

# Fixing the Great Indoors

## IAQ Problems and Solutions

Triangle ASHRAE Chapter

13 Sept 2017

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This ASHRAE Distinguished Lecturer is brought to you  
by the Society Chapter Technology Transfer Committee

# Please Complete the Distinguished Lecturer Event Summary Critique

❖ CTTC needs your feedback to  
improve the DL Program



Forms are available at:

[www.ashrae.org/distinguishedlecturers](http://www.ashrae.org/distinguishedlecturers)

# VOLUNTEER!

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**ASHRAE Members who are active at their chapter and society become leaders and bring information and technology back to their job.**

## YOU ARE NEEDED FOR:

- ❖ Society Technical Committees
- ❖ Society Standard Committees
- ❖ Chapter Membership Promotion
- ❖ Chapter Research Promotion
- ❖ Chapter Student Activities
- ❖ Chapter Technology Transfer



# Help from EPA

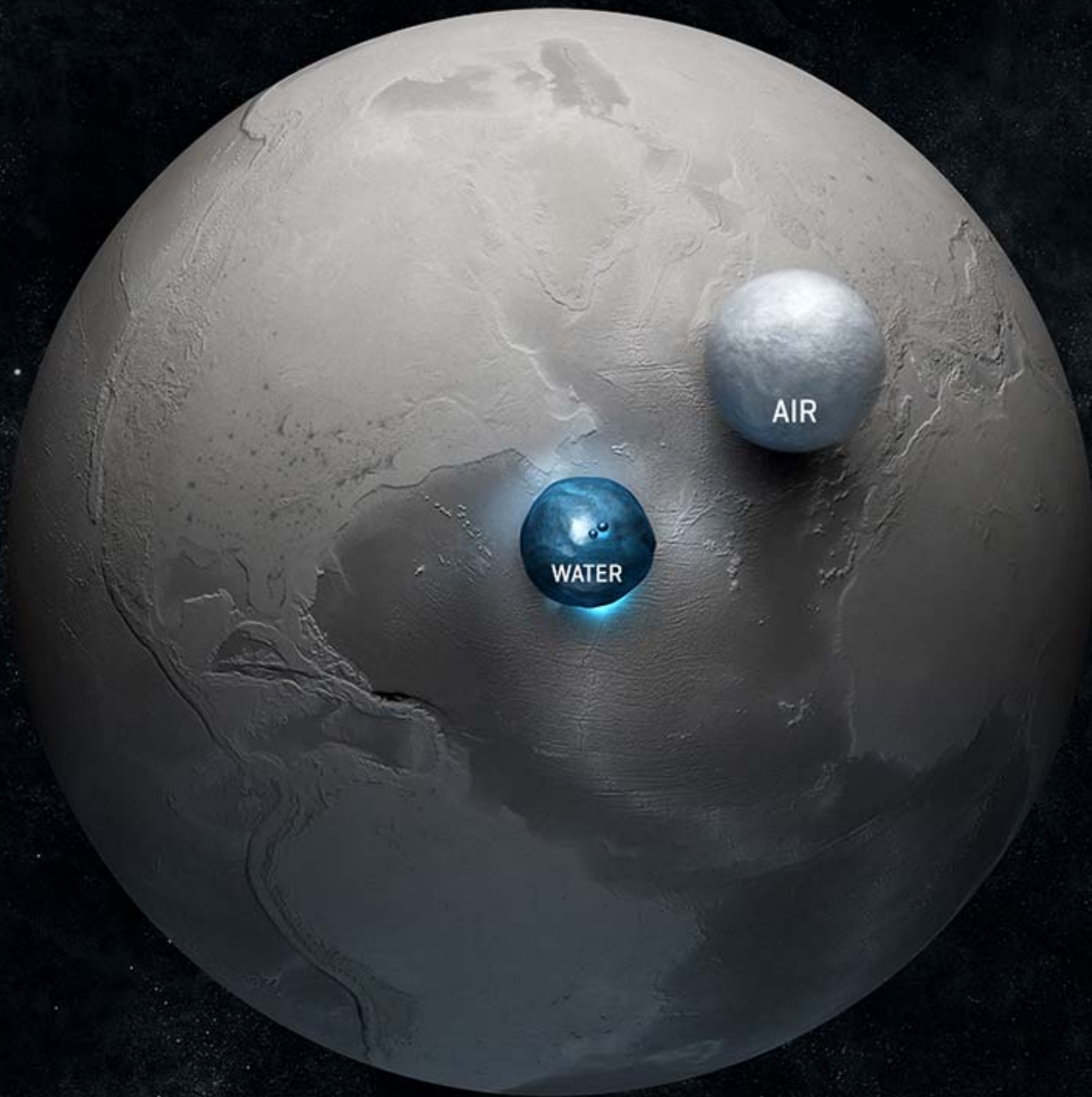
- EPA Indoor Air Resources

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

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

OR slack.henry at epa.gov

404-562-9143





# Does this office have a problem?

- Tenants report
  - Odors
  - Feel sick
  - “Not right”
- Would you test the air or inspect HVAC equipment?





# Since the 50's

- Carpets, wallboard
- Particleboard, finishes, glues, foam insulation
- Computers, printers, copiers (toner)
- Cleaning, personal care, pesticide chemicals
- Open windows rare





# What's In Our Air?

# What Is It?



- Radioactive RADON
- 2<sup>nd</sup> leading cause of lung cancer
- 21,000 deaths yearly
- Prevent: \$500-\$2500
- **TEST YOUR HOME!**
- Fix only w/ certified

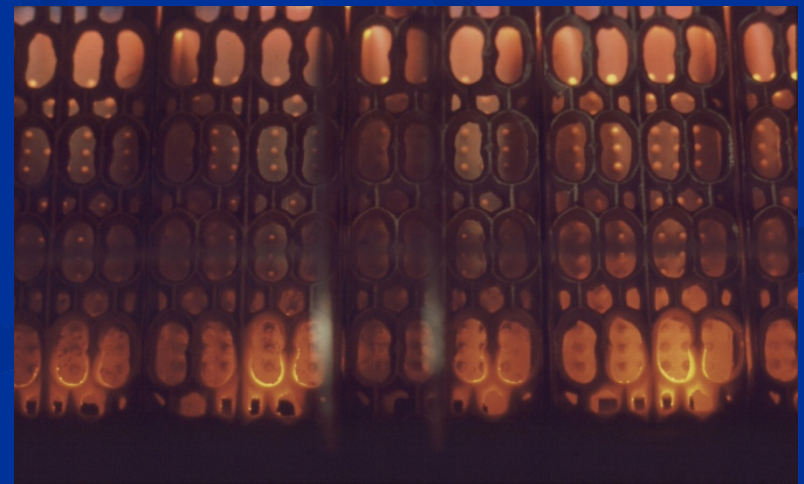
# What Is It?

- Secondhand Smoke
- Adults - lung cancer
- Children – asthma, bronchitis, pneumonia, ear infections, SIDS



# What Is It?

- Carbon Monoxide
- “Head” symptoms: dizzy, nausea, headache, tired, confused, flu-like
- From tailpipes, broken combustion equipment, charcoal grills, emergency power generators





# What Are They?

- Volatile Organic Chemicals (VOCs)
- Headaches, rash, respiratory symptoms
- From “wet” building products, pressed wood (formaldehyde), pesticides





# What Are They?

- Biological contaminants
  - Cat dander
  - Pollen
  - Roach or rat droppings
  - Dust mite droppings
  - Mold
- Allergy, irritation, etc.



# Health Effects from Biologicals

## ■ Infections

- Contagious (colds, flu, TB, measles)
- Enviro-source (*Legionella*, Histoplasmosis, aspergillosis)

## ■ Toxicoses (mycotoxins, endotoxins)

## ■ Hypersensitivity Diseases

- Allergy, asthma, Hypersensitivity Pneumonitis (HP)



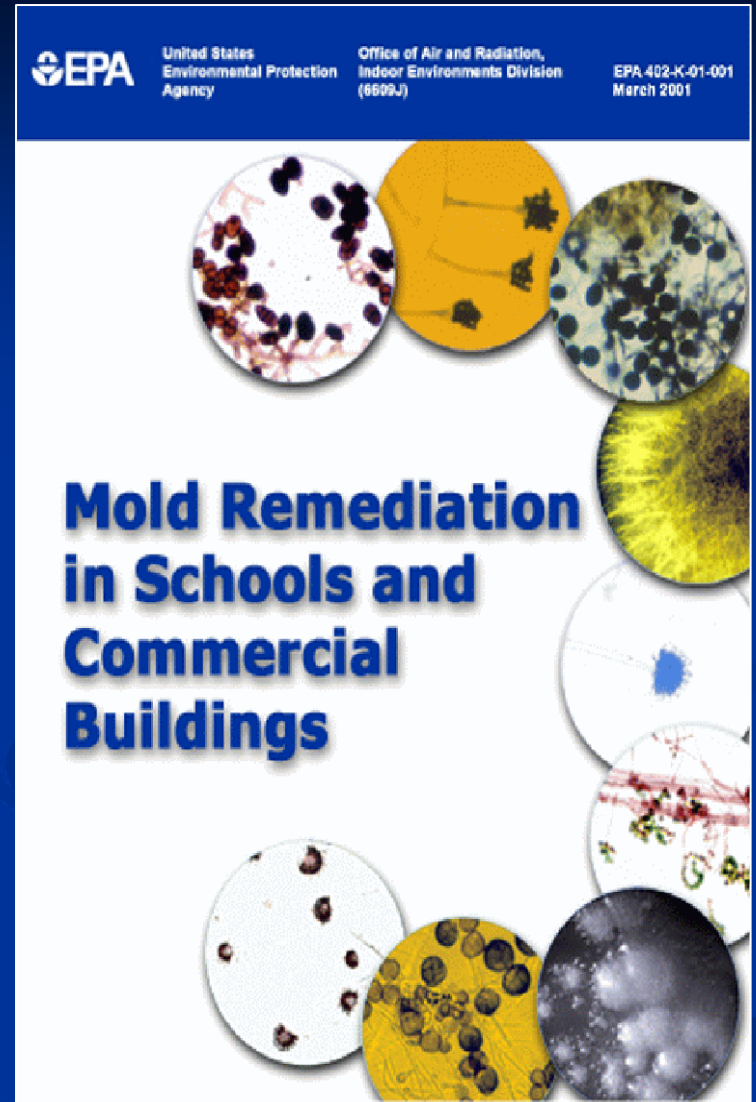
# Legionella



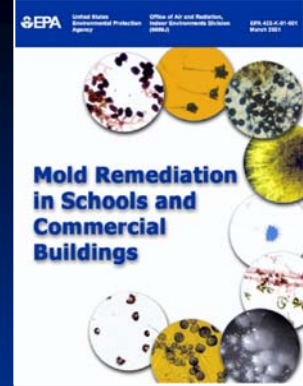
- Not just cooling towers
- Fountain, DHW line/shower, mist machine, humidifier, spa, ice-maker, others
- Grows at 70-110 F
- New guidance from both ASHRAE and AIHA in 2015 established standards
- Legionella is PREVENTABLE
  - Work practices should reflect new guidance

# EPA on Molds

- Popular guidance
- NO REGULATIONS
- Health Effects in Appendix B



# Big Ideas about Molds



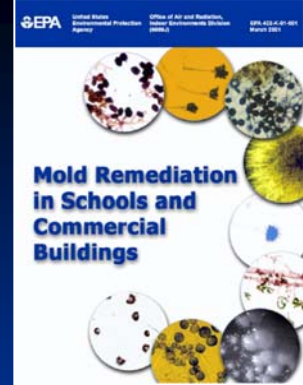
- **Mold = MOISTURE.** Get rid of both!
- Sample only for legal reasons, to find hidden mold, or if results changes M.D.'s treatment
- **No Federal mold standards**
- **No EPA regulations** for cleanups
- Biocides not recommended routinely



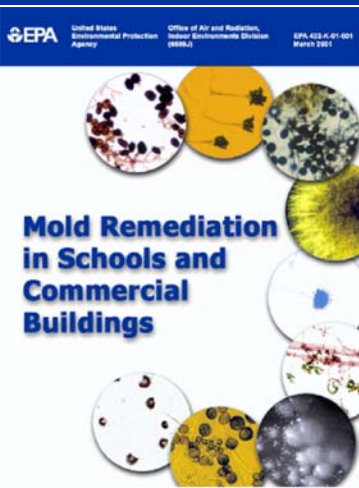
# Sampling = Snapshot



- Air sampling provides information only for the time of sampling
- Experience in interpretation of results is essential



# Guidelines for Remediating Mold Growth Caused by Clean Water



- Table 2, Page 14: EPA divides into
  - Small ( < 10 square feet)
  - Medium (10-100 square feet)
  - Large (>100 square feet)
- Cleanup, protective equipment, and containment vary with size

# What We Didn't Cover

Ingestion



- Lead-based paint
- Asbestos
- Sewer Gases
- Pesticides
- CO<sub>2</sub>





# Outside Air affects IAQ



# Finding IAQ Problems

- Talk to occupants (esp. maintenance)
- **Visual Assessment** – look for sources
  - IAQ “walk through”
- Then fix problems!
- Testing may be ineffective
  - Often does not identify sources, health concern





# Visual Inspection

- Often not complicated







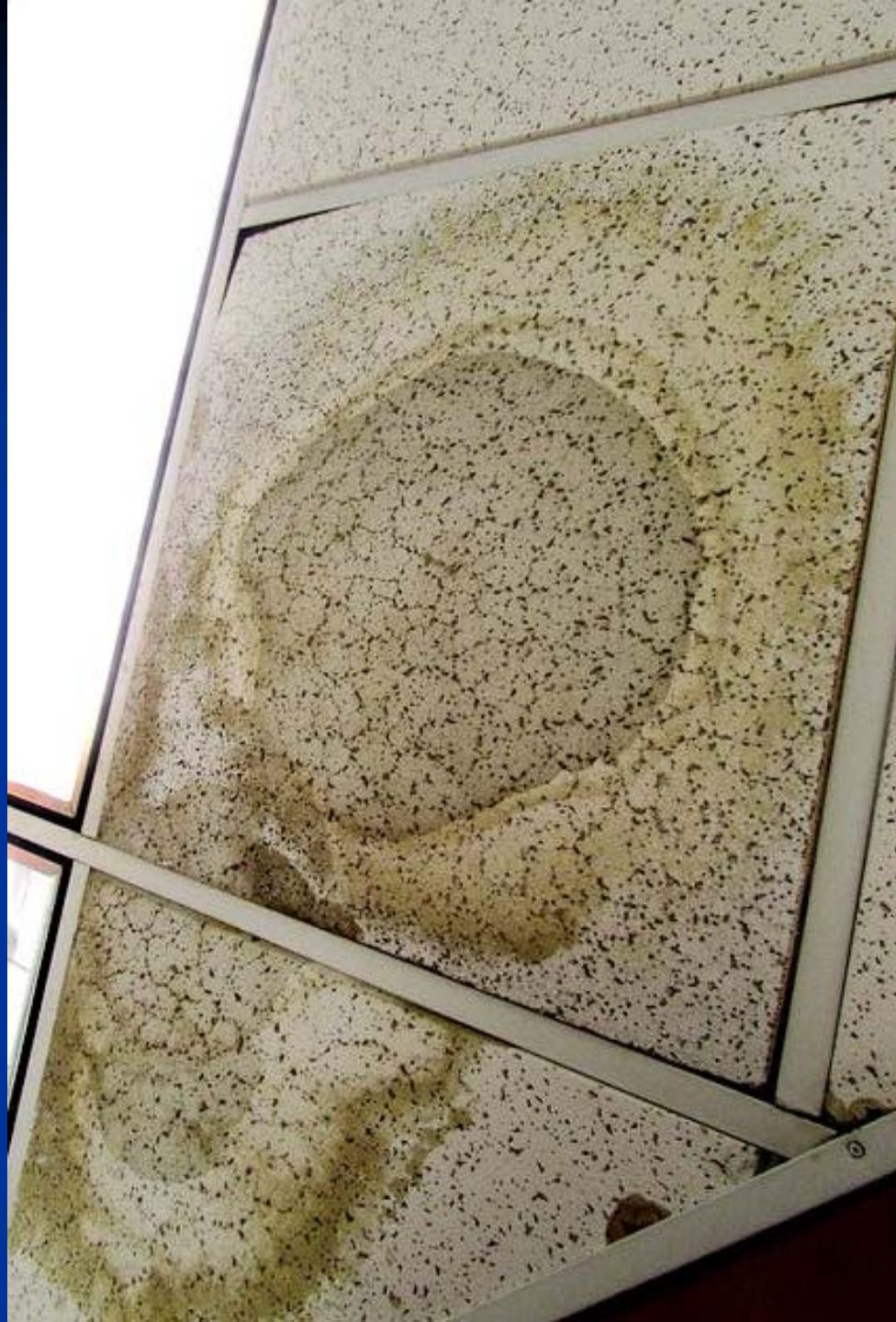




# On the roof







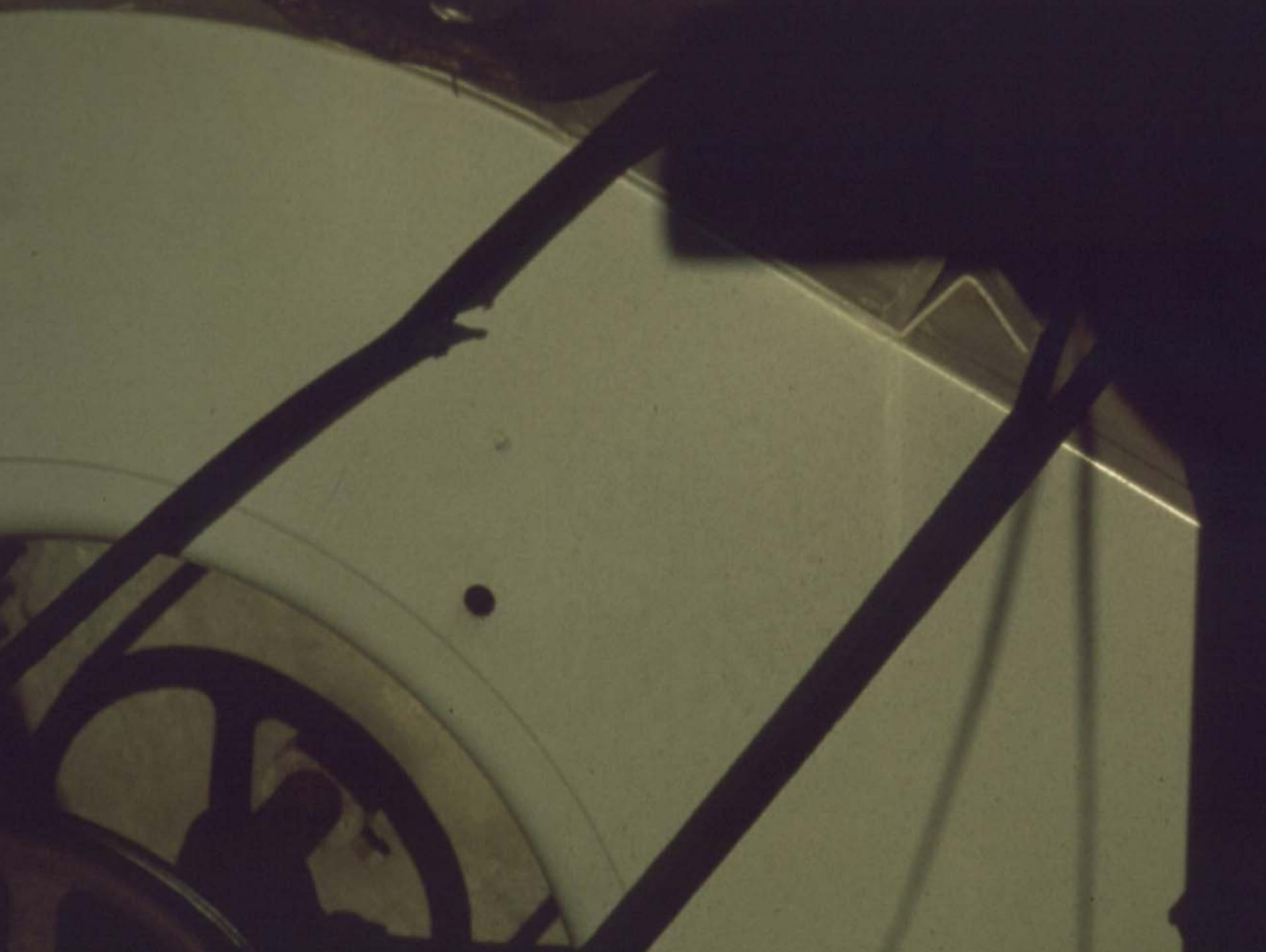




















FRESH AIR INTAKE  
PLEASE SHUT OFF  
VEHICLE

DO NOT  
PARK  
TOWAWAY ZONE

NO  
YARD  
WASTE  
GARBAGE  
ONLY

**WM**  
WASTE MANAGEMENT  
334-4115  
www.wm.com

CAUTION  
NO HAZARDOUS  
WASTES ACCEPTED  
DO NOT  
PARK

KEEP LIDS CLOSED

**WM**  
WASTE MANAGEMENT  
334-4115



# Visual Inspection Tools

- Thermometer, RH meter
- Ruler, flashlight, screwdriver, knife
- Moisture meter
- Smoke, feather or micromanometer



# What can we do for indoor air?



- **CONTROL** pollution sources
  - If inside, cover it or replace it
  - If outside, don't bring it in!



- **VENTILATE** to remove/dilute pollutants



- **CLEAN** the air, whether recirculated or “fresh”

# Source Control I – Keep It Out!



- Use low-emitting materials: paints, adhesives, carpets, wood products
- Use Green Cleaners – fewer VOCs/odors
- No Smoking!
- Seal ductwork, garage connections, etc.
- Trap dirt at doors (walk-off mats)
- Integrated Pest Management – less \$, chem



# Source Control II – If in, control !



- Cover stinky stuff – cap chemicals, wrap smelly stuff
- Use HEPA vacuum cleaners, floor buffers to capture particles
- Capture or exhaust dust or fumes from any other activities (hobbies, cooking)



# Controlling Mold



- **Moisture Control KEY to Mold Control**
- Use of antimicrobials (like bleach) not recommended routinely
- You see mold, it's there. Do you need to sample?
- Solve the moisture, then remove moldy material. Discard moldy porous items.

# Ventilation



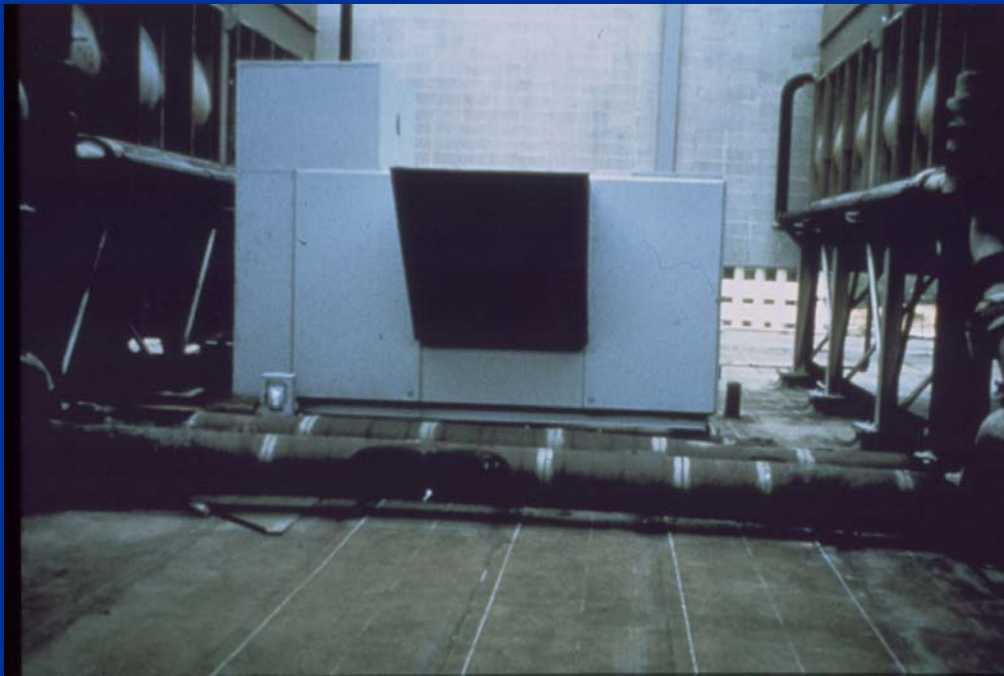
- Check HVAC operation, especially outside air – may not be working
- Are exhausts working? Add exhaust?
- Exhaust dirtiest air?  
Dilute with outside air?
- Increase OA flow?





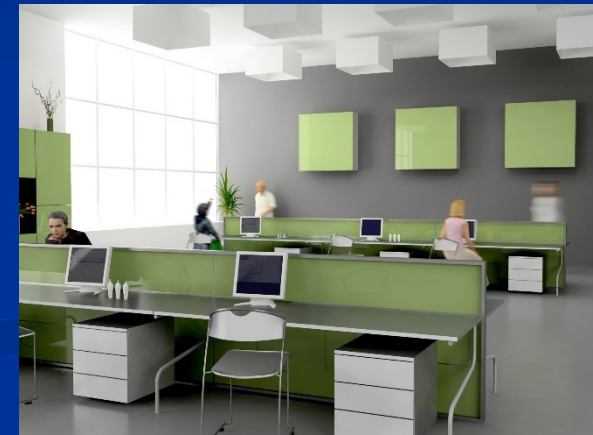
# Find outside air intakes

- Are they working?
- Is there damage? Change?
- Is a possible source nearby?



# Cost of office ventilation

- Class A office space may be \$15-20/sf/year
  - Utility bills are \$1-2/sf/year
  - HVAC is \$0.40-\$1/sf/year
  - Outdoor air is \$0.05-15/sf/year
  - Office salaries: \$200-\$300/sf/year
  - 1% change in productivity: \$2-3/sf/year
- \$2 >> \$0.15







# Clean or filter the air

- Filters – Min. Efficiency Rating Value (MERV)
  - Office, EPA recommends MERV 8+
- Higher MERV: more \$, more energy, less dirt in the air and lungs
- “Air purifiers” can help but not a full solution





# Ozone not “air cleaner”

- Ozone = lung irritant, regulated outdoors
- O<sub>3</sub> reacts quickly with some chem to make aldehydes & ketones, doubling VOC levels
- Other chem reactions take weeks+
- Be careful of new miracle technologies – they might produce ozone
- [www.epa.gov/iaq/pdfs/ozone\\_generator.pdf](http://www.epa.gov/iaq/pdfs/ozone_generator.pdf)

# Exposure Control

- Move people away from the problem
- For a day, or nightly, or more
- Temporary (vacation) or permanent



# For all solutions, communicate!



- Let occupants know you acted
- Be sure they understand what you're doing to fix the identified problem
- Always follow through.  
Build trust



# Future of Indoor Air

- Per LBNL, worst pollutant PM 2.5, tobacco smoke, radon, formaldehyde & acrolein
- **Particulate Matter 2.5** affects cardiovascular (elderly) + affects unborn and babies + easy to measure
- “Citizen Science” (wearable monitors) will drive concern
- **Legionella**: headlines and PREVENTABLE





# Go Resilient Design!

- We've had both more floods and droughts recently, with wildfires and heat waves
- Plan Ahead! Design with Resilience!
  - Put HVAC equipment to avoid floods
  - Design to capture rainwater, condensate
  - Filter outside air, for wildfires, ozone
  - Plan for capacity during heat waves

# Chicken Restaurant story

- 30K CFM exhaust, 15-20K CFM OA, seating area
- Negative pressure, sign on door: “Pull hard!”
- When closing, manager shut off seating area HVAC (and OA) while kitchen cleans, uses water from gas-fired water heater
- Water heater clicks on, gas flame starts, FLAME ROLLS OUT OVER FLOOR! WAKE UP!



# Stories

- Odor in lobby by coffee shop
- Unplanned filtration



# Help from EPA

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