

UF/IFAS Extension

The Journey to Sustainability Begins with Education



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Edible Mushroom and Earthworm Culture

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First, What Is The Largest Organism From The Following List?

- Giant earthworm from Australia?



- Redwood tree from California?

- Mushroom from Oregon?
(honey mushroom)



Answer

- **Honey Mushroom from Oregon**

- the discovery of this giant *Armillaria ostoyae* in 1998 heralded a new record holder for the title of the world's largest known organism, believed by most to be the 110-foot- (33.5-meter-) long, 200-ton blue whale.
- occupies some 2,384 acres (965 hectares) of soil in Oregon's Blue Mountains
- outline of the giant fungus stretches 3.5 miles (5.6 kilometres) across, and it extends an average of three feet (one metre) into the ground. It covers an area as big as 1,665 football fields.
- based on its current growth rate, the fungus is estimated to be 2,400 years old but could be as ancient as 8,650 years

Mushrooms



Amanita muscaria



Boletus aureissimus



Collybia sp.



Geastrum saccatum

<http://www.nettally.com/annep/FloridaFungi/index.html>



<http://www.youtube.com/watch?v=5fCjXZODZYc&NR=1>

Edible Mushroom Examples



Oyster Mushroom
(*Pleurotus ostreatus*)



Chanterelle
(*Cantharellus cibarius*)



"Yellow" Morel
(*Morchella esculenta*)



Shitake
(*Lentinula edodes*)



Field mushroom
(*Agaricus campestris*)

Mushrooms 101

II Overview: Classification

1. Animal, vegetable or mineral? You get 20 questions.
2. ... Whittaker's Five Kingdoms
3. Animalia
4. Plantae
5. Fungi
6. Protista
7. Monera

6

III Characteristics of Microorganisms

B. fungi

1. general description:

eukaryotic

nonphotosynthetic

cell walls

most form spores

sexual and nonsexual

reproduction

Mushrooms 101

Characteristics of Fungi

- Decomposers
- Mycelia
- Hyphae: large surface area
- Mycorrhizae: symbiotic relationship between fungi and plant roots

Fungi are Decomposers



Phyla

- **Chytridiomycota** - chytrids
 - Motile spores with flagella
- **Zygomycota** – zygote fungi
 - Zygosporangium at sexual stage
- **Ascomycota** – sac fungi
 - Sexual spores in asci (8 ascospores in each)
- **Basidiomycota** – club fungi
 - Mushrooms, shelf fungi, puff balls
 - Sexual structure – basidia
- **Lichens**
 - Symbiotic relationship between fungi and algae

Table 31.1 Review of Fungal Phyla

Phylum	Key Reproductive Feature
Chytridiomycota (chytrids)	Motile spores with flagella
Zygomycota (zygote fungi)	Resistant zygosporangium as asexual stage
Ascomycota (sac fungi)	Sexual spores borne internally in sacs called asci
Basidiomycota (club fungi)	Sexual spores borne externally on club-shaped structures called basidia

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Mushrooms 101

Phylum Chytridiomycota: Chytrids

- Mainly aquatic
- Some saprobes
 - Decomposer
 - Absorbs nutrients
- Some parasitic
- Flagellated spores
- Most primitive fungi



http://crookbiology.googlepages.com/L_Ch.31_fungi.pdf

Phylum Zygomycota: zygote fungi

- Mostly terrestrial
- Soil or decaying organism
- Some form mycorrhizae
- Coenocytic hyphae
- Zygosporangium – resistant to freezing and drying
- Examples:
 - *Pilobus*
 - *Rhizopus*



Rhizopus

Mushrooms 101

Pilobolus aiming its sporangia



[http://crookbiology.googlepages.com/
L_Ch.31_fungi.pdf](http://crookbiology.googlepages.com/L_Ch.31_fungi.pdf)

Phylum Ascomycota: Sac fungi

- Marine, freshwater and terrestrial
- Mostly saprobes
- About half form lichens
- Some form mycorrhizae
- Produce asci (ascus)
 - Fruiting body – ascocarp
 - 8 ascospores in asci
- Asexual spores – conidia
 - Produced in conidiophores



Mushrooms 101

Ascomycetes (sac fungi): Scarlet cup (top left), truffles (bottom left), morel (right)



[http://crookbiology.googlepages.com/
L_Ch.31_fungi.pdf](http://crookbiology.googlepages.com/L_Ch.31_fungi.pdf)

Phylum Basidiomycota: club fungi

- Mushrooms, shelf fungi, puffballs, rusts
- Decomposers – plants
- Some form mycorrhizae
- Some parasitic (rusts, smuts)
- Basidiocarp – fruiting body
 - Basidia – source of sexual spores (on gills under mushroom)
 - Basidiospores – spread by wind
- Fairy rings

Mushrooms 101

Basidiomycetes (club fungi): Greville's bolete (top left), turkey tail (bottom left), stinkhorn (right)

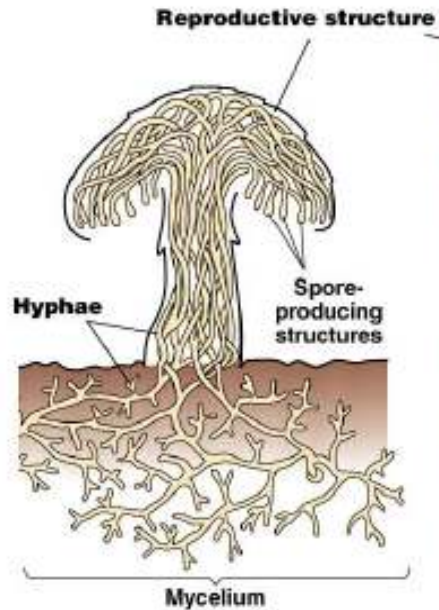


http://crookbiology.googlepages.com/L_Ch.31_fungi.pdf

Mushrooms 101

- Mushrooms are the **fruiting bodies** of certain fungi—the equivalent of the apple, not of the tree
- The fungal organism which produces the mushrooms you encounter on your lawn or in the forest is called a **mycelium**. It is composed of **hyphae**, which are "chains" of fungal cells (singular: **hypha**).

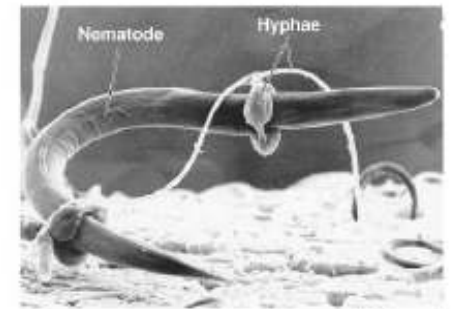
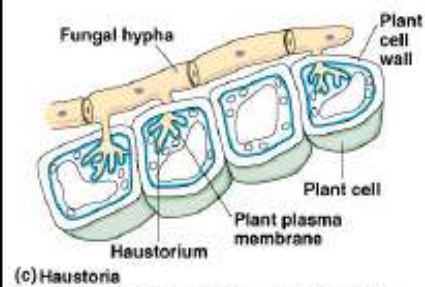
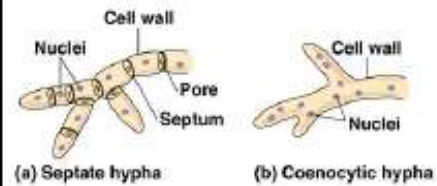
Mycelia



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Mushrooms 101

Hyphae



(d) Hyphae adapted for trapping and killing prey

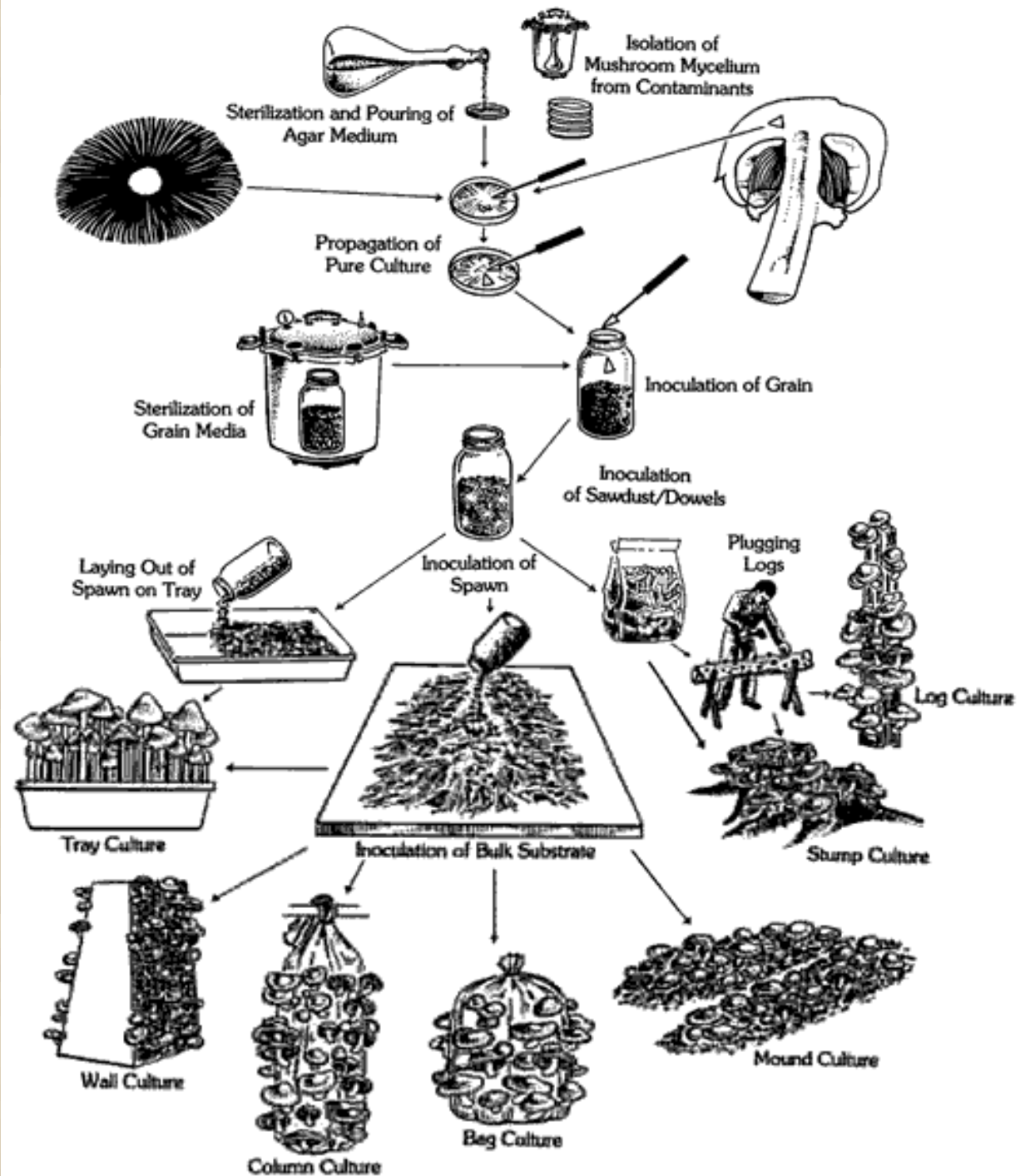
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Mushroom Cultivation

- Completely different to growing green plants
- Do not contain chlorophyll & depend on a substrate to decompose for their food
- Become familiar w/ life cycles of species of interest for production
- Outside production is possible
- Inside production provides more continuous fruiting but requires greater management

Steps In Mushroom Cultivation



<http://attra.ncat.org/attra-pub/PDF/mushroom.pdf>

Mushroom Cultivation In The Garden

- Use creativity and imagination when planting mushrooms in a garden
- Look for the "fundamentals," the necessities such as available substrates, microhabitats, sun, shade, wind, and humidity conditions
 - organic waste materials = substrates
 - tall plants = shade
 - a misting sprinkler = humidity

Choosing A Mushroom Species

- A mushroom cultivation kit is a handy way to begin to understand the fungal life cycle
- Afterwards purchase spawn that will grow on materials you have available
- design and test a system that duplicates the conditions favorable to all stages of growth
- oyster (*Pleurotus species*) is a good choice probably for most novices

Oyster Mushroom Example



Gray Oyster



Flamingo Oyster



Golden Oyster

<http://attra.ncat.org/attra-pub/PDF/mushroom.pdf>



Edible Mushroom Production Facility

Oyster Mushroom Production at E.C.H.O.

<http://www.echonet.org/>



Bag Culture Production



Oyster Mushroom Production at E.C.H.O.

<http://www.echonet.org/>

Edible Mushroom Production Facility

- wooden lattice shelving for mushroom bags placement
- Open ventilation
- Shaded
- Not air conditioned





Edible Mushroom Spawning Facility

Oyster Mushroom Production at E.C.H.O.

<http://www.echonet.org/>



Jar of spawn



Oyster Mushroom Production at E.C.H.O.

<http://www.echonet.org/>

Transfer table (laminar flow hood) for sterile mushroom spore inoculations of petrie plates and spawn jars.

Blueprint for homemade version available at:

<http://www.angelfire.com/il/Toddshome/lamflohd.pdf>



Refrigerator spawn incubator



Oyster Mushroom Production at E.C.H.O.

<http://www.echonet.org/>

Solar-heated substrate pasteurization
unit (i.e., a used, gutted refrigerator)



Other Edible Mushrooms Spp

- **Shitake**

- are grown on logs, either inside or outside. Inside, they can also be grown on compressed sawdust logs or in bottles or bags



Shiitake mushrooms fruiting on sawdust.

- **Morel**

- possible to establish a morel patch by using a morel starter kit



<http://attra.ncat.org/attra-pub/PDF/mushroom.pdf>
http://botit.botany.wisc.edu/toms_fungi/morel.html

Other Edible Mushrooms Spp

- **Huitlacoche**

- young, edible galls that form when ears of maize are infected by the basidiomycete *Ustilago maydis*



Huitlacoche mushrooms fruiting on ear of corn.

- **Paddy Straw mushroom**

- a high temperature mushroom grown largely in tropical and subtropical regions of Asia & accounts for 16% of total production of cultivated mushrooms in the world

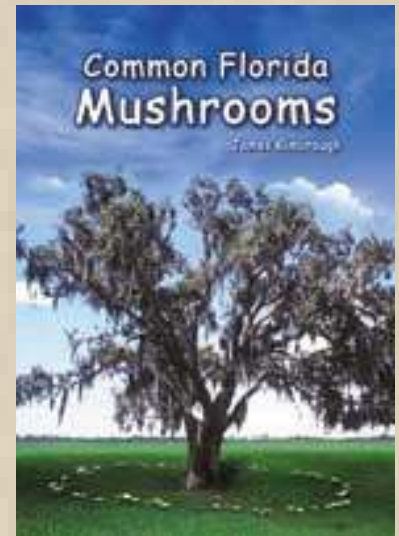


Volvariella volvacea

<http://www.troygardens.org/huitlacocheproject.html>
<http://www.isms.biz/edibles.htm>

Know Your Mushrooms

- **DO NOT EAT WILD MUSHROOMS** unless you are **ABSOLUTELY** sure you have identified the mushroom correctly and **KNOW** that it is edible.
- As to lawn damage by mushrooms, they rarely cause landscape problems. Most lawn mushrooms are fungi that feed on decomposing grass clippings or mycorrhizal spp.



Fairy ring mushroom