EEK! MOLD! HELP!

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Mold

- What is it?
- Contributing factors
- Prevention
- Health hazards
- Response
- Recovery

What is Mold?

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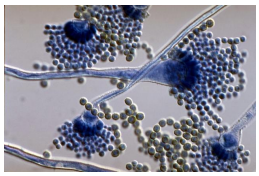
- Surface molds produce conidia (the spore carriers) AKA the instigator
  - *Aspergillus,* one of the most common species of mold
  - *Penicillium* , Penicillin (antibiotic); blue cheese
  - *Stachybotrys* AKA "(Toxic) Black Mold"

What is Mold?

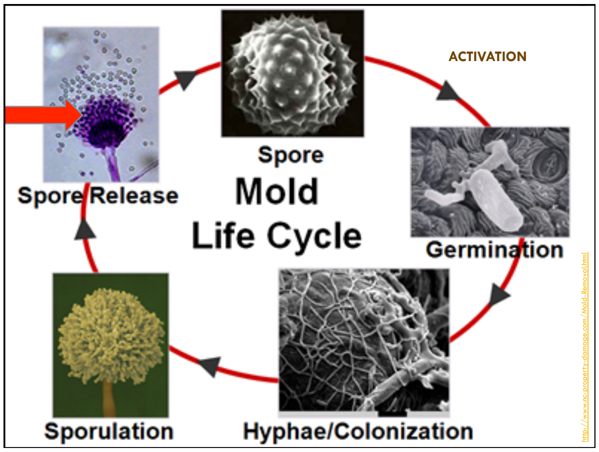
- Mold is everywhere and we cannot get rid of it!
- Surface molds produce conidia (the spore carriers) AKA the instigator
- The conidia and spores are specially designed for survival – they will only grow where they have a chance of survival (food and environment)



Aspergillus flavus

Spore Lifecycle

- Maturation and release
- Dormancy
- Activation
- Germination
- Hyphae
- Conidia formation
- …and the cycle continues…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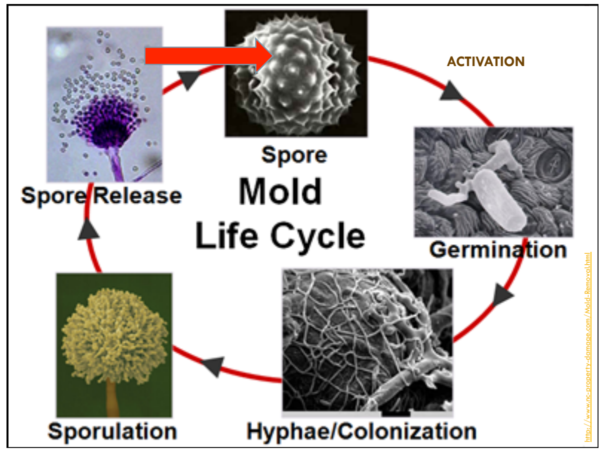
Spore Release
Mold
Life Cycle
Germination
Sporulation
Hyphae/Colonization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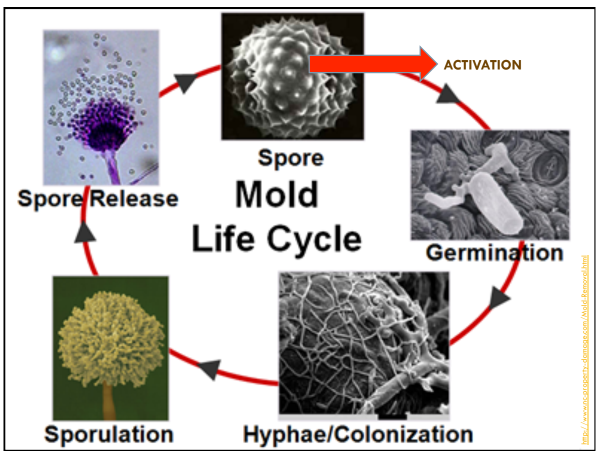
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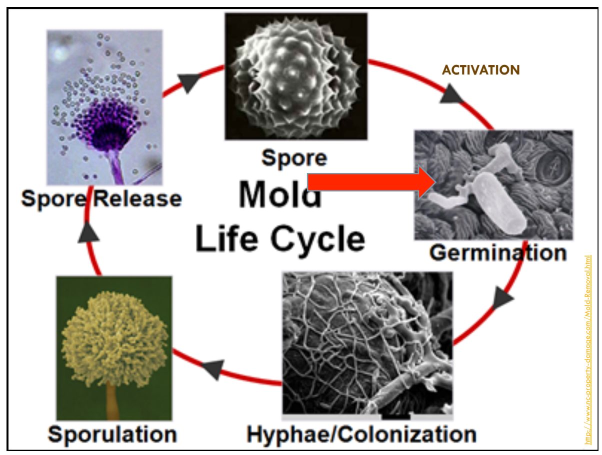
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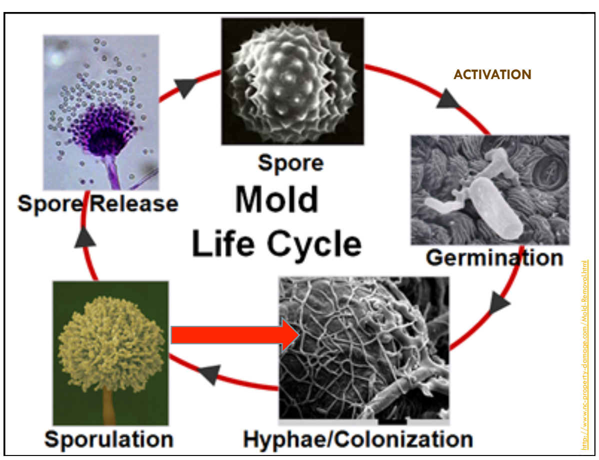
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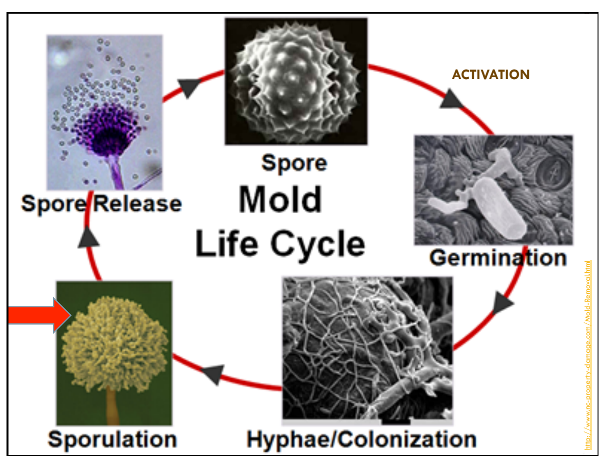
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Spore Characteristics

- Dormant conidia and spores can survive extreme environments (freezing, dry, hot, etc.) but not once the conidia has been activated and germinated.
- Dormant conidia can remain viable for over 20 years, waiting for the right environment to germinate
  - REMOVAL is key

Mold in action!

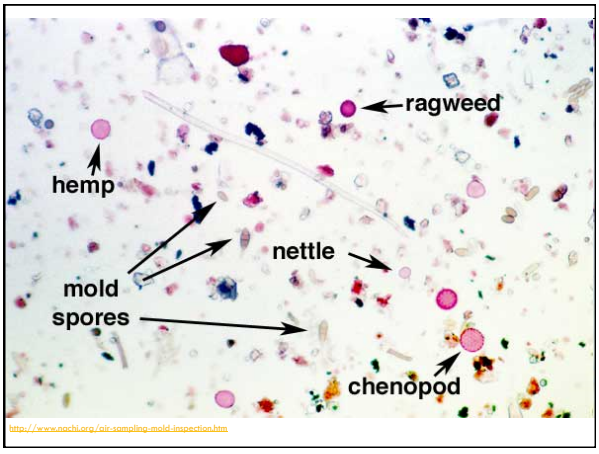
- *Rhizopus stolonifer*
  - AKA "black bread mold"
- The sequence spans 7 days with images made at 10 minute intervals

Mold in action!

- *Pleurotus ostreatus*
  - AKA "white oyster mushroom"
  - It's edible! Yum!
- Sequence spans 1 month 24 days

Sources of Spores and Conidia

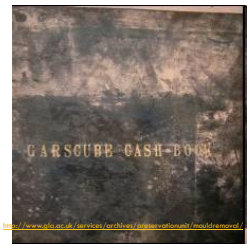
- Airborne particles ranging in size from 1 -100 µm (1 µm = 1/1000 mm)
- Indoor mold growth on plants, dust, food, collections materials, etc.
- Contaminated collections through manufacture, use, or history



Active vs. Inactive Mold Growth

Active Mold Growth

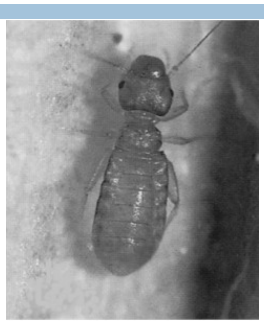
Inactive Mold Growth



http://www.gla.ac.uk/services/archives/preservationunit/mouldremoval/

Early Indicators

- Presence of insects
- Telltale odor

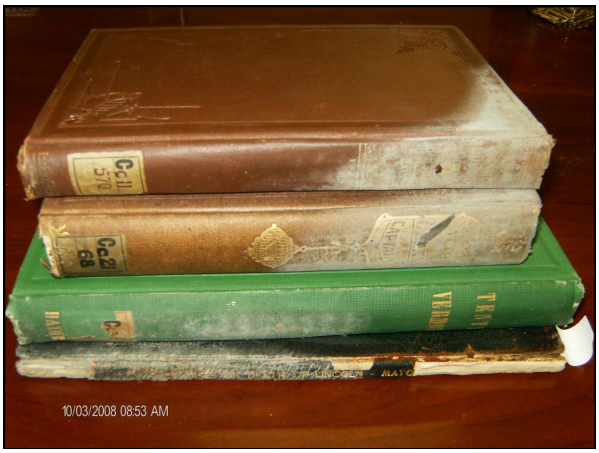


Booklouse (at high magnification)

http://www.insectslimited.com/museum%20pest.htm

Contributing Factors

- Microenvironments exist that can support mold
  - Behind shelves
  - Basement floor storage in cardboard boxes
  - Damp microenvironments due to location of water
  - Post water incident where drying did not take place immediately



Mold Prevention

- Get rid of excess moisture; reduce relative humidity and dew point!
  - Avoid storing collections in damp areas
  - Keep RH low (40-50%)
  - Ensure air circulation around collections
  - Respond quickly to water damage

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  - Respond quickly to water damage
- Materials that can hold more water than others are more susceptible
  - Hydrophilic (literally "water-loving") materials

Mold Prevention

- Regularly change air handler filters, clean ductwork if you have had a major outbreak

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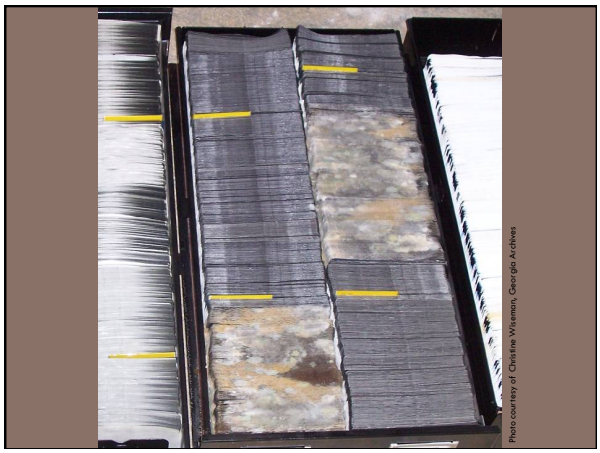
- Regularly change air handler filters, clean ductwork if you have had a major outbreak
- Isolate and examine incoming collections
- Regular housekeeping to keep shelves and other surfaces free from dust
  - Use disposable static rags, like those from Swiffer, that have no additives and a HEPA-filtered vacuum

Infestation

- Mold will grow on everything and anything!
  - Different molds like different conditions and food sources
  - Primarily exterior (bindings, boxes, etc.) but also likely to be found on endpapers and in gutters of books and edges of papers in boxes.



Health Hazards

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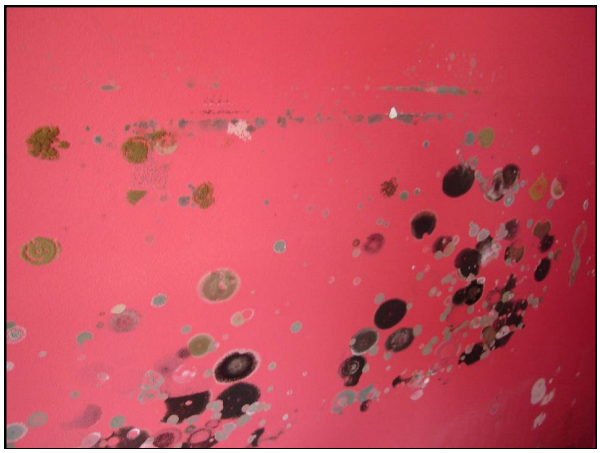
- For people, mold is first a sensitizer which then becomes an allergen and then can later become toxic.
- Some molds are toxic to begin with, but only testing will tell
  - Stachybotrys ("black mold") is one of the toxic variants and usually grows on construction materials



Health Hazards

- All molds pose a health risk and some people are more at risk than others
- For people, mold is first a sensitizer which then becomes an allergen and then can later become toxic.
- Some molds are toxic to begin with, but only testing will tell
- Testing is the only surefire way to know if the mold is a "toxic" – and you have to test ALL of them

Response

1. Confine the outbreak
2. Stop the growth of the mold
3. Kill the active mold growth
4. Take steps to prevent re-infestation
   - Ideally, response and recovery will be done by a vendor and not in-house!
   - Do nothing until you have your Personal Protective Equipment (PPE)!

Personal Protective Equipment (PPEs)

- Gloves
  - Nitrile or Latex for handling collections
- Masks
  - Full- or half-face respirators (requires medical approval and fit testing) or N95/N100 particulate respirators (masks)
- Unvented goggles
- Protective clothing
  - Tyvek coveralls with or without feet or, at a minimum, aprons or lab coats

Is It a Dust Mask or a Respirator?

Dust Mask (not OK)	N95 Particulate Respirator (OK)
	

Confine the Outbreak

- For large incidents:
  - Isolate the area,
  - Create a negative pressure room to ensure the mold does not spread to other areas
    - This includes shutting down any air handling vents that may return air from the area.

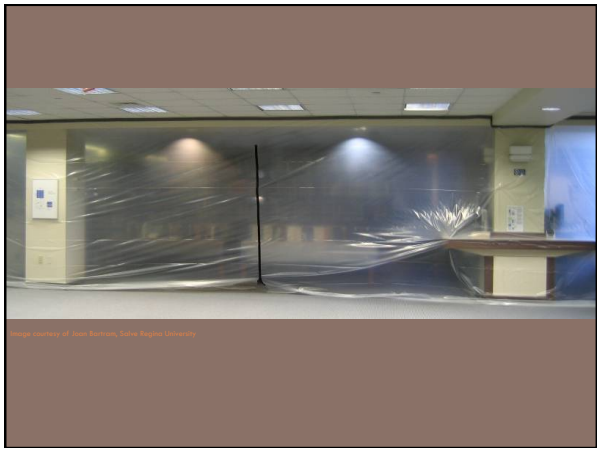


Image courtesy of Joan Barham, Salve Regina University

Confine the Outbreak

- For smaller incidents:
  - Pack (wrap using Tyvek or spun polyester, use plastic bags only if the materials are not wet)
  - Move collection to a quarantine area.

Stop the Growth

- Dehumidification *in situ*
  - Does not require moving collections
  - Dropping temperature is not sufficient
  - If this is a water incident, as well as mold, air-drying will not stop inks from bleeding, coated paper will stick, and distortion of objects can occur
  - Old Wives' Tale: Sunlight does not kill mold

Stop the Growth, Kill the Mold

- Freezing
  - Growth stops and active mold killed
    - Forms ice crystals causing cell to burst
  - Buys time for decision-making and recovery preparations
  - Use caution when freezing museum objects.
  - Freezing and then air-drying can reactivate mold

Stop the Growth, Kill the Mold

- Vacuum Freeze-drying
  - Done by a vendor who can also then clean materials
  - Best for large outbreaks in libraries and archives

A Note on Fungicides

- Can have a deleterious effect on collections and people so only done if there is no other possible solution
- Some chemicals only stop growth, not kill the mold, these are called fungistats.
- Ethylene oxide will actually increase some material's susceptibility to future outbreaks
  - It is also a strong health and safety risk to people and is now banned in the EU.

Prevent Re-infestation

- Clean entire space, not just collections, with a HEPA vacuum, smoke sponge, and, if necessary, wipe down shelving with a solution of no more than 1 cup bleach per 1 gallon water. Dry thoroughly after wiping down.
- Replace any carpet, padding, furniture, wallboard, etc. that was moldy
- Repair or replace any equipment or plumbing that may have caused the problem
- Begin an environmental monitoring program

Collection Recovery

- Always assume there is a health hazard and wear PPE's
- The inactive mold will need to be removed from collections to ensure they are safe to use again, as well as to prevent re-infestation.
- Mold does physical damage to collections so any in-house cleaning should be done by trained staff with PPE's and a knowledge of careful handling techniques for fragile materials.

Cleaning Collections

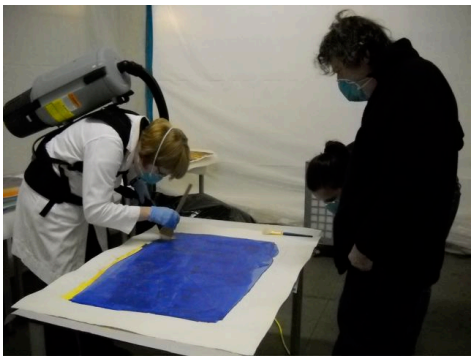
You should not clean your collections by yourself, leave it for the professionals!

Cleaning Collections

- Only clean once the mold has been rendered inactive
- Mold stain removal is tricky business; leave it to the professionals
- Consider replacement as a viable option for some materials

Cleaning Collections

- HEPA-Filtered Vacuum
  - Once mold is inactive, it can be carefully cleaned off of collection materials using either a soft brush to direct mold into the nozzle or by vacuuming through a screen.
  - This should be done in a fume hood, in an isolated space with negative air pressure or outside on a still, sunny day to reduce the risk of spreading mold throughout the building.
  - Wear PPE's!



Cleaning Collections

- Smoke Sponge - "Gonzo" sponge
  - Works after vacuuming
  - Vulcanized rubber that traps the mold and dirt and is easily cut with a scissors
  - It can also drive mold into un-sized papers

Thank you!

Any questions, please contact me!

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