DEPARTMENT OF
ENVIRONMENTAL SAFETY,
SUSTAINABILITY & RISK

Indoor Air Quality and HVAC Evaluation in a COVID-19 World

Presented by:

Michael Stumpo
University of Maryland
College Park

Objectives

- Indoor air quality introduction
- IAQ surveys and initiatives
- Overview of HVAC evaluations during the COVID-19 pandemic

What is Indoor Air Quality?

- What is "good indoor air quality"?
- What are some challenges for staff when investigating IAQ concerns?

Indoor Air Quality Can Impact

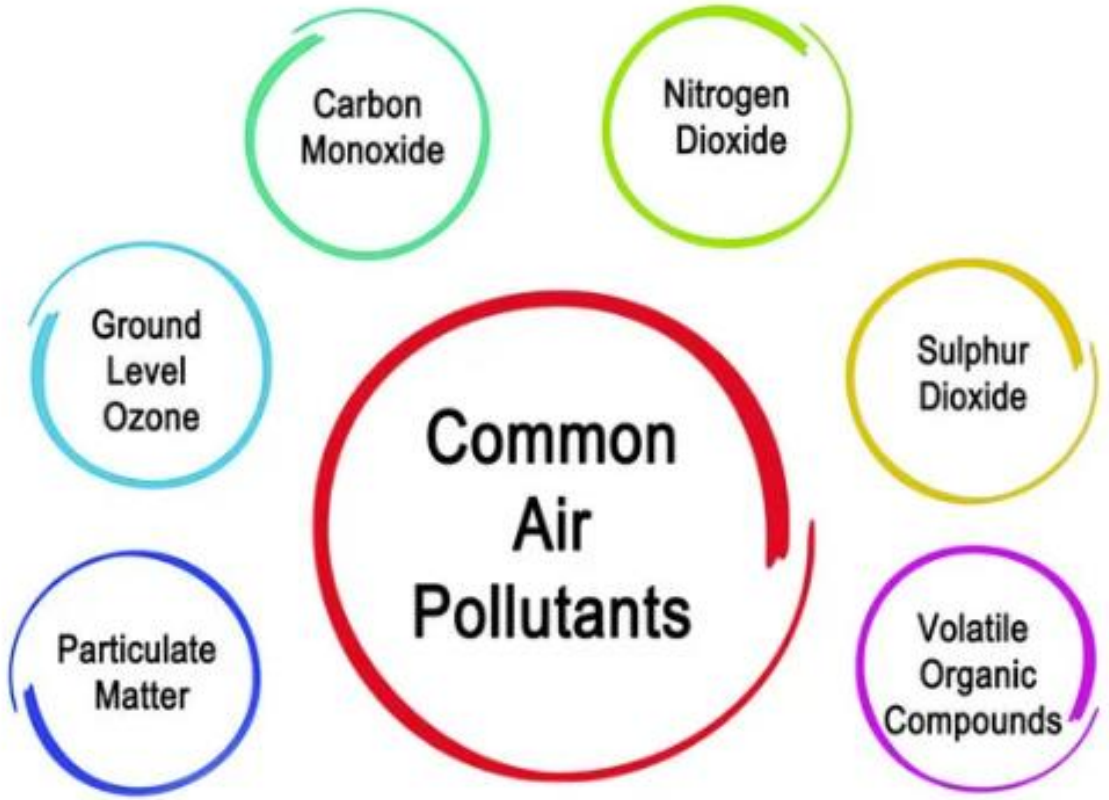
- Health / Wellbeing
- Productivity

"Good Indoor Air Quality"

- Indoor air with acceptable ventilation according to American Society of Heating, Refrigerating & AC Engineers (ASHRAE) standards.
- Sources of indoor air contaminants are minimized.
- 75% or more of building occupants are comfortable at work.

Common IAQ Pollutants

- Chemical
- Particulate Matter (non-biological)
- Biological



Chemical

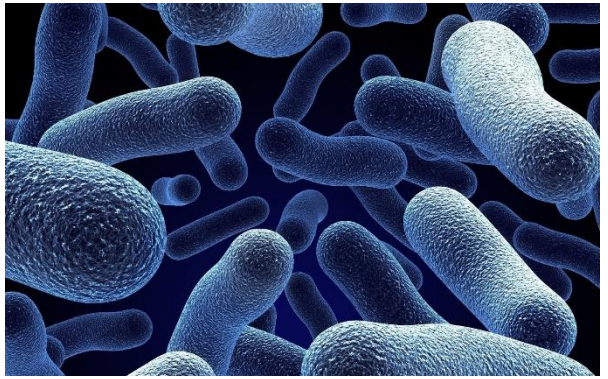
- Products used in the building
- Chemical spills
- Pesticides
- Construction supplies
- Products of combustion (CO and Formaldehyde)

Particulate Matter (Non-biological)

- Solid particles and liquid droplets
- Dust, dirt, pollen, smoke, soot
- Printing and copying
- PMs from construction
  - Fossil fuels
  - Fires
  - Cigarette smoke

Biological

- Bacteria
- Viruses
- Mold/fungi
- Dust mites
- Animal dander
- Pollen



Biological Health Effects

- Allergenic
- Respiratory system irritation
- Asthma
- Molds can cause localized skin or mucosal infections.
- Some may be more susceptible than others.

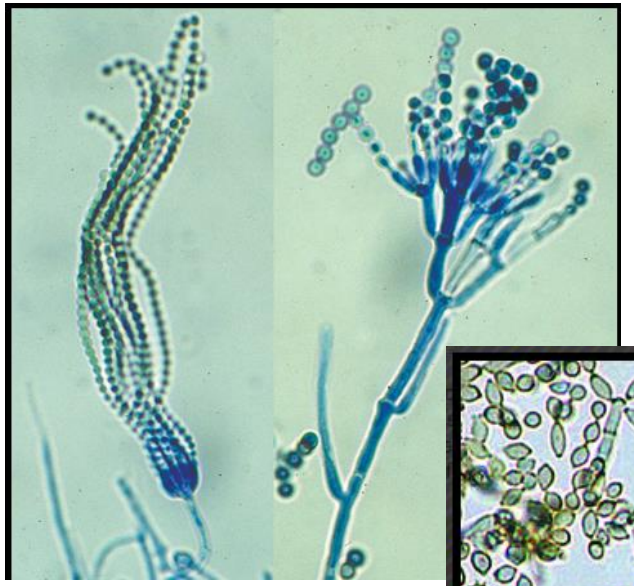
Mold Facts

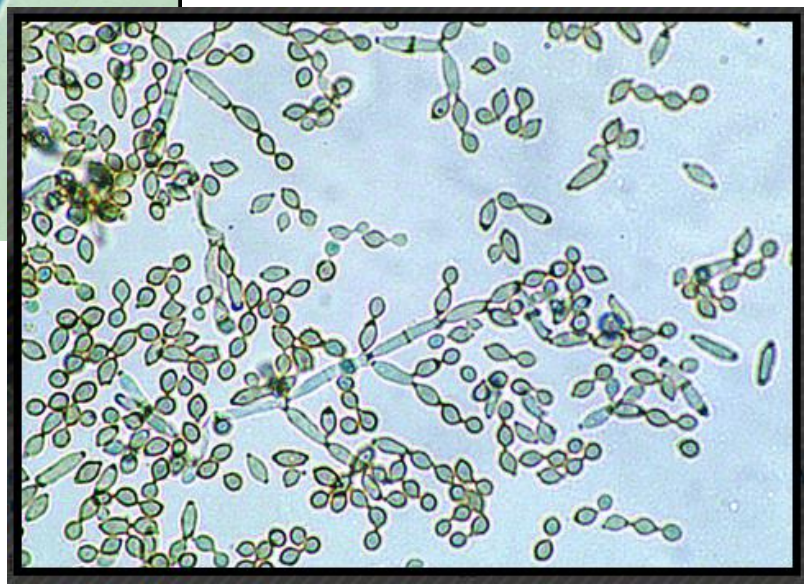
- Mold can be found almost anywhere.
- Mold requires moisture to grow.
- All molds have the potential to cause health effects.
- Health effects vary and are dependent on the individual.

Mold

https://www.cdc.gov/fungal/diseases/aspergillosis/index.html

https://mycology.adelaide.edu.au/descriptions/hyphomycetes/penicillium/





https://mycology.adelaide.edu.au/descriptions/hyphomycetes/cladosporium/

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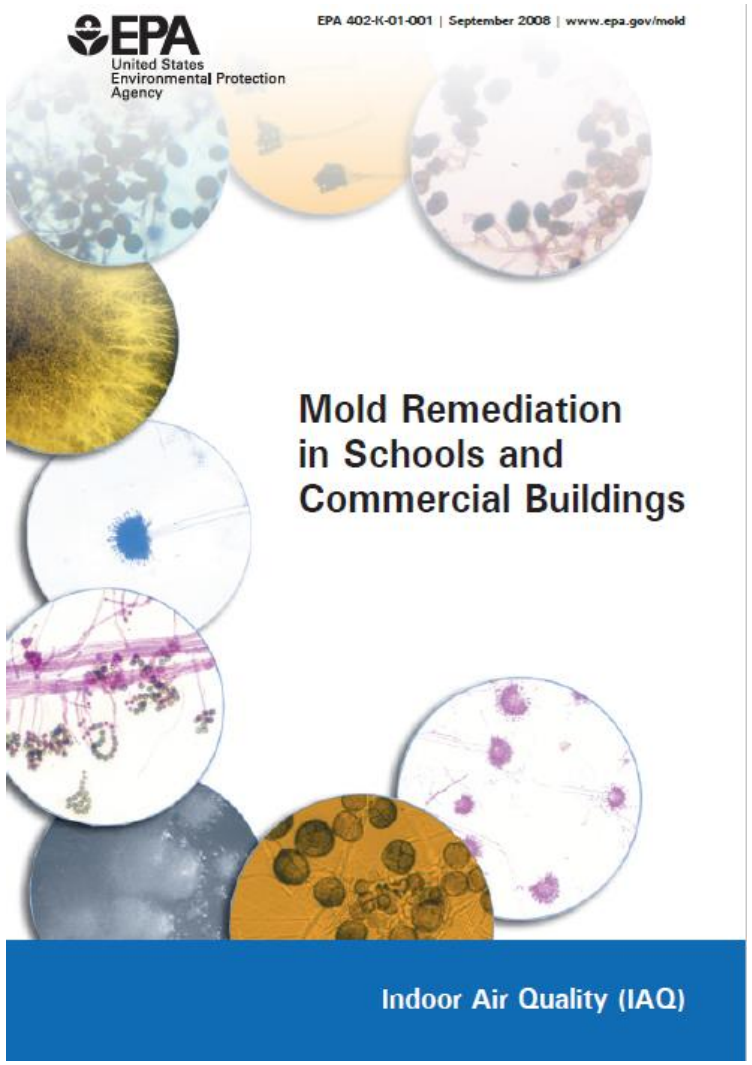
Mycotoxins

- Molds can produce mycotoxins.
- What we know is limited to effects after ingestion.
- Mycotoxins are not always present when mold is in a building.
- More research is needed on this topic.

Mold Regulations – Where Are They?

- Currently, there are no federal or state regulations for mold remediation.
- Developing regulations is difficult because there are no typical buildings, let alone a typical way they affect people.
- Accepted industry guidelines have been developed by the EPA, AIHA, and IICRC.

EPA – Mold Remediation in Schools and Commercial Buildings



- Presents ***recommendations*** on mold remediation.
- EPA does not regulate mold or mold spores in indoor air.

Prevention is Key: Moisture Control is Mold Control

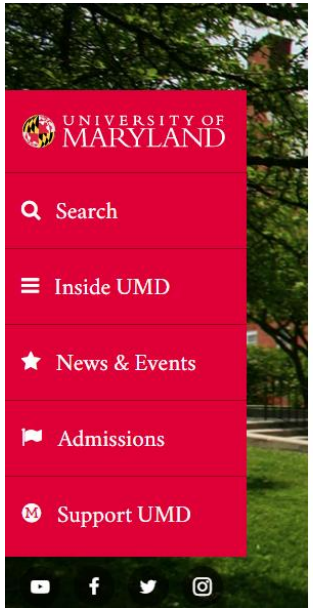
- Fix leaky plumbing and leaks as soon as possible.
- Watch for condensation and wet spots.
- Prevent moisture due to condensation.
  - by increasing surface temperature or reducing the moisture level in air (humidity).
  - To increase surface temperature, insulate or increase air circulation.
  - To reduce the moisture level in air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).
- Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed.

Prevention is Key: Moisture Control is Mold Control

- Vent moisture-generating appliances, such as dryers, to the outside where possible.
- Maintain low indoor humidity, below 60% relative humidity (RH), ideally 30 – 50%, if possible.
- Perform regular building/HVAC inspections and maintenance as scheduled.
- Clean and dry wet or damp spots within 48 hours.
- Don’t let foundations stay wet.
- Provide drainage and slope the ground away from the foundation.

Moisture Control Efforts

- Record-setting rain and high temperatures and humidity in 2018 that led to mold growth in campus housing.



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Moisture Control Efforts

Introduction

The health and safety of our university community is of paramount importance. Units across the university are working together to address moisture and mold on our campus, with care and concern for the well-being of the faculty, staff and students.

When our area experienced record-breaking heat, rain and humidity during the fall of 2018, we saw a significant increase in reports of mold in our residence halls and fraternity and sorority chapter houses. We thoroughly remediated the mold and hired two firms to provide an independent external review of the mold remediation processes and humidity control measures. There have also been reports of mold in academic buildings that face persistent moisture issues. Ongoing efforts have been in place to prevent mold in these areas. Mold grows on porous surfaces when the temperature and relative humidity are within a certain range. Hence, essential to mold control is moisture control.

The University's comprehensive moisture control initiative can be found below.

Moisture Control Efforts

The safety, health, and well-being of students, faculty, and staff is a matter of utmost concern for the University of Maryland. The university has implemented several efforts to address high humidity that may occur in the future.

CAMPUS & COMMUNITY

More Than 100 Mold-Prevention Projects Completed in 19 Buildings

Moisture-Control Efforts Included External Review, Dehumidifier Installation, Equipment Upgrades

By Maryland Today Staff / Aug 28, 2019

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Moisture Control Efforts

- Installing/using regular and commercial-grade humidifiers
- Installing humidity sensors
- Waterproofing foundations
- Upgrading air-conditioning fan coil units

Moisture Control Efforts

- Removing closet doors to improve air flow
- Reinsulating pipes
- Replacing window and roofs
- Training for staff on recognizing/identifying mold

Remember…

MOISTURE CONTROL

is the key to

MOLD CONTROL

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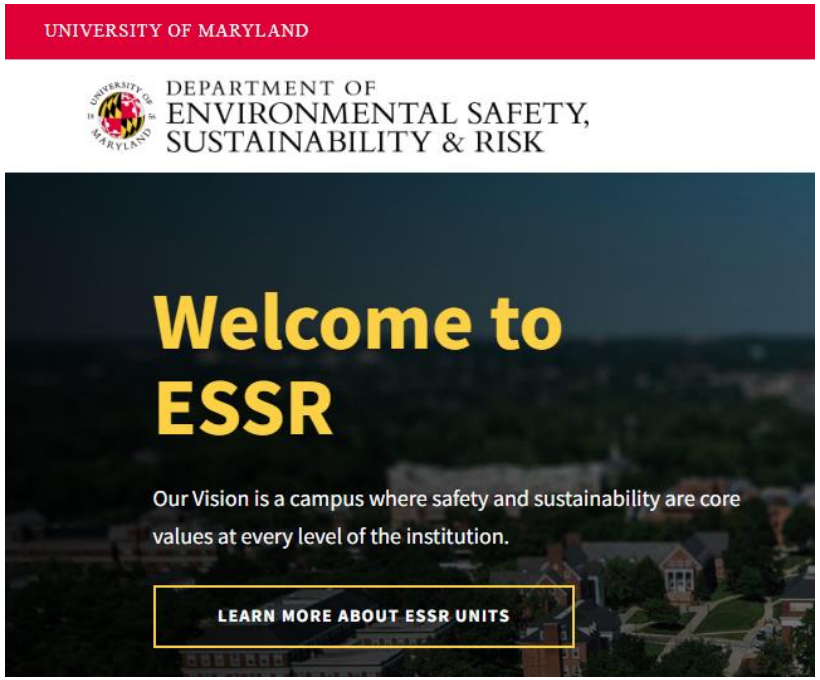
Conducting an IAQ Survey

Interview, Investigate, Evaluate and Remediate

Communicating and Receiving a Concern

- ESSR and Facilities Management both have Mold or Indoor Air Quality Concern "Buttons."



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Communicating and Receiving a Concern

Report A Concern about Mold or Air Quality on the UMD campus

Please use this form to communicate a concern about mold or air quality on the University of Maryland campus. Your report will be reviewed by UMD staff and you will receive a response at the email address you provide.

This form should not be used to report an emergency. To report a facilities emergency, contact Facilities Management at 301-405-2222. Other emergencies, including gas smells, smoke or unusual strong odors should be reported to Public Safety - call 911 from a campus phone or 301-405-3333 from any phone, or text #3333.

mstumpo@umd.edu Switch account

* Required

Email *

Your email

Name *

Your answer

Phone Number *

Your answer

Your current address *

Your answer

Status *

- Faculty
- Staff
- Student
- Other:

Location of concern (Building / Room Number) *

Your answer

Concern/Issue *

Please be as detailed as possible.

Your answer

When did this start? (if you know) *

Please be as detailed as possible.

Your answer

If you have reported this concern previously, please describe who you contacted and when, and the outcome (if you know)

Your answer

Send me a copy of my responses.

Submit

Clear form

What to Do First?

- Interview employees
- Interview building personnel
- Visual inspection
- Data/Sample collection (if warranted)

Employee Interview/Conversation

- Who, what, when, why, where?
- How are the conditions affecting the employee?
- Believe the occupant.
- Communicate the possible next steps to be taken.
- Stay in contact throughout the process.

Building Personnel Interviews

- What is the configuration of the HVAC system?
- What preventative maintenance is performed on the system?
- Any recent floods/moisture intrusion?
  - If so, what was the cleanup response?
- More questions
  - cleaning chemicals
  - furniture purchased
  - recent alterations

Investigate – IAQ Survey Tools

Evaluate – Table 1: Water Damage – Cleanup and Mold Prevention

Table 1: Water Damage – Cleanup and Mold Prevention

Guidelines for Response to Clean Water Damage within 24 – 48 Hours to Prevent Mold Growth*	
Water-Damaged Material†	**Actions**
Books and papers	* For non-valuable items, discard books and papers. * Photocopy valuable/important items, discard originals. * Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet and backing – dry within 24 – 48 hours‡	* Remove water with water extraction vacuum. * Reduce ambient humidity levels with dehumidifier. * Accelerate drying process with fans.
Ceiling tiles	* Discard and replace.
Cellulose insulation	* Discard and replace.
Concrete or cinder block surfaces	* Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	* Discard and replace.
Hard surface, porous flooring‡ (Linoleum, ceramic tile, vinyl)	* Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. * Check to make sure underflooring is dry; dry underflooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	* Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	* Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters. * May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	* May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. * Ventilate the wall cavity, if possible.
Window drapes	* Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	* Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) * Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. * Wet paneling should be pried away from wall for drying.

*If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 2 guidelines. Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline.

These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then Personal Protective Equipment and containment are required by the Occupational Safety and Health Administration (OSHA). An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.

† If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.

‡ The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

- Strategies to respond to water damage within 24-48 hours.
- Designed to help avoid the need for remediation by taking quick action before growth starts.
- If mold is found, refer to Table 2 for guidance on Remediation (to be discussed).

Evaluate – Table 1: Water Damage – Cleanup and Mold Prevention

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Evaluate – Table 1: Water Damage – Cleanup and Mold Prevention

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Questions Before Remediating

- Are there hazardous materials present?
- Are there existing moisture problems in the building?
- Have building materials been wet more than 48 hours?
- Are there hidden sources of water or is the humidity too high (high enough to cause condensation)?
- Are building materials or furnishings visibly damaged?
- What is the area (SF) of materials affected?

Table 2: Guidelines for Remediation

Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water*

Material or Furnishing Affected	Cleanup Methods†	Personal Protective Equipment	Containment
SMALL – Total Surface Area Affected Less Than 10 square feet (ft²)			
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		
MEDIUM – Total Surface Area Affected Between 10 and 100 (ft²)			
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		
LARGE – Total Surface Area Affected Greater Than 100 (ft²) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant			
Books and papers	3	Full Use professional judgment, consider potential for remediator exposure and size of contaminated area	Full 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, 4		
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, 4		

Table 2 continued

*Use professional judgment to determine prudent levels of Personal Protective Equipment and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased Personal Protective Equipment, if, during the remediation, more extensive contamination is encountered than was expected. Consult Table 1 if materials have been wet for less than 48 hours, and mold growth is not apparent.

These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

†Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

CLEANUP METHODS

Method 1: Wet vacuum (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.

Method 2: Damp-wipe surfaces with plain water or with water and detergent solution (except wood—use wood floor cleaner); scrub as needed.

Method 3: High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.

Method 4: Discard – remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Minimum: Gloves, N-95 respirator, goggles/eye protection
Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

CONTAINMENT

Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA-filtered fan unit. Block supply and return air vents within containment area.

Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA-filtered fan exhausted outside of building. Block supply and return air vents within containment area.

Table developed from literature and remediation documents including *Bioaerosols: Assessment and Control* (American Conference of Governmental Industrial Hygienists, 1999) and *IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration* (Institute of Inspection, Cleaning and Restoration, 1999); see Resources List for more information.

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Verification Inspection

- Performed by qualified personnel
- No visible dust/debris
- No moisture-affected materials
- No visible mold growth
- Ability to occupy or reoccupy the space

Air Sampling for Mold

- Air samples run for 2-10 minutes
- Dependent on time of day and weather
- Can cause false alarm or false assurance

Should I Collect Air Samples for Mold?

- There are no federal limits for mold in building air.
- The susceptibility of individuals can vary greatly either because of the amount or type of mold.
  - Sampling and culturing are not reliable in determining an individual's health risk.
  - If an individual is susceptible to mold, and mold is seen or smelled, there is a potential health risk, and it should be removed.

Should I Collect Air Samples for Mold?

Sampling

Is sampling for mold needed? In most cases, if visible mold growth is present, sampling is unnecessary. In specific instances, such as cases where litigation is involved, the source(s) of the mold contamination is unclear, or health concerns are a problem, you may consider sampling as part of your site evaluation. Surface sampling may also be useful in order to determine if an area has been adequately cleaned or remediated. Sampling should be done only after developing a sampling plan that includes a confirmable theory regarding suspected mold sources and routes of exposure. Figure out what you think is happening and how to prove or disprove it before you sample!

Primary Sources of IAQ Problems (500 IAQ Investigations by NIOSH)*

- Inadequate ventilation – 52%
- Contamination from inside the building – 16%
- Contamination from outside the building – 10%
- Microbial colonization – 5%
- Contamination from building fabric – 4%
- Unknown sources – 13%

Remember…

Visible mold growth on indoor materials **is not** an acceptable condition and should be corrected

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Campus Ventilation Assessments for COVID-19

Campus Ventilation Assessment Overview

- Evaluation task force assessed over 800 HVAC systems in almost 100 buildings.

- ASHRAE "transmission of the virus through the air is sufficiently likely that airborne exposure should be controlled."

Campus Ventilation Assessment Overview

- "Ventilation and filtration can reduce the airborne concentration of SARS-CoV-2 and thus the risk of transmission through the air."

- ASHRAE guidance covers three areas:
  - Dilution
  - Ventilation
  - Filtration

ASHRAE Ventilation and Filtration Guidance

Ventilation

- Increase outside air ventilation
- Disable demand-controlled ventilation
- Open outdoor air dampers to 100%

Filtration

- Improve filtration to **MERV-13** or highest achievable

Task Force

- Task force made up of UMD Engineering Services, Mechanical Engineers and HVAC Systems, Zone Supervisors.

- HVAC assessments were audited by a 3rd party Industrial Hygiene and Engineering firm.

- Occupied buildings were prioritized to implement mitigation strategies.
  - Research buildings and Health Center

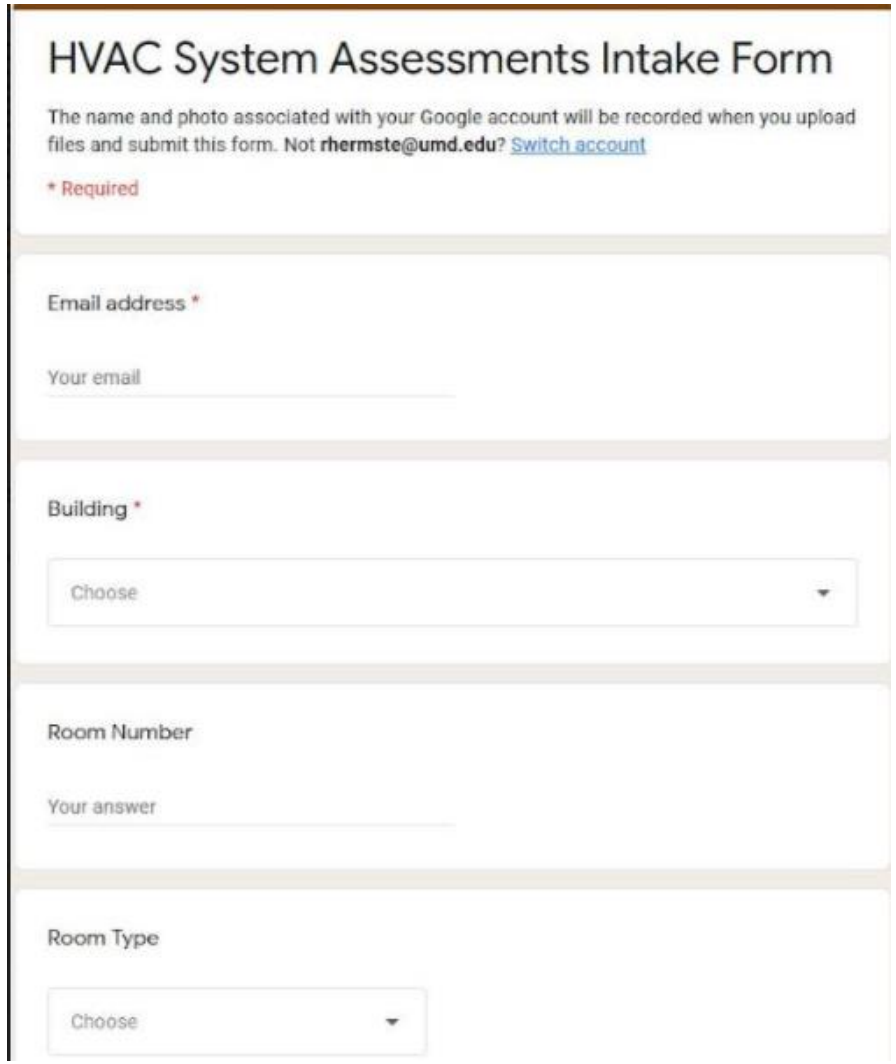
Task Force

- Low to no occupant buildings were assigned a lower priority and assessed while mitigation strategies were being implemented in higher priority buildings.

- Individual spaces reviewed upon request.

Assessment Tool

- Type of systems
- Automation systems
- Operation schedules
- Current filter efficiency rating
- Filter condition
- Suggested mitigation strategies



HVAC System Assessments Intake Form

The name and photo associated with your Google account will be recorded when you upload files and submit this form. Not **rhermste@umd.edu**? Switch account

* Required

Email address *

Your email

Building *

Choose

Room Number

Your answer

Room Type

Choose

Assessment Tool

- ○ AHU with RA / Perimeter FCU's
- ○ AHU - HD / CD
- ○ AHU with RA and UFAD
- ○ DOAS with Terminal VRF
- ○ DOAS & WSHP's
- ○ DX AHU
- ○ FCU
- ○ FCU with OA
- ○ H&VU
- ○ RTU with RA
- ○ S/S DX ACU
- ○ S/S HP's
- ○ Steam Radiator with Window A/C
- ○ WSHP
- ○ Other: _____

System Type *

- ○ AHU with RA
- ○ AHU with RA and VAV's
- ○ AHU with 100% OA
- ○ AHU with 100% and CHB
- ○ AHU with 100% OA for Labs & AHU's with Return Air for Offices

BAS *

- ☐ MS 1800
- ☐ Tritium Niagara
- ☐ ALC
- ☐ Pneumatics
- ☐ Local
- ☐ None
- ☐ Other: _____

Assessment Dashboard

HVAC System Assessment

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Reset | Share

											hours)	
Aug 18, 2020	048 FRANCIS SCOTT KEY HALL 4282 Chapel Ln. College Park MD 20742	0105	Lecture Hall	Greg Stup	HVAC Systems	AHU with RA	Rtu 1	Tritium Niagara	null	MERV 11	Fair	Increased Ventilation - percentage, Increased Ventilation - duration (flush building during off hours), Increased Filter Efficiency	null

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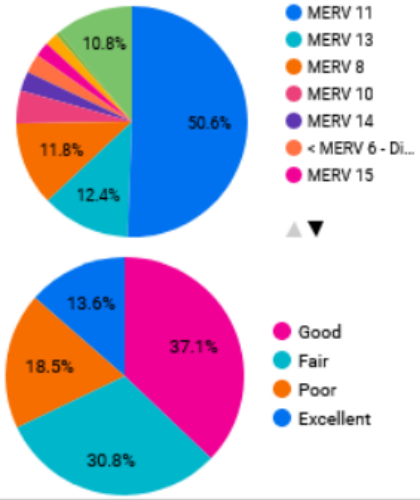
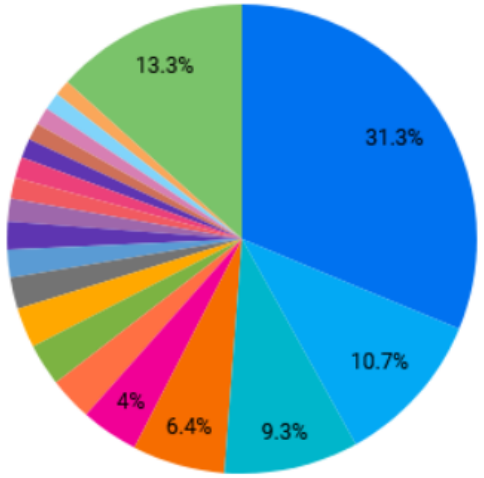
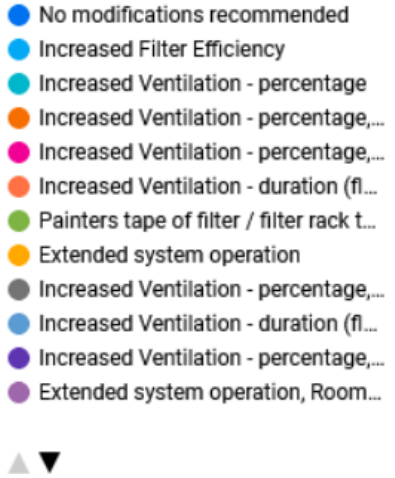
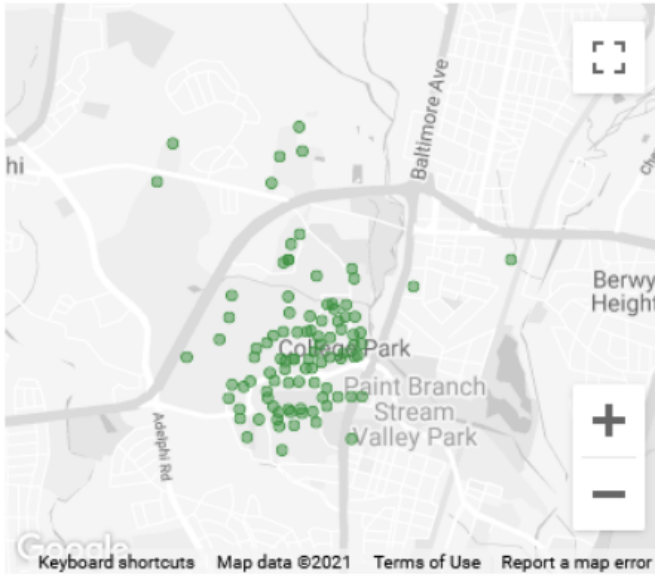
Buildings Surveyed
97

Surveys Completed
832









Summary

- Good Indoor Air Quality improves the overall working condition in buildings for employees.
- Controlling moisture reduces the possibility of mold growth.
- Visible mold growth should be remediated.
- Improving dilution, ventilation & filtration improves Indoor Air Quality.

Questions?

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ENVIRONMENTAL SAFETY,
SUSTAINABILITY & RISK

Michael Stumpo
OSH Coordinator

mstumpo@umd.edu
osh@umd.edu
safety@umd.edu

301.405.3982 (work)
301.405.3960 (front desk)