

20<sup>th</sup> Safety Professional Development Conference  
Hampton, VA  
13 March 2012

# **Indoor Environmental Quality: What Safety Professionals Should Know**

**Pat Krevonick, CHMM**  
**Navy and Marine Corps Public Health Center**



# IEQ: What Safety Professionals Should Know

## Course Outline

### ❖ Introduction to IEQ

- ❖ Head, Acquisition Tech Support, IH Dept., NMCPHC, 757-953-0754

### ❖ Mold Primer

- ❖ Head, IH Dept., NMCPHC, 757-953-0740

### ❖ Risk Communication

- ❖ Risk Communication, NMCPHC, 757-953-0664

The views expressed in this presentation are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U. S. Government



# Introduction to IEQ

- ❖ **What is it?**
- ❖ **When do I have a problem?**
- ❖ **What can I do about it?**
- ❖ **Where can I get help?**



# INDOOR ENVIRONMENTAL QUALITY

## WHAT IS IT?



# IEQ: What is it?

## Working Definition

- ❖ The quality of the *air and environment* inside a building\*
- ❖ Focuses on airborne contaminants and other health, safety, and comfort issues\*\*
- ❖ Includes ergonomics, noise, lighting, odors, temperature, aesthetics ....

\* CDC - <http://www.cdc.gov/niosh/topics/indoorenv/>

\*\* NIBS WBDG - <http://www.wbdg.org/design/ieq.php>



# IEQ: What is it?

ANSI/ASHRAE Standard 62.1-2010\*

## Definition of Acceptable Indoor Air Quality

“Air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.”

\* American National Standards Institute/ American Society of Heating, Refrigerating and Air Conditioning Engineers, *Ventilation for Acceptable Indoor Air Quality*



# IEQ: What is it?

## ANSI/ASHRAE Standard 55-2010\*

Acceptable environment – “substantial majority” of occupants satisfied

- ❖ Based on healthy adults
  - ❖ Indoor spaces designed for human occupancy
  - ❖ Inside the space at least 15 minutes
- ❖ Primary factors:
  - ❖ Personal - metabolic rate, clothing insulation
  - ❖ Environmental - air temp, radiant temp, air speed, humidity

\* American National Standards Institute/ American Society of Heating, Refrigerating and Air Conditioning Engineers, *Thermal Environmental Conditions for Human Occupancy*



# INDOOR ENVIRONMENTAL QUALITY



**WHEN DO I HAVE  
A PROBLEM?**



# IEQ: When Do I Have a Problem?

- ❖ Employee complaint
  - ❖ Verbal
  - ❖ File internal unsafe/unhealthful (OPNAV 5100/11)
  - ❖ File OSHA-7 Form, Notice of Alleged Safety and Health Hazards
- ❖ Visible evidence or suspect area seen or reported during site visit or inspection
- ❖ (See it on the evening news)



# IEQ: When Do I Have a Problem?

## Sick Building Syndrome (SBS)

“tight building syndrome”

A set of symptoms affecting occupants for which no specific cause or illness can be identified.\*

headache	cough
mental fatigue	eye, nose, throat irritation
dry mucus membranes	drowsiness, lethargy, fatigue
dizziness, nausea	dry, itchy skin

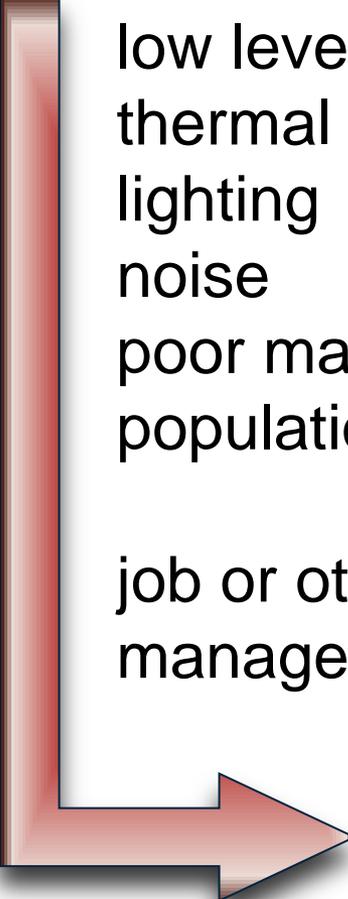
Symptoms resolve within 1-2 hours after leaving building - *may* return upon re-entry (may not!)

\* EPA – Indoor Air Facts No. 4, Sick Building Syndrome, <http://www.epa.gov/iaq/pubs/sbs.html>



# IEQ: When Do I Have a Problem?

## SBS resolution usually multifaceted



low level contaminants  
thermal gradients  
lighting  
noise  
poor maintenance  
population density

poor air circulation  
humidity (high or low)  
workstation design  
inadequate fresh air  
“sensitivity” to odors  
“cubicle” work stations

---

job or other stresses  
management issues

psychosocial issues  
co-worker issues

**Individual Susceptibility and Tolerance**



# IEQ: When Do I Have a Problem?

## Building Related Illness (BRI)

A distinguishable set of symptoms:

- ❖ Symptoms can be defined clinically
  - ❖ e.g., fever/chills, productive cough
  - ❖ Usually have identifiable cause
  - ❖ Medical diagnosis possible
  
- ❖ Usually affects small number of occupants



# IEQ: When Do I Have a Problem?

## BRI Examples

- ❖ Infectious microorganisms
  - ❖ *Legionella pneumophila* → Legionnaire's disease, Pontiac Fever
  - ❖ Ameba, bacteria (*B. subtilis*), fungi → humidifier fever
  - ❖ Molds → hypersensitivity pneumonitis
- ❖ Chemicals - formaldehyde, CO
- ❖ Chemicals - endo/ mycotoxins (bacteria, fungi)
- ❖ Allergens - dust mites, roaches, latex, dander



Building or workspace can (usually) be confirmed as source

# IEQ: When Do I Have a Problem?

## BRI Clues

- ❖ Medical takes the lead --- based on diagnosis, look for source(s)



- ❖ Symptoms usually resolve when the cause is eliminated
- ❖ Incidence low – consequences can be severe



# IEQ: When Do I Have a Problem?

## SBS

**Strong temporal relationship** with building occupancy

**Transient general complaints** - neurological, respiratory, dermatological

**Few or no** clinical findings

## BRI

Temporal **relationship** with building occupancy **less clear**

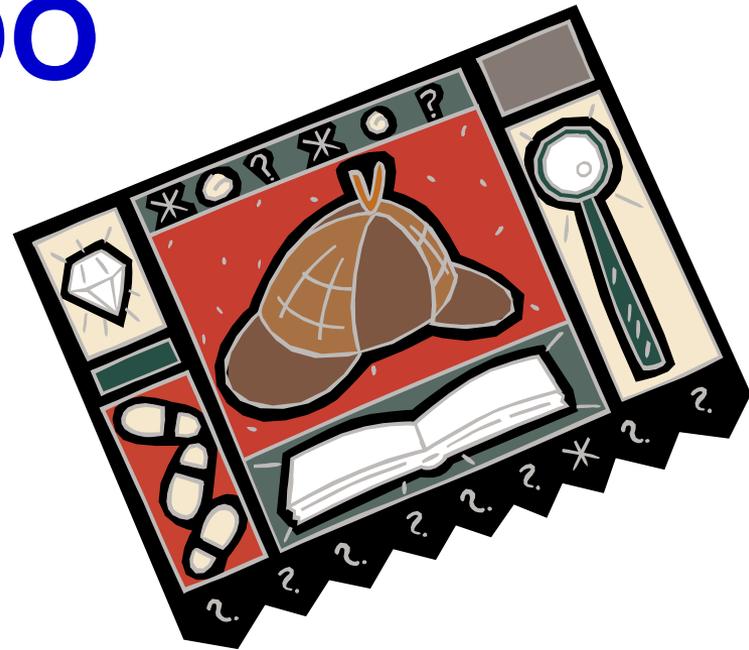
Complaints related to **infection** or hypersensitivity

**Clinical findings present;** diagnosis may help identify building source



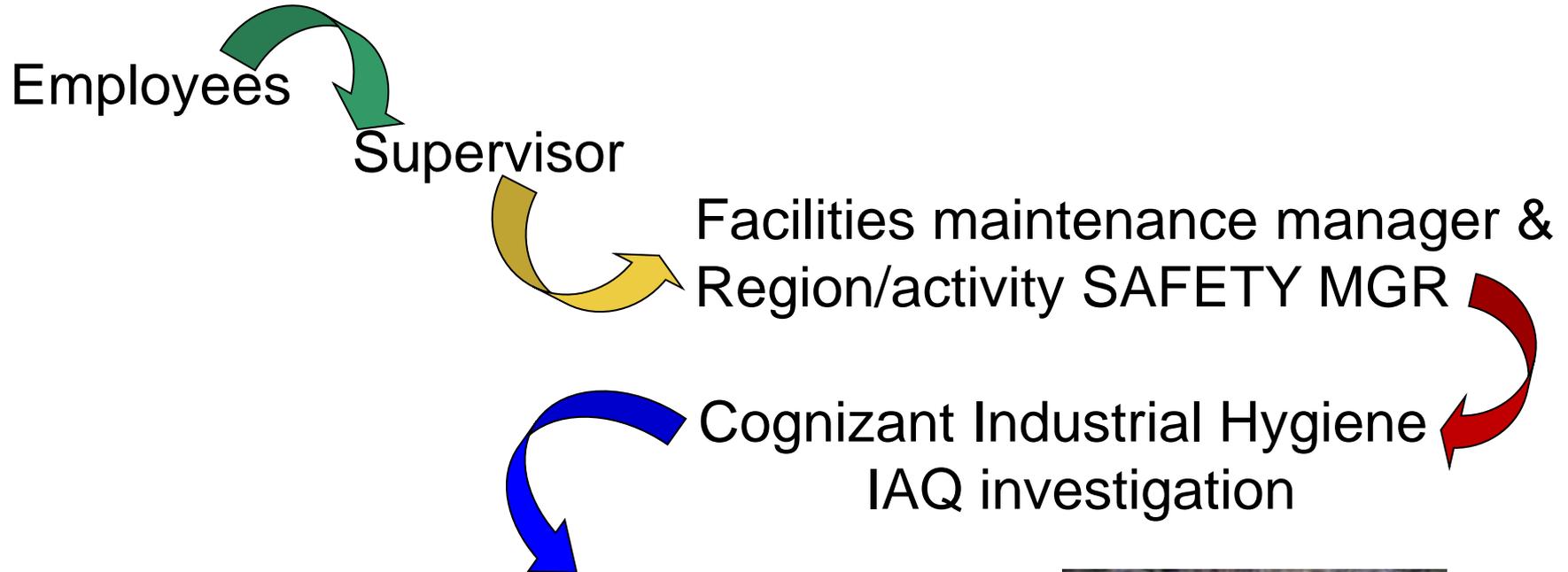
# INDOOR ENVIRONMENTAL QUALITY

## WHAT CAN I DO ABOUT IT?



# IEQ: What Can I Do About It?

## OPNAVINST 5100.23, Chapter 30, para 3002



BUMED Consultative Assistance Team (CAT)



# IEQ: What Can I Do About It?

- ❖ **All complaints deserve a site visit**
  - ❖ Facilities & maintenance respond to building
  - ❖ Safety Mgr responds to or liaises for occupant
  
- ❖ **All site visits deserve a follow up**
  
- ❖ **All findings deserve a resolution**



# IEQ: What Can I Do About It?

## Investigation - Initial Evaluation (Phase I)

### Safety Mgr & Maintenance

Walkthrough area & bldg

Daily activities

General conditions

Complaint patterns

Bldg relation to other sites

Chemical use/MSDS

Renovation history

HVAC – inspect/operate

Maintenance history

Crawl space, attics

### Medical (if needed)

Questionnaires

Interview occupants

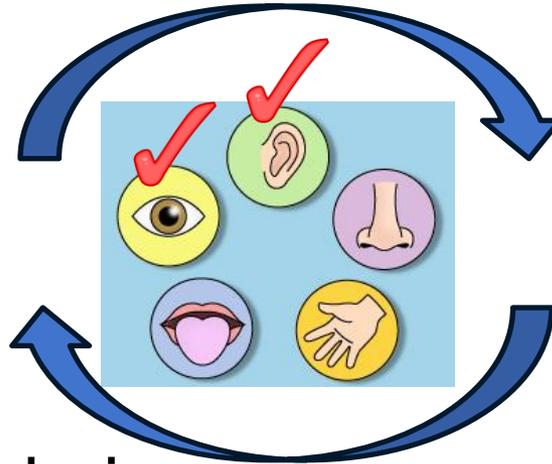
### IH (if needed)

Preliminary samples if warranted (e.g., CO<sub>2</sub>, RH, temp, VOCs, CO, formaldehyde)



# IEQ: What Can I Do About It?

Use your senses and your common sense ....



- ❖ Look for the obvious
- ❖ Listen carefully (underlying problems often emerge...)
- ❖ Anticipate the unexpected
- ❖ What doesn't add up?

# IEQ: What Can I Do About It?

## Look at Inside Sources

- ❖ Furnishings - furniture, carpet, shelving, cabinetry, flooring (VOCs, formaldehyde)
- ❖ HVAC - ducts, drip pans, coils, humidifiers, biocides/cleaners, deteriorated insulation (mold growth), inadequate ventilation, bath & kitchen exhausts
- ❖ Equipment - copiers, laser printers (O<sub>3</sub>, VOCs, particulates)
- ❖ Appliances - stoves, furnaces, heaters
- ❖ STRUCTURE - windows/doors, insulation, plumbing



# IEQ: What Can I Do About It?

## Inside Sources, cont'd.

- ❖ Chemicals - household cleaners, wax/polish, paint, pesticides, air freshener/deodorizers, perfumes
- ❖ Human activity - hobbies, smoking, cooking, engine repair, personal hygiene, perfumes/deodorants
- ❖ Remodeling or building - strippers, pressed wood, glue/adhesives, caulks, carpet, fabrics
  - ❖ disturbing lead, asbestos, fiberglass, mold
- ❖ Other - vacuuming, dry sewer drains/traps (H<sub>2</sub>S), spills
- ❖ Microbiological - more to come







# IEQ: What Can I Do About It?

## Look at Outside Sources

- ❖ Ambient - dust/pollen, fungal spores, ozone
- ❖ Human activity - pesticides/herbicides, landscape materials
- ❖ Emissions - dumpsters, odors, car exhaust (CO, NO<sub>x</sub>)
- ❖ Soil gases - radon, UST leaks, sewer gas, landfills
- ❖ Water sources - crawl space, roof, windows, sumps, wells
- ❖ Others - nearby businesses (dry cleaners, manufacturing/industry), traffic
- ❖ STRUCTURE - windows, doors, roof, crawl, grade, exterior finish





# IEQ: What Can I Do About It?

## Look at Physical Sources

- ❖ Ergonomic - tools, computers, repetitive motions
- ❖ Lighting - general, task, reading --- natural light?
- ❖ Noise - mowers, tools, music, cubicle conversation
- ❖ Comfort - temperature, relative humidity





# IEQ: What Can I Do About It?

## Look at Other Sources

- ❖ Stress - job and personal
- ❖ Unrelated illness
- ❖ Personal issues - family, money problems
- ❖ Personnel issues - management, job reassignment, coworkers, performance
- ❖ Lack of privacy - cubicles/quads



# IEQ: What Can I Do About It?

## Phase I Summary

- ❖ Wide variety, combinations of problems
- ❖ Indoor conditions + outdoor conditions
- ❖ Can be chemical, physical, biological, psychological
- ❖ Few true medical conditions



Everything is influenced by individual perceptions & susceptibilities

# IEQ: What Can I Do About It?

## Investigation - Phase II

- ❖ Add details – Look deeper
  - ❖ Sampling plan **based on initial findings**
  - ❖ Assistance from medical, NAVFAC, risk communicator, environmental health, etc.

## Investigation - Phase III

- ❖ Exhaustive – requires destructive techniques
- ❖ Rarely required



# IEQ: What Can I Do About It?

## Correct or remove the cause

- ❖ Chemical - eliminate, substitute, capture, isolate, filter, flush/bake out
- ❖ Physical – workstation redesign, improve lighting, body mechanics training
- ❖ Biological - eliminate source, control RH, remove biomass
  - increase (or start) maintenance!



# IEQ: What Can I Do About It?

## Correct or remove the cause

- ❖ HVAC - maintenance, increase outside air, balance system, relocate air intakes
  - ❖ duct cleaning - last resort! Beware biocides, disinfectants, encapsulants
- ❖ Personal – mediation/ intervention, policy changes, counseling, relocation



# IEQ: What Can I Do About It?

## Prevent another occurrence

- ❖ Furnace, air conditioning --- filters, drains, dampers, burners, ducts
- ❖ HVAC regularly scheduled checks & cleaning
- ❖ Repair leaks --- windows, doors, roof, plumbing
- ❖ Thermal control, RH (30-60%)



# IEQ: What Can I Do About It?

## Prevent another occurrence

### **Appliances, furnaces, combustion sources**

- ❖ Vent to outside
- ❖ Check regularly for leaks
- ❖ Keep clean and in good repair
- ❖ Use properly
- ❖ CO alarms/ checks



# IEQ: What Can I Do About It?

## Prevent another occurrence

### Furnishings & Building Products

- ❖ Use low VOC products
- ❖ Look for “green” products (carpets, furniture, paints)
  - ❖ low/no chemicals
  - ❖ tested for low emissions
  - ❖ off gassed before delivery
- ❖ Remodel carefully
- ❖ Protect building materials from weather
- ❖ Review building/ reno plans
- ❖ Consider occupant perceptions (colors, light, openness)



# IEQ: What Can I Do About It?

## Prevent another occurrence

### Human activities

- ❖ Personal hygiene – cleanliness, fragrances
- ❖ Space hygiene – sprays, candles, potpourri
- ❖ Respect personal spaces – music, noise, conversation, personal calls



- ❖ Notify occupants of repairs, maintenance in advance or schedule on weekends
- ❖ Green cleaners - store properly



# IEQ: What Can I Do About It?



An ounce of prevention....

- ❖ Maintenance, maintenance, maintenance
- ❖ Use common sense
- ❖ Be informed
- ❖ Consult with resources
  - ❖ Occupational medicine - IH
  - ❖ Facilities - Maintenance
  - ❖ Housing manager
  - ❖ PAO – Risk communicator
  - ❖ Preventive medicine
  - ❖ Labor rep



# IEQ: What Can I Do About It?

## UNDERSTAND MONETARY IMPACTS

- ❖ Good building operating cost ~ \$0.50/ ft<sup>2</sup>  
→ 4% loss in productivity = \$7.00/ ft<sup>2</sup> \*
- ❖ Estimated HALF of all employee illness caused or aggravated by IEQ issues  
→ \$60 B/yr (sick leave & lost productivity)\*\*
- ❖ IAQ is #1 growth area for litigation in US \*\*\*

\* ASHRAE

\*\* Proposed OSHA IAQ standard, 1994

\*\*\* American Trial Lawyers Journal, 1996



# IEQ: What Can I Do About It?



Prevention  
Maintenance  
Communication



Find it  
Fix It  
Follow up



Every complaint deserves a visit  
Every visit deserves follow-up  
Every finding deserves resolution



# INDOOR ENVIRONMENTAL QUALITY

## WHERE CAN I GET HELP?



# IEQ: What Can I Do About It?

**OPNAVINST 5100.23, Chapter 30, para 3002**



# IEQ: Where Can I Get Help?

- ❖ NMCPHC Industrial Hygiene Field Operations Manual, Chapter 13

[http://www.nmcphc.med.navy.mil/downloads/ih/ihfom/IHFOM\\_C\\_H13\\_Intro.pdf](http://www.nmcphc.med.navy.mil/downloads/ih/ihfom/IHFOM_C_H13_Intro.pdf)

- ❖ NMCPHC IEQ site

[http://www.nmcphc.med.navy.mil/Occupational\\_Health/Industrial\\_Hygiene/ieq\\_info.aspx](http://www.nmcphc.med.navy.mil/Occupational_Health/Industrial_Hygiene/ieq_info.aspx)



# IEQ: Where Can I Get Help?

## IHFOM Table of Contents

### Section 13.1 **General IEQ Investigations**

Appendix 13.1-A IEQ Concern Form; IEQ Questionnaire

Appendix 13.1-B Occupant Diary/Symptom Log

Appendix 13.1-C Sample Occupant Interview Form; Sample Interview Questions

Appendix 13.1-D Sample Walk-Around Inspection Checklist

Appendix 13.1-E Sampling Methods

Appendix 13.1-F HVAC Checklist – Short Form

Appendix 13.1-G Indoor Air Contaminant Guidelines

### Section 13.2 **Mold and Other Biological Contaminant Assessments: Investigating, Sampling, and Interpreting Results**

Figure 13.2-1 Bioaerosol Collection Methods

Appendix 13.2-A Microbiological Collection Methods by Analyte

Appendix 13.2-B Mycotoxins

### Section 13.3 **Mold Cleanup, Remediation, and Clearance Sampling**

Table 13.3-1 Mold Remediation Containment Guide

Figure 13.3-1 Mold Remediation Wheel

Figure 13.3-2 Clearance Sampling Process

Appendix 13.3-A Commonly Used Indoor Antimicrobial Products

### Section 13.4 **Mold Investigation Medical Guidance**

### Section 13.5 **Risk Communication**

### Section 13.6 **Resources**



# IEQ: Where Can I Get Help?

- ❖ No federal regulations - General duty clause applies
- ❖ Some state regulations – most for mold
  - ❖ Licensing for inspection/remediation (AK, FL, MD, NY, TX, VA)
  - ❖ Disclosure laws – lease/sales
- ❖ Consensus Standards
  - ❖ e.g., ASHRAE (Stds 55, 62), IICRC (S500, S520), NADCA (ACR 2006)
- ❖ Authoritative Guidelines
  - ❖ CDC/NIOSH, AIHA, EPA, OSHA, WHO, HUD, ACGIH, ASSE, WBDG, NY City, Most state Depts of Health, ACOEM, AAAAI, Health Canada, CPSC, HHI



# IEQ: Where Can I Get Help?

CDC – Centers for Disease Control  
NIOSH – National Institute for Occupational Safety & Health  
OSHA – Occupational Safety and Health Administration  
EPA – Environmental Protection Agency  
WHO – World Health Organization  
AIHA – American Industrial Hygiene Assn.  
ACGIH – American Conference of Governmental IH  
ASSE – American Society of Safety Engineers  
NADCA – National Air Duct Cleaners Assn  
HHI – Health House Institute

ASHRAE – American Society of Heating, Refrigerating & Air  
Conditioning Engineers  
HUD – Dept of Housing and Urban Development  
WBDG – Whole Building Design Guide  
ACOEM – American College of Occupational & Environmental  
Medicine  
AAAAI – American Academy of Allergy, Asthma & Immunology  
IICRC – Institute of Inspection, Cleaning & Restoration  
Certification  
CPSC – Consumer Product Safety Commission

ASHRAE Std 55 – Thermal Environmental Conditions for Human Occupancy (2010)  
ASHRAE Std 62.1 – Ventilation for Acceptable Indoor Air Quality (2010)  
ASHRAE Std 62.2 - Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings (2010)

ANSI/IICRC S100 – Standard and Reference Guide for Professional Carpet Cleaning (2011)  
IICRC S300 – Standard and Reference Guide for Professional Upholstery Cleaning (2000)  
ANSI/IICRC S500- Standard and Reference Guide for Professional Water Damage Restoration (2006)  
IICRC S520 - Standard and Reference Guide for Professional Mold Remediation (2008)

NADCA ACR 2006 – Standard for Assessment, Cleaning and Restoration of HVAC Systems (2006; currently under review)



# Introduction to IEQ – Final Check

- ✓ **What is it?**

  - Indoor environmental conditions & what affects it

- ✓ **When do I have a problem?**

  - Complaints

  - Contaminant source & exposure pathway

- ✓ **What can I do?**

  - Prevention, Maintenance

  - Resolution when necessary

- ✓ **Where can I get help?**

  - Lots of resources

