Mold and Indoor Air Quality in Sensitive Environments

Nebraska Extension
Indoor Air Quality (IAQ)

- Air quality can be affected by many compounds and organisms.
- Molds and other indoor air pollutants can have negative effects on occupants’ health.
- Some indoor air pollutants can be triggers for asthma.
  - A lung disease that, when triggered, can result in severe, acute attacks that can be life threatening.
GEO Report...

- Over 50% of the nation’s schools have poor ventilation and significant sources of pollution in buildings

Photo: USDA
Factors Affecting IAQ

- Tighter building construction or remodeling of old structures
  - Energy efficient practices without adequate ventilation and humidity control
- Synthetic building materials and furnishings
- Chemical products used indoors
  - Some give off Volatile Organic Compounds (VOCs)
- Pests - Cockroaches, rodents
- Dust mites and other components of dust
- Animals - classroom pets
Factors Affecting IAQ

- Pollen
- Secondhand smoke and combustion
- High humidity, condensation, leaking roofs (and other parts of buildings) cause moisture problems when food (organic matter) and other conditions are present

Moisture \[\rightarrow\] Time \[\rightarrow\] Mold!

Photo: University of Nebraska–Lincoln
Leaking Roofs and Buildings Allow Entry of:

- Moisture
- Insects
- Rodents
- Organic materials (i.e. soil)
- Pollutants

Photo: University of Nebraska–Lincoln
Potential Air Pollution Sources

- Inadequately vented gas appliances
- Formaldehyde from new building products
- Other products, including pesticides
Health Consequences of Poor Indoor Air Quality

- Short-term health effects of pollutants:
  - Asthma and wheezing attacks
  - Sinus congestion, sneezing, nose itching, coughing
  - Headache, fatigue, and shortness of breath
  - Eye, nose, throat, and skin irritation
  - Dizziness and nausea
Health Consequences of Poor Indoor Air Quality

- Long-term health effects of pollutants:
  - Respiratory diseases
  - Heart disease
  - Kidney disease
  - Lung cancer
Asthma Triggers

Mold is an Asthma Trigger!

- Other common allergens and irritants include:
  - Dust and Dust Mites
  - Pet Dander, Saliva
  - Cockroaches, Mice, and Rats
  - Pollen
  - Chemicals and Volatile Organic Compounds (VOCs)
  - Secondhand Smoke and Combustion Products

For more information on these triggers, please see the learning module: *Asthma Triggers in Sensitive Environments*
Managing Air Quality

- Reduce pollutants at the source!
- Exhaust pollutants and increase ventilation and air circulation
- Additional air filtration may be needed after source reduction and ventilation have been addressed

Photo: University of Nebraska–Lincoln
Managing Air Quality

- Increasing ventilation after source control can help reduce some pollutants

- Add mechanical ventilation such as:
  - Air to Air Heat Recovery Ventilation (HRV) Units
  - Energy Recovery Ventilation (ERV) Units
  - Bathroom vent
Managing Air Quality

Air to Air Heat Exchangers provide fresh intake air to buildings while pre-cooling or heating the intake air with transfer from the exhaust air. Some also pre-filter and control humidity levels as well.
Mold and Moisture

Photo: University of Nebraska–Lincoln
Mold Basics

Mold is a fungi that lives on plant and animal matter. To survive, it requires:

- Moisture source
- Food (organic materials)
- Oxygen

Mold is a pest!
Mold as a Pest

- Prefers warm, humid, dark places
- Feeds on damp organic materials
  - Wood, paper, carpet, soil, and other materials
- Studies link indoor mold and dampness to respiratory problems
Molds can produce substances with negative effects on health...

- **VOCs**—odors
- **Micotoxins**—200+ from common molds at certain times in their life cycle
- **Glucans** (pieces of mold cell walls)
- **Spore allergens**—remain allergenic even when dead or dormant

Photo: University of Nebraska–Lincoln
Sources of Moisture

- Inadequate ventilation
- Changes in building construction
  - Use of materials like drywall, which does not allow easy escape for moisture
- Roof leaks, non-vented combustion appliances, gutters that direct water toward or under building
Preventing Mold

- Keep humidity between **30-50%** as much as possible
  - Use dehumidifiers in humid areas
- Early discovery and moisture control
  - Check susceptible areas regularly
  - Can you smell it? See it?
- Increase mechanical ventilation
  - Air to air heat recovery units or heat exchangers
- Keep areas clean, remove trash
Preventing Mold

Moisture Control

- Fix water and moisture problems, such as leaks and flooding
- Maintain HVAC system
- Reduce condensation
  - Clean up wet spots within 24–48 hours
  - Increase air circulation
  - Reduce humidity
  - Warm up surfaces

Photo: University of Nebraska–Lincoln
Preventing Mold

Moisture Control

- Vent moisture-generating appliances (dryers, bathroom vents, etc.)
- Perform regular building maintenance inspections, including HVAC
- Keep HVAC drip pans clean, flowing properly, and unobstructed
Preventing Mold

Moisture Control

- Install and use exhaust fans in kitchen and bathrooms, shower rooms
  - Vent to the outside
- Clean out gutters and downspouts regularly
- Don’t let foundations stay wet and seal foundation cracks
- Avoid putting carpet on basement or slab materials that may absorb moisture
Preventing Mold

- Maintain and clean appliances where molds can grow
  - Heating and cooling systems
  - Humidifiers
  - Dehumidifiers
  - Refrigerator drip pans

Photo: Hometest, METS Lab
Preventing Mold

Plants

- Use good quality, pasteurized soil mixes for indoor plants
- Avoid overwatering as mold may grow in and on the soil. Constantly wet soil will attract Fungus Gnats and Phorid Flies

Photo: University of Nebraska–Lincoln
Preventing Mold

- Keep surfaces clean and dry
  - Locker rooms, showers, bathrooms
  - Kitchen cupboards and under sinks
  - Places where condensation occurs

Photo: University of Nebraska–Lincoln
Investigating and Mitigating Molds

- Assess the extent of damage; determine if remediation should be done in-house or out.
- If hiring a contractor, make sure the person has experience cleaning up mold. Check references and ask the contractor to follow the recommendations of EPA guide: *Mold Remediation in Schools and Commercial Buildings* and/or NY City Health Dept.
Investigating and Mitigating Molds

Avoid

- Touching moldy items with bare hands
- Getting mold or spores in eyes
- Inhaling mold or mold spores

Use personal protective equipment (PPE)
Mold Hiding Places

- Under carpets and wallpaper
- Pipe chases
- Utility tunnels
- Condensate drain pans inside air handling units
- Walls behind furniture

Photo: University of Nebraska–Lincoln
Mold Hiding Places

- Top of ceiling tiles
- Back side of drywall or paneling
- Porous liners inside ductwork
- Roof materials above ceiling tiles (due to roof leaks or insufficient insulation)
Tools for the Search...

- Moisture meter
- Hygrometer—humidity gauge
- Boroscope—to see in hard to reach places
- Goggles, gloves
- N-95 mask minimum

Photo: University of Nebraska–Lincoln
Before Remediation Begins, Consider:

- Are there existing moisture problems in the building?
- Have materials been wet more than 48 hours?
- Are there hidden sources of water or is humidity too high?
- Are there reports of musty or moldy odors?
Before Remediation Begins, Consider:

- Are building materials visibly damaged?
- Has maintenance been delayed or maintenance plan been changed?
- Has the building use changed or has there been recent remodeling?
- Is consultation with medical professionals indicated?
Basic Remediation Steps

- Fix water and humidity problems; revise maintenance plans
- Communicate with building occupants, address all concerns
- Wear appropriate PPE and completely clean up mold; dry all water damaged areas.
- Contain and remove all moldy materials properly
Mold Clean-Up Tips

If you experience water damage, you can prevent, minimize, or remove mold growth by following these steps for clean-up:

- Wet vacuum. Can be used on most surfaces where water has accumulated.
- Damp wipe. Mold can be cleaned from nonporous surfaces with water and detergent. Be sure to dry surfaces quickly to discourage further growth.
Mold Clean-Up Tips

- HEPA (High-Efficiency Particulate Air) Vacuum. This is good for final clean-up of remediation areas after thorough drying has been completed. It can pick up dust and other particles left behind in the area.

- Discard/Remove contaminated/damaged materials and seal in plastic bags. Double bag and discard in ordinary construction waste.
Mold Clean-Up Tips

- Gently spray area to wet and keep spores from spewing
- Capture and contain spores
- Wrap or cover porous materials and wrap in plastic before removal

Photo: University of Nebraska–Lincoln
Removing Mold

- Avoid direct contact and inhalation of molds and mold spores
  - Wear personal protective equipment—minimum N 95 HEPA mask, gloves, goggles, protective clothing
  - Adequate clean air supply
  - Follow label directions on cleaning products
Removing Mold

- Wash mold off hard surfaces with detergent and water, and dry completely. Use HEPA vacuum
  - Moldy absorbent materials should be replaced
  - Detergent and water help to remove the organic matter that fungi feed on.
  - “Capture” spores to prevent them from dispersing

- Clean and remove mold when building is not occupied
Removing Mold

- Biocides and fungicides are products that kill or inhibit living organisms and fungi but are generally not recommended for normal routine clean-up of mold and mildew
  - Don’t always kill all the spores
  - Some disinfectants are not as effective with organic matter (wood, paper, soil)
  - Be sure to use detergent or all purpose cleaner and water if a disinfectant is used on surfaces

- To clean mold in areas of dirty water (sewage, floods, etc.), use disinfectants
Removing Mold

- Use detergent and water for clean-up as first line of attack
- Aerosols can cause spores to spread
- Dead and dormant spores can still be allergenic
Removing Mold

- Remaining mold spores can grow and create new colonies if moisture levels have not been corrected. Some spores will probably remain in the area even with disinfectant use.

- Follow facility policies for use of disinfectants and other cleaning products; read the label and the Safety Data Sheets (SDS).
Use of Biocides

- Some biocides are considered pesticides
  - Follow label directions
  - Use non spray or non aerosolized biocides

- Very few pesticides (biocides) have been approved by EPA for use in duct systems and only in unlined metal systems. (See EPA’s publication: Should You Have the Air Ducts in Your Home Cleaned?)

- Fungicides developed for outdoor use should not be used in any indoor application unless that indoor location is also listed on the label.
Biocide Examples

- Sodium hypochlorite (chlorine bleach)
- Quaternary ammonium compounds
  - Possible asthma trigger
- Phenolics—phenol is listed in the ingredients
- Pine oil
- Hydrogen peroxide—may be more tolerable for sensitive persons
Mold Containment

- Limits release of mold during remediation

- Two kinds:
  - Limited
    - For areas involving between 10-100 sq. ft. of mold contamination
  - Full
    - For areas involving over 100 sq. ft. of mold contamination
Mold Containment

- Use double layers of polyethylene to create barrier between moldy area and other parts of the building.
- Maintain containment area under negative pressure relative to surrounding areas. Can be accomplished by using HEPA filtered fan unit exhausted to outside of the building.
Determining when Remediation is Complete

- Water problem fixed
- Mold removal completed
- Sampling done for mold spores in the building once clean-up has been completed
- Site revisited soon after remediation to check for signs of mold growth or water damage
- Occupants do not have health complaints or physical symptoms pertaining to mold
Other Mold “Remedies”

Ozone Air Cleaners

- At concentrations that do not exceed public health standards, ozone is not effective at removing many odor-causing chemicals or viruses, bacteria, mold, or other biological pollutants.
- Ozone is a lung irritant and may trigger asthma.
Other Mold “Remedies”

Use of Ultraviolet Light

- UV light shows some promise in mold spore control, however, the light must penetrate through the mold to reach spores underneath.
- Mold species respond differently to the amount of UV light effective in killing the spores.
IAQ Management Summary

- Good housekeeping and maintenance practices
- Good ventilation essential!
- Eliminate sources of contamination

Photo: University of Nebraska–Lincoln
IAQ Management Summary

- Remediate moisture problems as quickly as possible to prevent mold
- Maintain HVAC equipment and high efficiency filters
- Use vacuums with high efficiency filters (HEPA)
Additional Resources

- EPA Guidelines/Publications: [http://www.epa.gov/mold/mold_remediation.html](http://www.epa.gov/mold/mold_remediation.html)
- 800-438-4318
Additional Resources

- New York City Health Department Guidelines:
  212-788-4290

- American Conference of Government Industrial Hygienists: Bioaerosols: Assessment and Control
  http://www.acgih.org (search for Bioaerosols)
  513-742-2020
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