



Exploring the Fungi – in your garden and beyond



Matthew E. Smith – UF Plant Pathology
<trufflesmith@ufl.edu>

Moving beyond the 4 cocktail party discussions...



Not sure, but it could be a fungal infection...





Amanita muscaria



Psilocybe cubensis

Claviceps purpurea





Amanita bisporigera



**I found these cool mushrooms.
Can you tell me the species?**

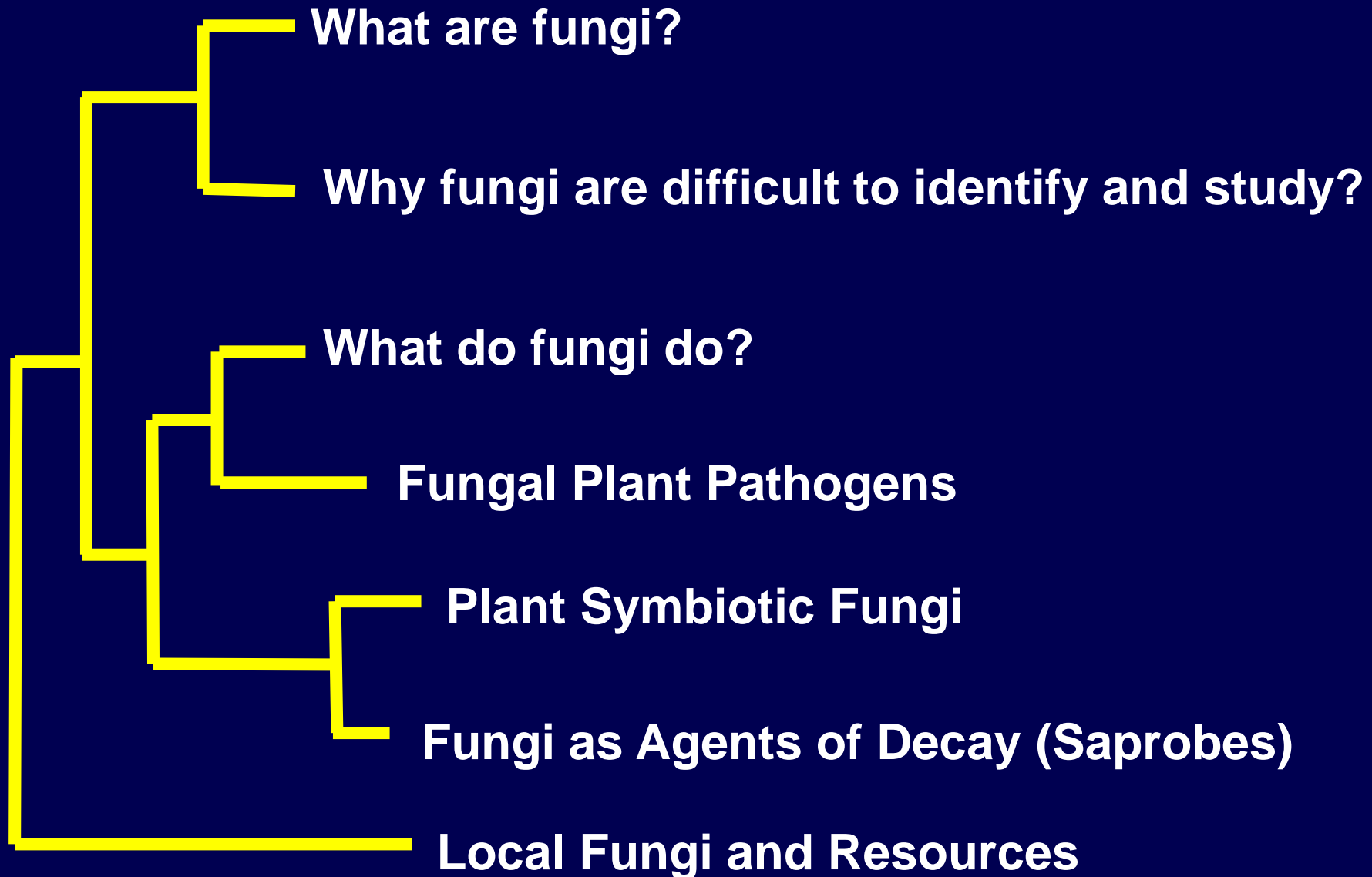
**Color?
Hmmm.
They may have
been orange???**



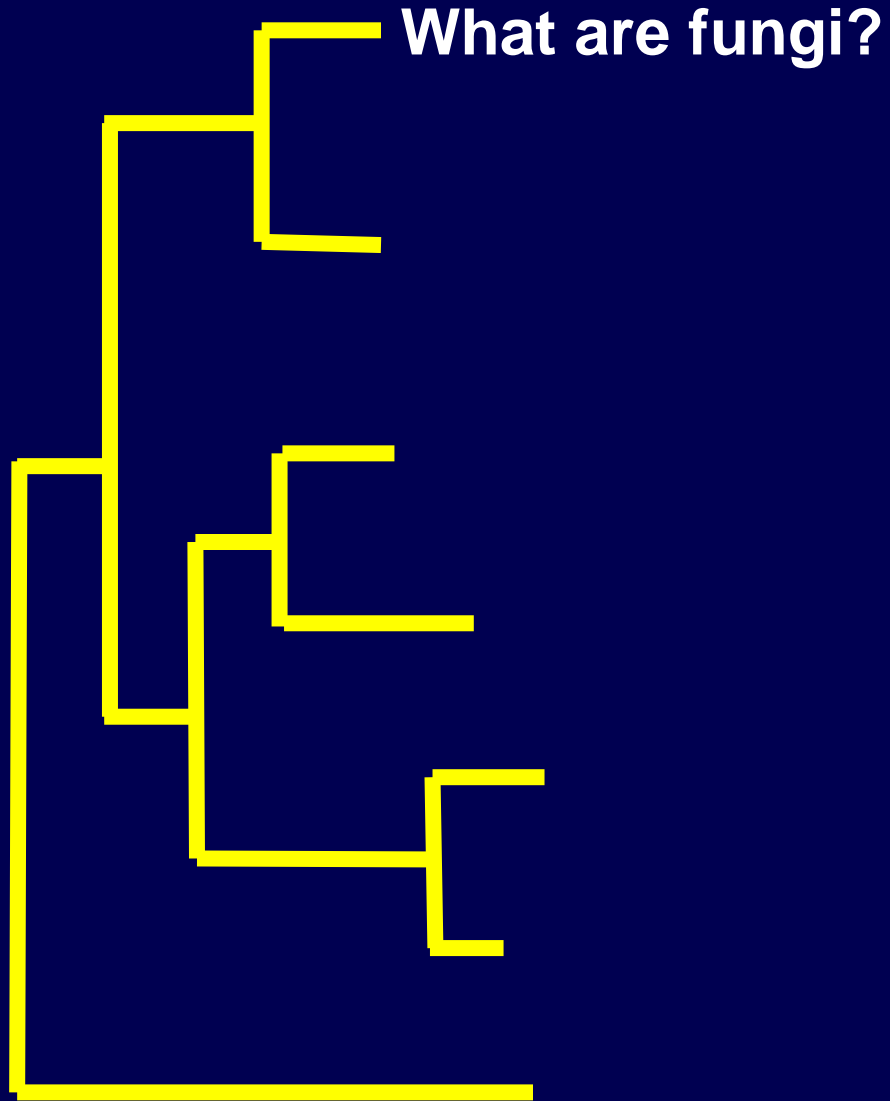


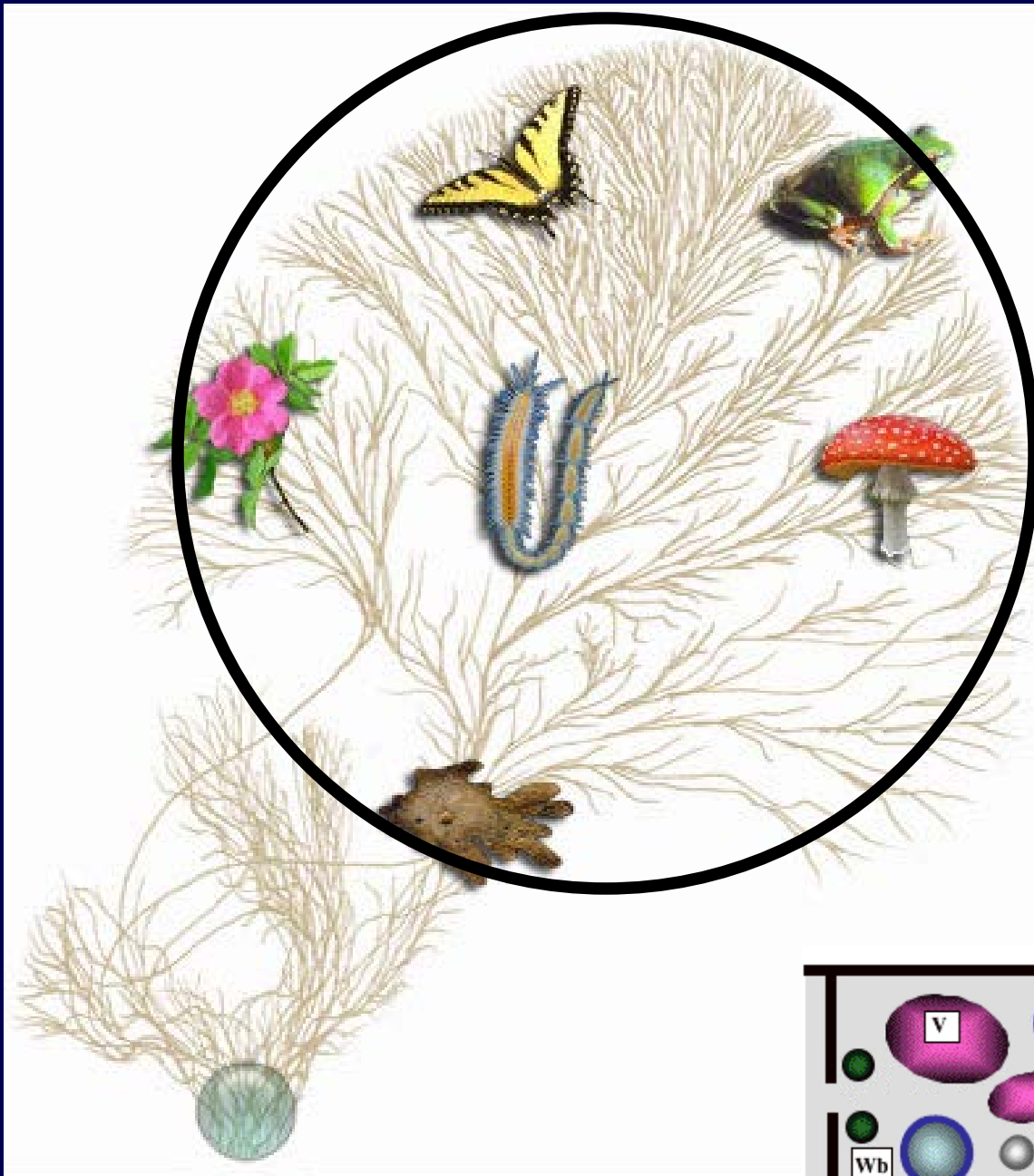
**Fungi seem a
bit mysterious.
What are they?**

Outline

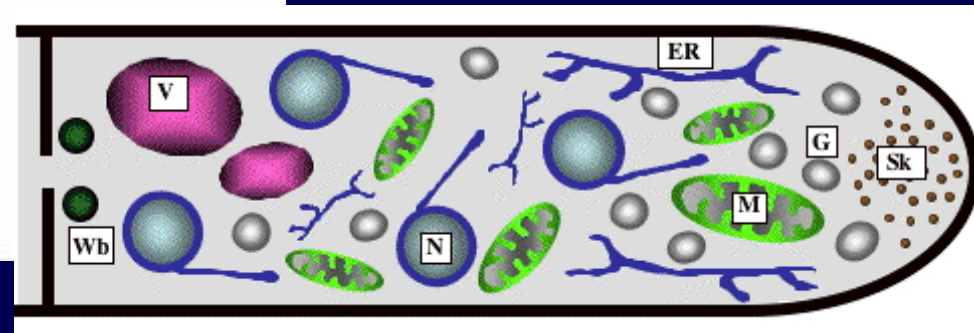


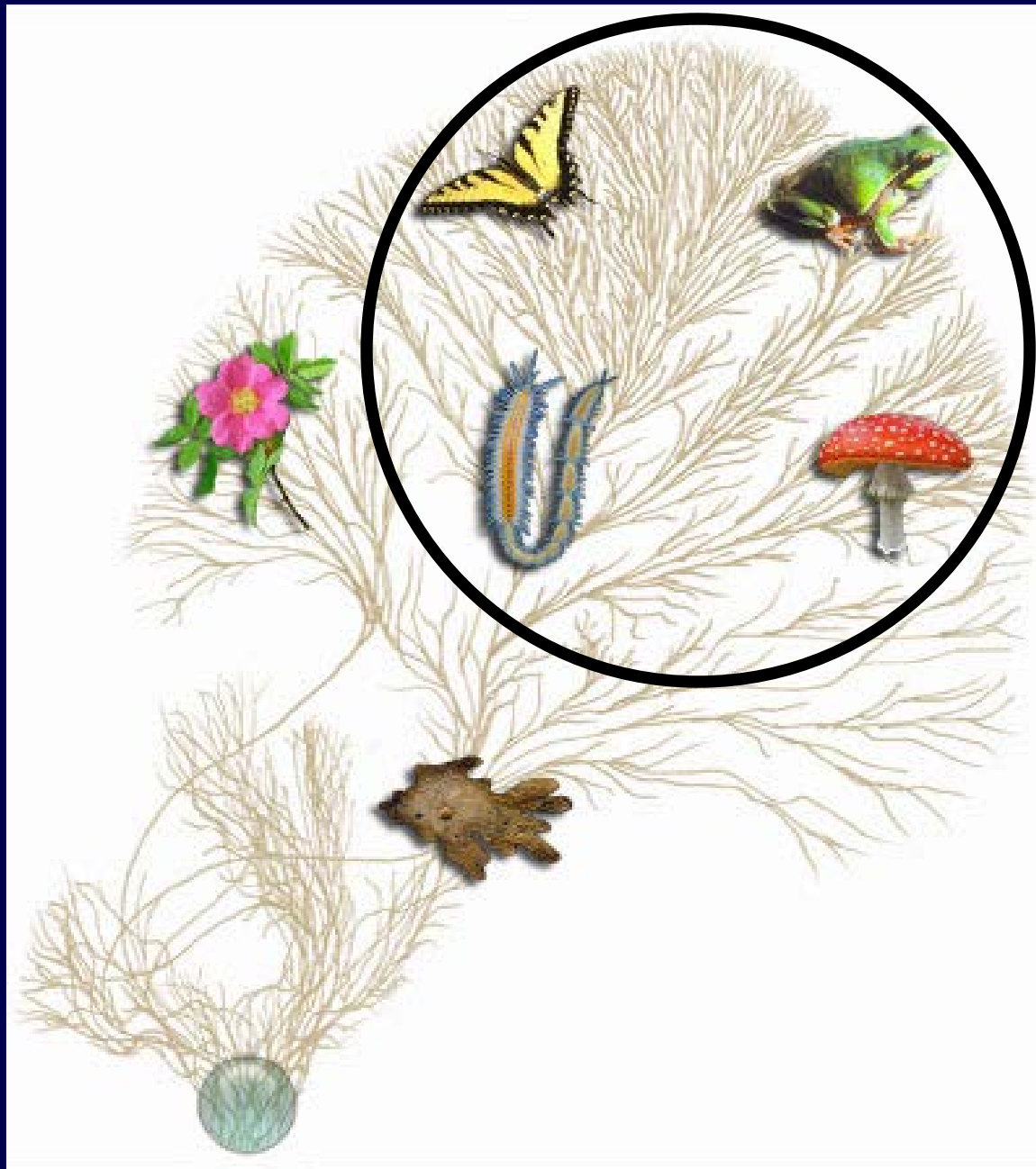
Outline





1. Eukaryotes
they have a
nucleus and
other organelles



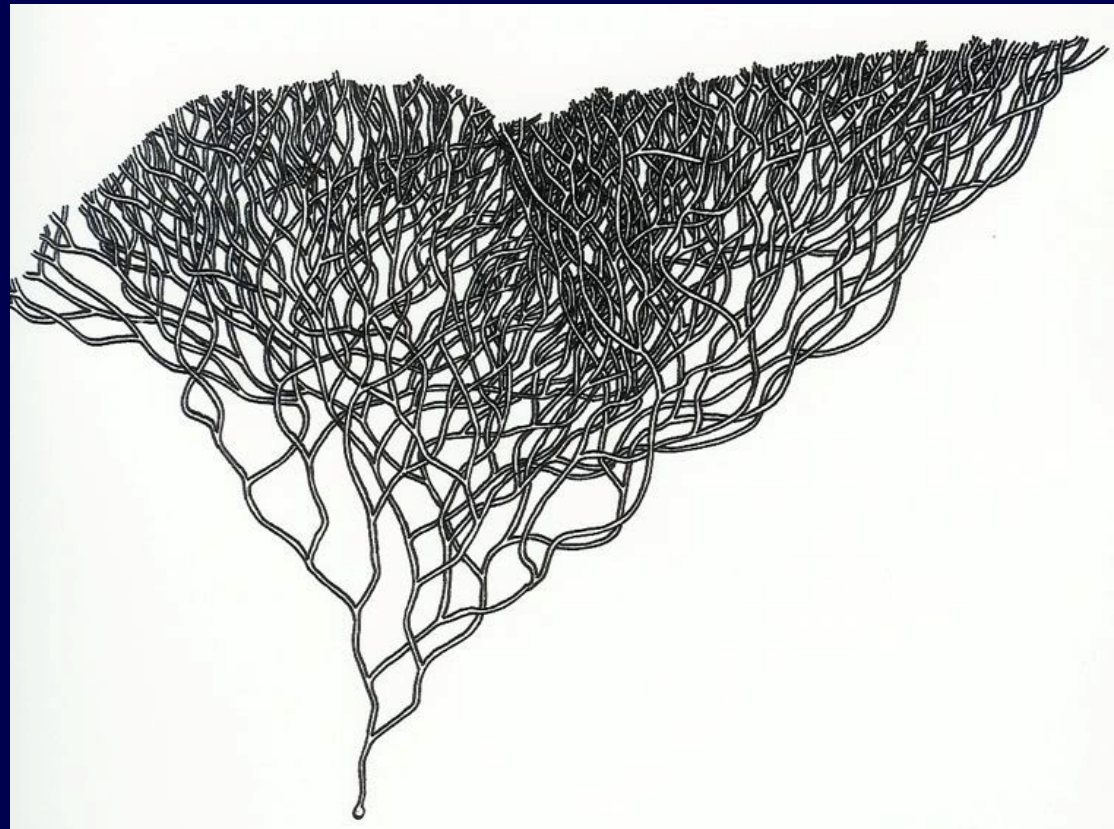


2. Heterotrophic
They obtain
nutrients from
other organisms.



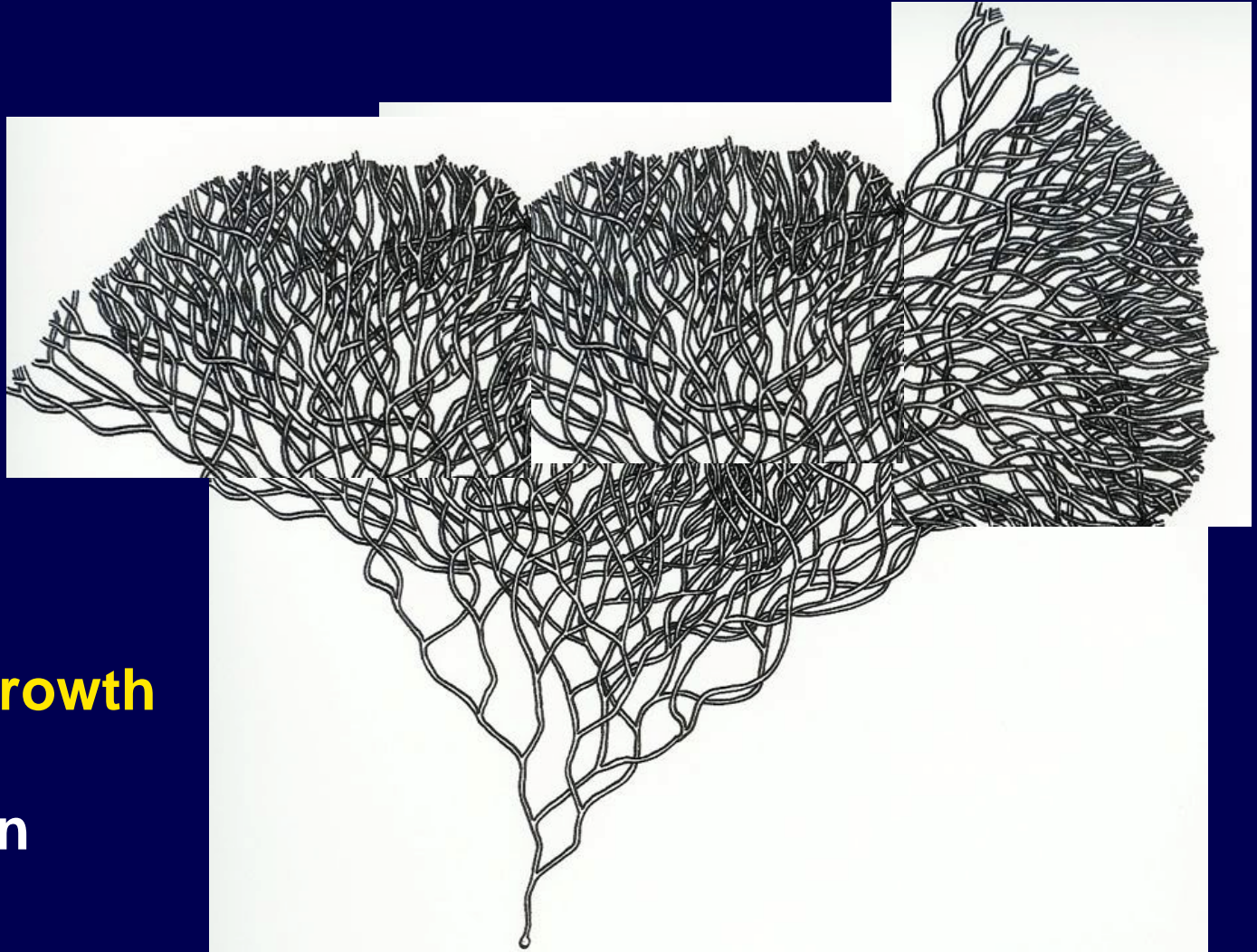
3. Indeterminate growth

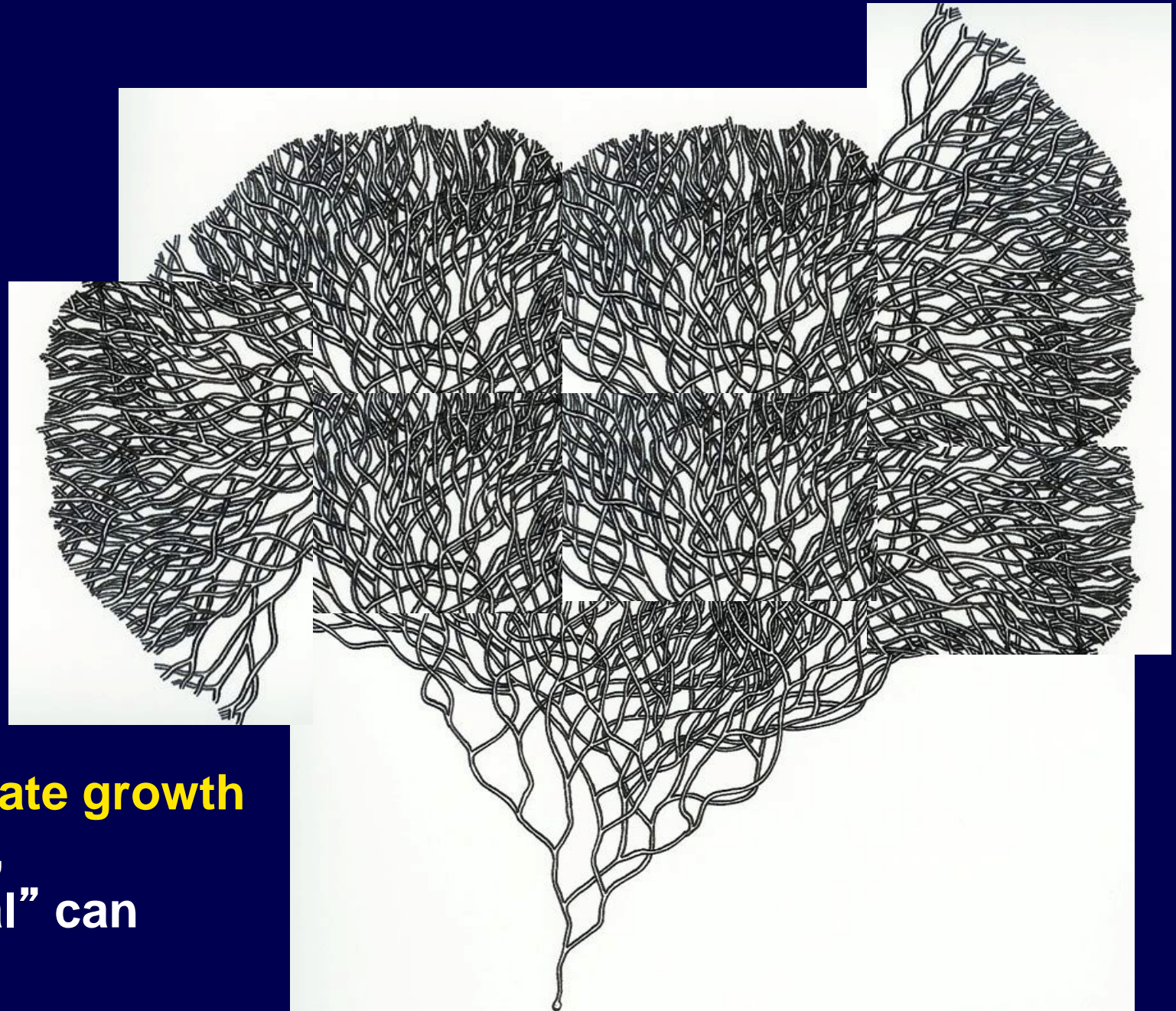
Theoretically,
an “individual” can
live forever.



3. Indeterminate growth

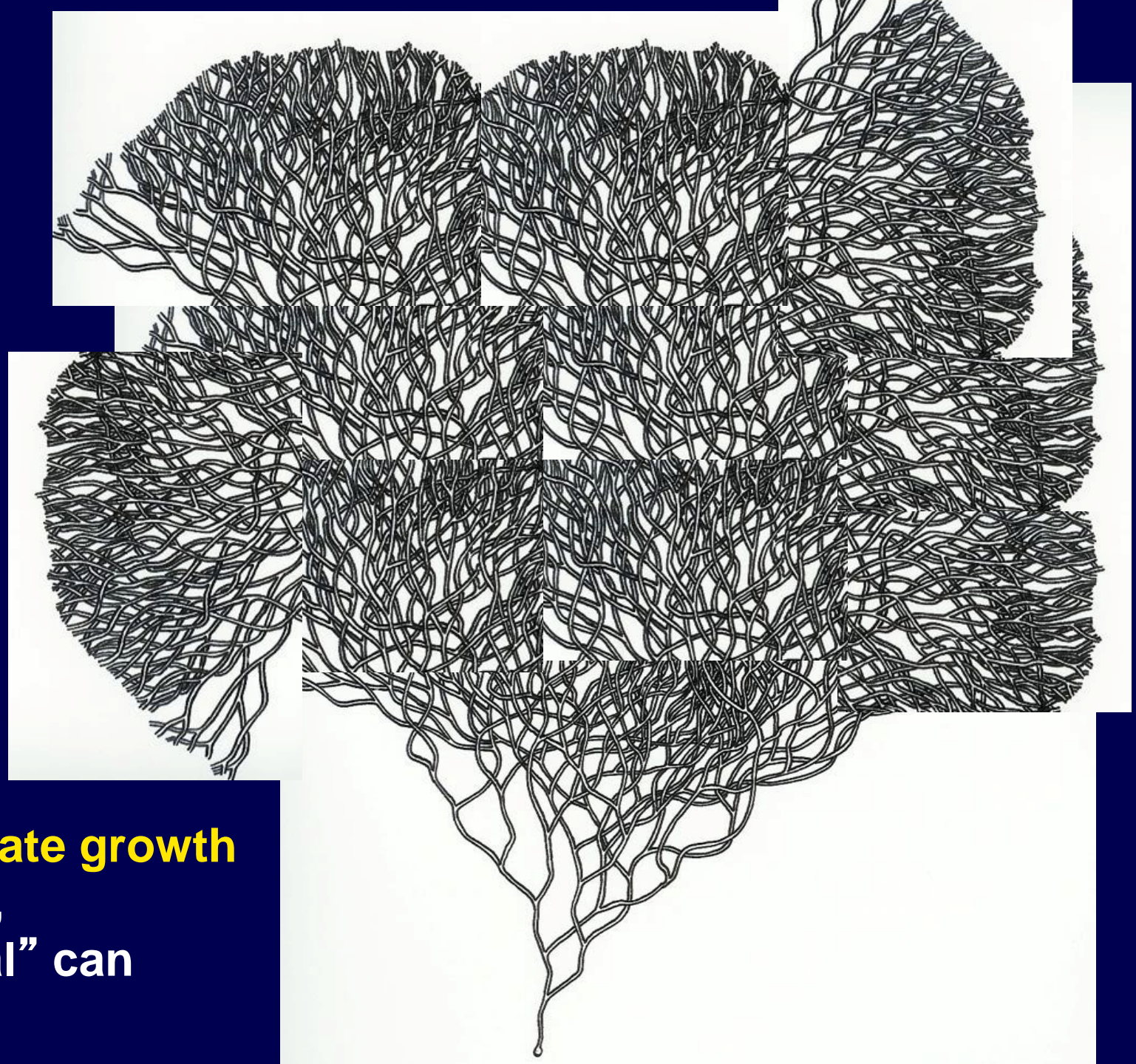
Theoretically,
an “individual” can
live forever.





3. Indeterminate growth

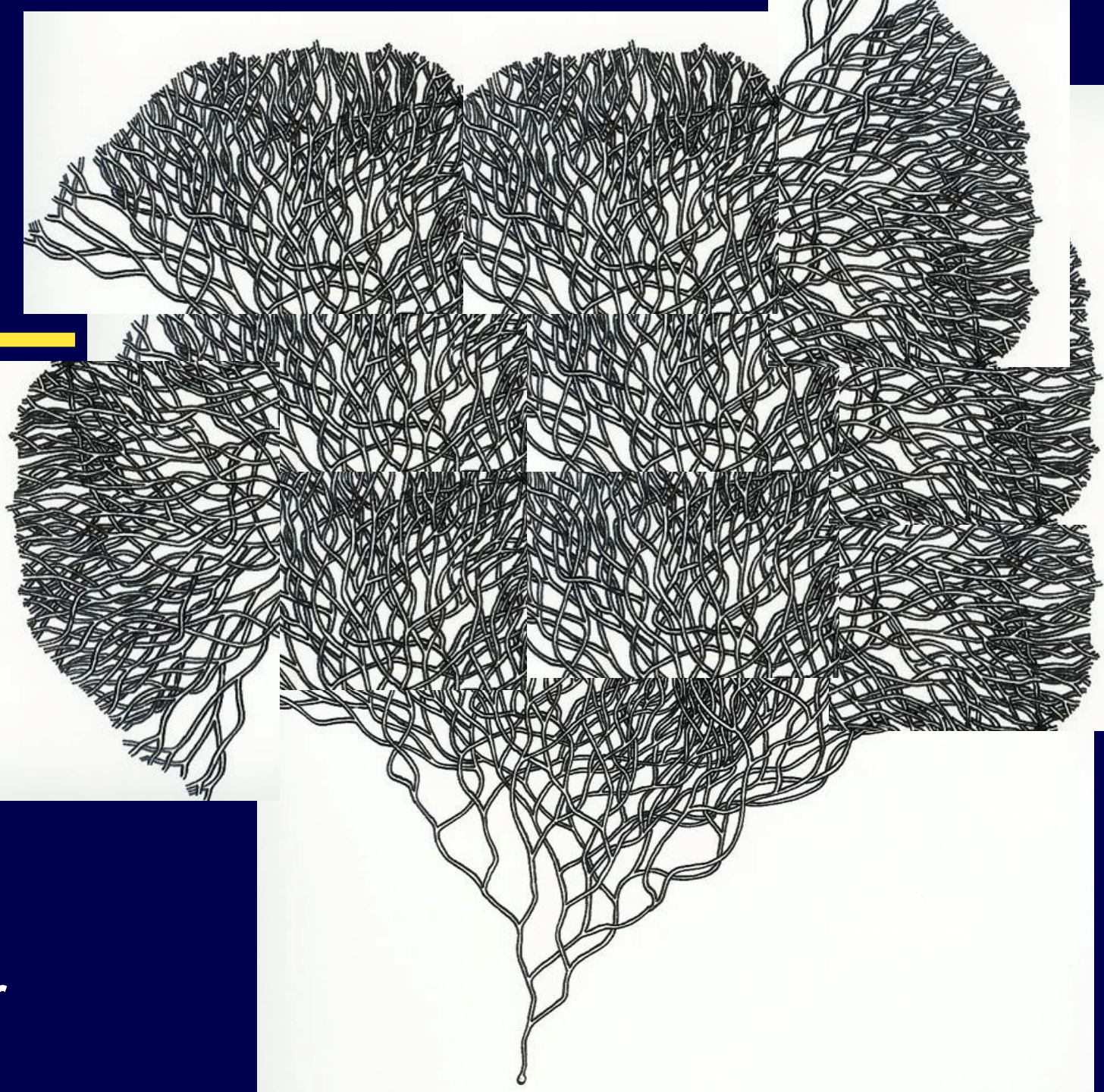
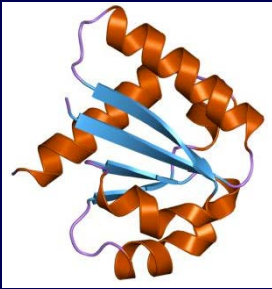
Theoretically,
an “individual” can
live forever.



3. Indeterminate growth

Theoretically,
an “individual” can
live forever.

enzyme

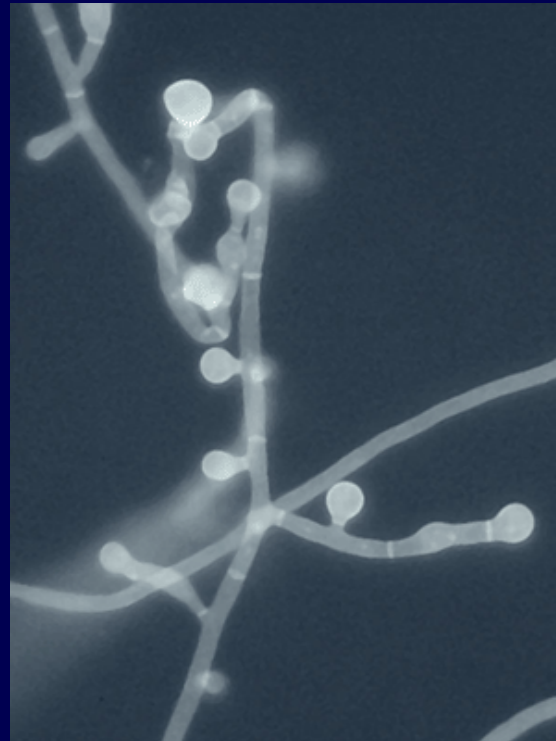
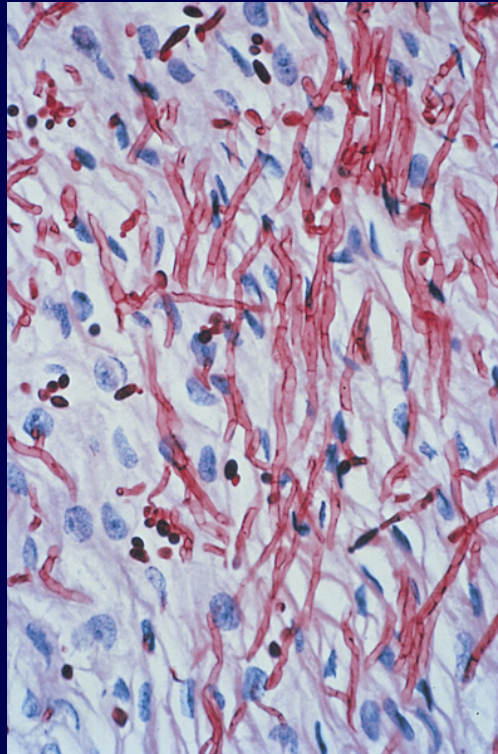
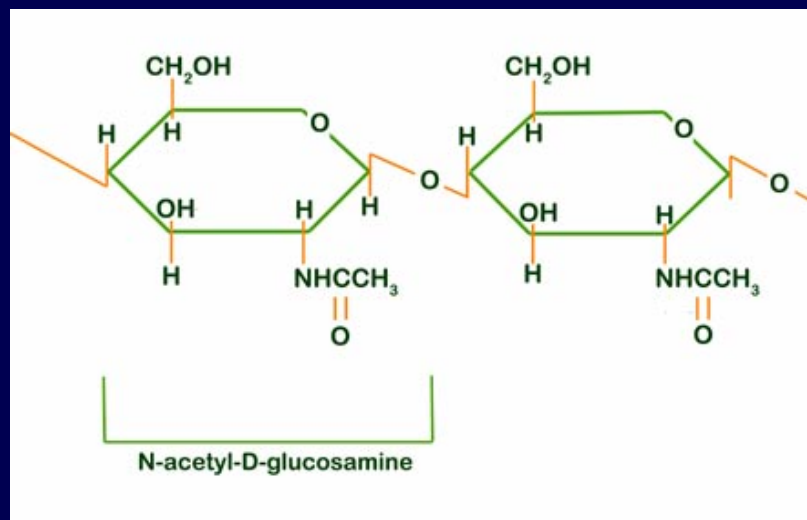


4. Absorptive nutrition

They secrete enzymes and digest food outside of their bodies

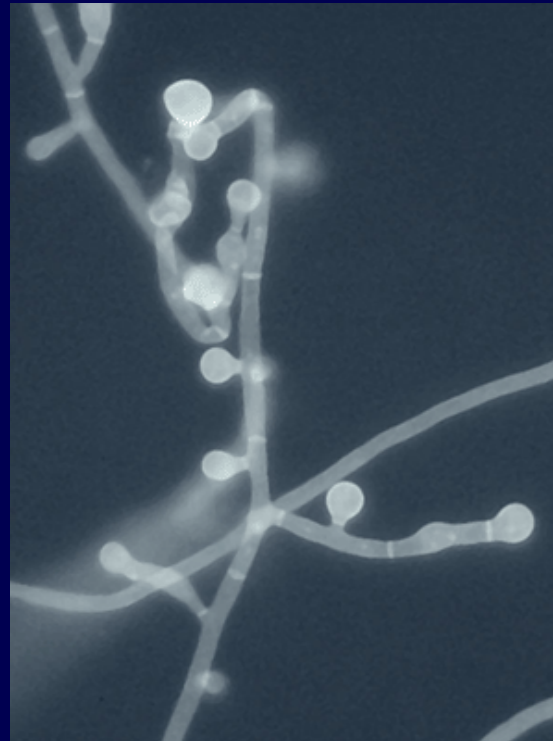
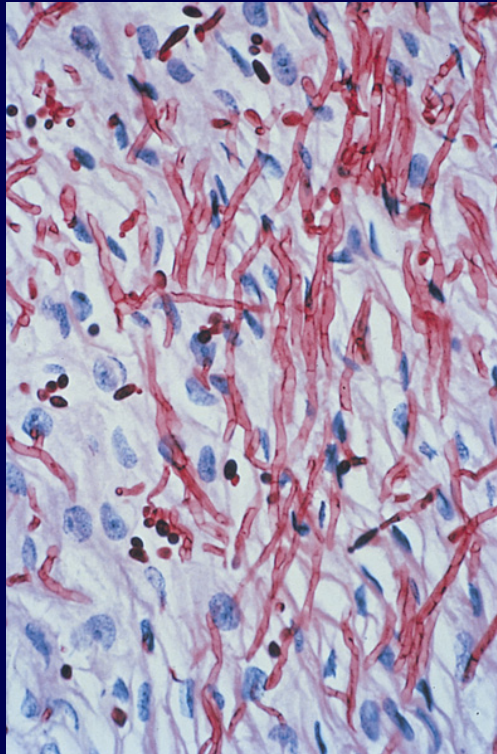
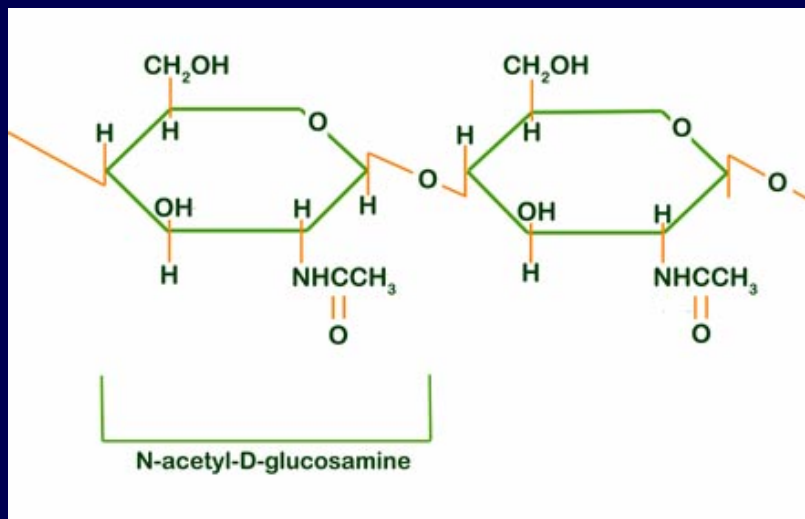
4. Cell walls lacking cellulose

Fungal cell walls instead have chitin and beta-glucans

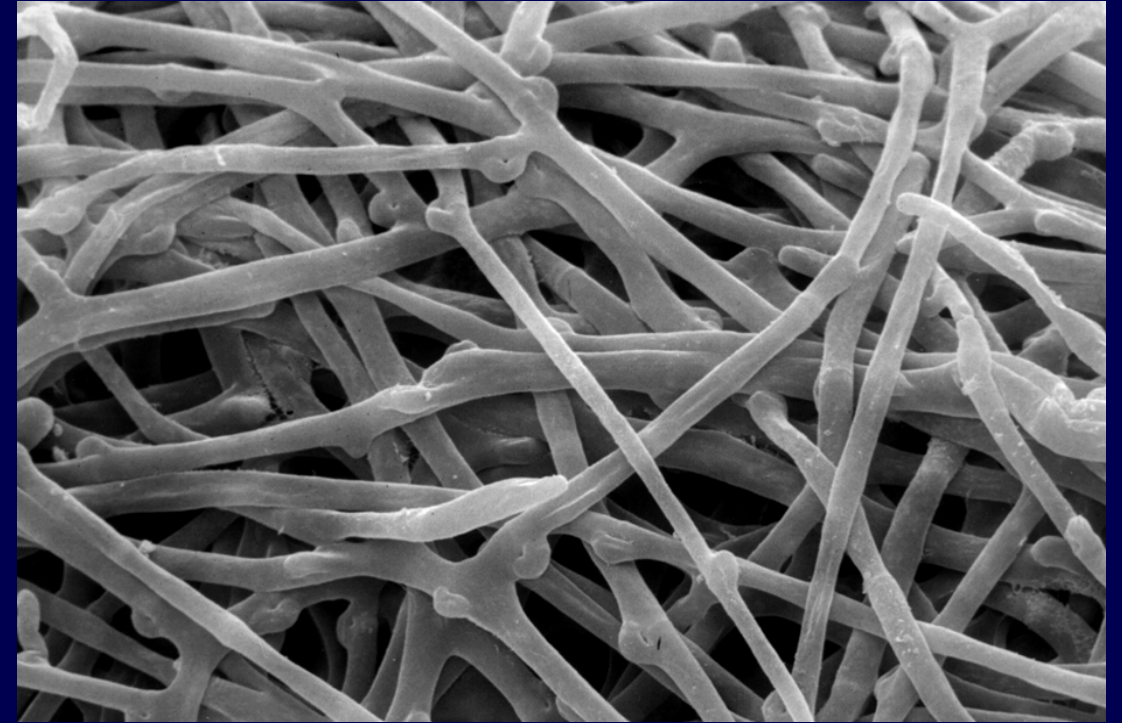
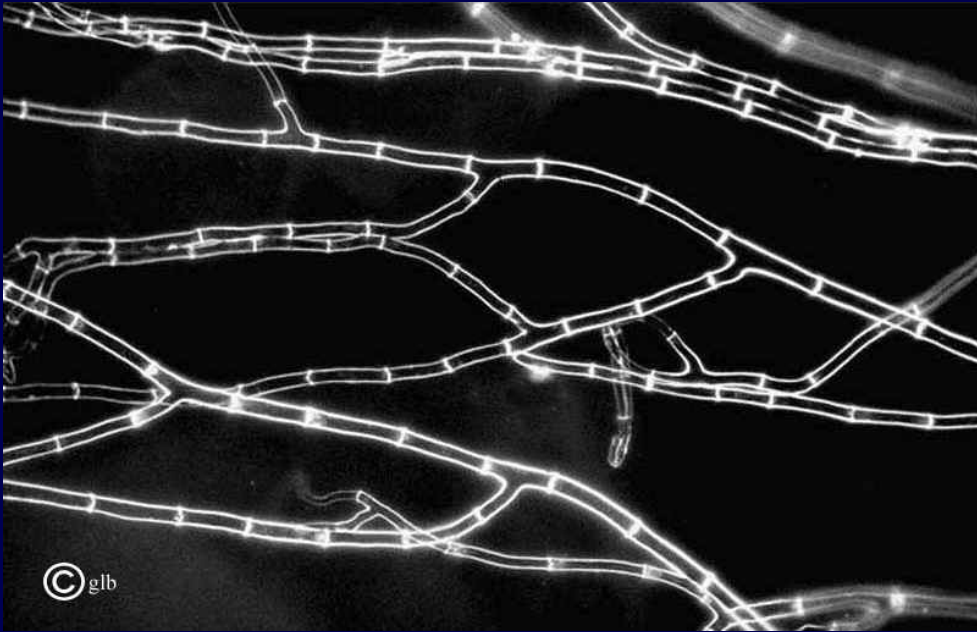


4. Cell walls lacking cellulose

Fungal cell walls instead have chitin and beta-glucans



Most fungi are **multicellular**.



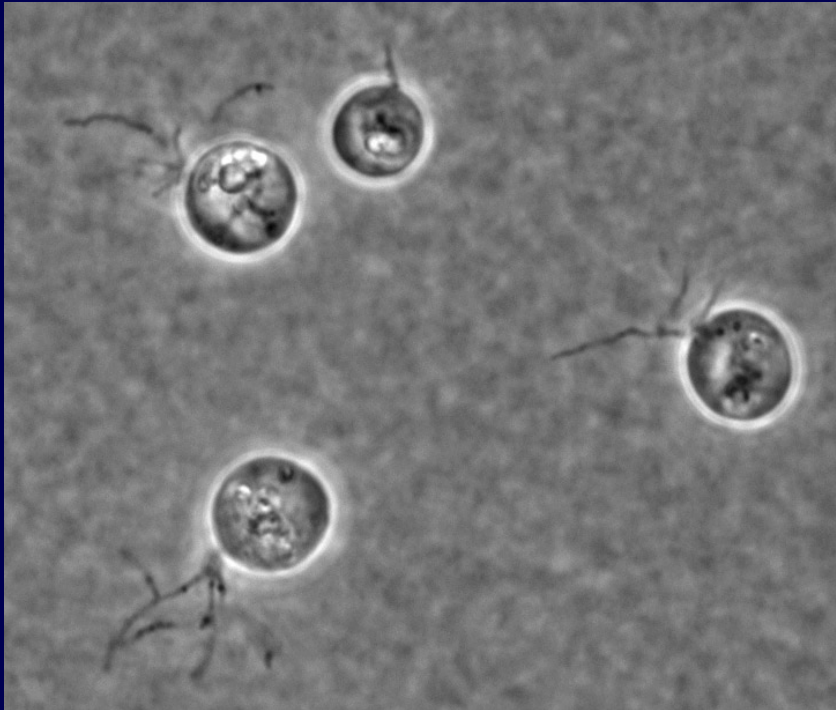
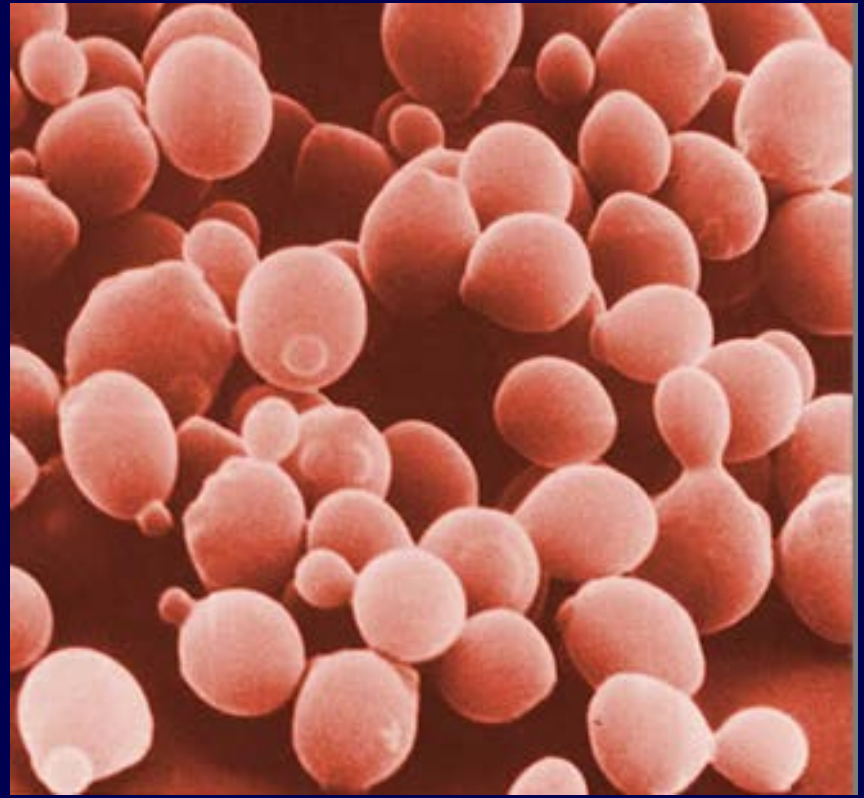
Their bodies are made of microscopic filaments called **hyphae**.

Hyphae grow at their tips.

Many hyphae are called a **mycelium**.

Sometimes fungi are **unicellular**.

Unicellular fungi without flagella are called **yeasts**. Yeasts reproduce by budding.



One group of fungi, (chytrids), have **motile, flagellated spores** called **zoospores**. (e.g. the “frog chytrid”)

Most fungi reproduce by **spores**. Many fungi make both **sexual** and **asexual** spores.



Nematode-trapping *Orbilia*

Macrocybe titans



**Some fungi make
massive fruiting
bodies with millions
of spores**

Other species never make a fruiting body at all.

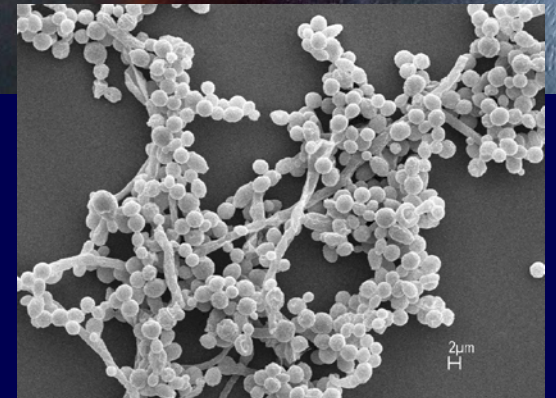


Saccharomyces cerevisiae



Penicillium and some other molds

Mushrooms, molds, truffles, yeasts = all are fungi

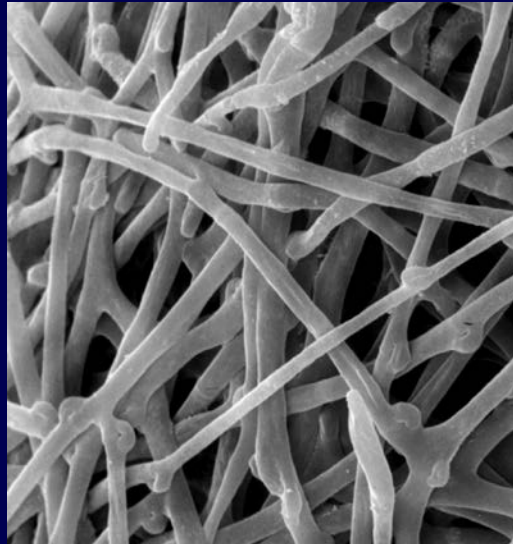


When they make fruiting structures they are ephemeral

Body of the organism



Fruiting structure



This is the body of the organism...



in soil



on a petri dish

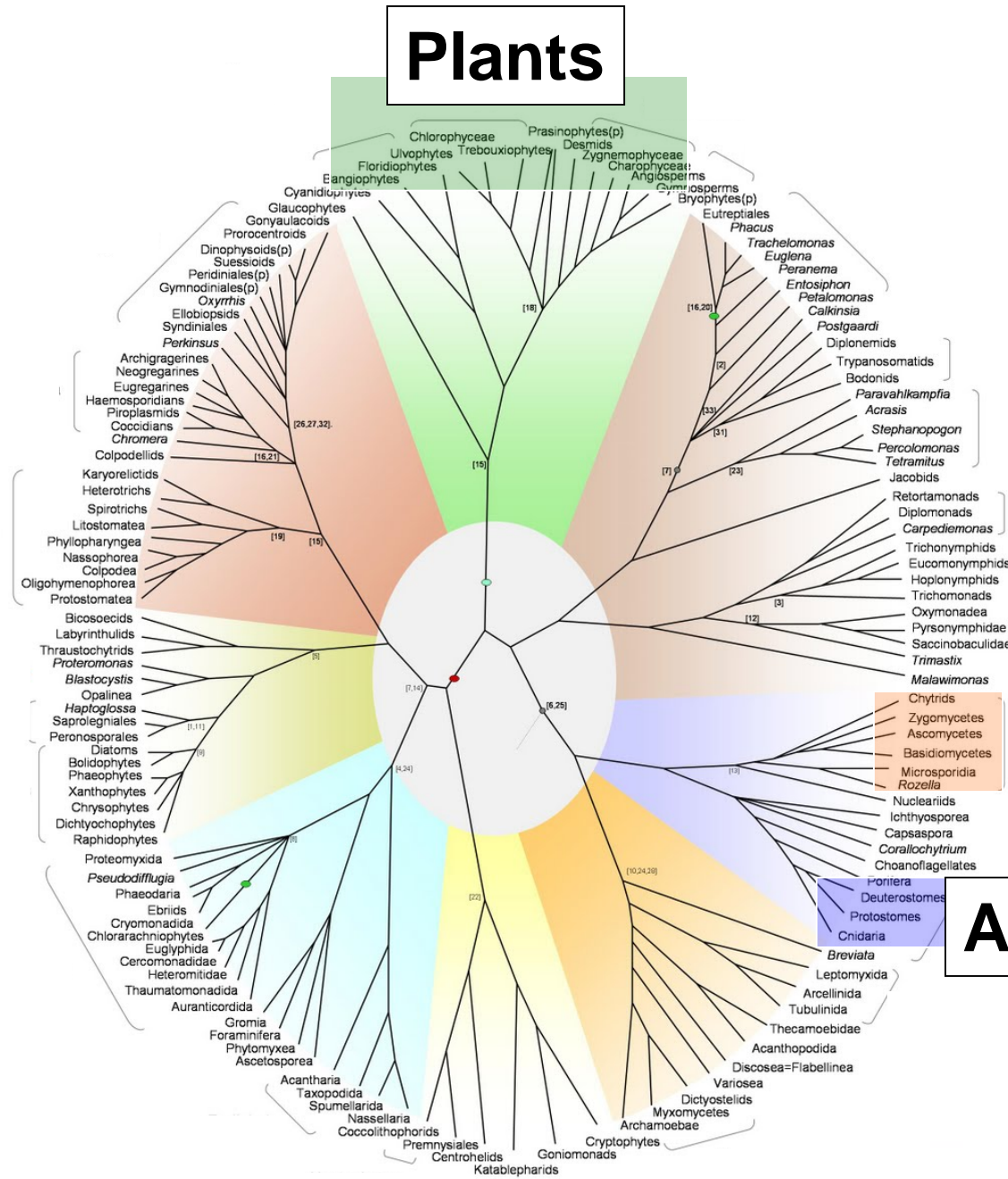


in wood



on a
plant

DNA clearly shows
that fungi
and animals are
'close' relatives!



Plants

**Eukaryotic
Tree of Life**

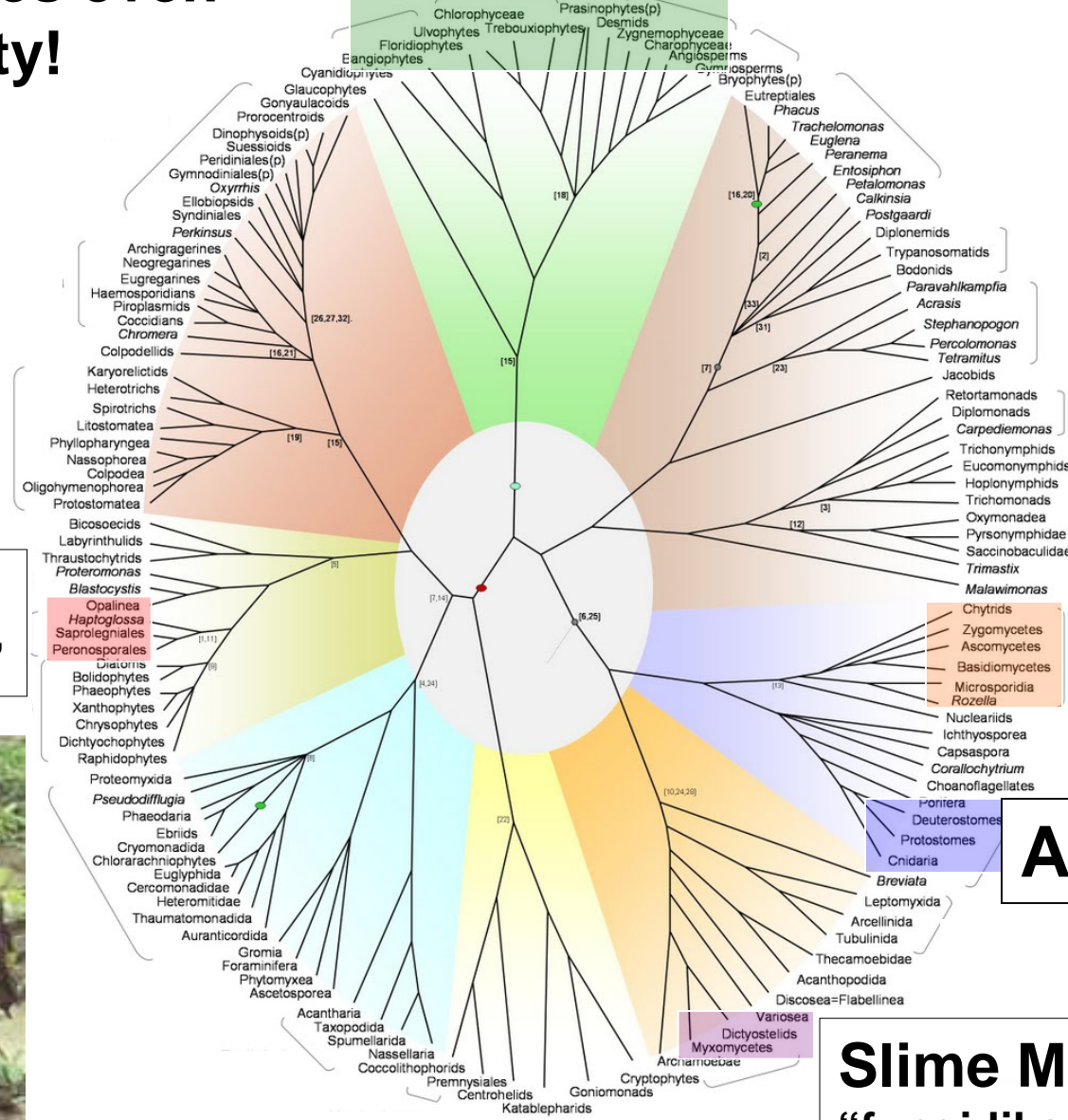
Fungi

Animals

‘fungi’ in the broad sense includes even more diversity!

Eukaryotic Tree of Life

Plants



Fungi

Animals

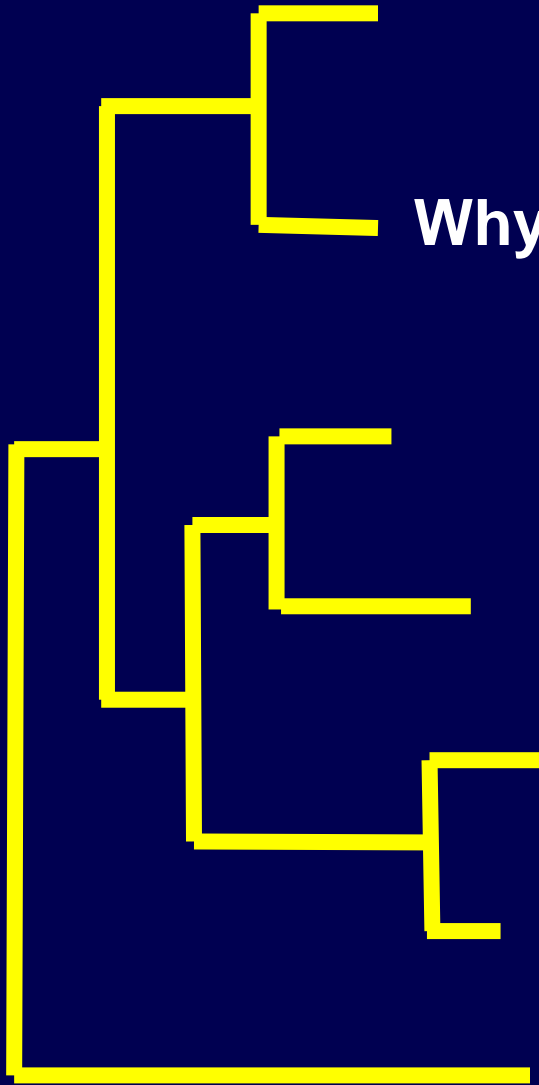
Slime Molds
“fungi-like organisms”



Oomycetes
“fungi-like organisms”

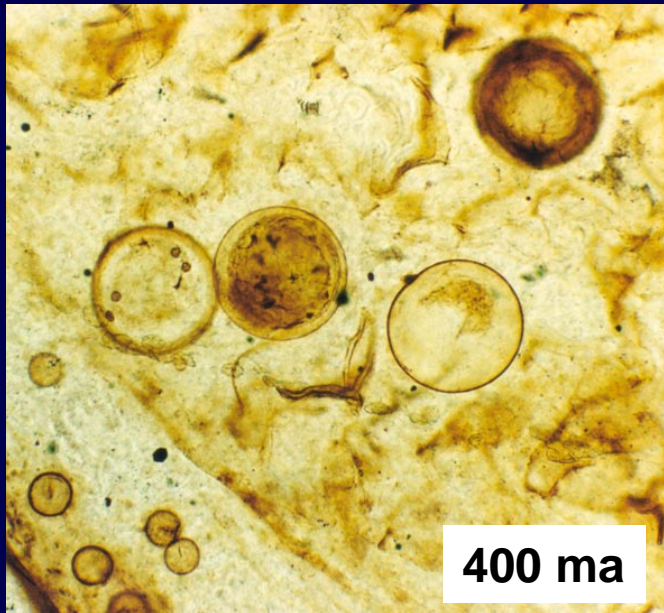
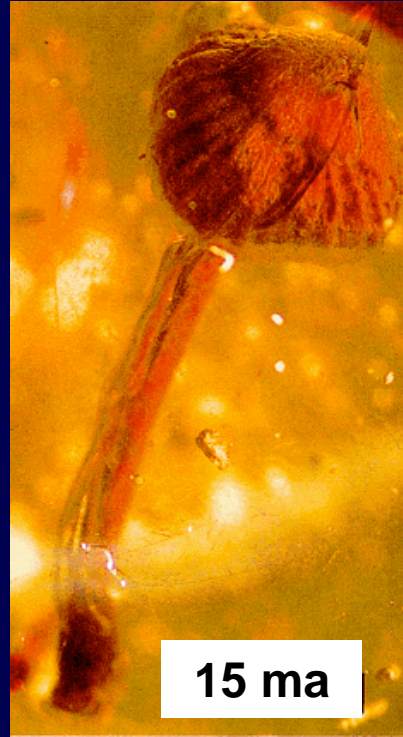


Outline



Why fungi are difficult to identify and study?

Sorry, understanding evolutionary history is challenging...
Fungi have soft bodies = not many fossils



However,

- earliest fungi fossils (1,400 mya)
- abundant in Rhynie Chert (400 mya)
- major fungal lineages present (350 mya)

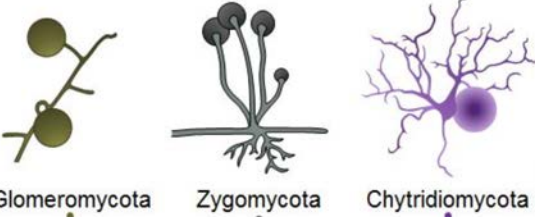
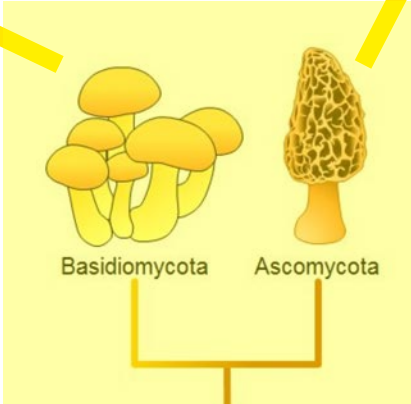
The simplified view of the fungal tree of life



Basidiomycota

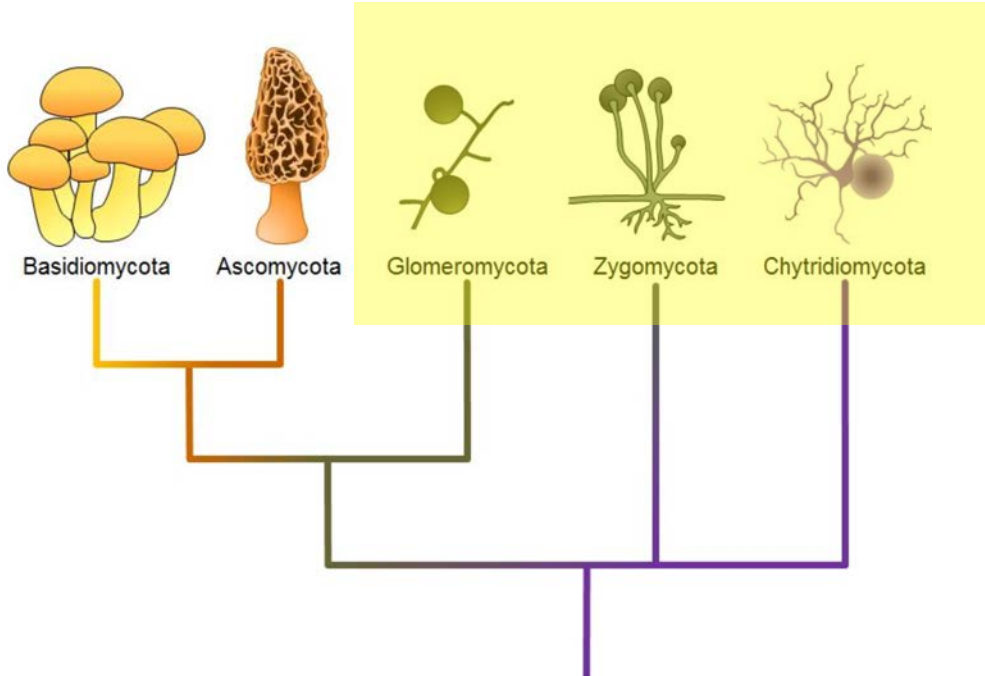
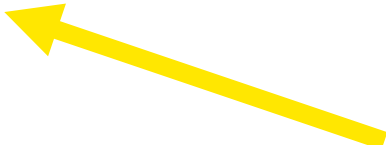
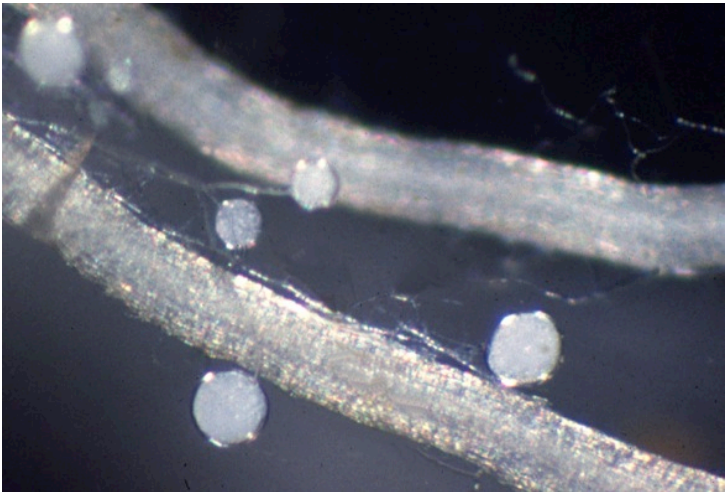


Ascomycota



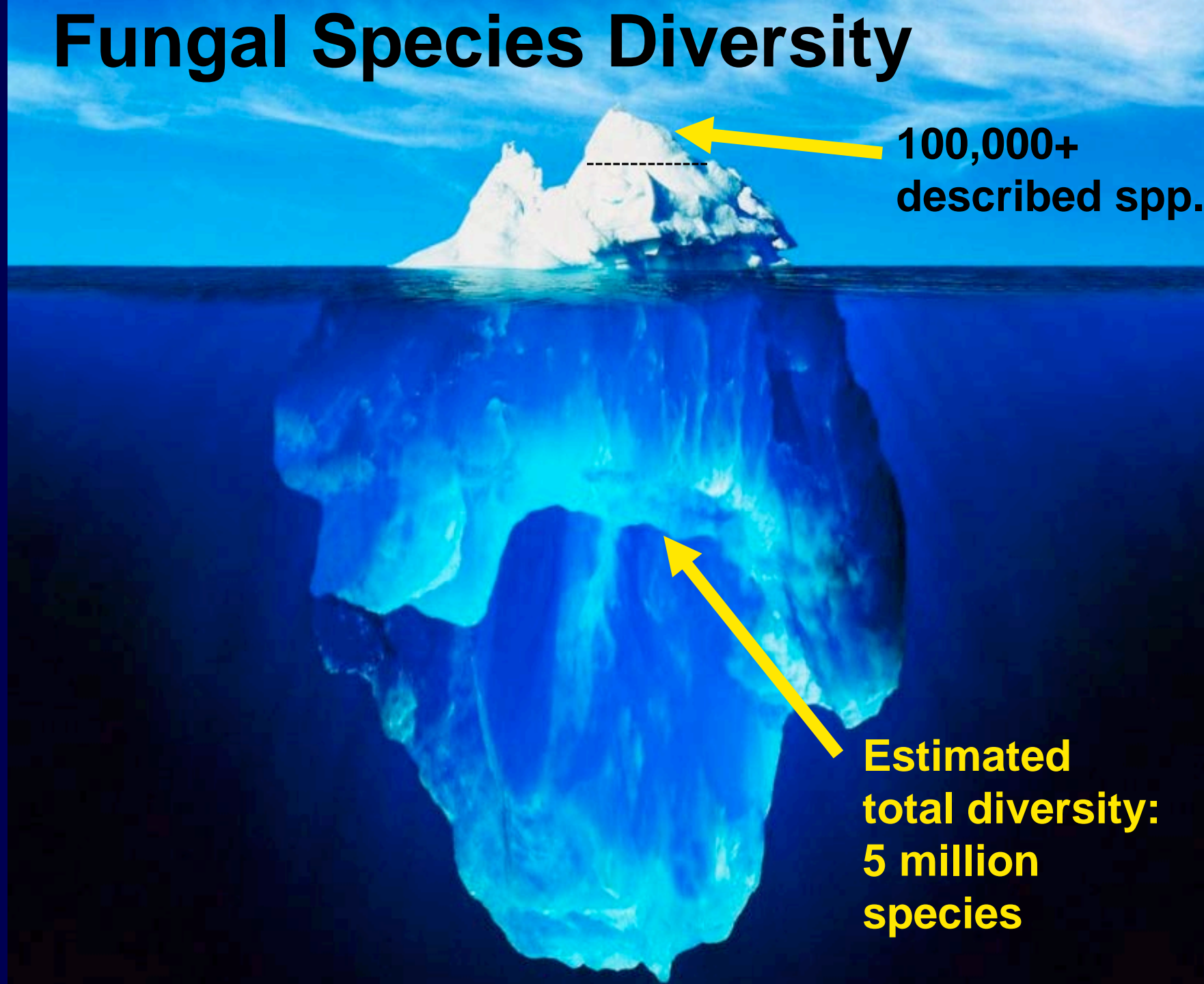
95,000 described species

The simplified view of the fungal tree of life

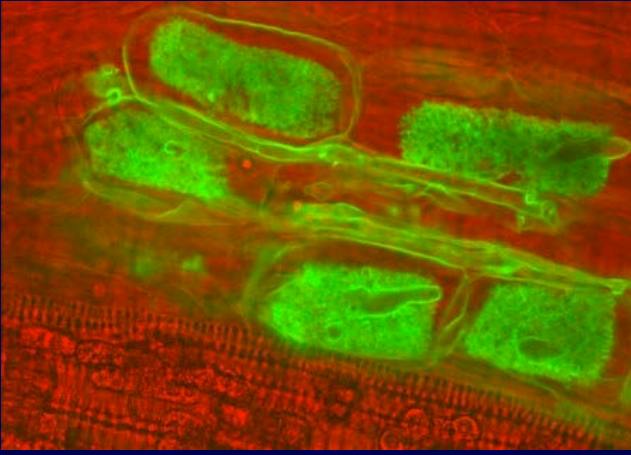


**Other microscopic fungi
= 5,000 described species**

Fungal Species Diversity



“high diversity” using classical methods



Arnold et al. (2000) cultured endophytic fungi from 2 tree species in Panama.

They used **83 leaves**.

They recovered **350 fungal species**.



“high diversity” using molecular methods

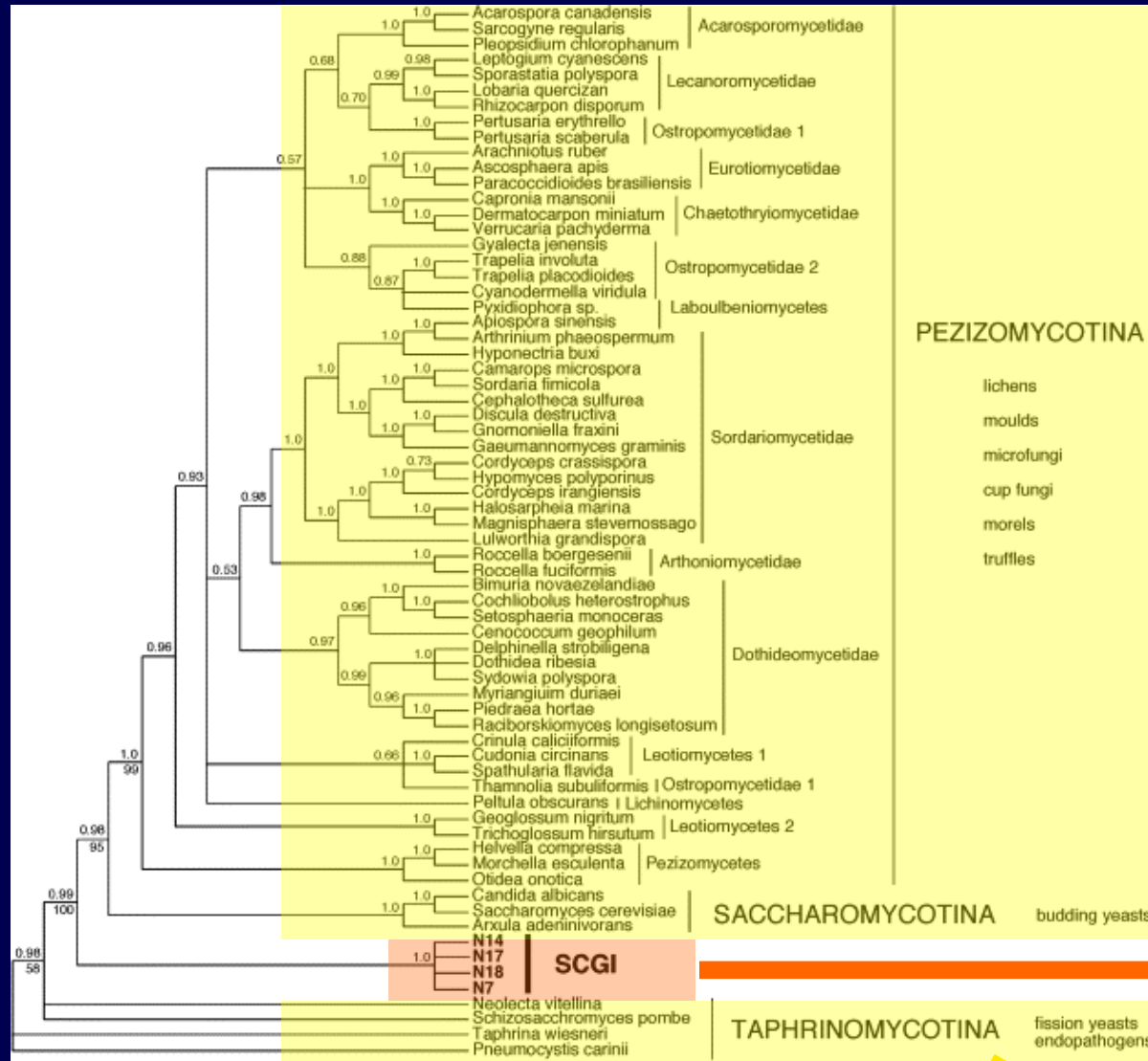
Taylor et al. (2014) used DNA sequencing to examine fungi in spruce forest soils in Alaska.

From **48 soil samples** at **12 sites** they recovered **>1000 fungal species**.



Forest soil =
huge pool of fungal diversity

Molecular methods are still detecting new fungal groups...

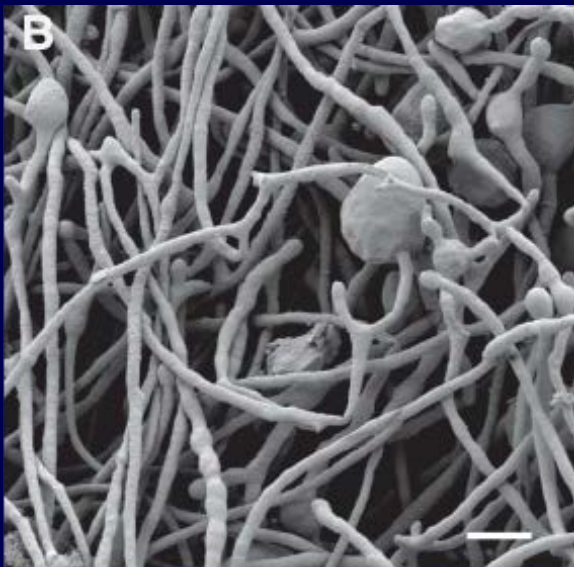
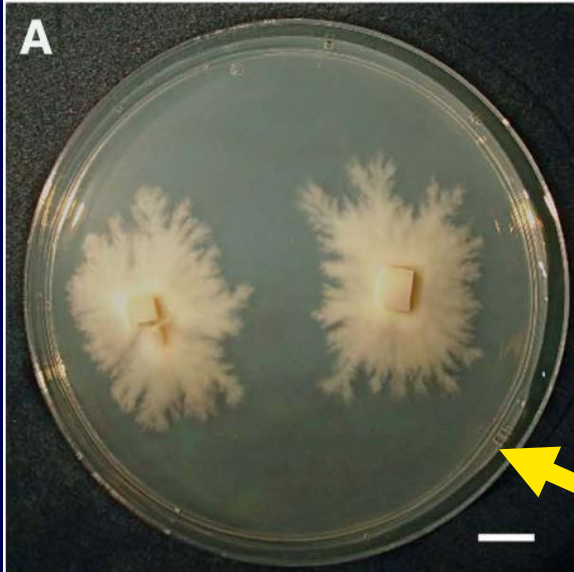


Previously known fungi

Fungi known only based on DNA sequences

Previously known fungi

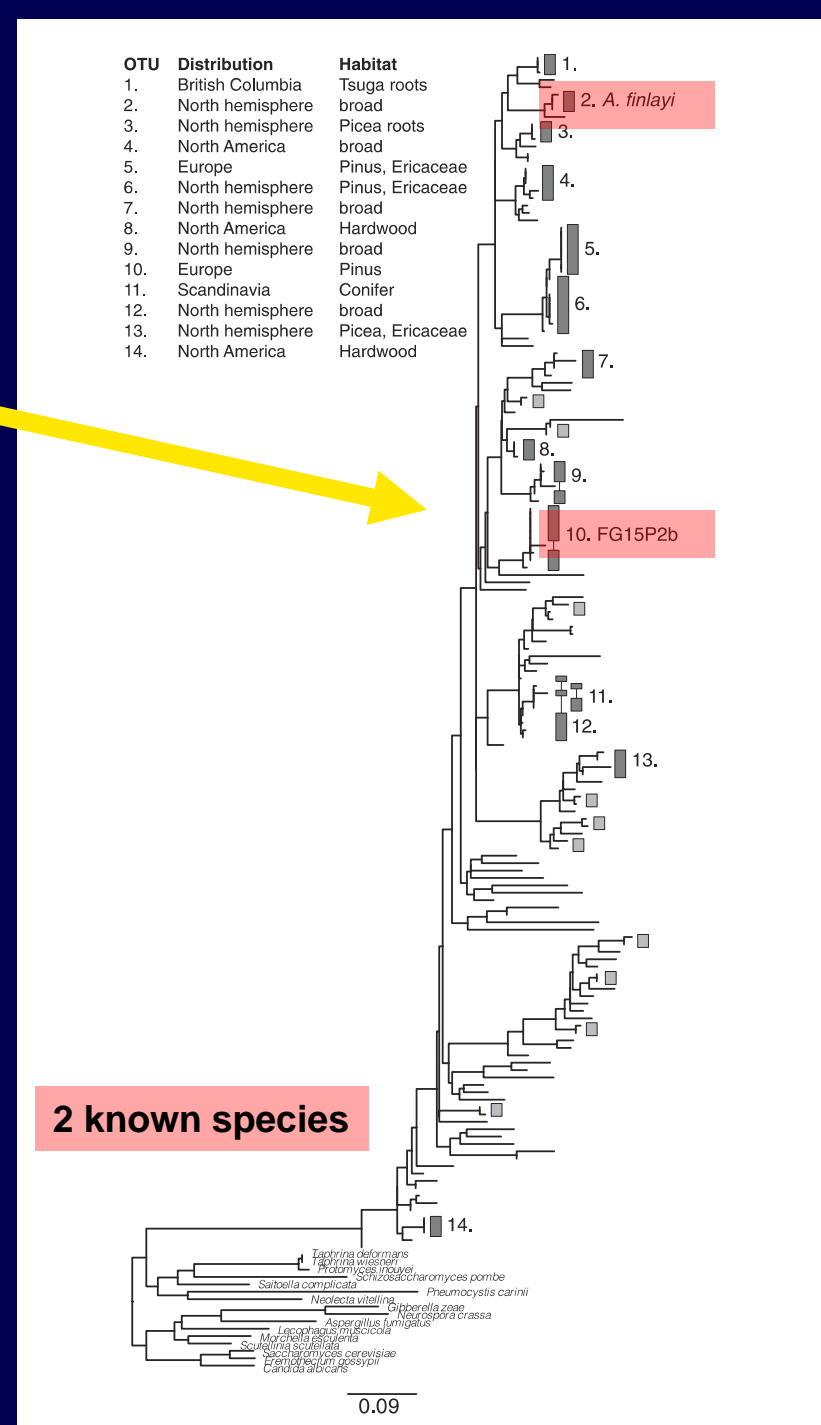
Archaeorhizomycetes: Unearthing an Ancient Class of Ubiquitous Soil Fungi



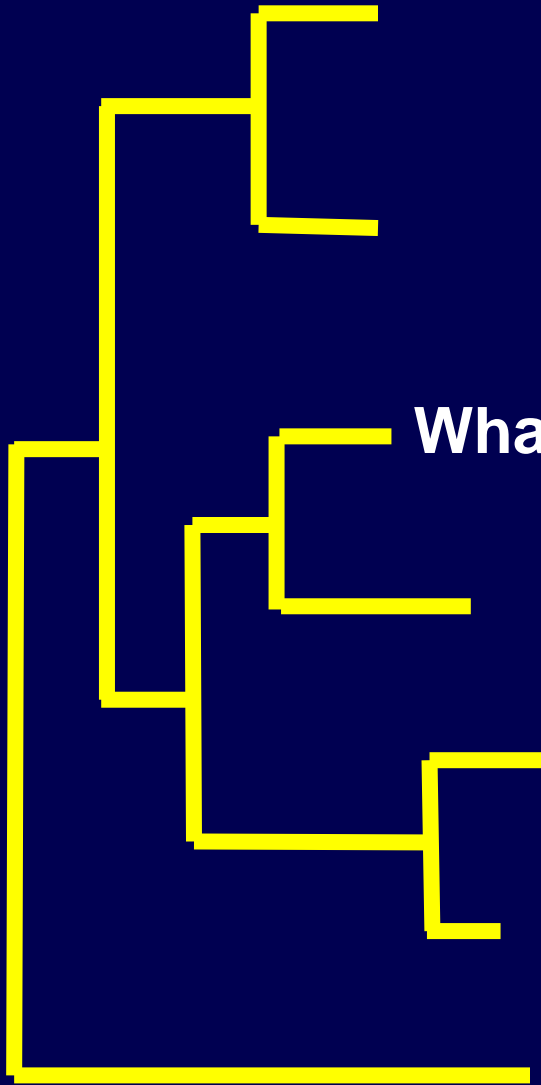
Molecular analysis found 162 species from 52 studies.

But there are only 2 known cultures.

Rosling et al. 2011



Outline



What do fungi do?

Fungi have many ecological roles



Plant pathogens



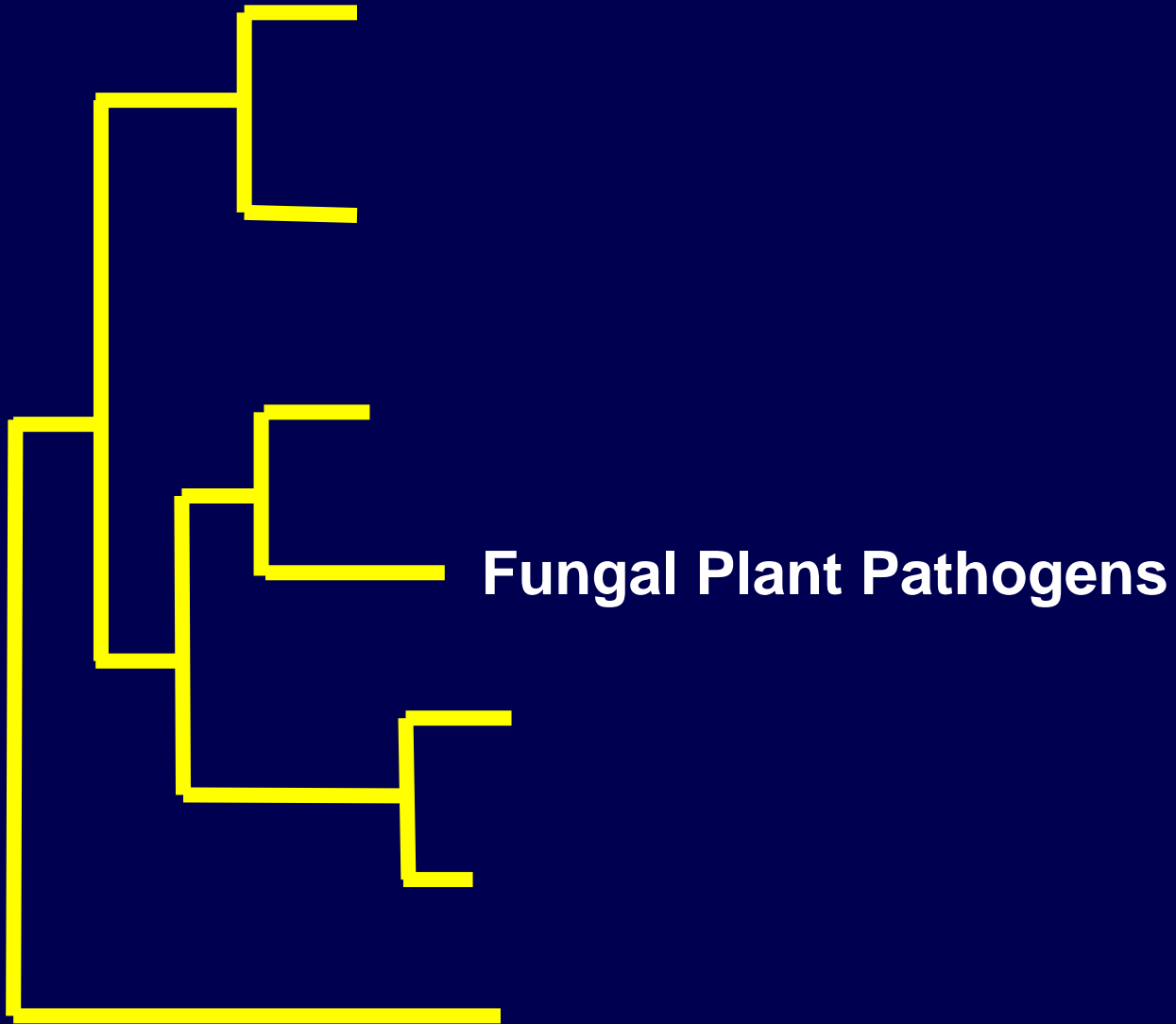
**Symbionts
(Mycorrhizas & Lichens)**



**Saprobies
(decay organisms)**



Outline



Fungi are the most diverse and devastating plant pathogens

(but viruses, bacteria, oomycetes, and insects kill plants too)



Fungi are the most diverse and devastating plant pathogens

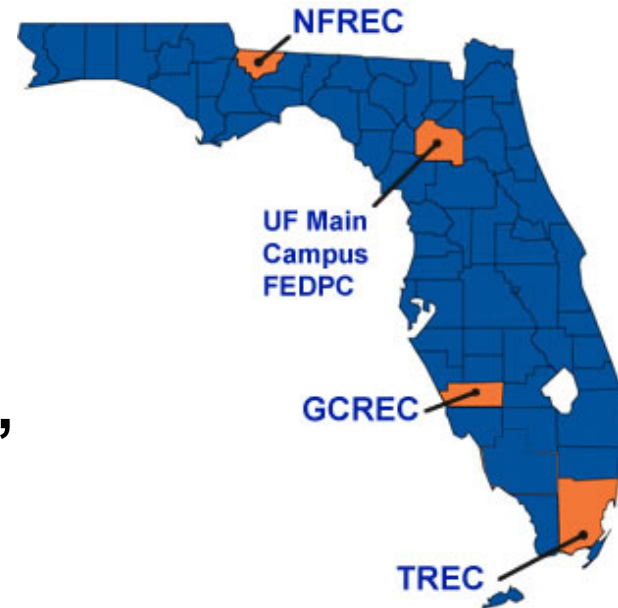
UF Plant Diagnostic Center

<http://plantpath.ifas.ufl.edu/clinic/index.shtml>

(352) 392-1795

Director: Dr. Carrie Harmon

**- Diagnosis of commercial, homeowner,
and extension plant disease samples**



***Armillaria tabescens* (Honey Mushrooms) – common root parasitic fungus in landscape environments**

- Found with dying woody plants
- Massive clusters of mushrooms in Fall
- Weak parasite & saprobe, problematic on stressed plants
- Persists in stumps and decayed wood – remove & discard decayed wood



<http://edis.ifas.ufl.edu/ep478>

Laccate (varnished) *Ganoderma* species

- Distinctive shiny red top & growth on wood, usually hardwoods
- Often referred to as “*Ganoderma lucidum*” but 10+ species in Southeast
- Thought to be medicinal (lingzhi or reishi) but local species haven't been tested
- Sometimes associated with tree decline



Ganoderma zonatum (Butt Rott of Palms) –

- Apparently restricted to palms, but attacks many species
- Associated with palm decline
- Shelf mushrooms are easy to diagnose
- Eliminate fruiting bodies and trees
- Do not replant with palms at the same site



<http://edis.ifas.ufl.edu/pp100>



- ▼ Department Links
 - Faculty Directory
 - Plant Diagnostic Center
- ▶ Topics
- ▶ Feature Pages
- ▶ Departments & Programs
- ▶ Authors
- ▶ Frequent Users

Plant Pathology Department EDIS Resources

- Online publications, A-Z
- Special Topics
 - Agronomic Crop Diseases
 - Citrus Diseases
 - DDIS - Distance Diagnostic Identification System
 - Fruit Diseases
 - Lawn and Garden Plant Diseases
 - Nursery and Ornamental Plant Diseases
 - Turf Diseases
 - Vegetable Diseases
- ◀ Return to Departments and Programs

Recent Publications

Bookmark / share this page

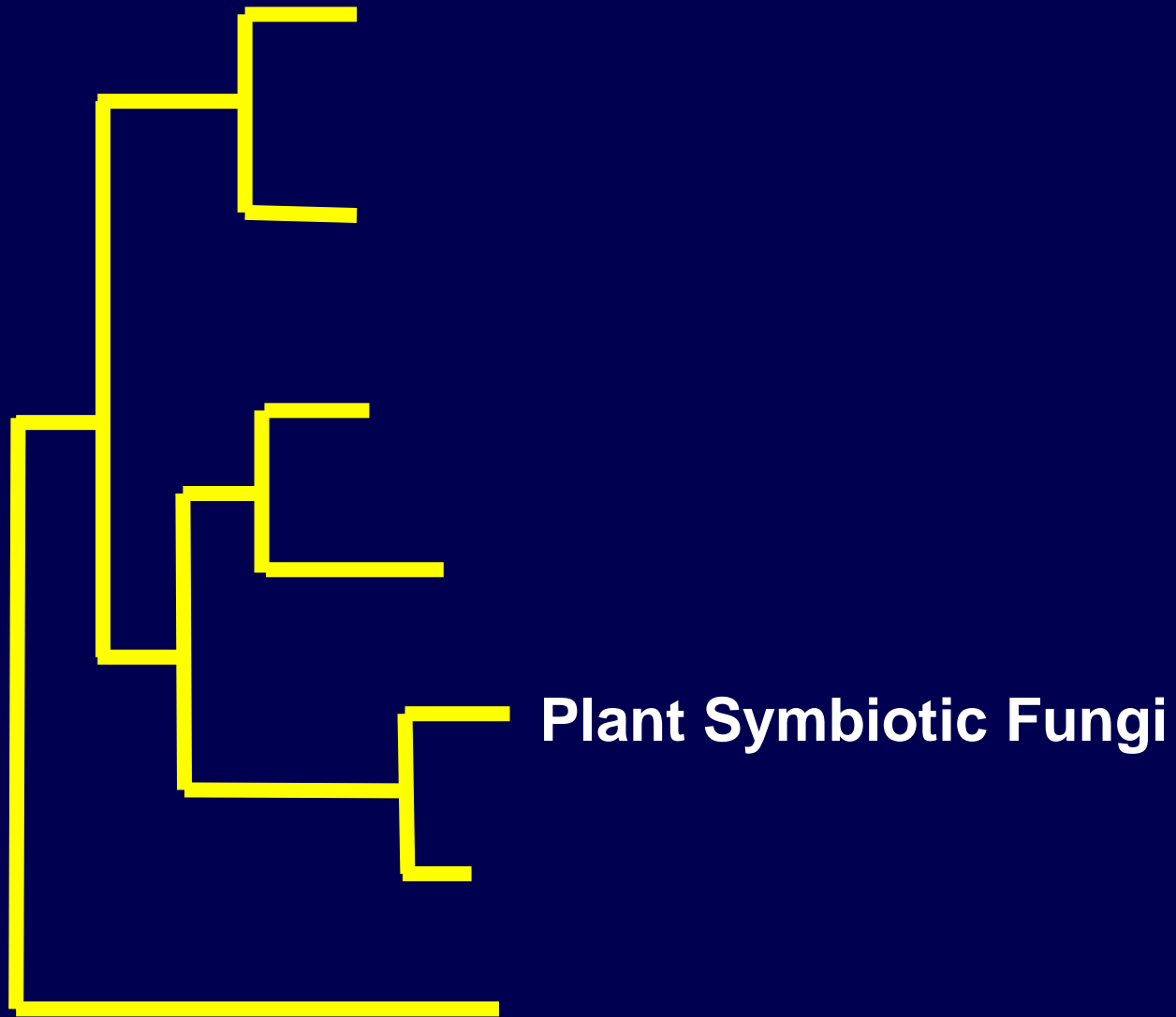
ADD THIS ...



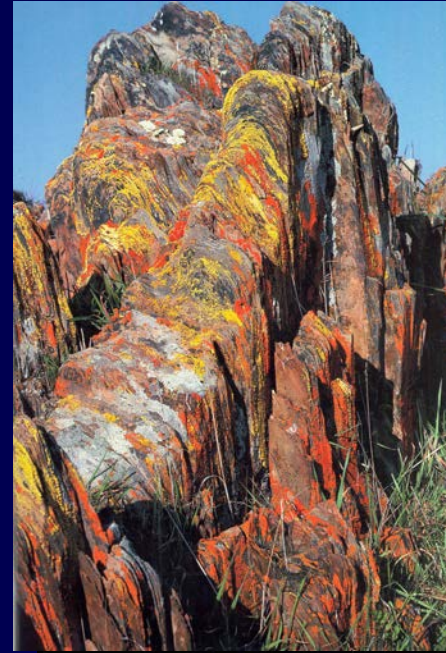
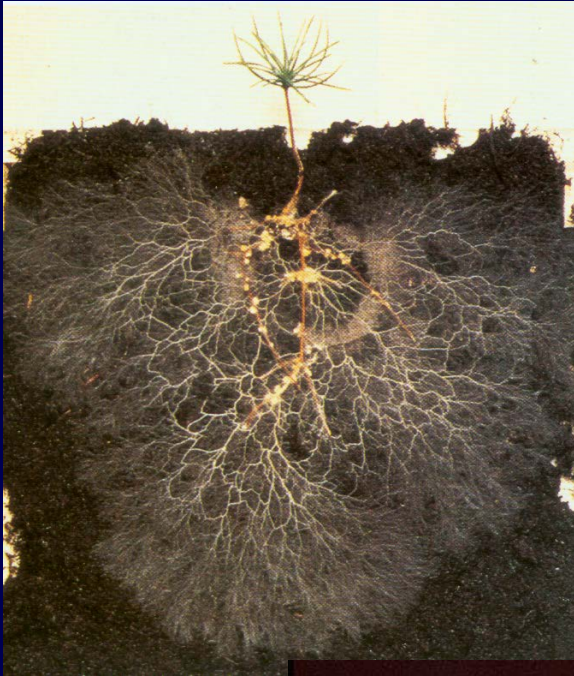
Contact Information
PO Box 110680
Gainesville, FL
32611-0680
(352) 392-3631
Fax:(352) 392-6532
Website

Authors
Authors: Plant Pathology Authors

Outline



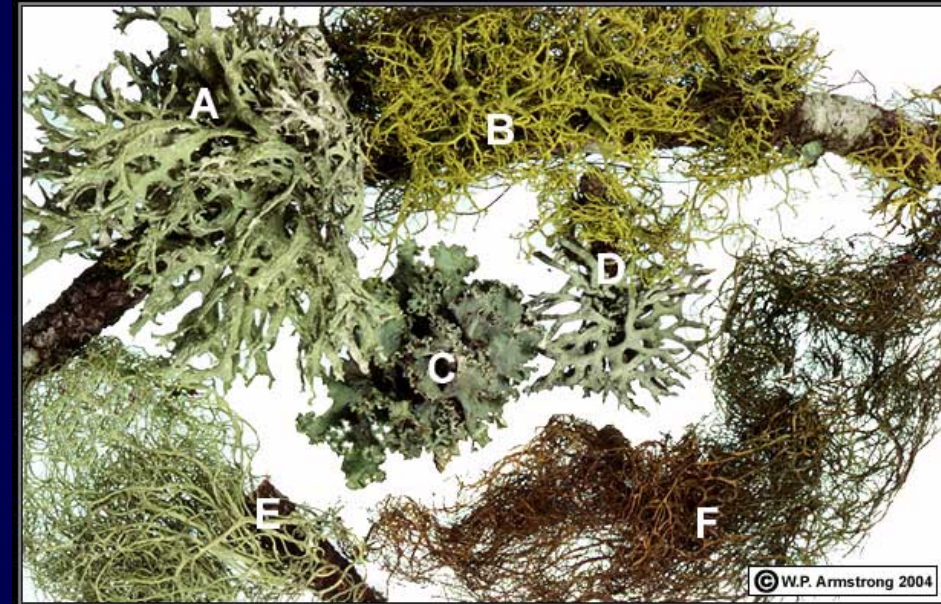
2. Fungi form symbiotic relationships with plants



Lichens

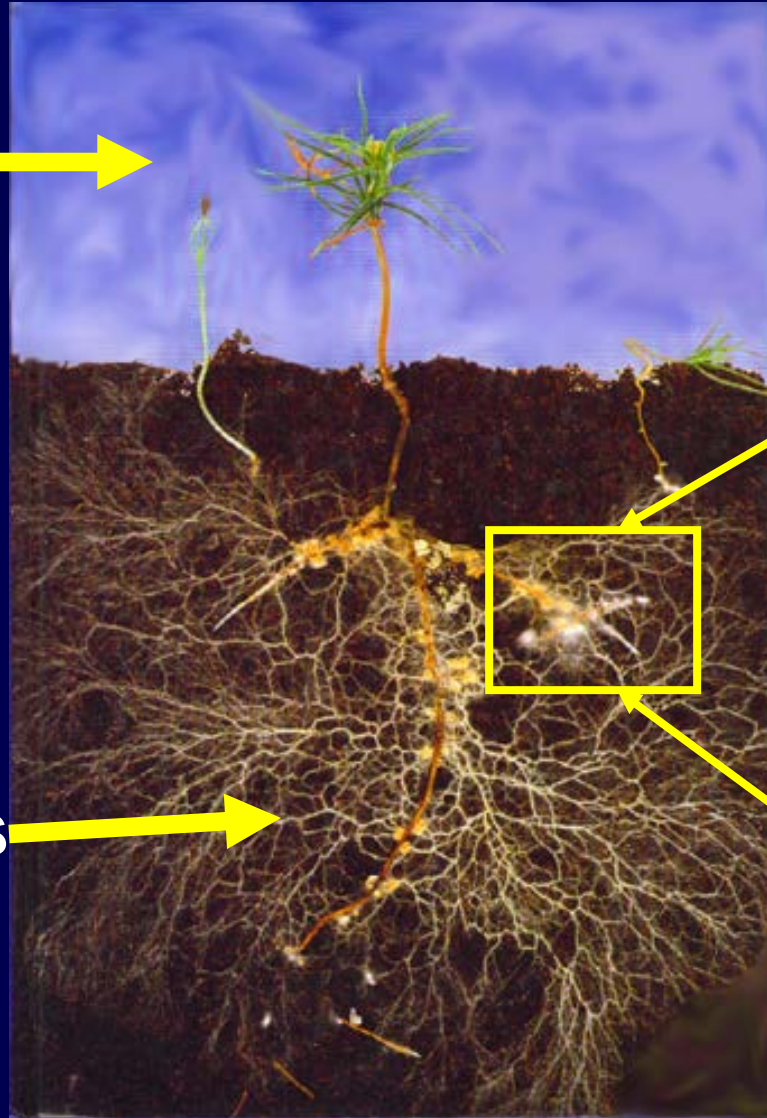


Mycorrhizas



Mycorrhiza - a fungal root?

Plant →



Fungus →

In Greek,
Myko = fungus
Rhiz = root



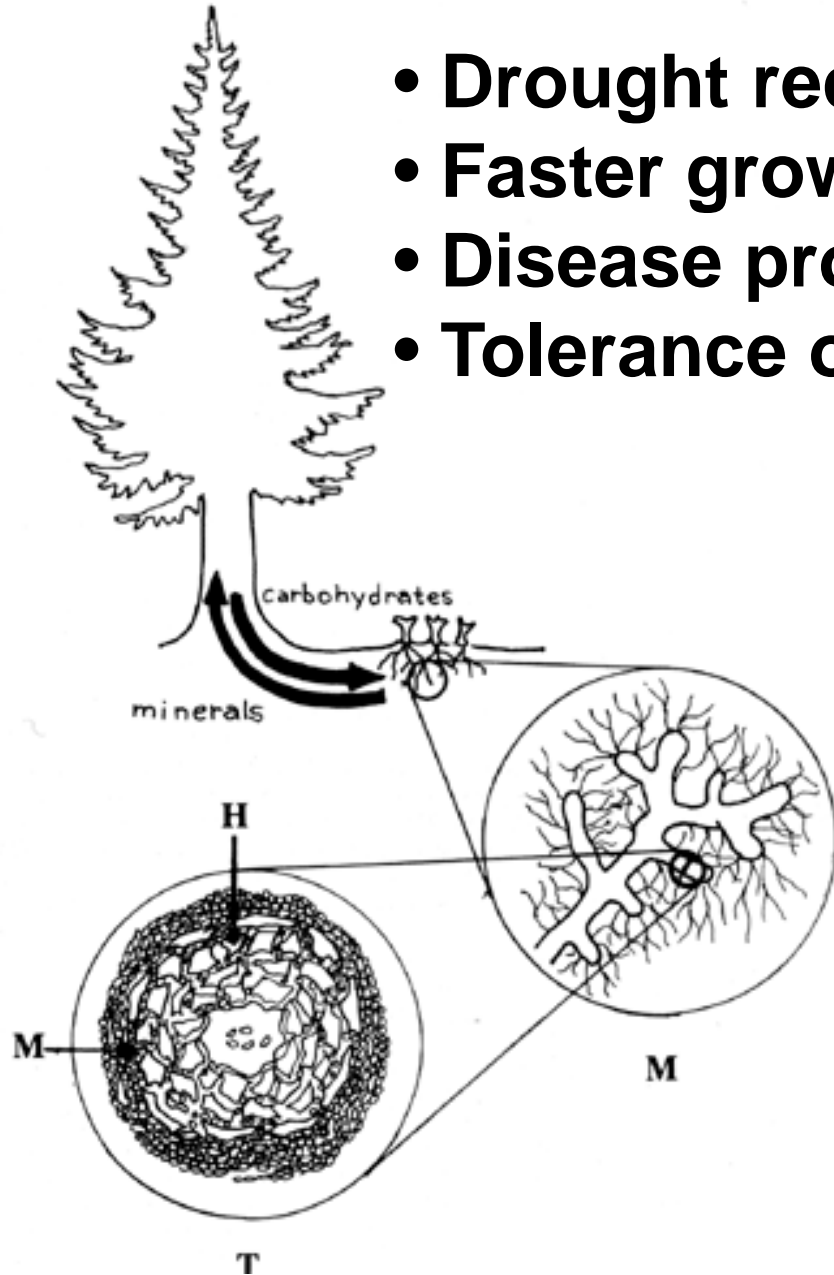
Mycorrhiza = resource mutualism

- Mycorrhiza increase nutrient uptake by increasing surface area (hyphae = 10x smaller than roots)
- Fungi provide scarce nutrients (Nitrogen, Phosphorous)
- Plants provide sugars (photosynthesis!)



Plants Grow Better with Mycorrhiza

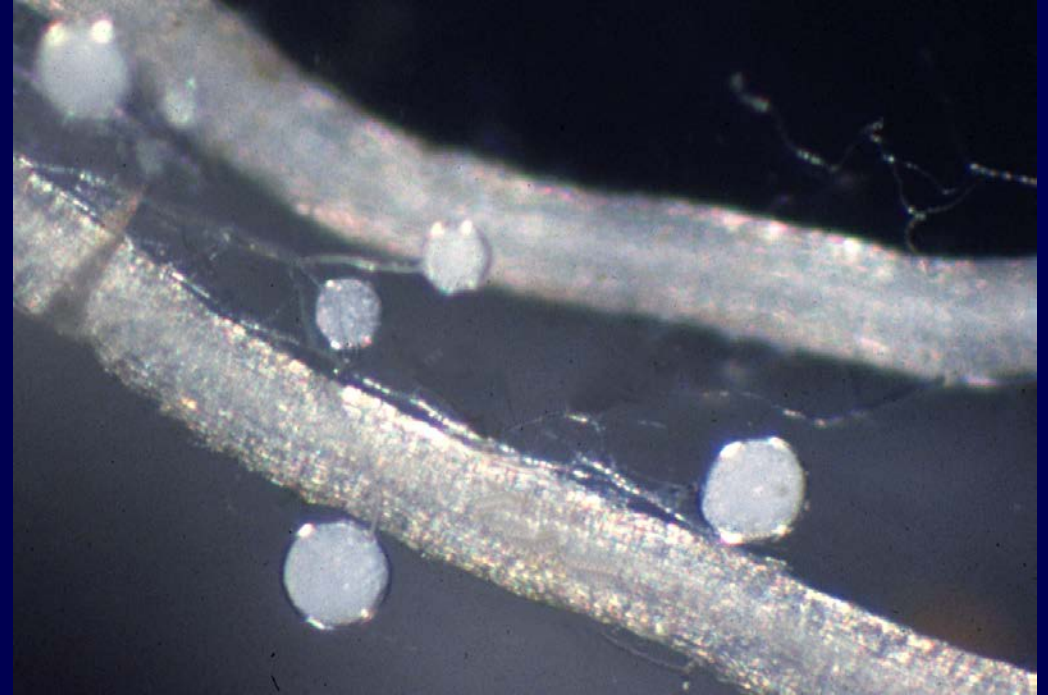
- Drought reduction
- Faster growth
- Disease protection
- Tolerance of poor soil conditions



Ectomycorrhiza (ECM)



Arbuscular Mycorrhiza (AM)

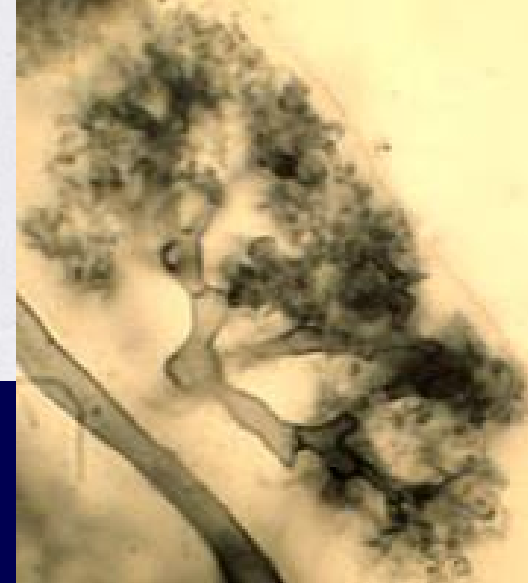
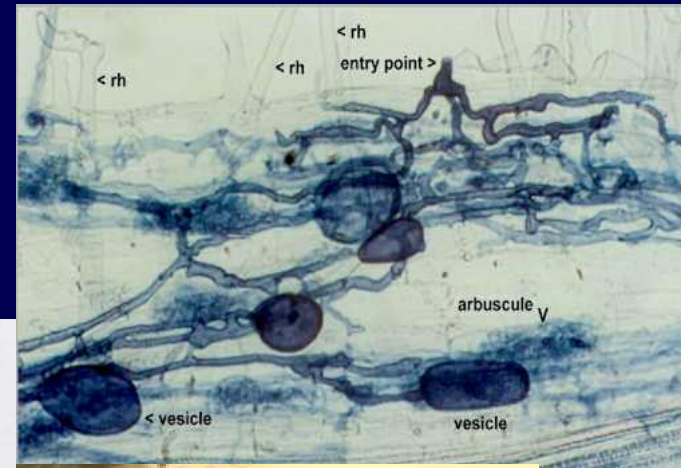
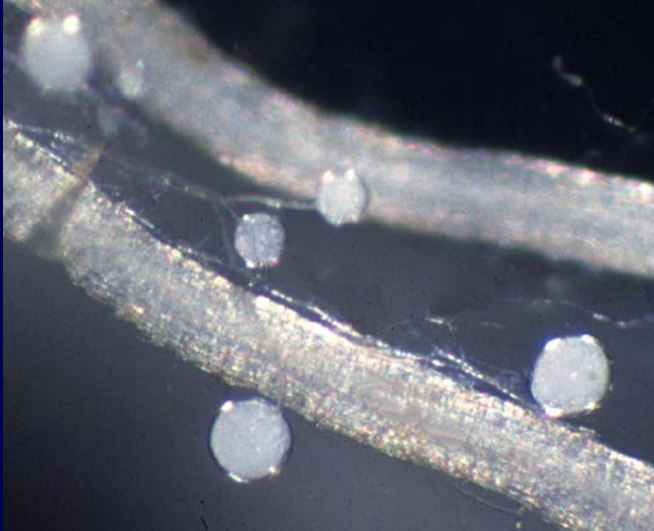


Two different fungal symbioses with plants

Arbuscular Mycorrhiza (AM)

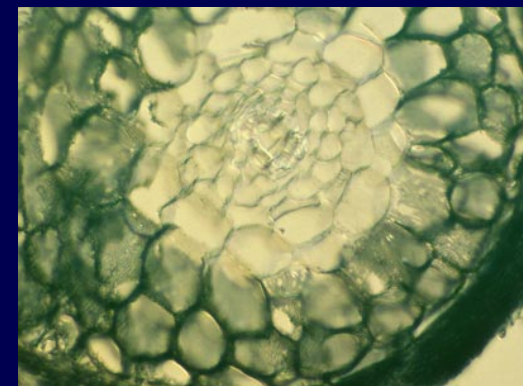
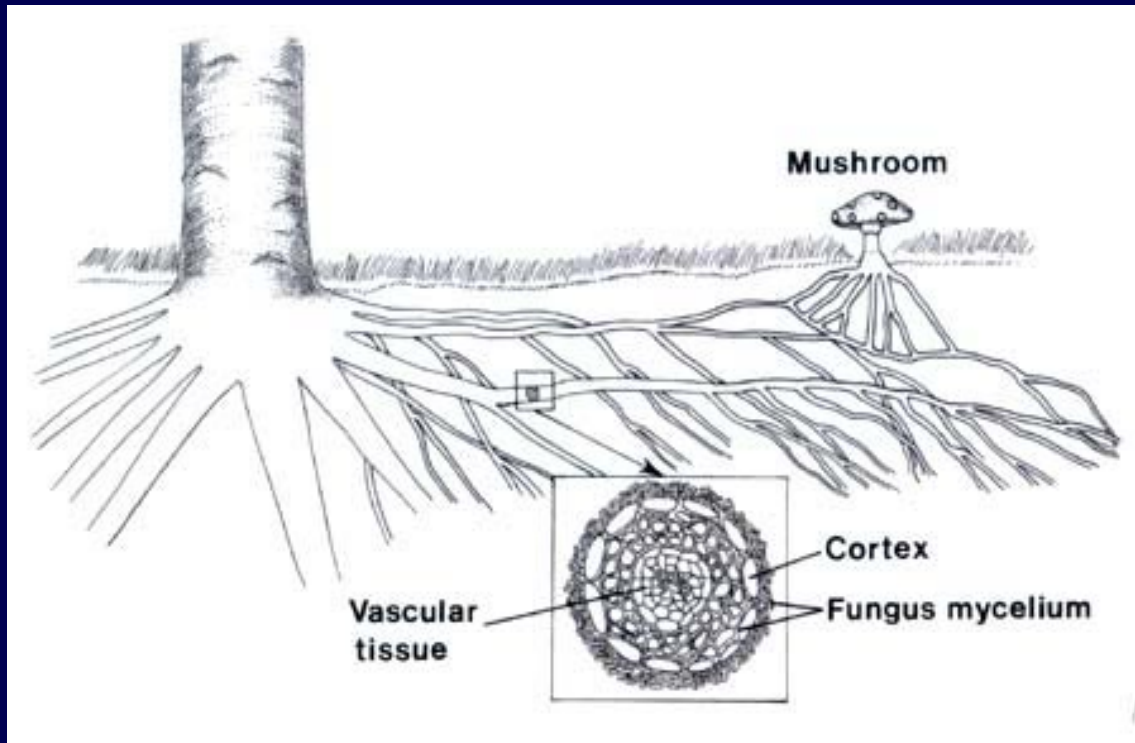
AKA: Endomycorrhiza,

Vesicular Arbuscular Mycorrhiza (VAM)



- Totally microscopic
- Found in 85-90% of land plants
- Herbaceous & woody plants (1000+ genera)
- **Almost every landscape plant forms AM associations**
- Low or no benefit if growing in highly fertile environment?

Ectomycorrhiza (ECM)



- Many mushrooms get their energy this way
- Found primarily in woody plants
- Important trees: oaks, pines, hickories, willows
- **In Florida landscapes, many ECM fungi (500-1000 or more)**

Ectomycorrhizal fungi include many interesting taxa...



Amanita virosa
(destroying angel)



Boletus edulis
(porcini, cepe)



Cantharellus species
(chanterelles)

Tuber lyonii
(the pecan truffle)



<http://edis.ifas.ufl.edu/pp330>

3. Fungi are important decay organisms (especially on wood)





Fungi as agents of wood decay

White Rot



Brown Rot



- Rot is white & stringy or spongy
- All wood components degraded

- Rot is brown & crumbly
- Cellulose & hemicellulose degraded but NOT lignin.



Fungi as agents of wood decay

White Rot



Brown Rot



but treatment is usually the same....

- 1. Eliminate rotted wood to get rid of fungus**
- 2. Reduce moisture**
- 3. Chemical treatments work poorly (wood is insulated)**

Stinkhorns: common wood decay fungi in the landscape



**It is not a clever name!
They really stink!**

Stinkhorns: common wood decay fungi in the landscape



Stinkhorn
"egg"



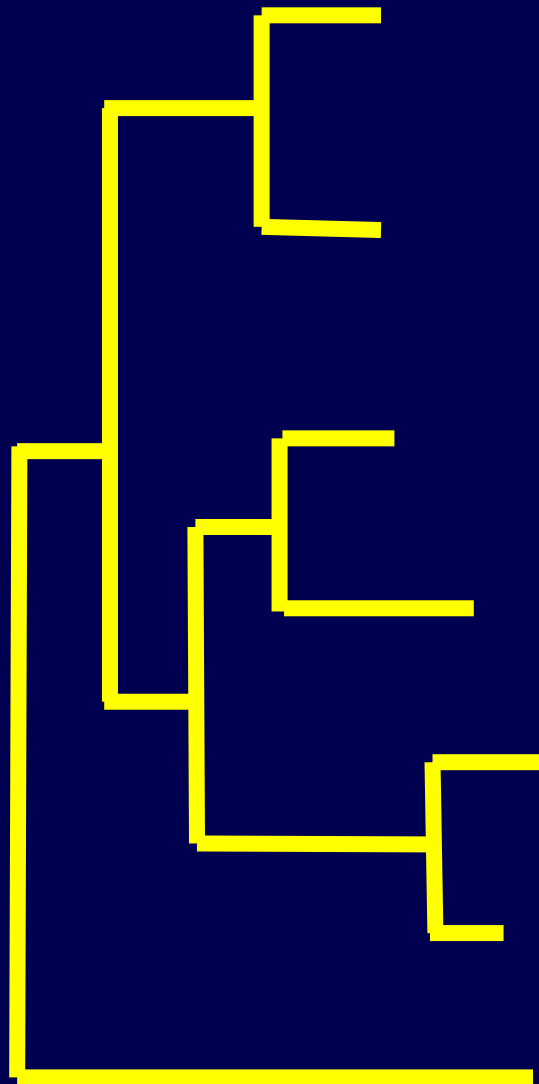
- Stinkhorns can be physically removed to reduce odor
- 'Solarization' or disturbance may reduce fruiting
- No good chemical controls

Chlorophyllum molybdites (Green-Spored Parasol) – Florida’s most common species of lawn mushroom

- Forms fairy rings in lawn
- Distinct green spores
- Decays organic waste & thatch, releases nutrients
- *Chlorophyllum* is toxic to ingest, causes “gastrointestinal distress”
- Problematic for pets and children
- <http://edis.ifas.ufl.edu/pp324e>



Outline



Conclusions and Resources

Florida - high mushroom diversity & rich mycological history



William A. Murrill
(1869 – 1957)
Described 500+
species of
Florida fungi



Amanita murriliana



Boletus floridanus



Cantharellus "cibarius"



Russula alachuana

www.MyCoPortal.org

Public access to
herbarium data



MYCOLOGY COLLECTIONS PORTAL

Home

Explore

Crowdsource

Checklist Projects

Other Resources

Acknowledgements

Welcome Erin! My Profile Logout Sitemap

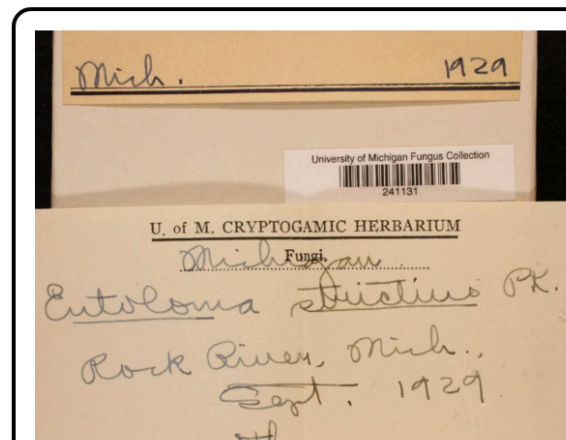
Welcome to the Mycology Collections data Portal

The Mycology Collections data Portal (MyCoPortal) is more than just a web site - it is a suite of user-friendly, web-based data access technologies to aid taxonomists, field biologists, ecologists, educators, and citizen scientists in the study of fungal diversity. The data are derived from a network of universities, botanical gardens, museums, and agencies that provide taxonomic, environmental, and specimen-based information. Using the Symbiota (<http://symbiota.org>) system of virtual online floras, these data are directly accessible to dynamically generate geo-referenced species checklists, distribution maps, and interactive identification keys, all linked with a rich collection of digital imagery documenting fungal diversity of North America.

Fungus of the Day



What is this fungus?



News and Events

- **NSF Press Release (#15-092)** - NSF awards fifth round of grants to enhance America's biodiversity collections
- **NSF Press Release (#12-082)** - US National Science Foundation awards support for The Macrofungi Collection Consortium, a collaboration of 35 institutions in 24 states for the purpose of databasing some 1.4 million dried scientific specimens of macrofungi (NSF ADBC 1206197).
- **December 2013** - 1,546,358 occurrence records supplied by 31 different data providers have been integrated into MyCoPortal.
- **NEW** - MaCC records are now part of the Zooniverse project *Notes from Nature*. Please help us by

MYCOLOGY COLLECTIONS PORTAL

[Home](#) [Explore](#) [Crowdsource](#) [Checklist Projects](#) [Other Resources](#) [Acknowledgements](#)

[Log In](#) [New Account](#) [Sitemap](#)

[Home](#) >> [Collection Search Page](#) >> [University of Florida Herbarium Details](#)

University of Florida Herbarium (FLAS)

The University of Florida Herbarium is a unit of the Department of Natural History of the Florida Museum of Natural History. The herbarium is affiliated with the Institute of Food and Agricultural Sciences, Florida Agricultural Experiment Station, Florida Cooperative Extension Service, Department of Biology and the Department of Plant Pathology. The FLAS acronym is the standard international abbreviation for the University of Florida Herbarium. It is derived from the herbarium's early association with the Florida Agricultural Experiment Station. Our mission focuses in plant collections acquisition and care, research based on the collections, education and public service.

Contact: Matthew E. Smith (trufflesmith@ufl.edu)

Home Page: <http://www.flmnh.ufl.edu/herbarium/>

Collection Type: Preserved Specimens

Management: Live Data managed directly within data portal


Global Unique Identifier: a1aa8e0a-d122-4fff-96df-0a83f585a2de


Usage Rights: CC0 1.0 (Public-domain)

Collection Statistics:

- 36063 specimen records
- 13180 (37%) georeferenced
- 30707 (85%) with images
- 29512 (82%) identified to species
- 300 families
- 1368 genera
- 8083 species
- 7989 total taxa (including subsp. and var.)

Extra Statistics

[Show Family Distribution](#) 

[Show Geographic Distribution](#) 

For mushroom reports, it helps to know the parts....

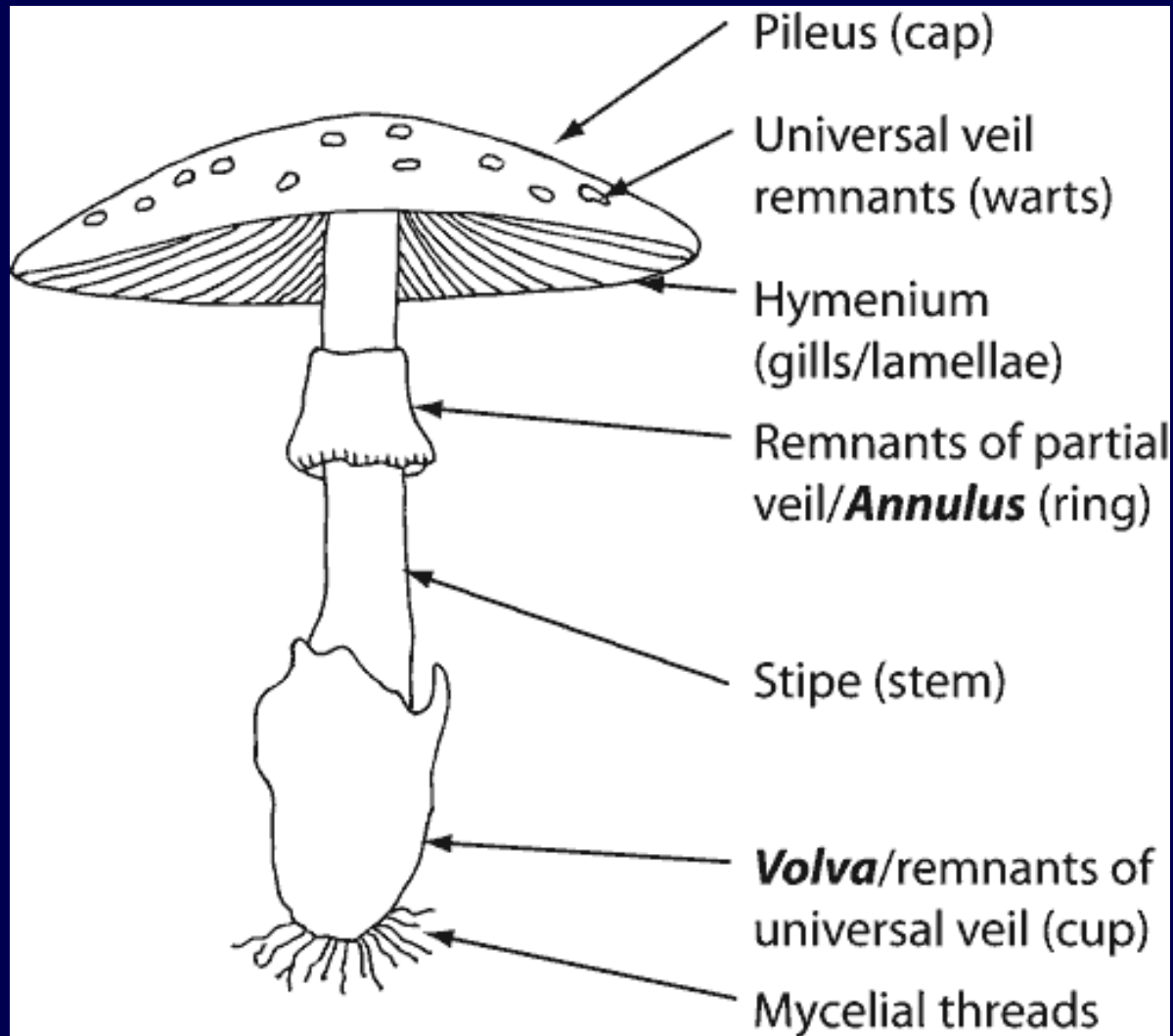
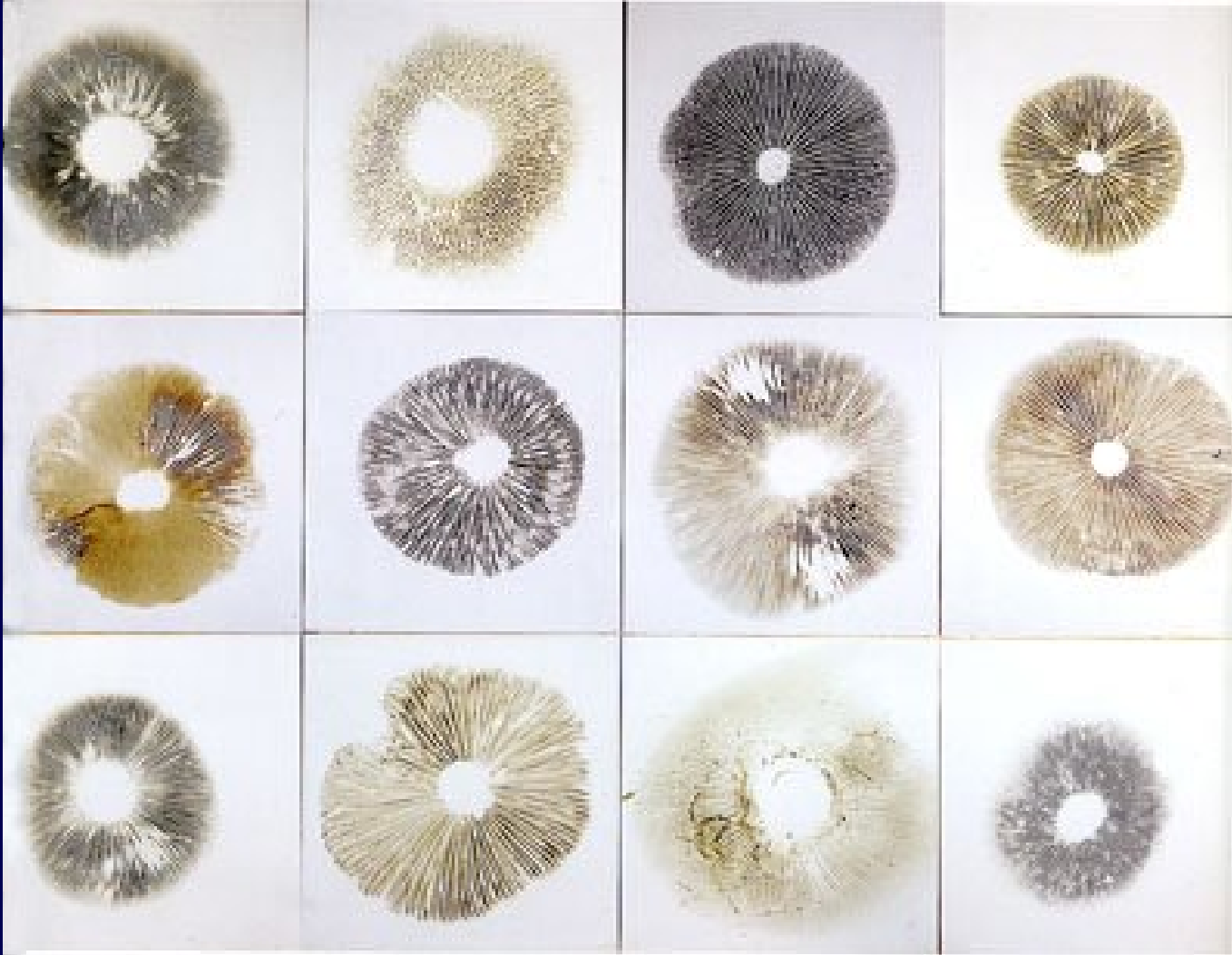


Fig. 1A

Key Features:

- where does it grow (wood, dung, soil)
- color of spores

and the spore color....



But a photo is worth a thousand words
(and a specimen is the best)

Public Enemy #1 – *Amanita*



Some are very poisonous!
These are woodland mushrooms
but they are found in suburban areas too!

Call or email before you send samples....!



Resources in Florida to answer your questions:

Matthew E. Smith

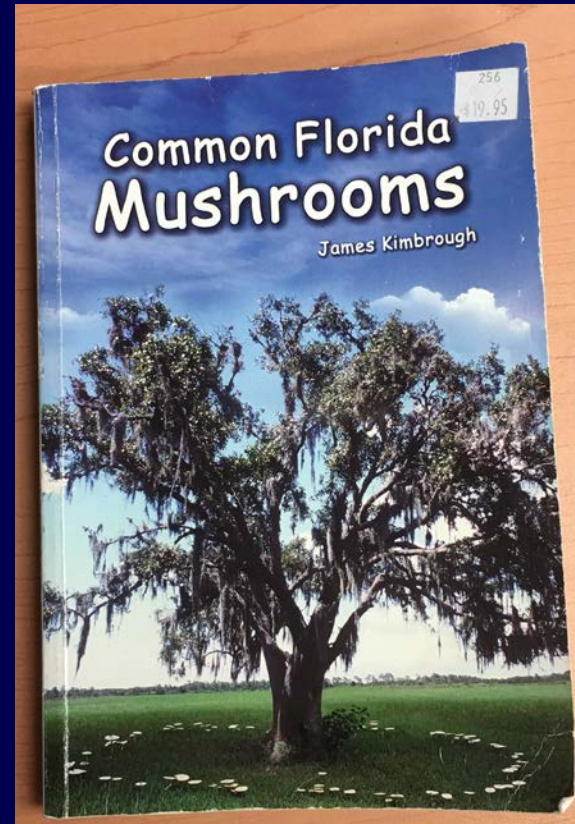
<trufflesmith@ufl.edu>

Plant Pathology, University of Florida

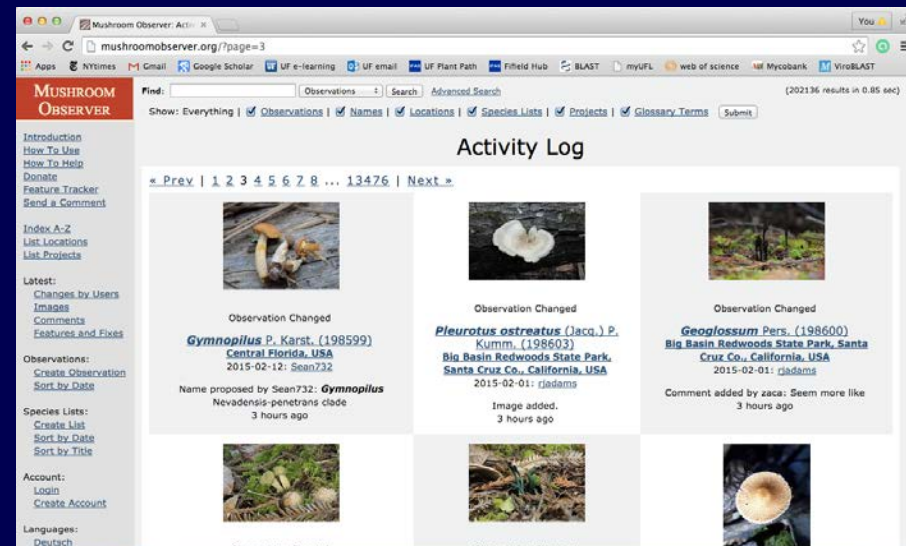
Florida Academic Lichen And
Fungi Enthusiasts League



FALAFELgnv



<http://ifasbooks.ifas.ufl.edu/>

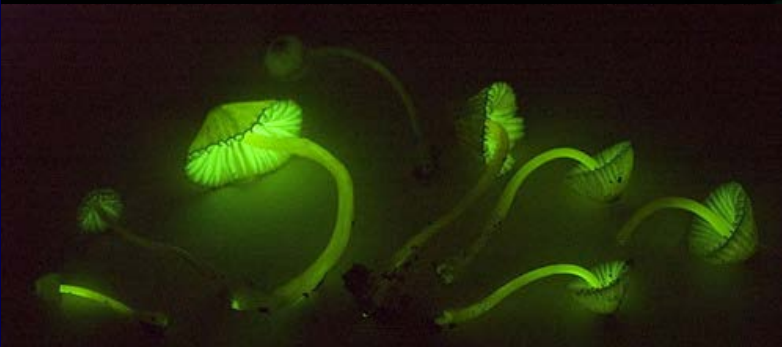


www.mushroomobserver.org

Thanks for your attention



 UNIVERSITY OF
FLORIDA
IFAS EXTENSION



**Fungi
are
Cool**

