

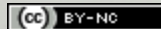
# Mycology for librarians: everything you never wanted to know about fungus



Amanda Rinehart, Data Librarian

Illinois State University

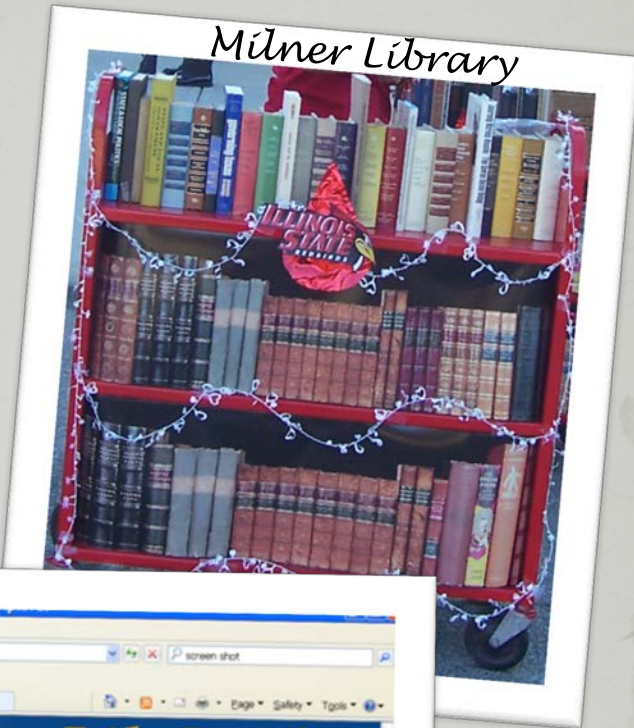
Photo courtesy of Kathie Hodge.







# Amanda Rinehart Data Librarian (Former) Mycologist



**USDA** **50** **Years of Progress**

**1921 to 1930**

**Noted Events**

**1925** – Mr. Bahrt of the Soil Fertility Investigations in Orlando, FL initiates the use of minor elements (such as manganese, zinc, copper, and iron) to alleviate bronzing and freckling symptoms of citrus.

**1925** – USDA's Dr. Denney of the US Fruit Utilization Laboratory in Los Angeles, CA discovered that ethylene was the coloring agent in the kerosene fumes used to degreen oranges.

**1929** – Identification of the Mediterranean fruit fly (medfly) in Orange County, FL, causing all citrus, guava, peach and fig fruit in 15,000 square miles to be destroyed. The USDA contributed \$4,500,000 and the invention of arsenical bait sprays to the eradication campaign.

**Mr. Yothers going to spray plots in the official car, Orlando, FL 1921**

**Greenhouse, US Subtropical Field Station, Orlando, FL 1922**

**Weighing fertilizers, Lake Alfred, FL 1928**

**The wreck with Mr. Tink and Mr. Winston Sebastian, FL**

**US Subtropical Field Station Staff, left to right: Mr. Farmer, Mr. Zow, Mr. Yothers, E. Gallinger, Miss Collicutt, Mr. Winston Sitting: Mr. Bowman, Mr. Mason, Mr. Cotton 1922**

**Citrus tree leaves Mitchell Grove, Vero Beach, FL March 20, 1931**

**Pathology Lab, US Subtropical Field Station, Orlando, FL 1922**

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Edge Safety Tools

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en gathered from scientists who want to share their passion. Topic has suggested keywords. These may be good as a place to start. Just click on any text in blue, and you'll find new and interesting information. If you come across unfamiliar terminology. Also, new science and technology often centers its.

**Author**



Amanda Rinehart



# Mycology 101

Circle of life

Microbes

Fungi

Reproduction

Types/classification

Spread

Food/habitats

Toxicity

Identification

Control

Book-eaters

Fun facts!



Photo courtesy of the Library of Congress

# Molds, mildew, and mushrooms...

Mycology – study of fungus



Photo courtesy of Milliped

Mold = common term, generally “fluffy” fungi on food

Mildew = common term, generally flat growing fungi

Mushrooms = fungi with fleshy, above-ground fruiting structure

Fungi = molds, mildew, mushrooms, and yeasts



# The Circle of Life...

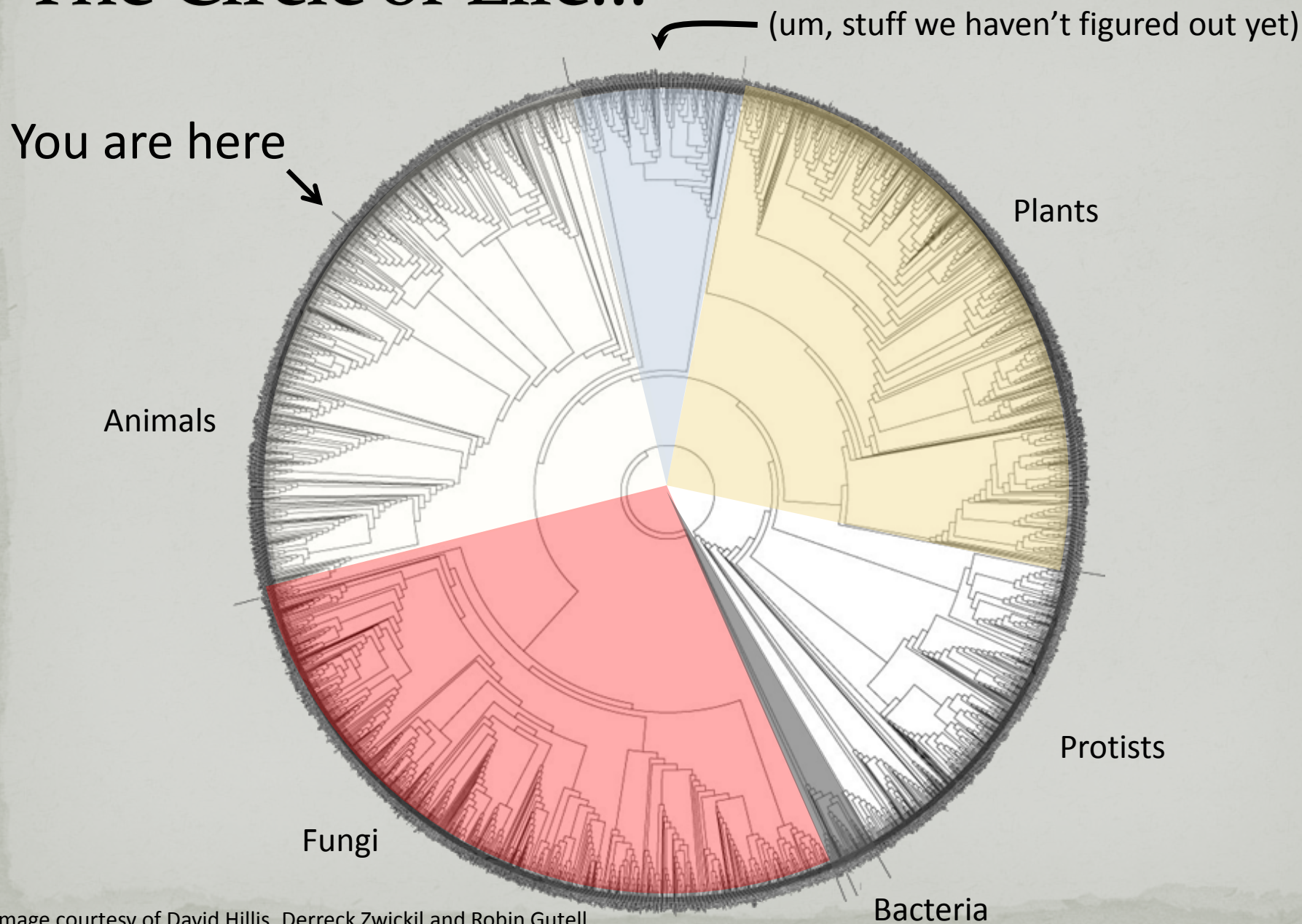


Image courtesy of David Hillis, Derreck Zwickil and Robin Gutell

# Fungi and Yeasts and Bacteria, oh my...

Kitchen  
Sponge

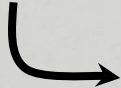
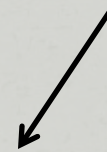


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for image 92340A.

Bacteria



Fungi



Yeast

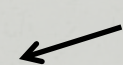


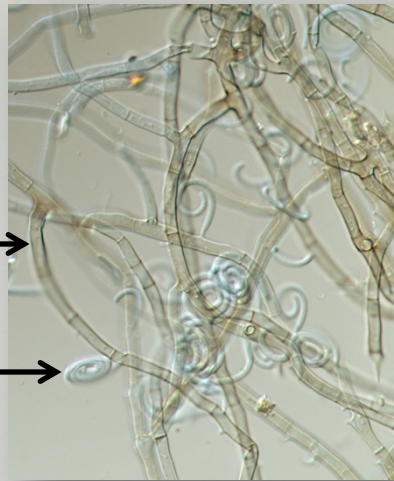
Photo courtesy of Dennis Kunkel. Copyright 2009 Dennis Kunkel Microscopy, Inc. ([www.denniskunkel.com](http://www.denniskunkel.com)).



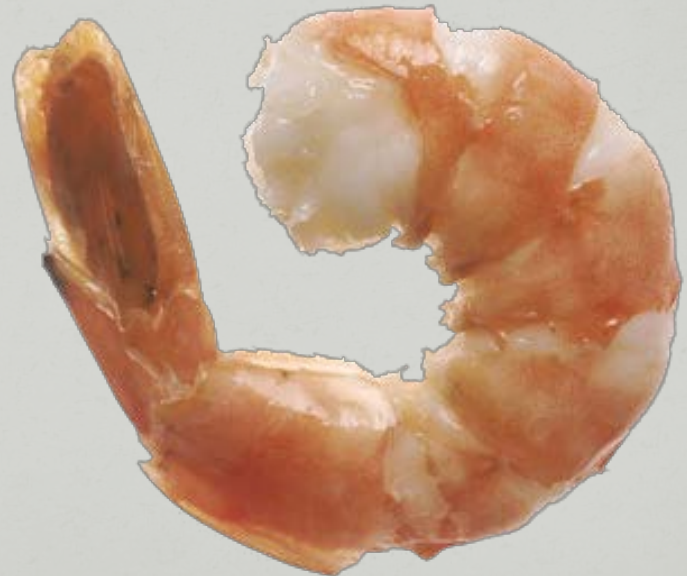
# Fungi

Hyphae/mycelia →

Spore/conidia →



# Chitin

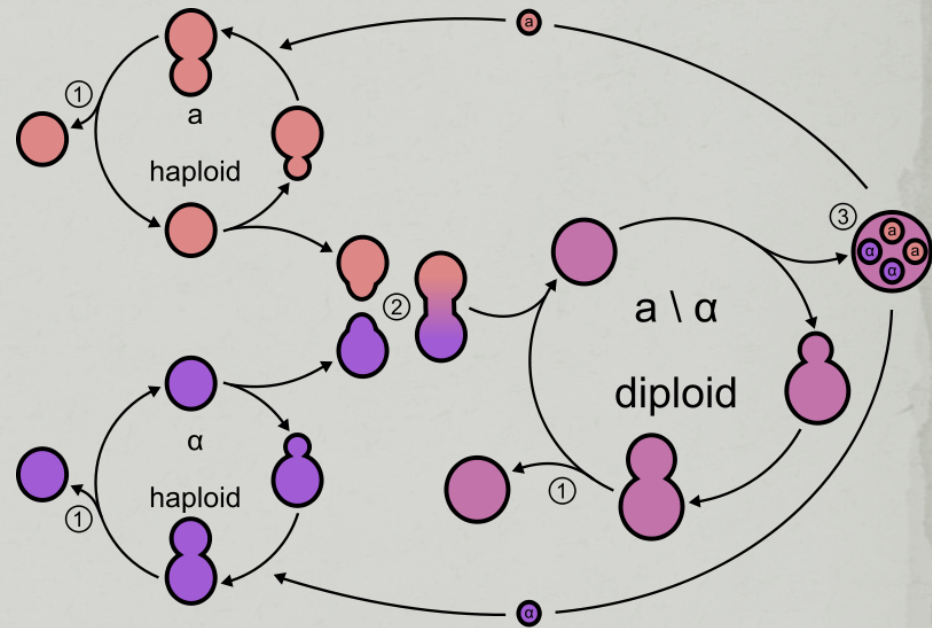
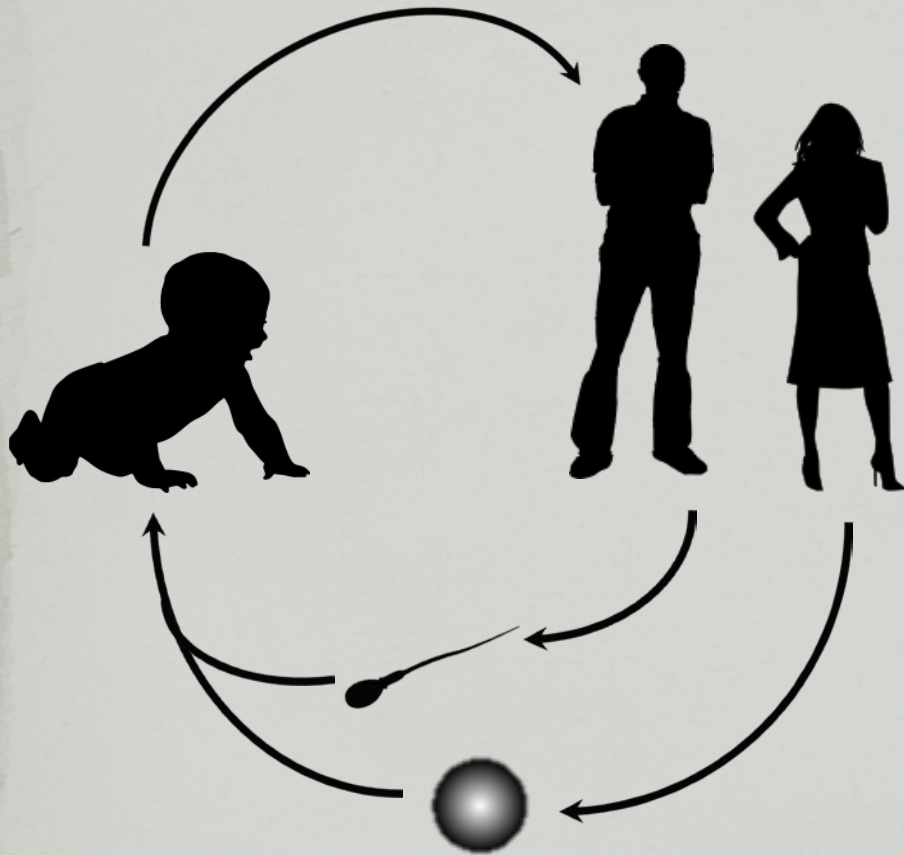


*Helicosporium griseum* image courtesy of Cornell Fungi at Flickr.com

Ant image courtesy of Pedro Moura Pinheiro'

Shrimp image courtesy of Renee Comet

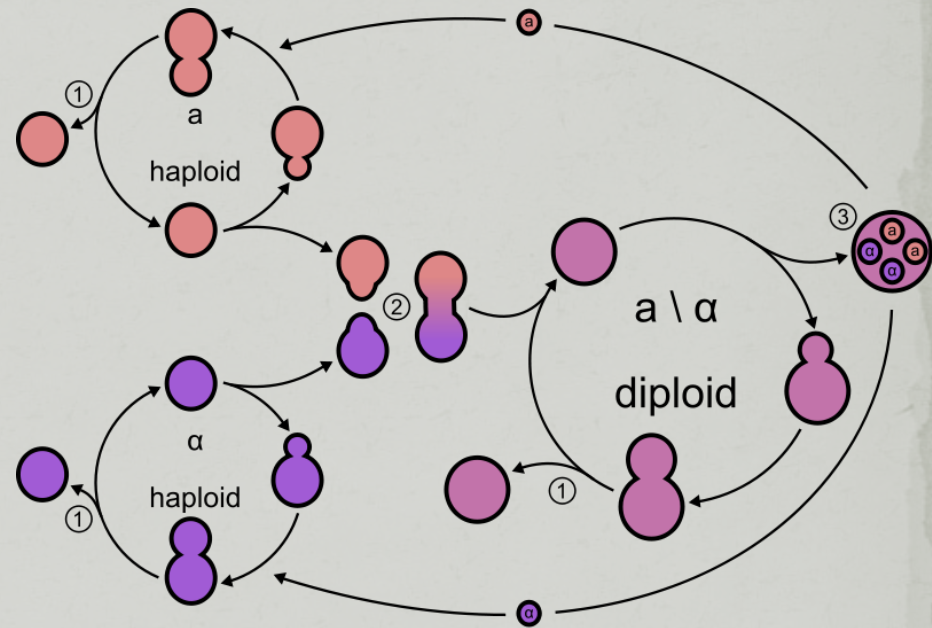
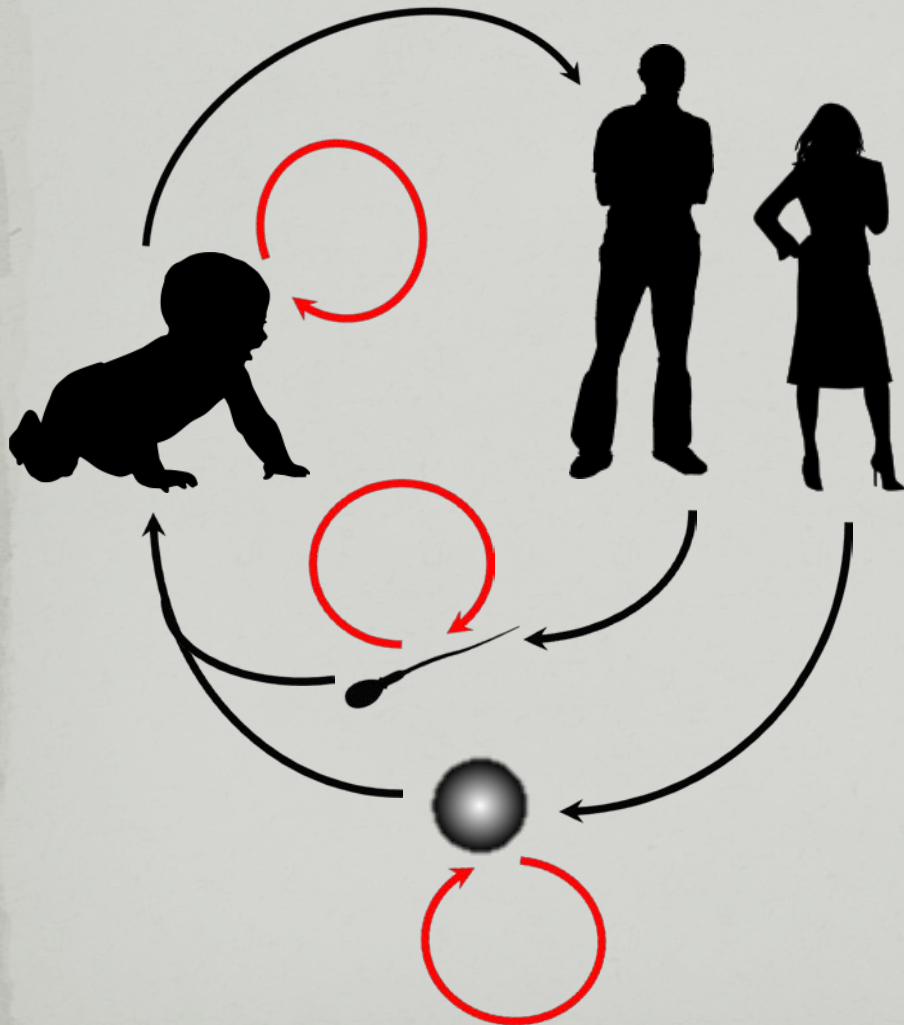
# Lifecycle



Fungal lifecycle courtesy of Masur.



# Lifecycle



Fungal lifecycle courtesy of Masur.

# Wheat Rust

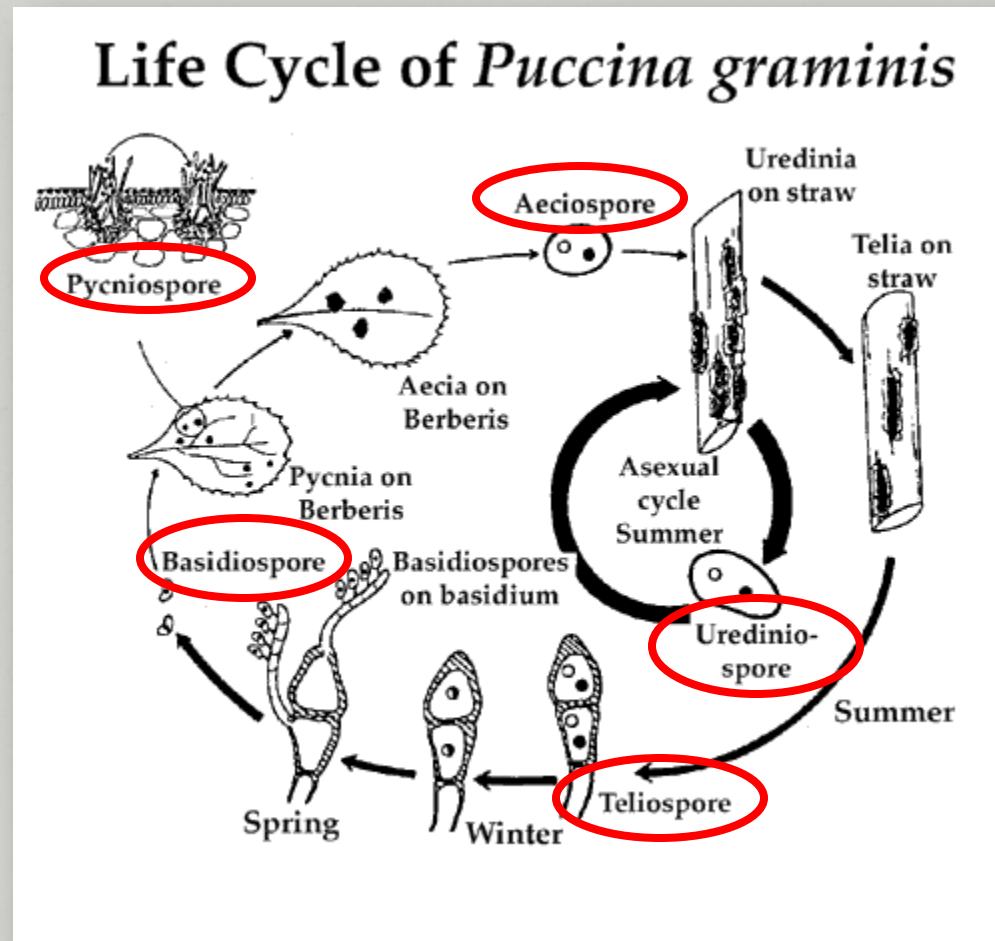
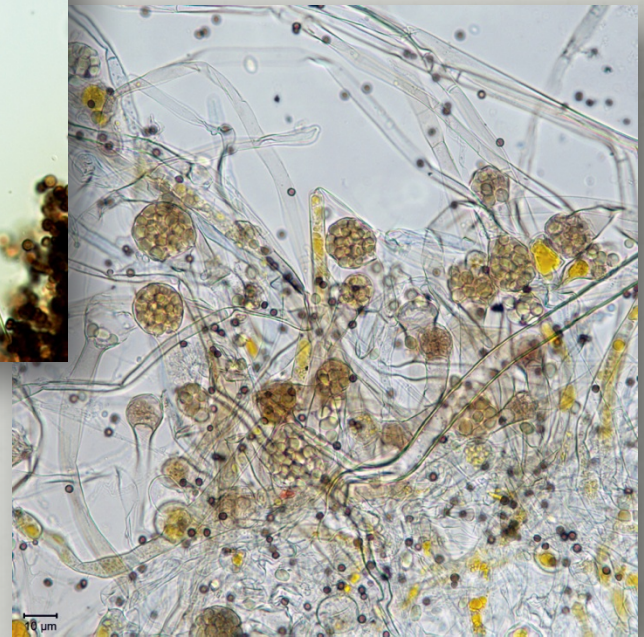
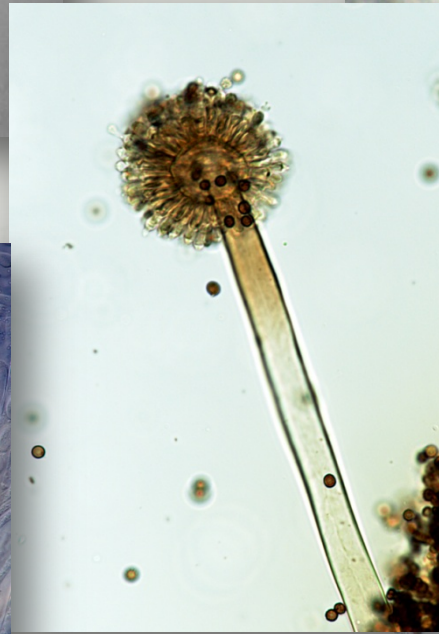


Photo courtesy of the Agricultural Research Service



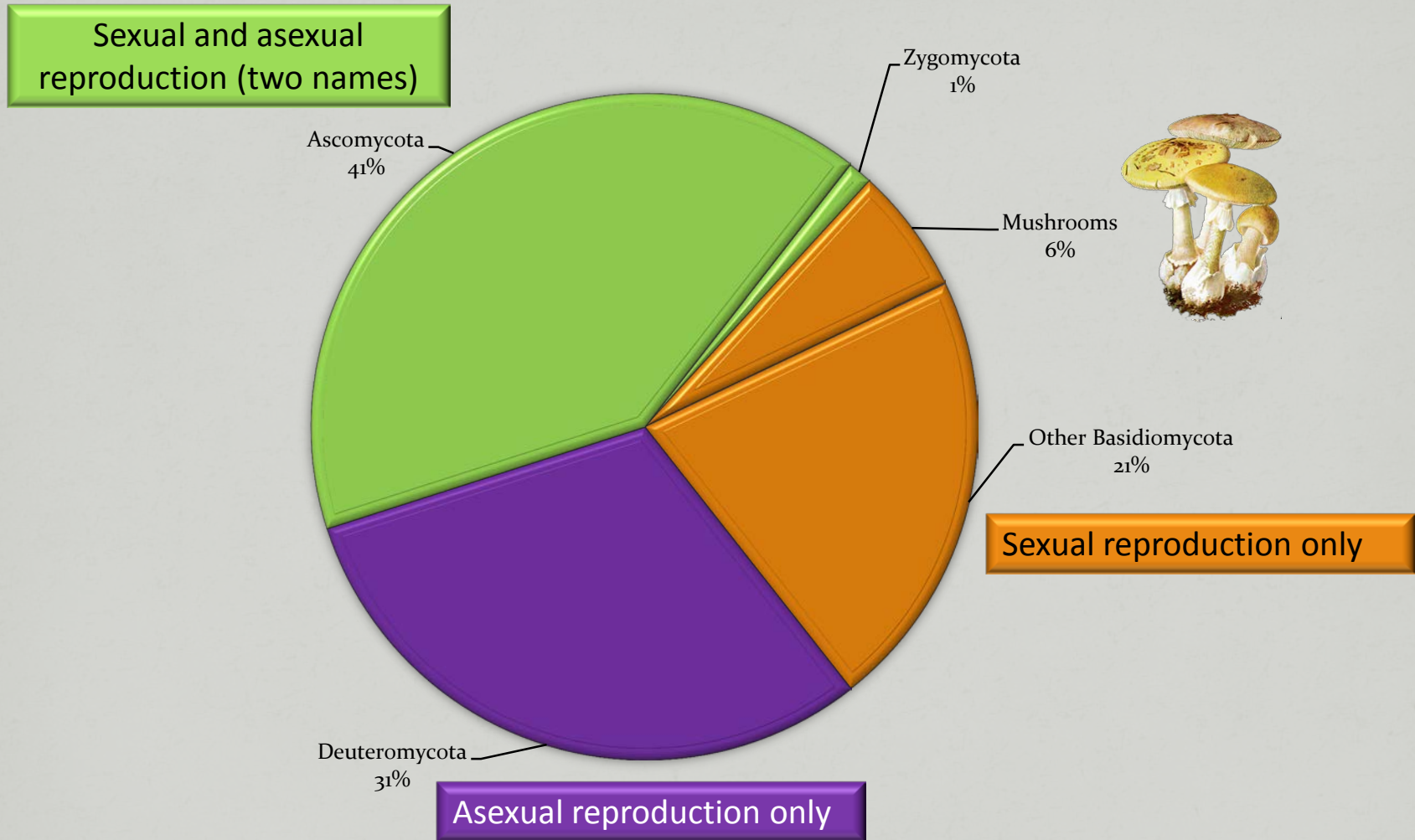
# Spore Types



*Aleuria aurantiaca*, Ingoldian hyphomycetes, *Aspergillus niger*, *Pestalotiopsis* sp., *Phycomyces blakesleeanus*, truffle spores, images courtesy of Kathie Hodge.



# Fungi sexual states



*Amanita phalloides* illustration courtesy of von Albin Schmalfuß.



# Dissemination

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<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0003237>

- Mechanical
- Air
- Water
- Insects/animals



Combine image courtesy of the US Agricultural Research Service.

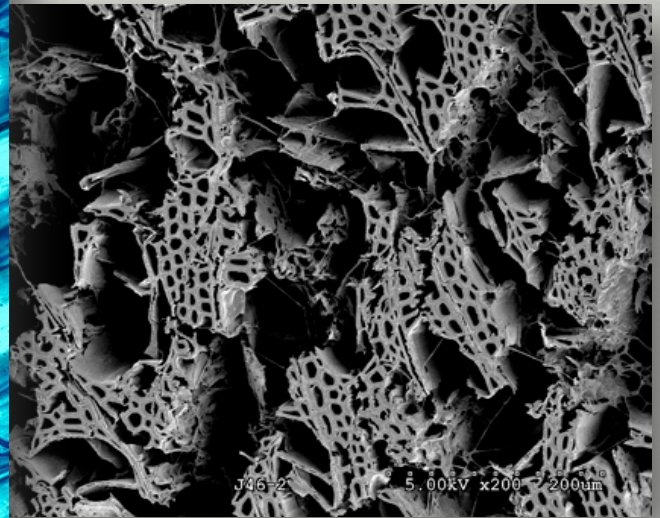
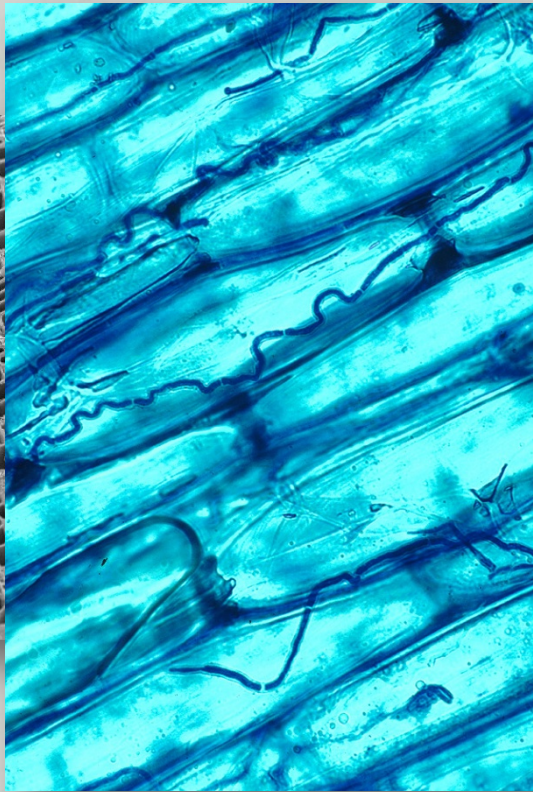
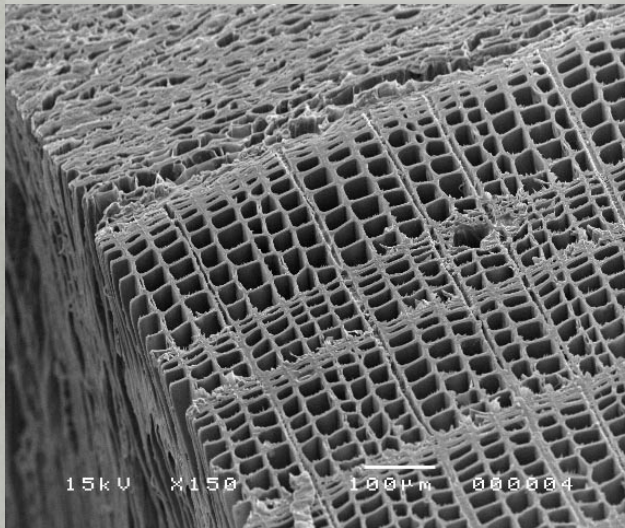
Yafetto, L., Carroll, L., Yunluan, C., Davis, D. J., Fischer, M. F., Henterly, A. C., Kessler, J. D., Kilroy, H. A., Shidler, J. B., Stolze-Rybczynski, J. L, Sugawara, Z., & Money, N. P. (2008). The Fastest Flights in Nature: High-Speed Spore Discharge Mechanisms among Fungi. *Plos ONE*, 3(9), 1-5. doi:10.1371/journal.pone.0003237. Retrieved from

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0003237>



# Food...

Facultative heterotrophs– cannot make their own food, but under stress can take advantage of multiple food sources



Saprophytic (eats dead things)  
Parasitic (eats living things)  
Symbiotic (mutual benefit)

Healthy wood photo courtesy of Constantin Sander.

*Neotyphodium coenophialum* in fescue leaf courtesy of the US Agricultural Service.

Degraded wood photo courtesy of Robert A. Blanchette and Joel A. Jurgens, University of Minnesota.



# Temperature and Humidity

- Temperature growth is highly variable
- Indoor relative humidity below 70%

Relative humidity = ratio of water vapor to maximum possible water vapor

Influenced by:

air pressure (elevation)

moisture in the air

temperature



# Basic Biology

- Large cells
- Hard cell walls
- Complicated and flexible lifecycles
- Distinctive spores, basis for classification
- Mechanisms to spread spores
- Flexible living and eating habits

# Bad fungi

- Allergies, asthma (~5%)
- Infections
  - Superficial
  - Immune compromised
  - 4 outdoor human pathogens
  - Organic dust toxic syndrome
- Toxic compounds (mycotoxins)
  - Mushroom poisoning (~90% *Amanita phalloides* )
  - Large, relatively immobile molecules
  - Warfare “Yellow Rain”, aerosolized



*Amanita phalloides* illustration courtesy of von Albin Schmalfuß.



# Black Mold

- Dematiaceae - 36 species
- ~ 50 *Stachybotrys* sp.

*S. chartarum* (*S. atra*)

*S. Chlorohalonata*

## Infant pulmonary hemorrhage

1993-94

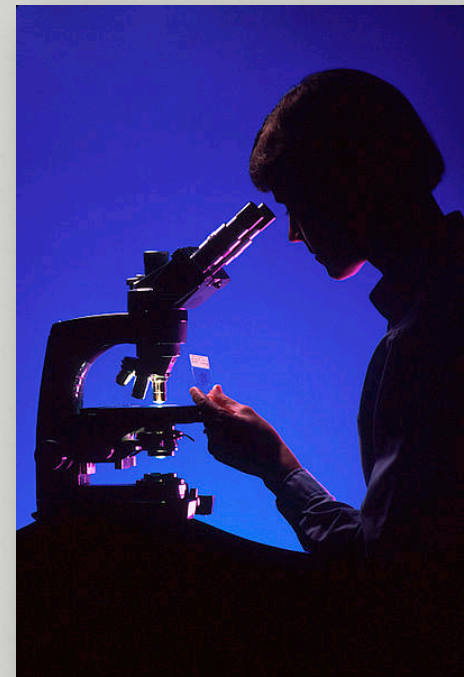
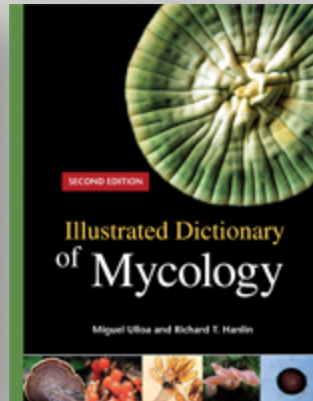
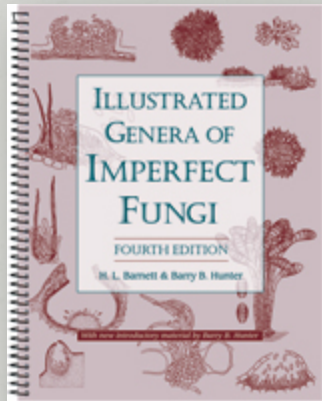
## No causational evidence

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for image 22016A.

# Identification

- Microscope
  - Tape mount spores (colonies or spore trap)
  - View under 40X or 60X
  - Identify with key

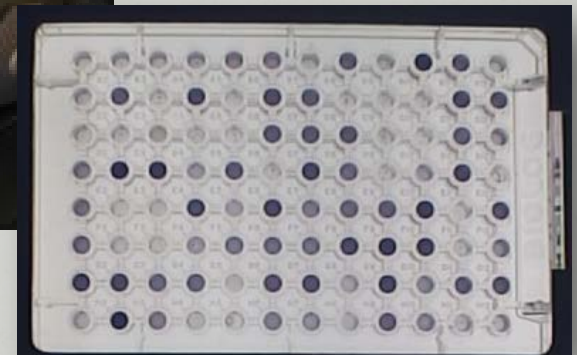
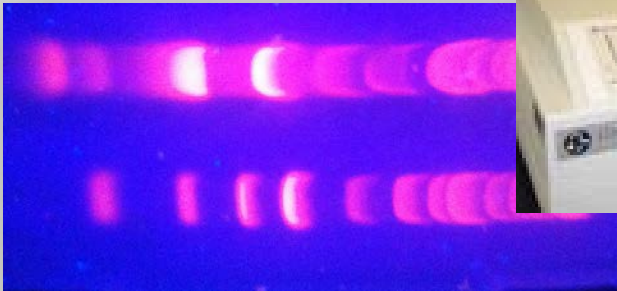
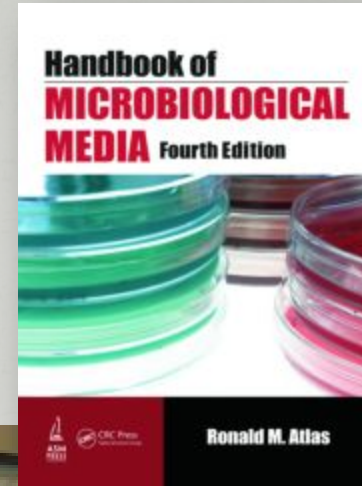


Barnett, H. L. (1960) *Illustrated genera of imperfect fungi* /Minneapolis : Burgess.  
Ulloa, Miguel,, Hanlin, Richard T.,, Aguilar, Samuel.Aguirre Acosta, Elvira.  
(2000) *Illustrated dictionary of mycology* /St. Paul, Minn. : APS Press.



# Identification con't.

- Selective culture media
- Metabolic fingerprint
  - BioLog.com
- DNA



Atlas, Ronald M., Parks, Lawrence C. (1993) *Handbook of microbiological media* / Boca Raton : CRC Press.

Biolog and 96-well plate image courtesy of Amanda K Rinehart.  
Stained DNA photo of Joseph Elsbernd.

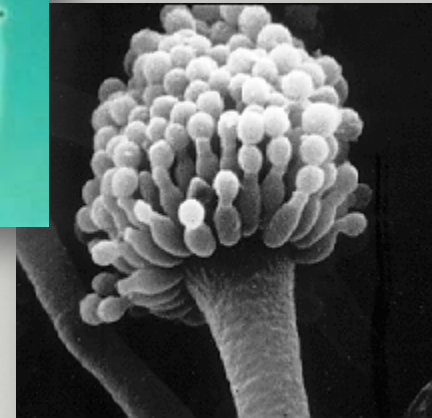
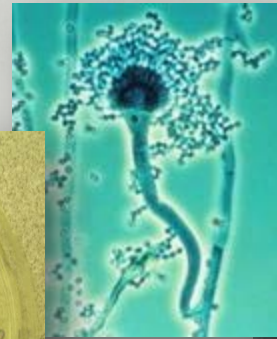
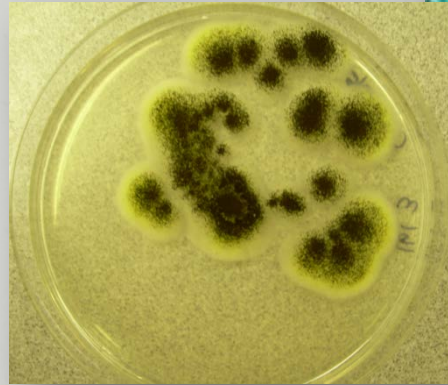
# Methods of eradication

- Physical removal
  - Flame, UV light, lasers
  - Scrubbing, removing fungal items
- Environmental dormancy (humidity, temperature)
- Fungicide/fungistatic
  - Fumigation - exclude oxygen (methyl bromide, ethylene oxide)
  - Surface protectant (iodine, copper, sulfur, organic compounds)
  - Systemic – many organic compounds (plants and animals only)

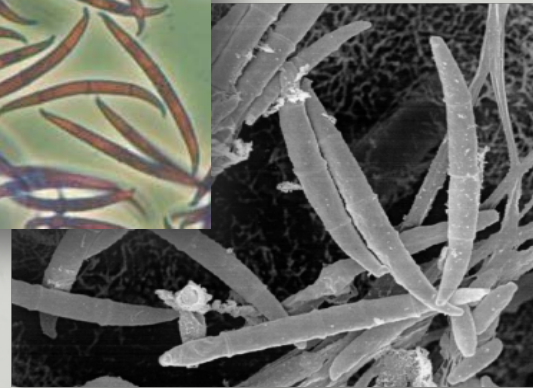
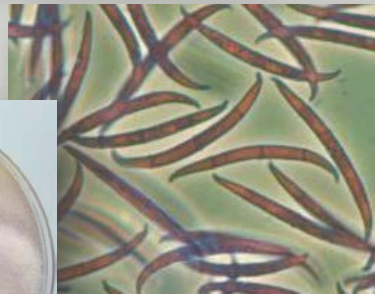


# Some book eaters...

*Aspergillus sp.*



*Fusarium oxysporum*



*Aspergillus sp.* light microscope image courtesy of US Department of Health and Human Services.

*Aspergillus sp.* SEM image courtesy of US National Institute of Health.

*Aspergillus alliaceus* colonies photo courtesy of Ninjatacoshell.

*Fusarium oxysporum* light microscope image courtesy of Gerald Holmes, Valent USA Corporation, Bugwood.org.

*Fusarium sp.* colonies photo courtesy of estherase.

SEM *Fusarium oxysporum* spores courtesy of Amanda K Rinehart.

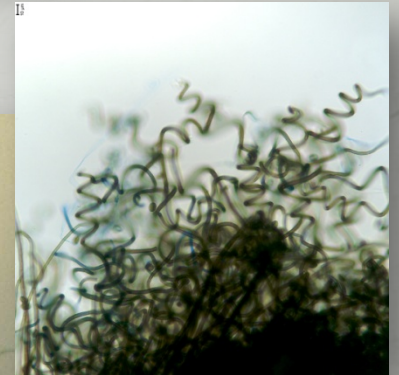
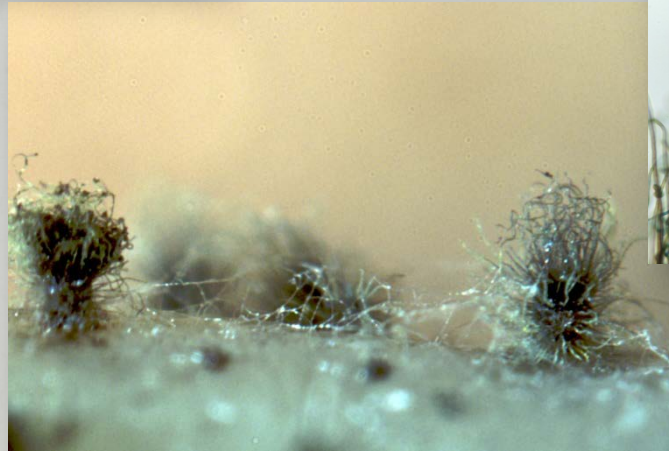


# More cellulolytic fungi...

*Alternaria solani*



*Chaetomium globosum*



Wet paperback novel →

*Alternaria solani* light microscope image courtesy of Paul Bachi, University of Kentucky Research and Education Center, Bugwood.org.

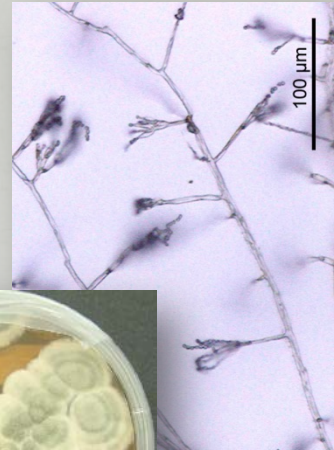
*Alternaria* sp. Courtesy of Ninjatacoshell.

*Chaetomium* sp. light microscope images courtesy of Kathie Hodge.



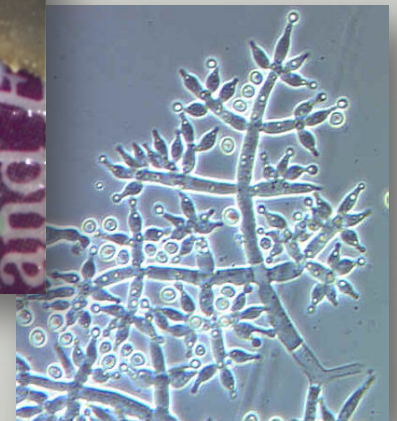
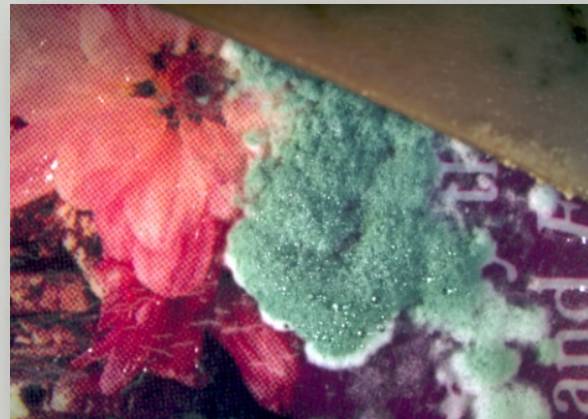
# And even more ...

## *Penicillium notatum*



## *Trichoderma sp.*

Wet paperback novel →



*Penicillium notatum* colonies photo courtesy of Crulina 98.

*Penicillium* sp. Light microscope photo courtesy of Y\_Tambe.

*Penicillium* sp. SEM image courtesy of AJC1.

*Trichoderma* sp. colony courtesy of Kathie Hodge.

*Trichoderma harzianum* light microscope image courtesy of the US Agricultural Research Service.



# Without fungi, we wouldn't have...

- leavened bread, yogurt, soy sauce, miso, or any alcohol.
- food supplements and additives, such as carotene dye, B12, and citric acid.
- antibiotics such as penicillin cephalosporin, and griseofulvin (anti-fungal)
- statins for high cholesterol
- immuno-suppressants for organ transplants



# Fun facts...

- The fungal cannon (*Pilobolus cystallinus*) is the fastest known organism in the world
- The largest organism in the world is a fungus (*Armillaria ostoyae*); over 4 square miles wide and at least 2400 years old in eastern Oregon
- St. Anthony's Fire, a hallucinogenic disease and possibly the basis of the Salem Witch Trials, is caused by a fungus, *Claviceps sp.*
- You can make both paper and ink from mushrooms!



*Coprinus comatus* ink photo courtesy of Kathie Hodge.

# Selected Resources

American College of Occupational and Environmental Medicine. (February 24, 2011). *Adverse human health effects associated with molds in the indoor environment*. Retrieved from [http://www.acoem.org/AdverseHumanHealthEffects\\_Molds.aspx](http://www.acoem.org/AdverseHumanHealthEffects_Molds.aspx)

Clarke, J.A., Johnstone, C. M., Kelly, N. J., McLean, R. C., Anderson, J. A., Rowan, N. J., Smith, J. E. *A technique for the prediction of the conditions leading to mould growth in buildings*, Building and Environment, Volume 34, Issue 4, 1 July 1999, Pages 515-521, ISSN 0360-1323, 10.1016/S0360-1323(98)00023-7.

Szczepanowska, H. M. & Moomaw, W. R. (1994). *Laser stain removal of fungus-induced stains from paper*. JAIC, 33:2:25-32. Retrieved from <http://cool.conservation-us.org/jaic/articles/jaic33-01-002.html>

U. S. Department of Labor. *A brief guide to mold in the workplace*. SHIB 03-10-10. Retrieved from <http://www.osha.gov/dts/shib/shib101003.html>

World Health Organization. (2009). *WHO Guidelines for Indoor Air Quality: Dampness and Mould*. Retrieved from <http://www.osha.gov/dts/shib/shib101003.html>