Moving Beyond “Is it Mold?”

Sophia Kapranos, Industrial Hygienist

Smithsonian Facilities

Nora S. Lockshin, Senior Conservator

Smithsonian Institution Archives

Smithsonian Affiliations

Visiting Professional – a Fellow for All Reasons

Laura Wahl, Library Conservator

Hagley Museum and Library, Wilmington DE

- Short-term, focused, motivated professional.
- Matched needs

Hagley

Smithsonian

Smithsonian Affiliations

Visiting Professional – a Fellow for All Reasons – Mutual Goals

Hagley Museum and Library

- Identification
- New methods of control, conservation treatment and mold remediation

Hagley + Smithsonian ➔ **PRODUCT**

Smithsonian Institution Archives

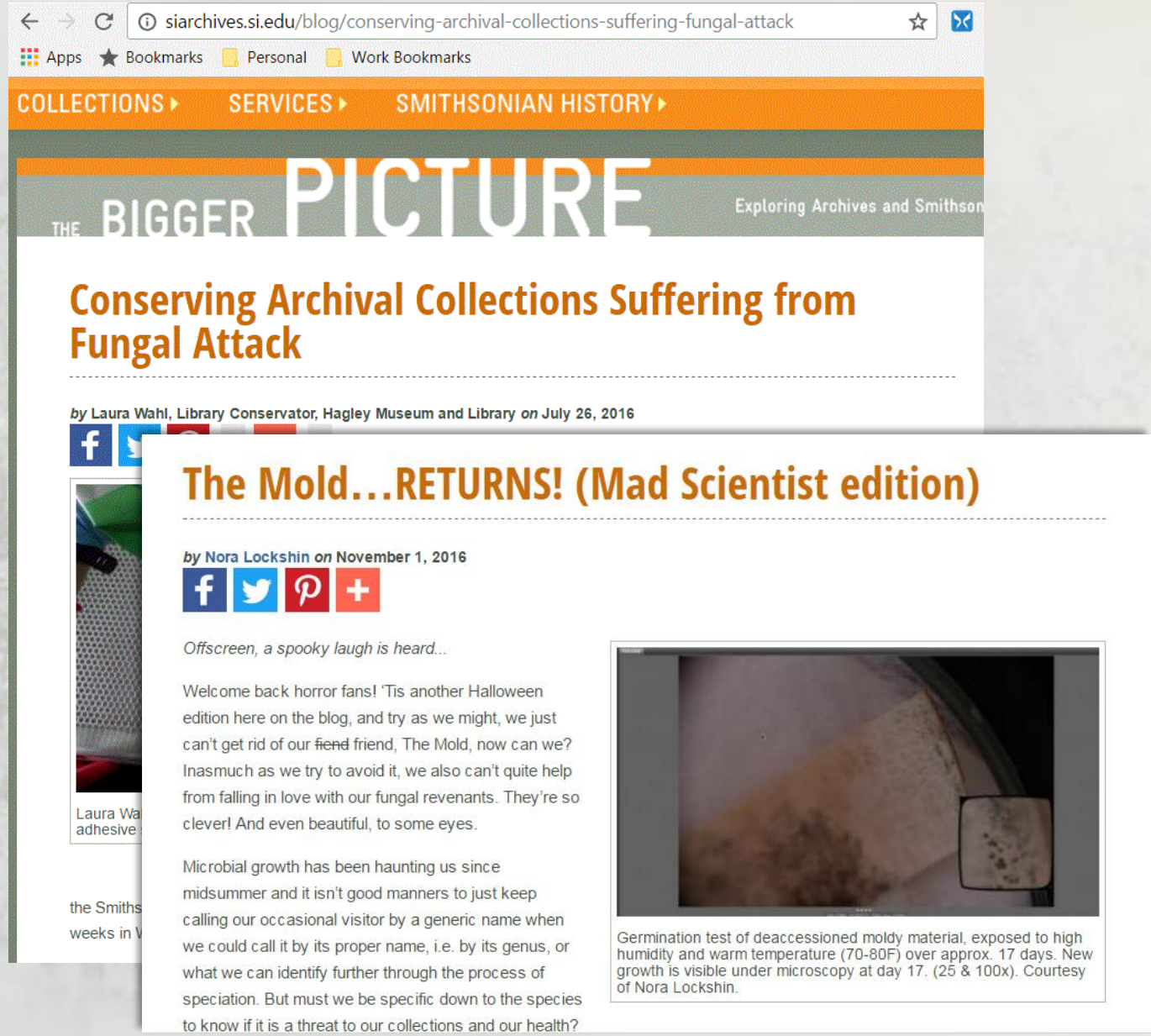
- Identification & Viability
- Practical implementation of control and mold remediation
  - Cost baselines
  - Tools/Resources
  - Disaster planning
- Stakeholder education
  - Right to Know (Staff & Users)
  - Responsible Collection Management

Smithsonian Affiliations

Visiting Professional – a Fellow for All Reasons

"Increase and diffusion of knowledge for all…"

siarchives.si.edu/blog



WHY identify?

"It is essential to know - if what you think is a fungal infestation is not a wax bloom, crystalline chemicals , dust fibers, food debris, paint or ink splatter, etc."

Mary-Lou Florian (2012)

Conidia, ascospores, ascocarps and ethyl alcohol.

- Microscopy may be enough for a conservator to consider treatment, with ethanol based solutions, or outside vendor approaches.

✓ Worker protection
✓ Regulatory compliance
✓ Targeted remediation plan / decision-making
✓ Quality assurance

Methods to identify

- Conservator + Industrial Hygienist
  - Visual identification/Microscopy
  - Culturing for viability = **$0-10**
  - ATP bioluminescence (swab + analyzer) = **$2,000+**

(Initial investment)

- Conservator + Industrial Hygienist + External Lab
  - Microscopy/spore count (Genus level) = **$40-50**
  - Culturing for swab, air, bulk, and dust samples = **$100-150**

per test

(genus-speciation)

WHY culture and speciate?

"Culturing is not always conclusive. Some fungi require a specific environment and are unculturable, some are viable conidia that are airborne recent contaminates, some may be dead fungal structures, many infestations are of mixed species."

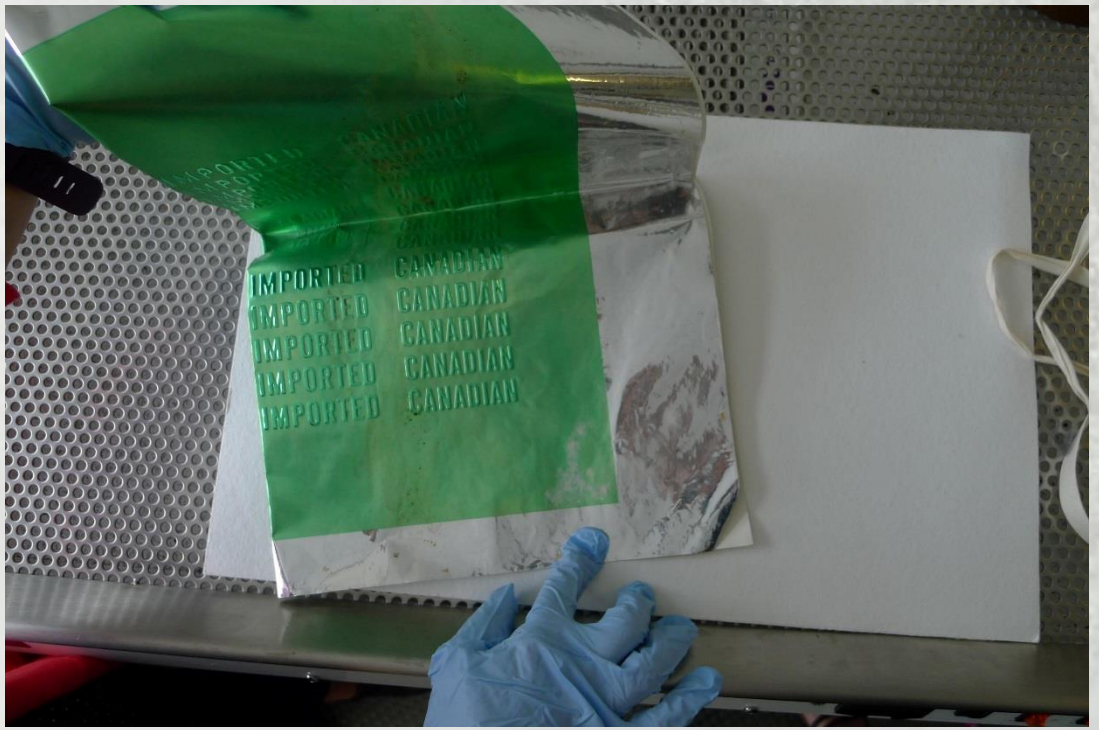
Mary-Lou Florian (2012)

Conidia, ascospores, ascocarps and ethyl alcohol.

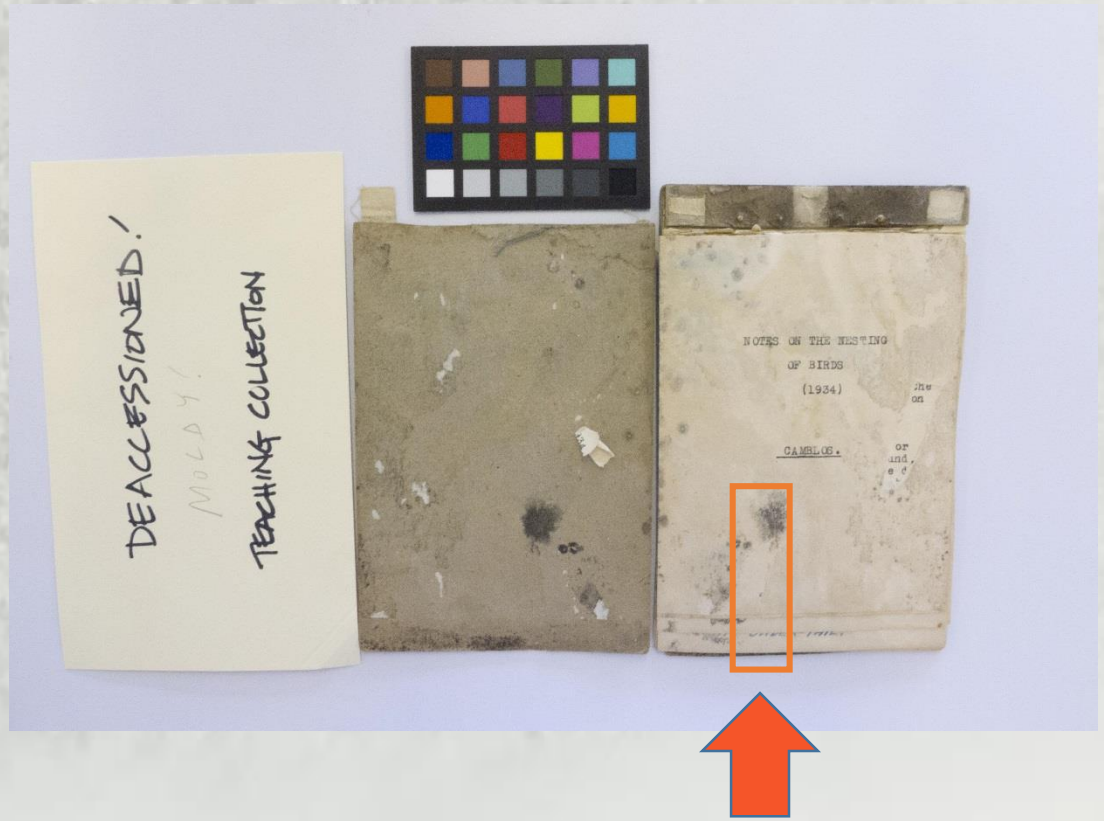
- Determine vulnerabilities or persistence of the species
- Determine efficacy of remediation after treatment *(new or recurring species?)*
- Provide information for worker health monitoring program, or for physicians working with an affected worker.

Sampling subjects

Hagley Museum and Library



Smithsonian Institution Archives



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Culturing subject

Smithsonian Institution Archives

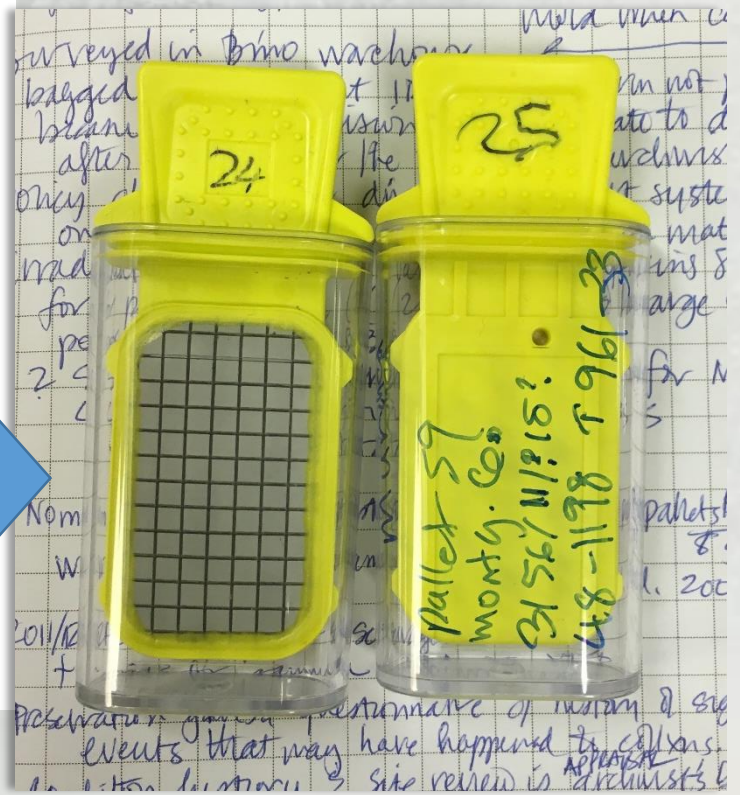
- Low-tech, low cost (in-house)
- Can determine viability
- False positives possible

17 days @
high RH
70-80F

In-house culturing with lab/vendor support

- Low-tech, low cost
- Yes/No + colony count
- False positives possible
- Yeast & Mold – non-specific
- Wet wipe sample –
  potentially destructive

= **$10/test**
(25/pk)



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Culturing for Monitoring @ MdSA

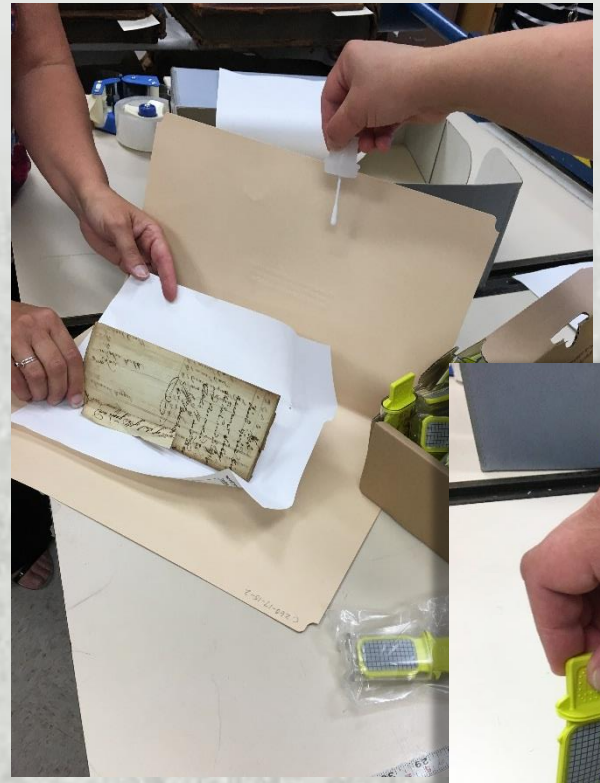
A collection assumed to be biocontaminated from floodwaters

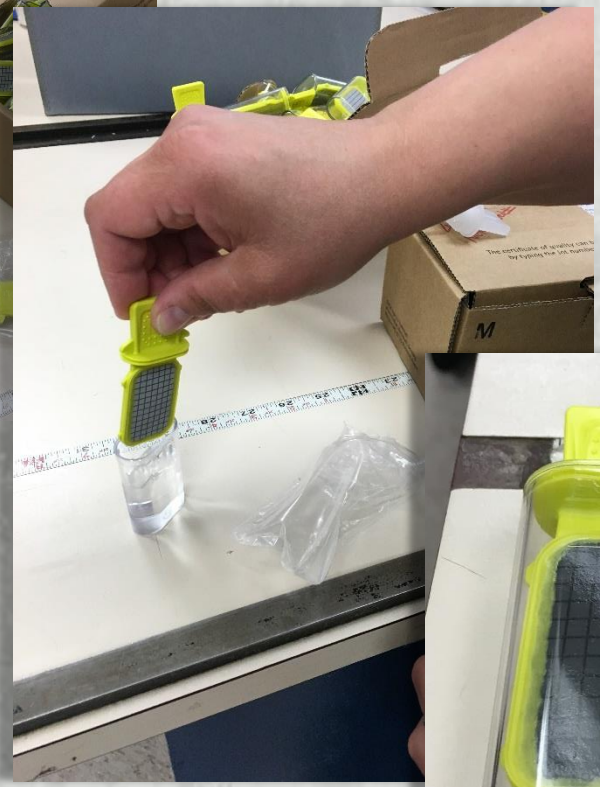
Gamma irradiated by vendor

In-house wipe samples after treatment

- Quality Assurance determination
- Preventative Conservation / Monitor for reoccurrence
- With/without lab support services

Gamma irradiation = $91,500
QA ≈ $250

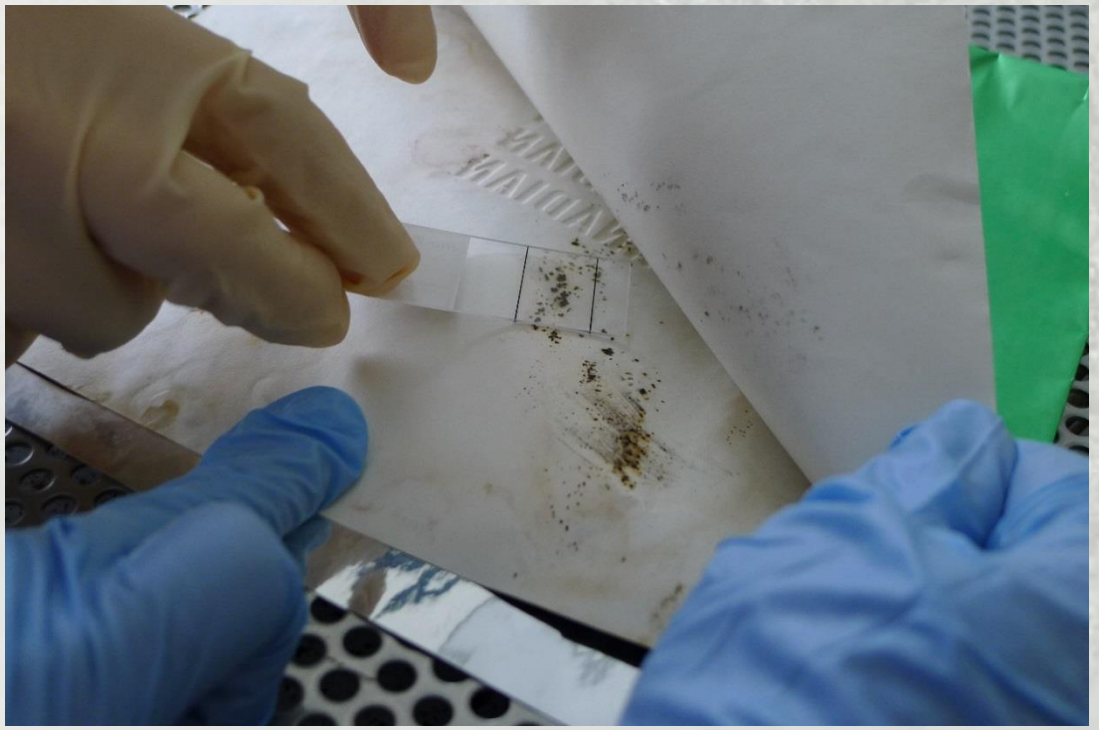


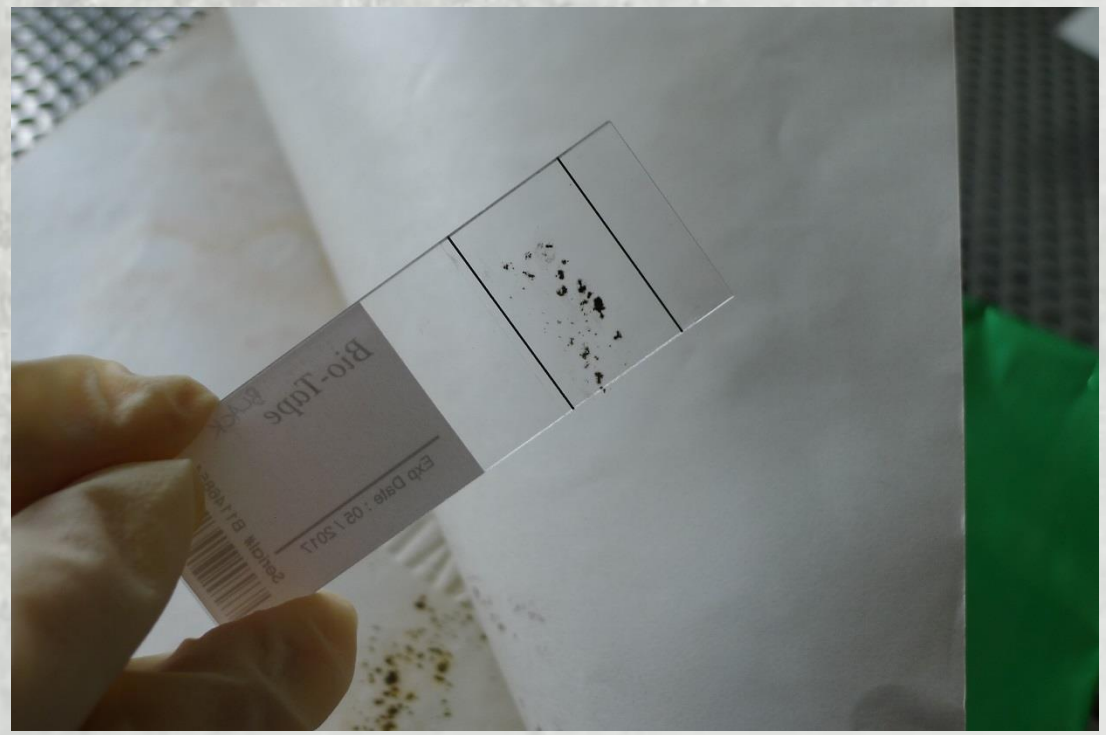


Smithsonian

Sampling at Smithsonian (+ vendor for analysis)

Tape lift (vendor supplied glass slide, or plain clear tape)

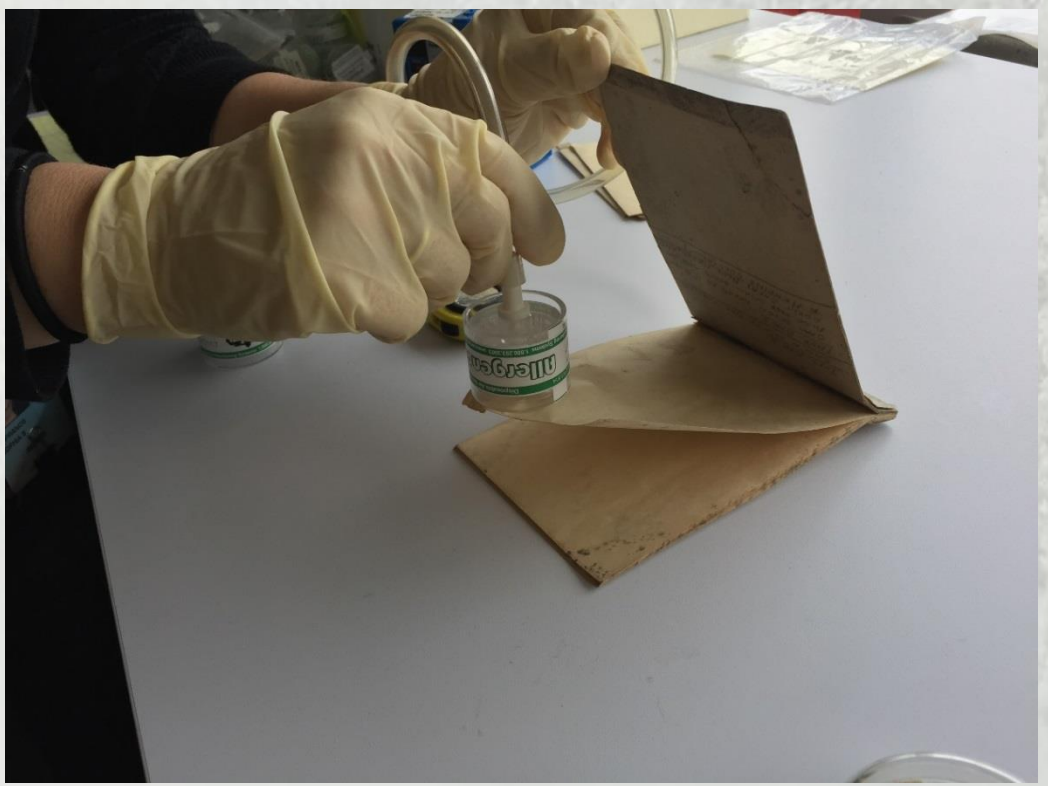




Sampling at Smithsonian (+ vendor for analysis)

Vacuum Air Sampling

Note suction force on unrestrained object



versus mounted/restrained surface

Treatment at Smithsonian

Internal

- IH Group:
  - Training re: Safety (PPE and Engineering Controls)
- SI Conservator
  - Can offer scaled remediation training & lab support
  - Consult (collection level)
  - Treat (item level)

CFCH RRFA's Greg Adams uses SIA lab facilities to process and surface clean moldy collections.

Video excerpt. Smithsonian Institution Archives. Nora Lockshin reducing mold on the Nat Turner Bible, NMAAHC 2011.28.

Treatment at Smithsonian

External

- Disaster services Contractor/ Vendor
  - Freeze dry / disaster services
  - Vacuum / surface clean
  - Gamma irradiation
  - Electron beam radiation
- Independent conservator/regional conservation group

Mille Lacs Band of Ojibwe Archives Mold Remediation. Minnesota Historical Society & Midwest Art Conservation Center. Grant funded. =**$9,694**

Setting up safe protocols

Why do we want it?

- For assessment
- For treatment
- For disaster response
- For storage
- For **access** to known/potentially hazardous objects

How do we do it? Best Practice.

- Education
- Inclusion in collection management database
- Right to Know documents
  - Information sheets
  - Job Hazard Analysis
  - SOPs
  - Warning labels (~ HazComm)

Setting up safe protocols

- for Staff (including interns, volunteers)
- and External Researchers

- External Researchers access collections in reading & study rooms
- Precedent for HazComm to external stakeholders: NMAI

Setting up safe protocols

models @ Library of Congress and National Archives and Records Administration

Library of Congress Preservation Directorate, Collections Recovery Room

- Dedicated workspace for recovery of wet or formerly wet collections.
- Stocked with supplies, equipment & engineering controls
- Serves all intramural units
- SOPs define training in PPE & equipment, actions from response to disposal, collection movement, warning labels

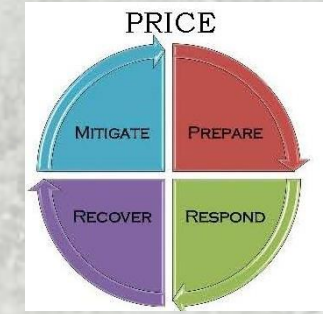
Future Smithsonian Facilities + Smithsonian Institution Archives → PRODUCTS

Job Hazard Analysis
- For Staff

Visual guide / information sheet
- For Staff
- For External Researchers

Resource summary for Disaster Implementation guides
- vendors, types, steps, cost estimates
- ✓SIA
- ○ PRICE

Preparedness and Response in Collections Emergencies (PRICE)



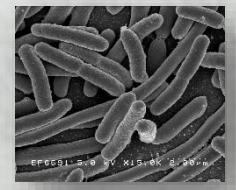
- IDIQ & SoWs for disaster services w/OCON
- JHAs; training w/ SF-OSHEM


{Intermission}
EVERYBODY STRETCH!

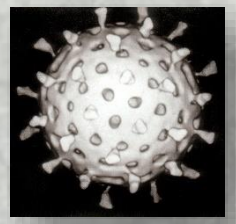
Microbial Classifications

- Fungi
  - **Mold** & Mushrooms (multicellular)
  - Yeasts (single-celled)

- Bacteria



- Viruses



- Algae, amoebas, protozoa, etc.

- Dust mites (common allergens, needs water to reproduce)

Microbial Sampling Methods

Smithsonian Institution Archives Paper Conservation Lab

- Surface Tape-Lift Samples
  - Direct microscopy: spore count & genus ident (used this method)
  - Cultured: incubation & speciation
- Surface Vacuum Dust Samples
  - Direct microscopy: spore count & genus ident (used this method)
  - Cultured: incubation & speciation

Additional Microbial Sampling Methods

- Surface swabs
- Bulk samples: culturable (species or genus level)
- Area or personal air sampling: culturable (species or direct microscopy
- Water samples
- ATP Bioluminescence direct-reading meters
  Relative Light Units (RLUs)
- Merck Millipore's Samplers and Swab Test Kits
- IR thermal camera & moisture meter

Microbial Remediation Methods

* **Eliminate water source** (e.g., repair water leak, lower humidity)
  Drying water damaged material within 48 hours will likely prevent microbial growth.
  Remediation methods if microbial growth is observed:

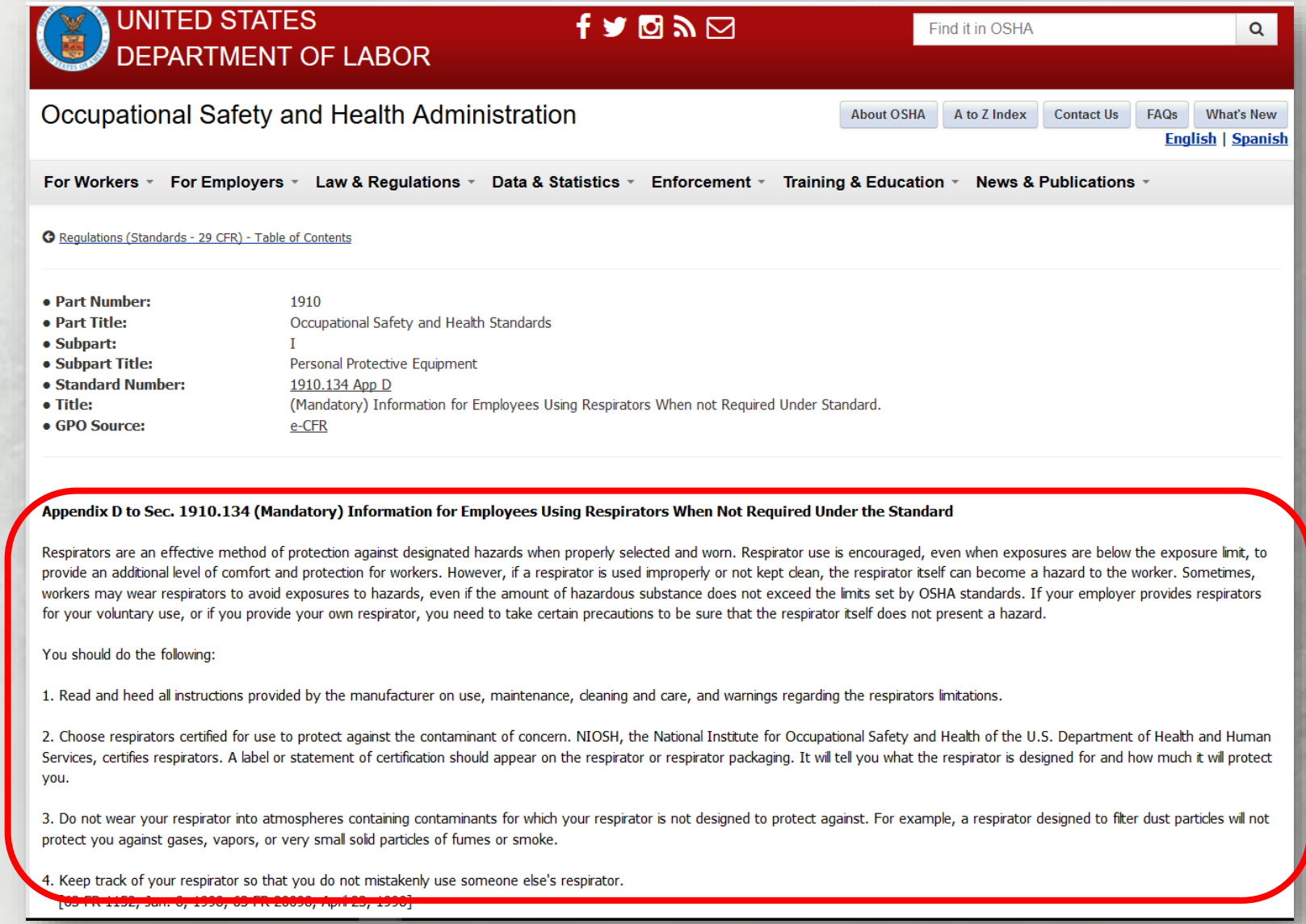
  - Air Drying: fans, dehumidifiers
  - Freezing: < 0°F ~24 hours
  - Wiping/spraying: antimicrobials/biocides, 70% ethyl alcohol, isopropyl alcohol, etc.
  - Gamma Irradiation: can “melt” objects
  - HEPA Vacuums
  - Specialized abatement companies
  - Vulcanized smoke sponge

Personal Protective Equipment (PPE)

- Handling Small Objects
  - Disposable gloves
  - Dust mask/filtering facepiece
  - Eye protection/goggles
- Handling Large Objects
  - Disposable gloves
  - Dust mask/filtering facepiece or Air purifying respirator
  - Eye protection/goggles
  - Protective clothing (e.g., Tyvek®)

- **NOTE:** OSHA's regulations for voluntary dust mask use. 1910.134 Appendix D

OSHA 1910.134, Appendix D



UNITED STATES
DEPARTMENT OF LABOR

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Regulations (Standards - 29 CFR) - Table of Contents

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** I
- **Subpart Title:** Personal Protective Equipment
- **Standard Number:** 1910.134 App D
- **Title:** (Mandatory) Information for Employees Using Respirators When not Required Under Standard.
- **GPO Source:** e-CFR

Appendix D to Sec. 1910.134 (Mandatory) Information for Employees Using Respirators When Not Required Under the Standard

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

Proper Handling & Engineering Controls

- Proper Handling
  - Wear appropriate PPE
  - Disinfect surfaces or use disposable surfaces (e.g., unprinted newspaper, sheets of poly/plastic)
  - Store in airtight containers
- Portable air purifiers with HEPA filter and UV lamp
- Dispose contaminated material in airtight bags the same day
- Engineering Controls
  - Chemical/fume or snorkel hoods
  - Portable air purification unit with HEPA filter & UV lam

Mold Prevention

- Climate controlled storage environments
- Low humidity (relative humidity < 40%)
- Circulated air
- Store objects off the floor
- Routine HVAC maintenance
  (e.g., replace filters, duct cleaning)
- Do not introduce contaminated objects into “clean” environments
- Store contaminated objects in airtight containers

With thanks

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