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Mold: Recognizing an Outbreak and Clean-up Procedures

What are mold and mildew?

Molds are fungi**,** and obtain nutrients from organic compounds (compounds containing carbon). Cellulose is the most common organic compound on earth and is easily digestible. Library materials are composed largely of cellulose (paper and cloth), and will readily support mold growth given the right environmental conditions. Mildew is another name for mold. Microscopic molds or molds on cloth are often referred to as mildew.

Life cycle of mold

The spore (conidium) is the unit of reproduction. Inactive mold spores are microscopic. They are floating in the air and resting in the dust on surfaces all around us. If a mold spore is able to land on a surface with organic material, and if the environmental conditions are conducive to growth, such as a relative humidity above 60%, or a surface that is continually moist, the mold spore will germinate, grow vegetative stalks (hyphae) and develop into a colony (mycelium). The mold colony will produce specialized spore sacs (conidiophores) that produce and release new spores. During the germination and growth processes, molds secrete enzymes and toxins that digest the substrate supporting the colony.

Types of mold

Molds are categorized as *xerophilic* (tolerant of dry conditions) or *hydrophilic* (tolerant of wet conditions). Xerophilic molds are able to extract the moisture they need from the air. That is why the humidity levels are so critical. Xerophilic mold spores may begin germinating within twenty-four hours if the relative humidity exceeds 60% for that long. Common xerophilic molds found in our homes are aspergillus, and penicillium. If you are allergic to penicillin you may be particularly sensitive to other penicillium molds.

Hydrophilic molds live on surfaces that are continually moist. A particularly dangerous hydrophilic mold is Stachybotrus or “black mold”. This mold is found on wet building materials, and can be responsible for severe neurological symptoms such as memory loss and even paralysis.

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Effects of mold

Since mold digests the material it grows on, it causes permanent weakening and staining of paper and cloth. Mold stains may be bleached, but the stains will return. More important, mold is a health hazard, and exposure to growing colonies or inactive spores may cause flu-like symptoms, trigger allergy attacks, weaken the immune system, cause dizziness, and other neurological symptoms

While it's possible to clean inactive mold from the covers and edges of books, if mold colonies have spread throughout the materials they should be discarded, unless they are valuable or irreplaceable. In that case you should contact a conservator or a mold remediation specialist. Materials that have been severely affected by mold are more at risk for a recurrence of mold growth.

Killing mold

Although it is relatively easy to kill the visible, vegetative portions of the mold colony, it is very difficult to kill mold spores. Sub-zero temperatures, high heat, or chemicals will kill some molds, but not all.

The most effective way to eliminate mold growth is by lowering the relative humidity and drying the substrate supporting the colony. The vegetative portion of the mold dies and shrivels up, spores become inactive, and the mold can then be removed by mechanical means. However, the moisture problem must be fixed or the mold will come back.

Recognizing a mold outbreak

- Growing or active mold has a distinctive musty odor.
- Mold colonies are visible. They are generally green or black, but may be any color. Active mold may look fuzzy, and smears when you rub it. The toxins and digestive enzymes may be any color.

Coping with a mold outbreak

Initial response

- Locate the source of the moisture (leak, HVAC malfunction etc.) and initiate drying.

- Lower the humidity, using dehumidifiers if necessary.

- Acquire personal protective equipment (PPE) such as masks, gloves, non-vented goggles, and coveralls. Mold is toxic and allergenic. You should be protected from inhaling it, touching it or ingesting it.

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Personal Protective Equipment

N95 respirators. These are disposable respirators that capture up to 95% of airborne particles. The respirator must have a tight seal against your face in order to work effectively. Facial hair will prevent a good seal. To test the seal, place both hands over the respirator, and exhale sharply. If air-leaks are detected, re-adjust the respirator; exhale sharply again. If air leaks are present, readjust the nosepiece, straps, and secure the respirator to your face; check the fit again.

People with chronic heart or lung conditions (e.g. congestive heart disease, asthma) should consult their health care provider before using a respirator. If you have trouble breathing or have any other trouble when wearing a respirator for clean-up work, stop working and contact a health care provider.

Non-vented goggles. These offer protection against dust and vapor.

Nitrile gloves. These are made from synthetic latex. They are inexpensive, flexible, and offer protection against dust and chemicals. Since they do not contain latex proteins, they do not cause latex-allergy reactions. They should not contain any type of powder.

Aprons should be disposable or washable.

You should wear protective clothing that may be removed or discarded when you leave the area. Discard gloves and masks when you leave the area.

Recovery

- Determine size of the outbreak and the extent of the damage in order to decide whether or not you need to call professional help.

- Isolate affected items and move them to a clean-up area with low humidity and good air circulation. Set up directional air flow with the air being blown away from you, preferably out a window. When transporting materials to the clean-up area, place them in a loosely closed plastic bag. Once there, remove them from the plastic bag. Do not seal the bag or you will be creating a microclimate that will worsen the mold growth.

- Dry the affected items, and dehumidify the area. Provide good air circulation. Since library materials are hygroscopic, it may take additional time for them to dry out even though the relative humidity in the area is below 50%. If more than a few items are affected, consider contacting a mold remediation specialist.

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- Immediately dispose of materials that cannot be salvaged. Contact the Department of Preservation and Collection Maintenance or a conservator if you are unsure whether or not materials can be salvaged.

Do not attempt to remove active mold.

- Once the mold is inactive it may be removed. Since mold spores are extremely small it's best to use a vacuum with a HEPA (high efficiency particulate air) filtration system. HEPA filters can remove at least 99.97% of airborne particles 0.3 micrometers in diameter. Mold spores range in size from 1-200 micrometers in diameter. It is important that your vacuum cleaner have an enclosed system so that all of the expelled air has to pass through the HEPA filter. Use the brush attachment to gently vacuum the materials and the surrounding area. If you do not have a vacuum with a HEPA system, you can wipe your books and other materials using disposable "magnetic" cloths. Swiffer cloths are one commercial brand. These cloths hold dust using an electrostatic surface charge. Discard them as soon as they are full. Do not use any cloths that have been impregnated with chemicals or perfume.

  You may also clean inactive mold from book covers and text block edges by wiping them with a disposable cloth that's been dipped in 70% alcohol and well wrung out. Wipe the cover and edges quickly; do not rub. Do this in a well-ventilated room, preferably with directional air flow away from you, while wearing personal protective equipment.

  Cleaning books
  Start with the top of the book. Hold the book upright with one hand around the spine. Using the other hand, wipe or brush from the back of the book towards the front. Then, turn the book over and wipe/brush from the back towards the front. Then, wipe the fore-edge, the front board, back board and spine.

  Vacuuming single sheets
  Lay a sheet of fiberglass window screening over the paper you need to vacuum, and hold it in place with small weights on the corners. You will then be able to vacuum the document through the screening.

- Thoroughly clean the area where the mold outbreak occurred. You may use soap and water, commercial products, or a bleach solution made up of no more than one cup of bleach per gallon of water. Be careful not to mix bleach with commercial cleaners or ammonia. When washing the area with commercial or bleach solutions use non-porous gloves and protective eye wear. Provide good ventilation and air circulation. When you have finished cleaning, discard vacuum filters, cleaning cloths, masks, disposable aprons and gloves. Clean goggles and brushes with alcohol or a bleach solution. Wash aprons and other protective clothing in a bleach solution if they are not disposable.
- Do not return materials to the affected area until the shelves and furniture are thoroughly dry and the room humidity is below 50%.

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- Check for signs of mold growth on air conditioners, HVAC vents, and throughout the ventilation system and take corrective action.
- Continue to closely monitor the temperature and relative humidity of the affected area.

If you have questions or encounter an outbreak, feel free to contact the Department of Preservation and Collection Maintenance, (607) 255-2484.