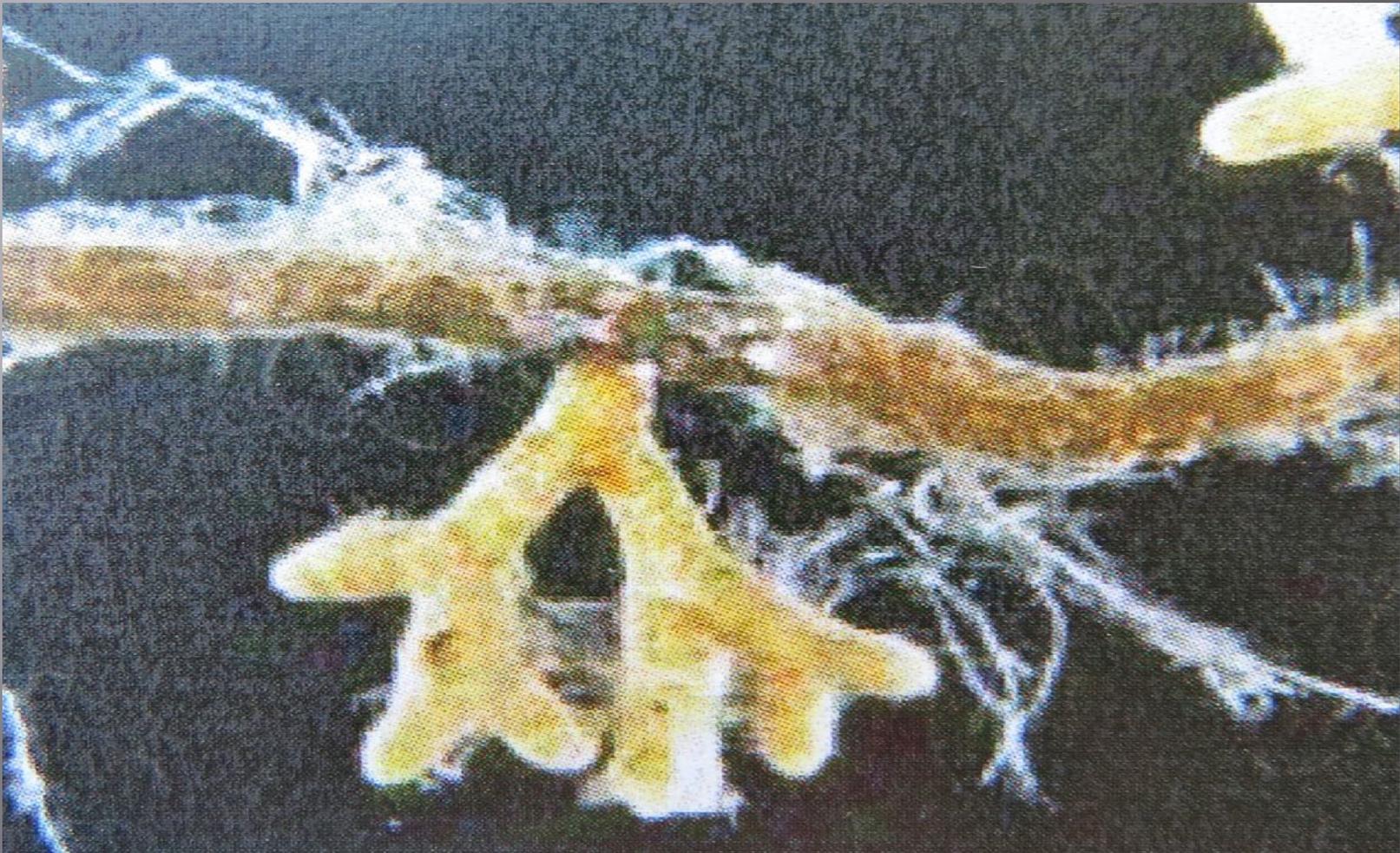
EM Fungi- The Secret Handshake

- ▣ EM fungi evolved with trees, first Conifers, then Broadleaf.
- ▣ Pinaceae, Fagaceae, Betulaceae, Diptocarpeae and others.
- ▣ Ash, Sycamore and Maple are MOSTLY AM
- ▣ EM evolved from wood decay and parasitic lineages.
- ▣ High species diversity of EM fungi indicates a healthy, stable forest.

Characteristics of EM Fungi

- ▣ EM Fungi favor trees in poor xeric, shallow soils.
- ▣ Rich deep mesic soils have few EM
- ▣ Trees actively seek out EM partners with chemical signals.
- ▣ EM Fungi seek out trees to partner with.
- ▣ When fungi approach a tree root a chemical “getting to know you” signal exchange ensues.
- ▣ Scientists are just beginning to unlock the extent of the complexity of chemical signaling between fungi and trees in the ectomycorrhizal relationship.

EM Colonized Roots are short, stubby and near the surface



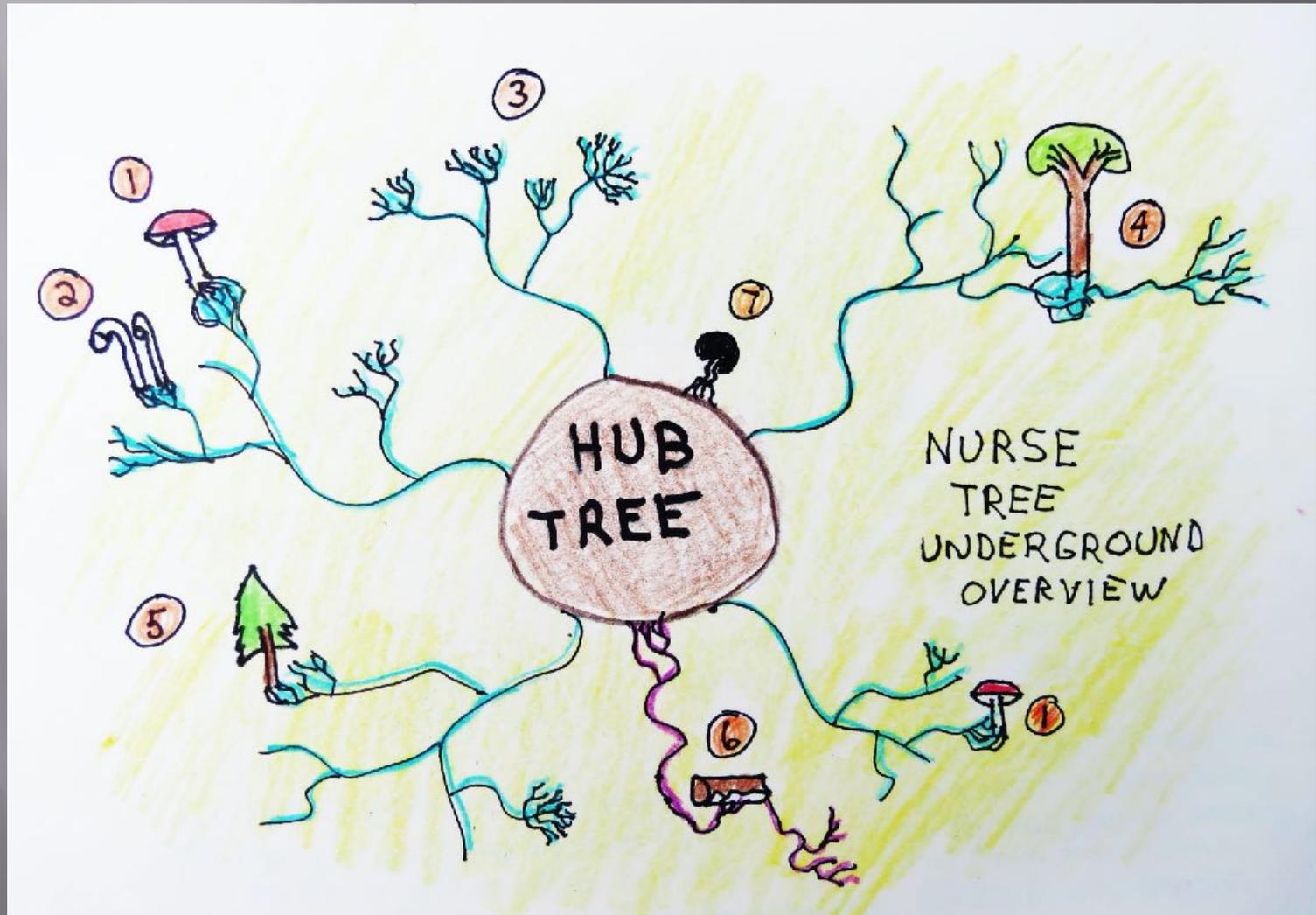
Extraradical Mycelium

- ▣ After an EM fungus colonizes tree roots it can leave the root as EXTRARADICAL MYCELIUM AND DO MANY THINGS-
- ▣ 1- make a mushroom
- ▣ 2- translocate sugars to another tree (maybe a needy seedling)
- ▣ 3- forage the soil for organic material
- ▣ 4- forage the soil for the host tree and send N, P, K, H₂O
- ▣ 5- find another tree to colonize
- ▣ 6- send messages to other trees

Extraradical Mycelium continued

- ▣ 7- get robbed of Carbon by a mycoheterotroph
- ▣ 8- colonize a Ericaceous plant
- ▣ 9- Extraradical mycelium can do all of these things and more because the mycelium is a **TWO WAY STREET!!** Everything above can flow away from the tree **OR** back to the tree depending on the needs of all the connected partners. Extraradical mycelium creates and integrated, interconnected distributed network of transport and communication throughout the forest.

NURSE (OR HUB) TREES



Two views of a Forest

ABOVE GROUND

Competition- reach for the sky.

Every individual for themselves

In the rush for real estate there's winners and losers and only the strong survive

The above ground view is an illusion

BELOW GROUND

- ▣ Cooperation- everybody is connected
- ▣ Roots interact with fungi and bacteria and share resources...the rhizosphere.
- ▣ The primary goal is the survival of the community
- ▣ Interconnectedness and interdependence is the hidden reality of forests

A Forest is more than the sum of its Trees



Thank you all- Bill Yule



Resources on the Web

- ▣ Mushroom Expert dot com
- ▣ Mushroom observer dot com
- ▣ Indiana Mushrooms dot com
- ▣ I-Naruralist dot com
- ▣ Youtube videos-
- ▣ Learn Your Land
- ▣ Fungi Perfecti with Paul Stamants