

# Basics of Mold Remediation

<http://www.epa.gov/mold/>

Shelly Rosenblum  
415-947-4193  
rosenblum.shelly@epa.gov



# U.S. EPA / Region 9 San Francisco

Indoor Air Quality



Tools For Schools

## Indoor Environments Team

Katie Stewart

415-947-4119

Stewart.kathleen@epa.gov

Shelly Rosenblum

415-947-4193

rosenblum.shelly@epa.gov

Monique Nivolon

415-947-4195

Nivolon.monique@epa.gov

Priyanka Pathak

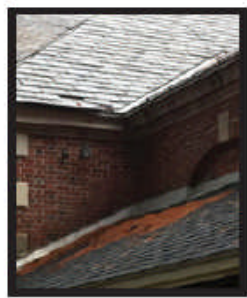
415-972-3576

Pathak.priyanka@epa.gov

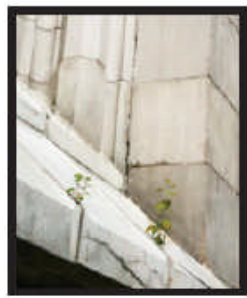
[www.epa.gov/iaq](http://www.epa.gov/iaq)

Bookmarks

- Moisture Control Guidance for Building Design, Construction and Maintenance
  - Chapter 1: Moisture Control in Buildings
  - Chapter 2: Designing for Moisture Control
  - Chapter 3: Constructing to Prevent Moisture Problems
  - Chapter 4: Operating and Maintaining Moisture-Controlled Environments
  - Appendix A
  - Appendix B
  - Appendix C
  - Appendix D



[http://usgbc-centraltexas.org/wp-content/uploads/2014/02/moisture-control EPA Dec 2013.pdf](http://usgbc-centraltexas.org/wp-content/uploads/2014/02/moisture-control_EPA_Dec_2013.pdf)



# Moisture Control Guidance for Building Design, Construction and Maintenance



# Recognition, Evaluation, and Control of Indoor Mold

*Edited by*

**Bradley Prezant, MSPH, CIH, CPE**

**Donald M. Weekes, CIH, CSP**

**J. David Miller, PhD**



A Publication of the  
**American Industrial Hygiene Association**

[https://webportal.aiha.org/Purchase/ProductDetail.aspx?Product\\_code=1a6b8b5c-3766-e211-b612-005056810034](https://webportal.aiha.org/Purchase/ProductDetail.aspx?Product_code=1a6b8b5c-3766-e211-b612-005056810034)



# CANADA MORTGAGE AND HOUSING CORPORATION

Type your search

**First Nation Communities and Housing Organizations** ▾ [http://www.cmhc.ca/en/ab/bumaho/bumaho\\_002.cfm](http://www.cmhc.ca/en/ab/bumaho/bumaho_002.cfm)

> **About First Nations Housing**

> **Housing Programs and Financial Assistance**

> **Building and Managing Housing**

> **Caring for Your Home**

■ **Publications & Reports**

■ **CMHC Events Register Online!**

■ **Housing Market Information Portal**

[Building and Managing Housing](#) > [Mold in the Home](#) — [Indoor Air Quality Resources for First Nations](#)


## Mold in the Home

### Indoor Air Quality Resources for First Nations

CMHC offers a wealth of valuable resources on mold prevention and remediation, as well as indoor air quality. From workshops to fact sheets, we can help you become better informed about housing quality challenges and how to address them.

#### Mold in Housing Series

Information for First Nations Communities:

 [Home Occupants' Guide](#)

A guide for First Nations home occupants on how to recognize mold problems and what to do about them.

 [Housing Managers' Guide](#)

<http://www.epa.gov/mold/>

# Mold Course

time to complete ~ 1 hour, 9 Chapters

[1 - Introduction to Mold](#)

[2 - Where and Why Mold Grows](#)

[3 - Finding Mold and Moisture](#)

[4 - General Remediation Issues](#)

[5 - Large Areas and Other Special Concerns](#)

[6 - Containment and Personal Protective Equipment \(PPE\)](#)

[7 - Evaluating the Remediation](#)

[8 - Communicating with the Building Occupants](#)

[9 - Prevention](#)



# Mold Course

<http://www.epa.gov/mold/>

**NO CERTIFICATION** - EPA will not provide a certificate, certification, or any other credential for viewing the course - it is for informational purposes only. Some organizations may choose to offer continuing education credits (CEUs) for completion of the course. EPA does not track test results or provide the information to any other party.

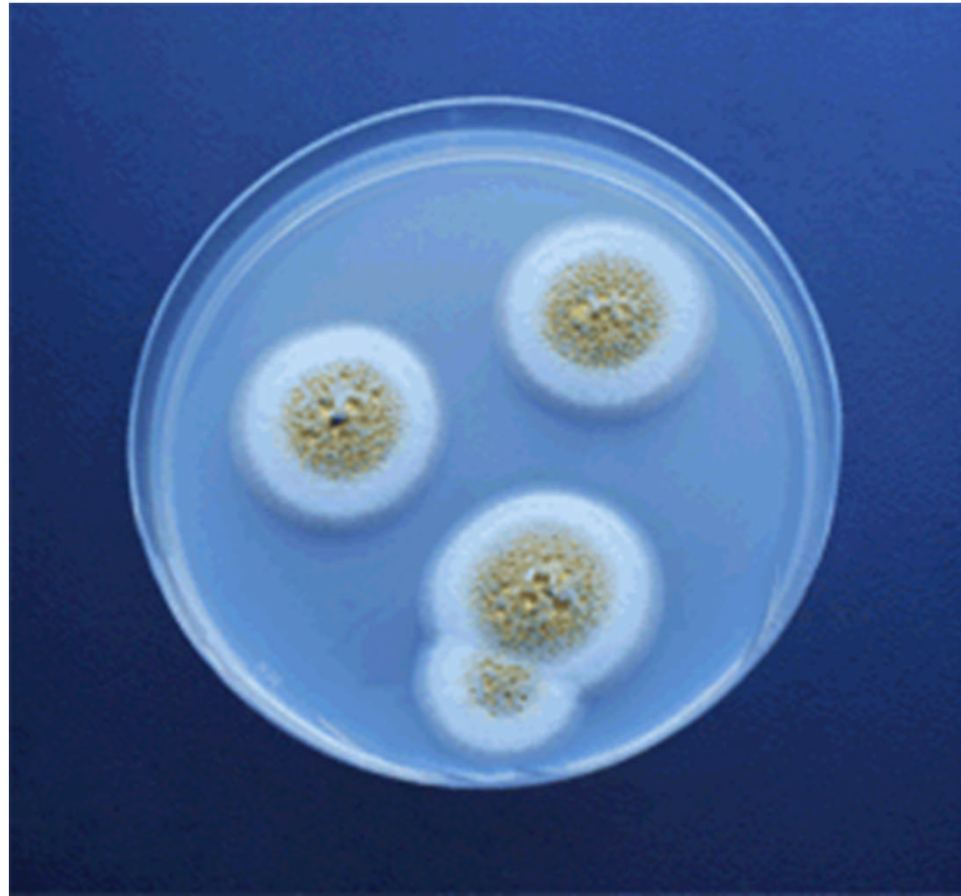
Voluntary Knowledge Tests

Resource List

Glossary

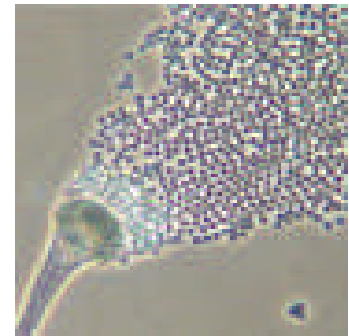


# What is mold?





- Separate kingdom: Fungi - neither plant nor animal.
- No chlorophyll so it feeds by digesting dead organic matter: plant or animal remains, wood, paper, dust or organic films on glass or metal.
- Mildews are mold.
- Mushrooms are a reproductive structure of some molds.
- Molds reproduce by spores.
- Mold tissue filaments are called hyphae.

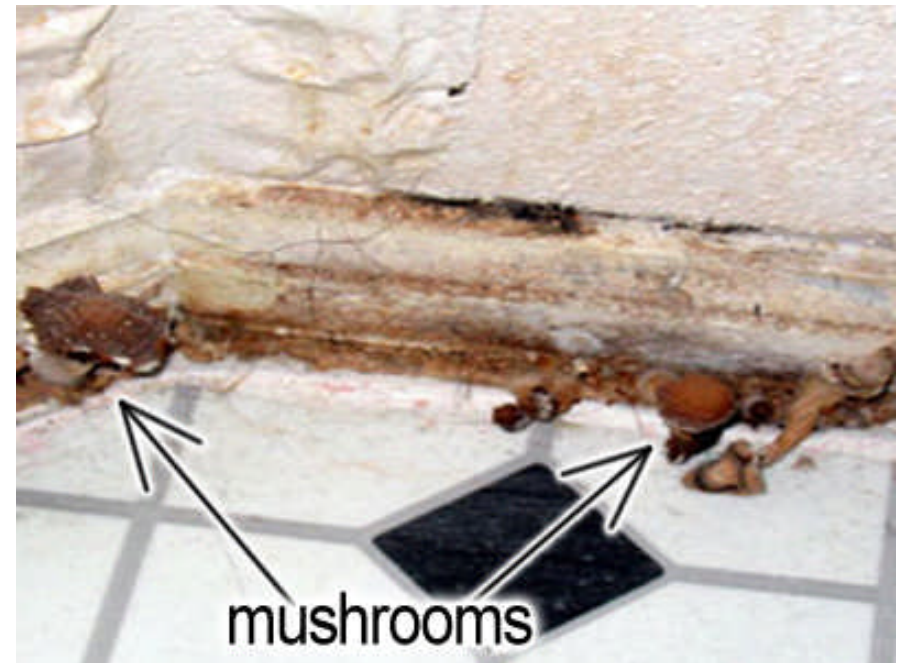


Mold needs only:

- Air
- Water / moisture
- Organic matter

The key to mold\* control is moisture control.

\* And other organisms!

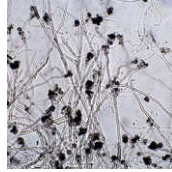


Many species of mold in many colors and needing different environmental conditions.



# Moisture Characteristics

Stachybotrys spp.



Continuously wet materials

Alternaria, Cladosporium spp.,

Aspergillus versicolor

Continuously damp materials

Aspergillus glaucus group,

Some penicillium

Relatively dry materials



# Mold is not new to buildings.

Leviticus 14 describes a plague on the walls of a home and provides instructions on how to get rid of it.

Modern construction seems to provide pre-digested mold food: particle board; sheetrock paper; and once wet, tight houses and insulation hold onto moisture.



# Moisture Rules

- **Moisture flow is from warm to cold**
- **Moisture moves from more to less**
- **Air carries moisture from high pressure areas to low pressure areas**
- **Gravity pulls water down**
- **Water wicks up**
- **Drainage is critical**

# Investigation

Go where the moisture goes!  
But protect yourself in  
the process.

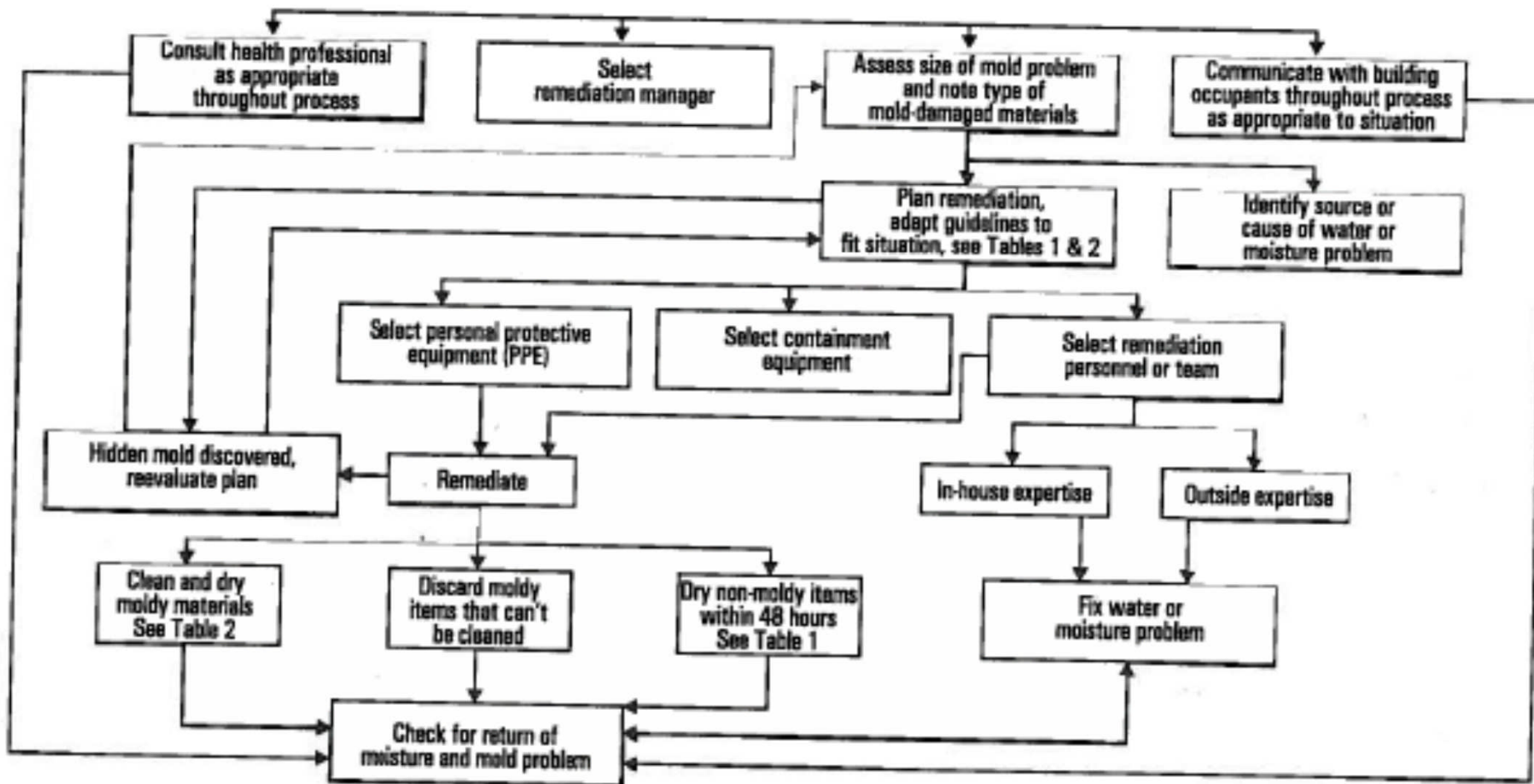


# To consider before remediating:

- existing moisture problems
- wet for more than 48 hours?
- hidden sources of moisture or is the humidity too high?
- building occupants reporting musty or moldy odors?
- building occupants reporting health problems?
- building materials or furnishings visibly damaged?
- maintenance been delayed?
- building been recently remodeled or its use changed?
- consultation with medical or health professionals indicated?



# The Remediation Plan



# Remediation Planning

- Assess the size of the mold problem.
- Select a remediation manager for large or small jobs requiring more than one person.
- The plan should include steps to fix the moisture problem.
- Should cover the use of PPE.
- Should cover the use of containment.
- Plans can vary greatly in size and complexity.
- Highest priority: protect the health & safety of the occupants and remediators.
- Communicate with occupants. Do they need to be relocated?



# Communication

## Working With Your Community\*



Trust & Credibility:  
How To Earn It  
How To Keep It

\*And living to talk about it!

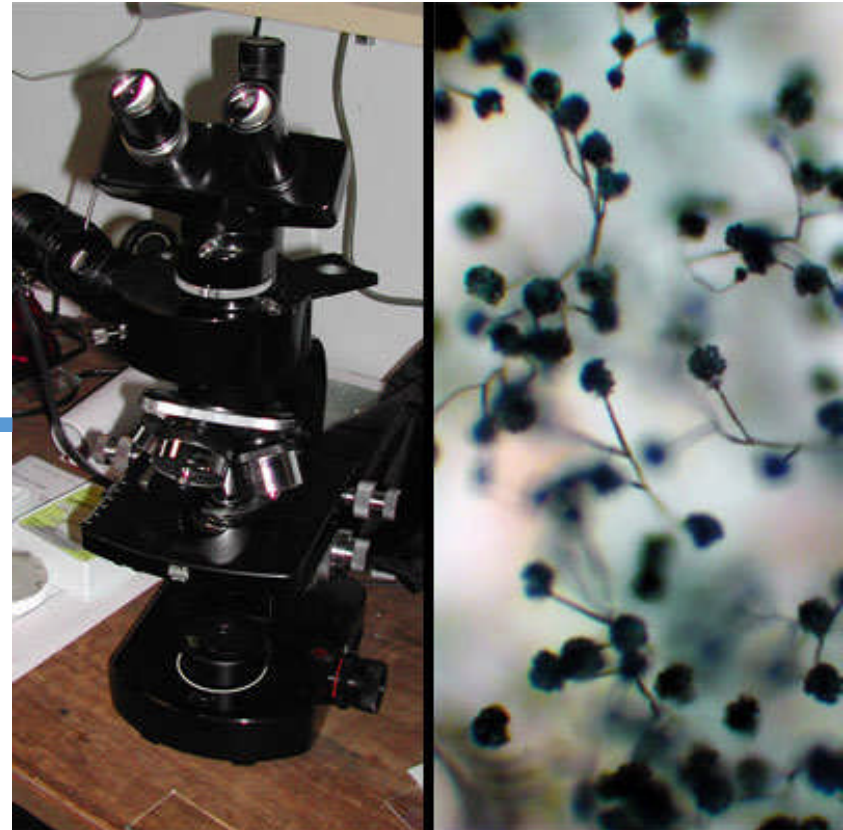
# Communication

- People will probably demand that you test the air whether it is warranted or not.
- Be prepared to explain why you will or why you won't. You may need an expert.
- However, outside experts are often viewed by a suspicious community as a "hired gun."
- Consider involving the affected community in selecting a consultant.
- Release information quickly. Reports not released quickly become "secret" reports which "can't be good news."



# Sampling

- If you can see mold you really don't need to test.
  - There are no standards for what is safe or not safe.
  - Know how you will use the results – will it affect your decisions in any way.
  - How many samples and what kind of samples?
- 
- Is there hidden mold?
  - Do you expect litigation?
  - Has remediation been effective?
  - Do I need a professional?
  - Page 25 in the handbook for more discussion.



# HVAC System

- Do not run the system if you suspect it is contaminated with mold.
- Consult EPA's guide, [\*Should You Have the Air Ducts in Your Home Cleaned?\*](#) Before taking further action.
- Use high-quality filters in the system during remediation. Conventional filters are not typically effective in removing mold spores. Consider upgrading to a MERV 8. Change them regularly and after remediation.



# Hidden Mold

- Investigating hidden mold can lead to inadvertent exposure.
- Opening walls, peeling up carpet, removing wall paper can release spores.
- Wear PPE when investigating.
- Revise remediation plan if you discover hidden mold.
- You may decide you need a professional remediator.



# Remediation

What to save?

What not to save?

Table 1: Water Damage – Cleanup and Mold Prevention	
Guidelines for Response to Clean Water Damage within 24-48 Hours to Prevent Mold Growth <sup>4</sup>	
Water-Damaged Material <sup>†</sup>	Actions
Books and papers	<ul style="list-style-type: none"><li>* For non-valuable items, discard books and papers.</li><li>* Photocopy valuable/important items, discard originals.</li><li>* Freeze (in frost-free freezer or meat locker) or freeze-dry.</li></ul>
Carpet and backing – dry within 24-48 hours <sup>5</sup>	<ul style="list-style-type: none"><li>* Remove water with water extraction vacuum.</li><li>* Reduce ambient humidity levels with dehumidifier.</li><li>* Accelerate drying process with fans.</li></ul>
Ceiling tiles	<ul style="list-style-type: none"><li>* Discard and replace.</li></ul>
Cellulose insulation	<ul style="list-style-type: none"><li>* Discard and replace.</li></ul>
Concrete or cinder block surfaces	<ul style="list-style-type: none"><li>* Remove water with water extraction vacuum.</li><li>* Accelerate drying process with dehumidifiers, fans, and/or heaters.</li></ul>
Fiberglass insulation	<ul style="list-style-type: none"><li>* Discard and replace.</li></ul>
Hard surface, porous flooring <sup>5</sup> (Linoleum, ceramic tile, vinyl)	<ul style="list-style-type: none"><li>* Vacuum or damp wipe with water and mild detergent and allow to dry; sc if necessary.</li><li>* Check to make sure underflooring is dry; dry underflooring if necessary.</li></ul>
Non-porous, hard surfaces (Plastics, metals)	<ul style="list-style-type: none"><li>* Vacuum or damp wipe with water and mild detergent and allow to dry; sc if necessary.</li></ul>
Upholstered furniture	<ul style="list-style-type: none"><li>* Remove water with water extraction vacuum.</li><li>* Accelerate drying process with dehumidifiers, fans, and/or heaters.</li><li>* May be difficult to completely dry within 48 hours. If the items cannot be</li></ul>



# How large an area?

Small: less than 10 sq ft

Medium: between 10 and 100 sq ft

Large: greater than 100 sq ft or potential for significant occupant exposure.

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water *			
Material or Furnishing Affected	Cleanup Methods <sup>†</sup>	Personal Protective Equipment	Containment
<b>SMALL – Total Surface Area Affected Less Than 10 square feet (ft<sup>2</sup>)</b>			
Books and papers	3	Minimum N-95 respirator, gloves, and goggles	None required
Carpet and backing	1, 3		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1, 2, 3		
<b>MEDIUM – Total Surface Area Affected Between 10 and 100 (ft<sup>2</sup>)</b>			
Books and papers	3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3, 4		
Wallboard (drywall and gypsum board)	3, 4		
Wood surfaces	1, 2, 3		
<b>LARGE – Total Surface Area Affected Greater Than 100 (ft<sup>2</sup>) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant</b>			
Books and papers	3	Full	Full
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		

# Remediation

## Cleaning methods

Method 1: Wet vacuum

Method 2: Damp wipe

Method 3: HEPA vacuum

Method 4: Discard – should be double bagged in 6-mil polyethylene bags. Large items should be wrapped in polyethylene sheeting.

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*			
Material or Furnishing Affected	Cleanup Methods <sup>1</sup>	Personal Protective Equipment	Containment
<b>SMALL – Total Surface Area Affected Less Than 10 square feet (ft<sup>2</sup>)</b>			
Books and papers	3	Minimum N-95 respirator, gloves, and goggles	None required
Carpet and backing	1, 3		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3		
Wallboard (drywall and gypsum board)	3		
Wood surfaces	1, 2, 3		
<b>MEDIUM – Total Surface Area Affected Between 10 and 100 (ft<sup>2</sup>)</b>			
Books and papers	3	Limited or Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Limited Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1, 2, 3		
Non-porous, hard surfaces (plastics, metals)	1, 2, 3		
Upholstered furniture & drapes	1, 3, 4		
Wallboard (drywall and gypsum board)	3, 4		
Wood surfaces	1, 2, 3		
<b>LARGE – Total Surface Area Affected Greater Than 100 (ft<sup>2</sup>) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant</b>			
Books and papers	3	Full	Full
Carpet and backing	1, 3, 4		
Concrete or cinder block	1, 3		

# Wet vacuum

- Special vacuum designed for water.
- Should only be used when materials are still wet. May spread spores if not sufficient liquid.
- Tanks, hoses, and attachments should be thoroughly cleaned and dried after use since spores may stick to internal surfaces.



# Damp wipe

- Dead or alive, mold is allergenic and some are toxic. Use PPE.
- Wiping or scrubbing with water or water and detergent.



# HEPA Vacuum

- High efficiency particulate air filter.
- For final cleanup after materials have been dried and decontaminated.
- Assure that filter is properly installed.
- Wear PPE when emptying vac and changing filter.
- Dispose of contents and filter in well-sealed bags.



# Biocides

- **Molds are allergenic** (and some may be toxic) whether **dead or alive** so molds must be removed, not just killed
- Once mold is removed, the key to preventing re-growth is moisture control
- **Professional judgment may call for use of a biocide, such as chlorine bleach, in certain circumstances (immune compromised present)**
- If you use a biocide, such as bleach:
  - Follow all label directions, precautions, and state and local laws. About 1-1.5 cups bleach/gallon.
  - Ventilate! But don't blow spores all around.
- **BLEACH IS NOT A CLEANER, it isn't tested for efficacy (working) on dirty surfaces**

# Personal Protective Equipment

- Remediation/investigation may disturb mold and mold spores.
- Avoid inhaling spores and skin and eye contact.
- Minimum: N95 respirator mask, goggles with no vent holes, rubber gloves, long sleeves and long pants.



# Personal Protective Equipment

## More respiratory protection

- Limited: half or full face purifying respirator with HEPA filter cartridge.
- HEPA filters do not provide protection against vapors or gases.
- Should always be approved by NIOSH.
- NOTE: All individuals using half or full face respirators must be trained, have medical clearance and must be fit-tested by a trained professional. The use of respirators must follow a complete OSHA program.





# Personal Protective Equipment

## More respiratory protection

- Full: Use in situations when high levels of dust or spores are likely or when intense long-term exposures are expected.
- Full-face powered air purifying respirator (PAPR) is recommended.



# Personal Protective Equipment

## Clothing

- Disposable clothing is recommended during medium or large jobs.
- Limited: disposable paper overalls
- Full: mold-impervious head, body and feet clothing made of breathable material such as TYVEK.



# Containment

- To prevent the release of spores to the uncontaminated areas.
- Moldy debris should not leave the containment before bagging.
- Table 2 recommends Limited and Full depending on the size of the area.
- Choice should be based on professional judgment.
- A large wall surface lightly contaminated and easily cleaned would only require limited containment.



????

# Containment

## Limited Containment

- Generally for areas between 10 and 100 sq ft.
- Single layer of fire-retardant polyethylene sheeting.
- Slit entry and covering flap on outside.
- Sheeting may be taped to walls, floors and ceilings or wooden or metal frames may be used.
- If the space above the ceiling is used as a return air plenum then containment should extend from the floor to the ceiling deck and the filters in the air handling units replaced at end of the job.
- The containment must be maintained under negative pressure using a HEPA filtered fan unit or exhaust fan exhausted outside the building.



# Containment

## Full containment

- Generally for areas greater than 100 sq ft.
- Double layers of fire-retardant polyethylene sheeting.
- A decon chamber or air lock should be installed.
- The chamber should be big enough to hold a waste container and to allow people to change clothing.
- Negative pressure must be maintained. Sheeting should be sucked into the containment rather than billowing outward.



# Equipment

## Moisture meters

- Monitor moisture levels in building materials.
- May be used to find damp areas that may harbor hidden mold and to monitor the drying process.
- Can be used on carpet, wallboard, wood, brick and concrete.

## Humidity Gauges or Meters

- Often under \$50 and measure temperature also.

Moisture Meter



*Photo 9: Moisture meter measuring moisture content of plywood subfloor*

# How do you know when you're done?

- You've completely fixed the moisture problem.
- Visible mold and mold damaged materials and moldy odors no longer present.
- If you've sampled, mold spores indoors should be similar to those found outdoors.
- No new signs of moisture or mold growth.
- Occupants report no health problems.
- Ultimately: it's a judgment call.



# Conclusion

- What can I do myself?
- Probably confined to areas of less than 10 sq feet.
- Simple PPE.
- Limited or no containment.
- Beginning stage of mold growth.
- Clearly defined area - not hidden.
- Look for early signs of moisture. Keep the structural problem from becoming a health problem.





## CHECKLIST FOR MOLD REMEDIATION\*

### Investigate and evaluate moisture and mold problems

- Assess size of moldy area (square feet)
- Consider the possibility of hidden mold
- Clean up small mold problems and fix moisture problems before they become large problems
- Select remediation manager for medium or large size mold problem
- Investigate areas associated with occupant complaints
- Identify source(s) or cause of water or moisture problem(s)
- Note type of water-damaged materials (wallboard, carpet, etc.)
- Check inside air ducts and air handling unit
- Throughout process, consult qualified professional if necessary or desired

### Communicate with building occupants at all stages of process, as appropriate

- Designate contact person for questions and comments about medium or large scale remediation as needed

### Plan remediation

- Adapt or modify remediation guidelines to fit your situation; use professional judgment
- Plan to dry wet, non-moldy materials within 48 hours to prevent mold growth (see Table 1 and text)
- Select cleanup methods for moldy items (see Table 2 and text)
- Select Personal Protection Equipment – protect remediators (see Table 2 and text)
- Select containment equipment – protect building occupants

## **RESOURCES LIST – EPA**

### **U.S. Environmental Protection Agency (EPA), Indoor Environments Division (IED)**

#### **[An Office Building Occupant's Guide to IAQ](http://www.epa.gov/iaq/pubs/occupgd.html)**

[www.epa.gov/iaq/pubs/occupgd.html](http://www.epa.gov/iaq/pubs/occupgd.html)

#### **[Biological Contaminants](http://www.epa.gov/iaq/pubs/bio_1.html)**

[www.epa.gov/iaq/pubs/bio\\_1.html](http://www.epa.gov/iaq/pubs/bio_1.html)

#### **[Building Air Quality Action Plan \(for Commercial Buildings\)](http://www.epa.gov/iaq/base/actionpl.html)**

[www.epa.gov/iaq/base/actionpl.html](http://www.epa.gov/iaq/base/actionpl.html)

#### **[Floods / Flooding](http://www.epa.gov/iaq/pubs/flood.html)**

[www.epa.gov/iaq/pubs/flood.html](http://www.epa.gov/iaq/pubs/flood.html)

#### **[Indoor Air Quality \(IAQ\) Home Page](http://www.epa.gov/iaq)**

[www.epa.gov/iaq](http://www.epa.gov/iaq)

#### **[IAQ in Large Buildings / Commercial Buildings](http://www.epa.gov/iaq/base/index.html)**

[www.epa.gov/iaq/base/index.html](http://www.epa.gov/iaq/base/index.html)

#### **[IAQ in Schools](http://www.epa.gov/iaq/schools/index.html)**

[www.epa.gov/iaq/schools/index.html](http://www.epa.gov/iaq/schools/index.html)

#### **[Mold Remediation in Schools and Commercial Buildings](http://www.epa.gov/iaq/pubs/molds.html)**

[www.epa.gov/iaq/pubs/molds.html](http://www.epa.gov/iaq/pubs/molds.html)

#### **[Mold Resources](http://www.epa.gov/iaq/pubs/moldresources.html)**

[www.epa.gov/iaq/pubs/moldresources.html](http://www.epa.gov/iaq/pubs/moldresources.html)

# References

National Academy of Sciences Damp Indoor Spaces Report

<http://books.nap.edu/catalog/11011.html>

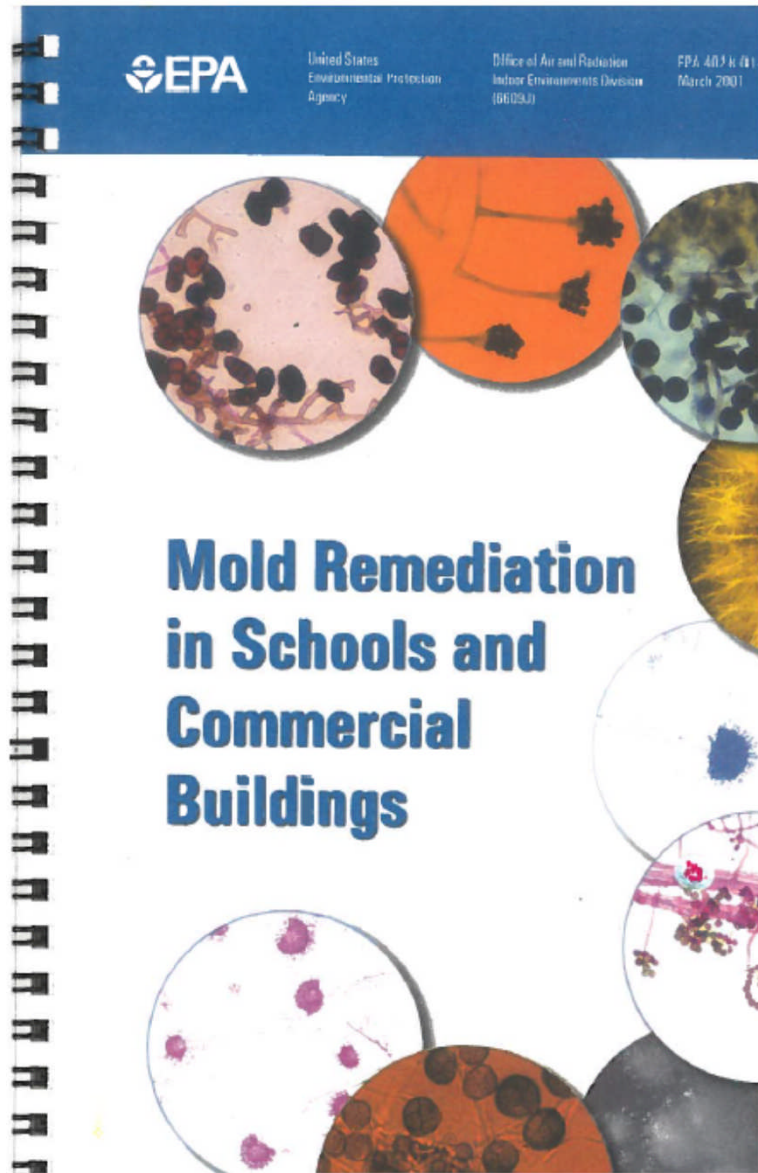
IAQ Scientific Findings Resource Bank – Indoor Dampness, Mold, and Health. [www.iaqscience.lbl.gov/dampness-summary.html](http://www.iaqscience.lbl.gov/dampness-summary.html)

Mold Related Webinars – check for announcements on

[www.epa.gov/iaq](http://www.epa.gov/iaq)

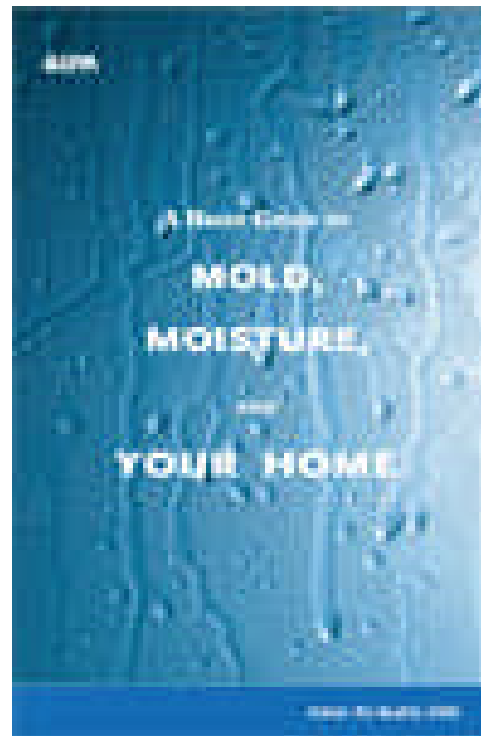
Northwest Clean Air Agency – Mold Guide for Tenants and Landlords.

[http://www.nwcleanair.org/pdf/aqPrograms/indoorAir/Mold\\_Guide\\_Tenants\\_Landlords.pdf](http://www.nwcleanair.org/pdf/aqPrograms/indoorAir/Mold_Guide_Tenants_Landlords.pdf)



# Questions?

<http://www.epa.gov/mold/>



Shelly Rosenblum  
415-947-4193  
rosenblum.shelly@epa.gov