Indoor air quality investigations

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Table of contents

Introduction

The effort to conserve energy and build more energy-efficient buildings over the last several decades has created a different indoor environment for humans. Buildings were constructed to be tighter in order to conserve energy costs. Sealed windows, doors, roofs, and walls help reduce infiltration of weather and more extreme temperatures. This forces a greater reliance on ventilation to dilute indoor air contaminants and helps provide a comfortable, healthy environment for building occupants.

The built environment impacts occupants through actual and perceived effects. Indoor air quality (IAQ) is one of many elements that affect the work or business environment and an occupant's ability to perform their work activities. Occupant health, comfort, and productivity can be directly impacted by IAQ problems.

There are a number of factors that can affect the quality of indoor air. It's important that employers and building owners respond to and investigate IAQ concerns in a timely manner. A failure to do so may result in increased energy costs, delayed repairs, and even more costly issues such as decreased employee productivity, employee health impacts, increased medical costs, and workers' comp insurance claims.

Purpose

This publication provides internal and external business partners with the knowledge and tools to perform an assessment of potential factors affecting indoor air quality.

At the end of this publication, you will find checklists to guide you through walk-through assessments, some example IAQ scenarios, and a list of additional resources. First, let's discuss and define indoor air quality.

What is indoor air quality (IAQ)?

Indoor air quality describes how inside air can affect a person's health, comfort, and ability to work. It can include temperature, humidity, lack of outside air (poor ventilation), mold from water damage, or exposure to other chemicals.

The qualities of good IAQ should include comfortable temperature and humidity, adequate supply of fresh, filtered outdoor air, and control of pollutants from inside and outside of the building. This means that any intrusions of water, pests, pollens, and other sources of indoor contaminants are prevented or mitigated and controlled. Good indoor air quality can also be created and maintained by thoughtful selection of materials used for cleaning, maintenance, remodels, and any other indoor processes or uses.

Building design plays an important role in achieving good indoor air quality. All interior spaces should be well ventilated, thermally controlled, and have proper room and storage for goods and materials. Good housekeeping practices for indoor spaces and preventive maintenance of building systems, including heating, ventilation, and air conditioning (HVAC) systems also help to maintain good indoor air quality.

Perhaps one of the best general definitions is from Oregon OSHA, which defines good IAQ as:

- Introduction and distribution of adequate ventilation air,
- Control of airborne contaminants, and
- Maintenance of acceptable temperature and relative humidity

Many studies have demonstrated that IAQ problems can be caused by improper design, installation, operation, and maintenance of HVAC systems. Common factors affecting indoor air quality include environmental tobacco smoke (ETS), combustion sources, volatile organic compounds (VOCs), ozone, fiberglass insulation, HVAC maintenance, microbiological contamination, and insufficient outdoor air.

The following are some important definitions and typical symptoms associated with different indoor air quality situations.

Sick building syndrome (SBS) is also known as "tight building syndrome." It refers to a set of symptoms affecting more than 20 percent of building occupants for which no cause can be identified. Typical symptoms include nose or throat irritation, headaches, lethargy, and difficulty in concentration. The distinguishing factor in all cases is that symptoms are relieved shortly after leaving the building.

Building-related illness (BRI) is an IAQ problem with a known cause and effect. BRI can be confirmed by a physician's diagnosis of a specific illness (allergic rhinitis, Legionnaire's disease, hypersensitivity pneumonitis, humidifier fever, or Q fever) resulting from exposure to specific contaminants in building.

Mass psychogenic illness (MPI) refers to an epidemic of complaints for which the source is psychological rather than toxicological. Symptoms include headaches, fatigue, nausea, hyperventilation, and fainting. MPI is characterized by a sudden onset of symptoms, frequently coinciding with an unusual odor, and seems to spread by contact like a contagious disease.

Other medical terms include irritant response, toxic response, infectious response, and allergic response. Factors such as dust, low humidity, volatile organic compounds, and temperature extremes can cause irritation. Colds, flu, and other infectious agents can be spread through the workspace due to inadequate ventilation. Infectious agents often lead to an increase of absenteeism among building occupants. Molds, dust mites, other bioaerosols, and certain chemicals can cause allergic responses in sensitive individuals. Many allergic responses are associated with itching. Allergic individuals may develop symptoms such as red itchy eyes, nasopharynx (nose and throat) irritation, and a runny nose. A toxic response is usually immediate and, in most cases, there is a definite cause-and-effect relationship. Additionally, seasonal allergens, such as pollens, introduced through windows and doors can cause susceptible individuals to suffer symptoms like itchy eyes, sneezing, congestion, and headaches.

Indoor air quality investigations

When a concern extends beyond thermal comfort and is related to the quality of the indoor air, it should initiate an indoor air quality (IAQ) investigation. The first part of an IAQ investigation includes collection of information from concerned occupants, a physical walkthrough and observations of the indoor and outdoor building environment, and an assessment of the ventilation for the area(s) of concern by an HVAC technician. Most of the time corrective actions targeted at findings from this level of assessment resolve IAQ issues.

There may still be concerns and/or questions related to poor indoor air quality after performing corrections related to findings from an IAQ investigation. A more detailed profile of indoor air quality may be necessary when additional concerns remain, or the situation is unresolved.

Whether you have findings and corrective actions or need to consult with experts, it is important that you communicate clearly during an IAQ investigation. Providing a timely and comprehensive response to reported concerns will help employees know what actions are being taken to protect their health. Let's look at some important aspects of IAQ investigations.

Communication

Historically, building occupants have been referred to as having complaints rather than having concerns. This perception and position can set the tone for more adversarial and challenging communication. A shift from this perception is necessary in order to create better communication. Open and clear communication is essential to successfully addressing indoor air quality concerns at all phases of the investigations. The original concern must be well understood to accurately characterize the issue. How you listen and communicate with affected persons during an IAQ investigation can determine how well, or whether, an IAQ issue is resolved.

Keep in mind when receiving and assessing concerns that there are many resources describing IAQ and the potential health effects of poor indoor air quality. Someone suffering from symptoms potentially due to poor indoor air quality will often look for answers outside their organization if they believe their concerns are not being addressed in a timely fashion. Understanding that a suffering individual can be exposed to various sources of information (credible and not credible) regarding indoor air quality will assist the investigator with obtaining information and communicating compassionately. Below is an example of two different voices describing indoor air quality (notice these are not descriptions of poor or good indoor air quality, just indoor air quality in general).

Example 1 (Credible source):

This excerpt is taken directly from the U.S. Environmental Protection Agency's (EPA) webpage:

> "Indoor air levels of many pollutants may be 2-5 times, and occasionally, more than 100 times higher than outdoor levels. Indoor air pollutants are of particular concern because most people spend as much as 90% of their time indoors."

Example 2 (Questionable source):

This excerpt is taken directly from a different webpage (DrAxe.com) and references the U.S. EPA's statement above:

> "According to the EPA, our indoor environment is two to five times more toxic than our outdoor environment, and in some cases, the air measurements indoors have been found to be 100 times more polluted."

It is important to understand the concept behind the U.S. EPA statement. The indoor environment has a smaller volume of air than the outdoors. This sets the stage for emitted pollutants to concentrate inside versus outside. The EPA is describing concentrations of pollutants indoors versus outdoors due to the difference in total air volume and in limited indoor air exchange with outdoor air.

The use of the words "more toxic" in the second statement can exacerbate occupant opinions about pollutants in the indoor air and lead to undue stress and panic for building occupants.

Keep in mind the different perceptions possible for IAQ, listen openly to concerns, stay with the facts as they arise, and communicate clearly. These are essential for resolving IAQ issues.

Building basics

Buildings have several features that are important to understand when discussing and investigating indoor air quality issues. Building structures such as roofs, walls, windows, and doors are designed

to separate and protect the indoor space from outside elements. Yet buildings have to "breathe" and have operating systems that function properly to maintain a healthy environment inside. More new buildings are being designed with indoor air quality in mind. Material and equipment selection, ventilation, and indoor design are all considered more in the building design phase than in previous years. Older buildings and poorly designed buildings, however, remain a challenge.

Building materials

Building materials range from organic materials such as wood, adhesives, glues, and solvents to inorganic materials such as concrete, steel, glass, and aluminum. Indoor furnishings and décor are made of a variety of materials, too. A basic understanding of how and why building materials can become a source of pollution or a source of food for microbial growth (where there is moisture infiltration) will help the investigator even in the initial phases of an IAQ evaluation.

Items such as new furnishings, equipment, and flooring can emit odors and possibly chemical compounds. Photocopy machines, printers, and certain portable air cleaners can emit ozone. Paints, sealants, adhesives, and cleaning products can all produce odors and, in some cases, high levels of irritants in the air and can impact building occupants. Products should be reviewed before purchase to evaluate their potential impact on IAQ.

Products with no or low volatile organic compounds should be selected when feasible. A review of products currently in use (and substitution if needed) and ensuring ventilation is adequate when using these products will prevent or reduce the chance of adversely impacting IAQ and building occupants. Scheduling cleaning and maintenance activities when building occupants are not present can help to reduce odors experienced by occupants and overall adverse impacts on IAQ.

Pathways for pollutants

Outdoor air pollutants can enter the indoor space through doors, windows, gaps in building seals, roof leaks, and other pathways. If the building is under negative pressure, infiltration of pollen, dust, mold, and any other outdoor pollutants will happen easily through an open pathway. People often track dirt, allergens, and leaf litter from their shoes when they walk into a building. Pests can also find their way inside the building and create an indoor pollutant source. Keeping doors closed and having a preventive maintenance program that keeps joints caulked and sealed and weather-stripping where needed will help reduce the chance for outdoor contaminants to enter the building. A regular cleaning schedule is also important to prevent buildup of dust and other indoor contaminants. A more intensive cleaning may need to be scheduled every so often depending on indoor uses, housekeeping practices, and general cleanliness.

Ventilation

Buildings require some form of ventilation in order to control temperatures, humidity, and indoor odors and pollutants that can build over time. The most common way to address building indoor air quality and comfort is through a heating, ventilation, and air conditioning (HVAC) system. Indoor air is circulated through a mechanical ventilation system, cooled or heated, and then supplied back into the indoor space. Filters on the HVAC unit help filter out particles in the air. HVAC unit system filters should be rated at a minimum of MERV 8 for particulate removal for most indoor environments such as offices and classrooms. For environments where higher filtration is desired, a rating of MERV 13 is recommended, especially for heavy smoke days during wildfire season, as long as the system fan can handle the pressure.

Outdoor air intakes and wildfire smoke

The outdoor air quality index (AQI) should be monitored whenever there is a wildfire burning and the smoke may impact a building's fresh air intake. The AQI is a color-coded, category system created by the EPA that describes outdoor air quality based on specific air pollutants. The graphic

below provides the categories and potential health effects. When the outdoor air quality index (AQI) begins to approach the unhealthy category (or unhealthy for sensitive groups, depending on the building occupant makeup), facilities should consider closing outdoor air intakes and operating on recirculated air until the hazard no longer exists.

Category	AQI	PM2.5 ($\mu g/m^3$) 24-hour
Good	0-50	0.0-12.0
Moderate	51-100	12.1-35.4
Unhealthy for Sensitive Groups	101-150	35.5-55.4
Unhealthy	151- 200	55.5-150.4
Very Unhealthy	201-300	150.5-250.4
Hazardous	301-500	250.5-500.4

An **AQI of 100** corresponds to a PM2.5 health standard of **35 $\mu g/m^3$**. AQI values > 100 are associated with increasing concentrations of PM2.5.

Table 3. Air Quality Index (AQI) for PM2.5

Graphic from AQI Basics | AirNow.gov

Dilution of indoor air using a small amount of fresh outdoor air is how the reduction of odors and indoor air pollutants is typically achieved. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) has published standards that most building codes have adopted regarding minimum outdoor air volumes per person in a building (based on building use and indoor activity). Generally, 15 cubic feet per minute (cfm) of outdoor air per person is necessary to control odors and satisfy 80 percent of building occupants.

Achieving this volume of outdoor air may be a challenge for some older buildings and systems. When outdoor temperatures fall below freezing or increase to very high temperatures, bringing in outdoor air becomes problematic. Air conditioning coils can freeze and burst in very low temperatures, cooling excessively hot outdoor air is costly, and outdoor air may contain smoke from forest or other local fires. However, this is the basis for dilution of the indoor air and the capacity of a system to reduce indoor air pollutant sources. Exhaust fans should be strategically installed in a building to remove odors and help mitigate air contaminants. Typical locations for exhaust fans are bathrooms, kitchens, and utility rooms.

A preventive maintenance program should be in place that routinely checks and changes filters on ventilation systems as necessary. Belts and fan motor function should be checked on exhaust fans and ventilation units. Condensate drains should be checked and cleared to prevent microbial growth and overflows or leaks. Bird screens should be installed on outdoor air intakes and kept clear and clean. The overall function of thermostats, vents, dampers, and other heating and cooling systems components should be inspected periodically.

Plumbing

Plumbing systems play a role in indoor air quality because they provide a system of pipes and vents for water, gray water, sewage, and sewer gases to flow out of the building. If any of these systems is blocked or not functioning properly, it should be addressed immediately. If sewer system vents are located too close to outdoor air intakes or windows, odors can enter buildings and create IAQ problems.

Most drains have a "trap" designed into the pipe that holds water and prevents sewer gas from coming back into the indoor space. Drains can dry out if they are in a location, such as public

bathroom floors and utility rooms, where no water flows through them regularly. Dry floor drains are notorious for causing odors and indoor air quality concerns. A preventive maintenance program that includes checking drains, especially floor drains where no water typically flows, will go a long way in preventing sewer gas odors from occurring.

Water leaks and mold

The term mold is most commonly used to describe any visible form of fungal growth. Mold cannot be completely eliminated in the indoor environment since mold and fungal spores are a part of the natural environment. Fungal spores can be tracked indoors by shoes and brought in with other items (such as cartwheels, etc.) and can enter the indoor space via air through doors and windows. Thus, molds are typically not a problem indoors unless mold spores land on wet or damp surfaces and begin growing.

Mold growing in the indoor environment is unacceptable since molds have the potential to cause negative health impacts. The growth of mold most commonly occurs due to water intrusion or excessive moisture and neglect. The most important action to take is to stop the water source immediately. Mold commonly begins to grow within 24 to 48 hours of water intrusion on wet or moist, porous surfaces. Once moisture problems or water leaks have been addressed, remediation and removal of all damaged building materials, especially those that show visible mold growth, should be completed immediately. This will reduce possible health impacts and ensure no further damage to materials occurs.

Occupants of damp and/or moldy buildings most frequently complain of cough, rhinosinusitis, worsening of asthma, and increased susceptibility to respiratory and other infections. Such infections typically last longer than "normal," recur, and are often resistant to treatment, as in immune-compromised patients. Extreme fatigue, headache, memory problems, difficulty concentrating or thinking clearly, and numbness and other nervous system effects have been reported. Individual susceptibility and allergic responses vary widely and can only be confirmed by a physician if mold or other indoor allergens are suspected.

Sampling for mold is typically not necessary. Immediate action to correct moisture problems and mitigate mold growth, as discovered through visible inspection, should relieve symptoms once mold-damaged materials are removed from the environment. However, if visual inspection does not reveal obvious fungal growth, symptoms persist that are common to mold exposure, and/or there are specific claims regarding mold exposure, sampling may be warranted. A SAIF consultant or other expert consultant should be contacted for assistance.

IAQ investigations step by step

It is very important to respond in a timely and thorough way to concerns about indoor air quality. Timely responses lead to catching problems before they turn into major issues, such as leaks or equipment malfunctions. Also, a timely response provides occupants with the clear understanding that their concerns are being heard and addressed.

Information gathering

The proper investigation of an indoor air quality problem may need to involve management, building engineers or maintenance personnel, landlords (if applicable), supervisors, and employees. The parties involved in the investigation need to clearly understand their responsibilities and a formal system should be set up to accomplish this. The initial approach should be broad and flexible in scope considering the various factors that can impact indoor air quality.

The following information should be collected at this stage of the investigation:

Nature of concern

The original nature of the concern should be clearly established. The nature of the concern may include health symptoms. Collecting the following information before walking the site will assist in focusing efforts during the Phase I investigation and any follow-up investigations:

- Specific health symptoms and comfort issues reported and the proportion of building occupants reporting each concern
- Time patterns (e.g., hour, day, season) of the onset of discomfort, odors and/or any health impacts (symptoms improve or worsen)
- How long employee has worked in this location or building
- Location patterns (e.g., normal work area or other work areas) of the affected employees.
- Changes in the work environment
- Relationships between predominant health and comfort concerns and potential sources (e.g., chemicals, copiers, or other equipment)
- If, when, and where potential source materials (new carpeting, adhesives, etc.) have been introduced into the building
- The individual's perception of the cause of the problem

Building history and information

Building information collected before performing the on-site walkthrough, including a map of the facility, can provide valuable information to establish any potential relationships between the nature of concern(s) and possible causes. The following is a list of basic information to obtain and document for this part of the assessment:

- Date of construction
- Size of building
- Type of ventilation
- Presence of ventilation in the area of concern
- Presence of return and supply air in the area of concern
- New construction or remodel work
- History of any leaks/water intrusions
- Type of construction

Site walkthrough

Visual inspection

During the visual inspection, some of the important items to look for include:

- Staining or evidence of water intrusion
- Suspect mold growth
- Evidence of general cleanliness and housekeeping practices (e.g., dust buildup, stains from spills, overflowing trash receptacles)
- Evidence of pests

- Plants, pets, stored food

HVAC system inspection

A NIOSH study of indoor air quality in 500 buildings found that inadequate ventilation was the cause of IAQ concerns 52 percent of the time.

- System operating properly
- Outdoor air intake operating and clear
- Location of outdoor air intake and any contaminant sources nearby (e.g., near loading dock, building exhaust vents, trash collection areas, and other environmental contaminants)
- Supply and return vents (not blocked, clean)
- Exhaust fans working and free of debris
- Ducts (e.g., connected, insulated)
- Grilles (e.g., clean, clogged, blocked)
- Filters (clean, changed regularly with proper replacement filters)
- Rooftop unit cabinets (e.g., general cleanliness, dirt build-up on coils, fans, fan belts in good condition)
- Drain pans clear (free of debris and draining properly)

Plumbing system inspection

- Vent systems clear
- Standing water or odors at drains

Chemicals and cleaning materials and storage

- Chemicals and cleaning materials not leaking and contained/stored properly (ammonia products stored away from bleach products, no residues on outside of containers, no broken caps or spills)
- Location of stored chemicals in relation to area of concern
- Odors
- Condition of paint, adhesive, and other building product containers — sealed and stored properly
- Recent changes in cleaning products

Building materials and furnishings

- New paint or other finishes in the area
- New equipment (copiers, etc.)
- Other new materials or furnishings
- New or damaged carpet

IAQ investigation findings and corrective actions

The forms in the appendices assist with collecting and documenting important information during an IAQ investigation. Additional notes or observations should be added as needed.

A thorough walk-through of the indoor and outdoor space should be conducted. An assessment of the ventilation system should be conducted by someone familiar with the system to ensure it is operating properly.

Depending on the findings during the initial walkthrough, there may be further action to take. Repairs to malfunctioning equipment, correction of water leaks, proper treatment of pest infestations, or addressing other more straightforward issues should be completed immediately. All findings and actions should be communicated to building occupants. If a solution will take time (for instance, a part is needed to repair the air conditioner or significant mold damage was discovered), the planned schedule of repairs should be communicated to building occupants along with any of the following applicable information:

- The findings and observations
- Immediate actions taken to stabilize the situation
- Plan to repair or remediate the issue
- Protective measures (including moving occupants if necessary) to protect occupants during repairs or remediation
- Point of contact for questions during the repairs
- Timeline for repairs to be completed and operations to return to normal

Further expertise and assistance

If IAQ concerns continue after the IAQ investigation is completed and corrective actions have been performed, further consultation may be necessary. A more detailed IAQ evaluation can be performed by a SAIF industrial hygienist or outside consultant. All of the information from the initial walk-through, basic IAQ measurements, corrective actions taken, and any observations/findings pertinent to concerns should be provided to the IAQ consultant.

Additional resources

The IAQ Investigator's Guide, American Industrial Hygiene Association Indoor Environmental Quality Committee, 2006.

An Office Building Occupant's Guide to Indoor Air Quality, Environmental Protection Agency (EPA), https://www.epa.gov/sites/production/files/2014-08/documents/occupants_guide.pdf

Building Air Quality, A Guide for Building Owners and Facility Managers, Environmental Protection Agency, https://www.epa.gov/sites/production/files/2014-08/documents/iaq.pdf

Indoor Air Quality in Commercial and Institutional Buildings, Occupational Safety and Health Administration (OSHA), 2011, https://www.osha.gov/Publications/3430indoor-air-quality-sm.pdf

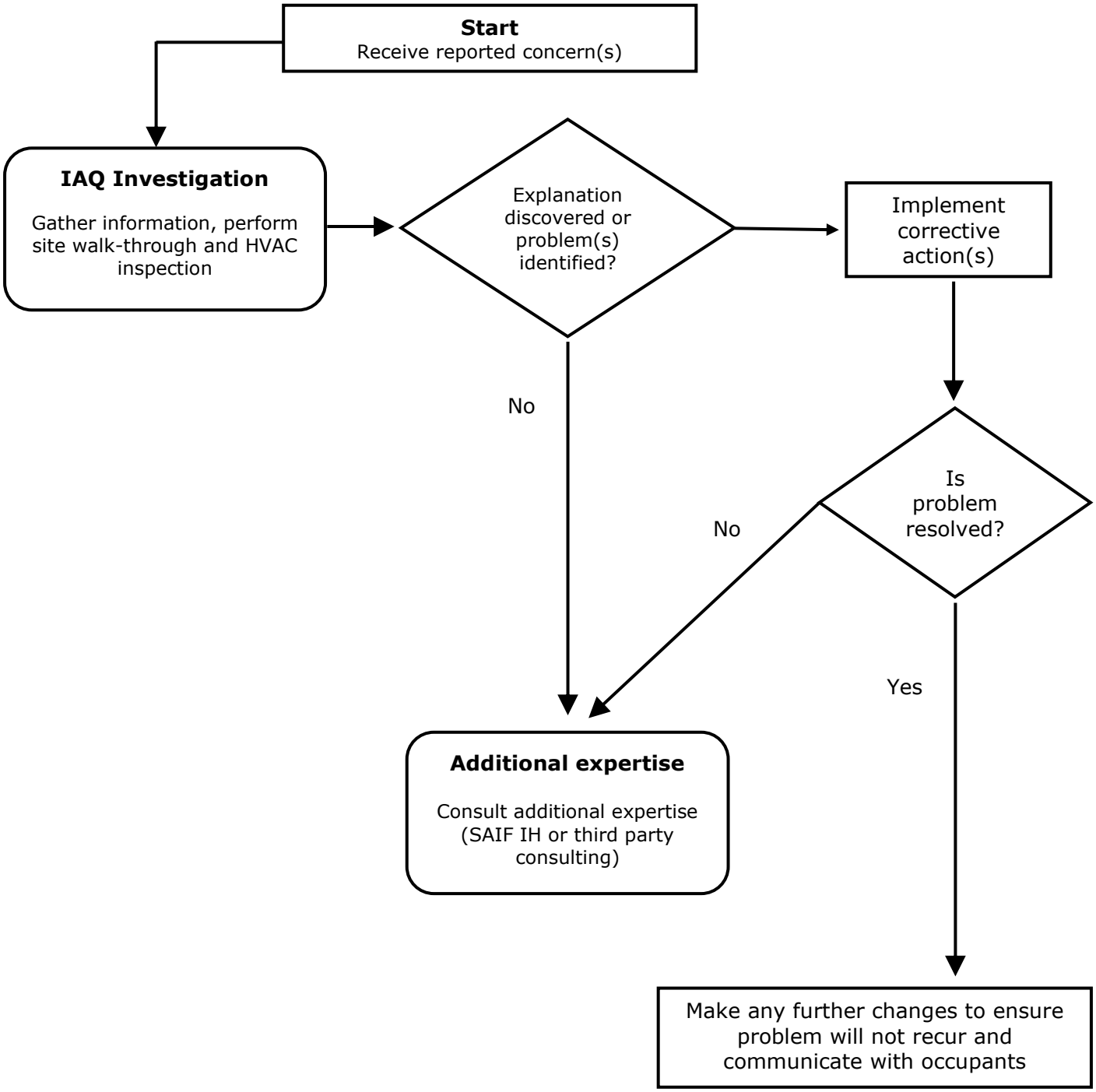
Mold Remediation in Schools and Commercial Buildings Guide, Environmental Protection Agency, https://www.epa.gov/sites/production/files/2014-08/documents/moldremediation.pdf

Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools, and Other Nonindustrial Buildings, DHHS (NIOSH) Publication No. 2013-102, http://www.cdc.gov/niosh/docs/2013-102/pdfs/2013-102.pdf

Thermal Environmental Conditions for Human Occupancy, American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), ASHRAE Standard 55-2020, https://www.ashrae.org

Ventilation for Acceptable Indoor Air Quality, American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), ASHRAE Standard 62.1-2019, https://www.ashrae.org

IAQ investigation process map



Example scenarios

Example 1

Concern: Employee reports odor in work area and sinus irritation.

Initial walk-through findings:

1. The employee work area is clean and well kept.
2. Investigator notices a transient odor.
3. Potential sources nearby
    a. Break area with microwave, food containers, refrigerator, trash can
    b. Restrooms
4. Ventilation is checked by the facilities department and found to be working with clean filters and outdoor air functioning.
5. Further investigation leads to floor drains in restrooms. They have sewer odor emanating from them.

Action: Facility maintenance staff pour water down floor drains in restrooms to fill p-traps.

Communication: Findings and action taken are communicated to the employee.

Follow-up: A few days later, the employee reports no more odors or irritation.

Example 2

Concern: Several employees complain of sneezing, cough, and chest congestion.

Initial walk-through findings:

1. Employee offices are cubicles located in one large open space.
2. All cubicles are well-kept and clean.
3. There are no odors.
4. Potential indoor pollutant sources nearby
    a. The window was leaking during the last rainstorm and mold is observed growing on the inside of the window frame.
    b. No other possible sources noted
5. Ventilation is checked and found to be working with clean filters and outdoor air functioning.

Action: The window leak is repaired and mold on the inside window frame is removed.

Communication: Findings and action taken are communicated to employees.

Follow-up: A few days later, one employee reports still having symptoms; the other employees no longer report symptoms.

Further action: Safety consultant fills out IH referral for further, detailed investigation.

Communication: Policyholder informs employees that further efforts are being made to determine if there are any other indoor air quality issues.

Example 3

Concern: Odor is present in HR area and employees are concerned for their health. Several employees are reporting headaches, dizziness, fatigue, and nausea.

Initial walk-through findings:

1. During walkthrough of the HR area there is a very distinct odor present, which has a musty sweet type of odor.
2. It is immediately apparent that the odor is stronger in one location than the other areas of the HR office.
3. The odor is not coming from the supply air vents.
4. After narrowing down the area where the odor is strongest, an investigation is conducted by searching all around the desk area (under, behind, walls, floors, and inside desk drawers).
5. A rotten orange is found in one empty desk drawer.

Action: Rotten orange is removed and disposed of outside in garbage. Desk drawer is cleaned up and fans are used to dilute and move air out of the HR office area.

Communication: Employees are made aware in person and by email of the rotten orange found in the desk drawer and that it was removed. Within an hour the odor in the HR area is barely noticeable.

Further action: Employees are reminded about eating around desks and not storing foods that decompose in drawers.

Follow-up: The odor was absent when a check was made with the HR department the next morning. No further action was needed.

Example 4

Concern: Several building occupants report headaches, feeling sluggish, and a general stagnant feeling in the air.

IAQ investigation findings and actions:

1. Employee office areas are dispersed on two floors in cubicles and offices.
2. All office areas are generally clean with no obvious sources of pollutants.
3. No water leaks have been noted and no new cleaning products or office equipment have been introduced.
4. Ventilation is checked and filters are changed.
5. Inspection of the ventilation system is performed and the linkage to the outdoor air damper is found to be broken. The linkage is repaired, and the outdoor air damper is confirmed to be working.

Communication: Findings and repair is communicated to employees.

Follow-up: Several days later, employees report improved symptoms.

Example 5

Concern: Several employees complain of the work area being stuffy and are reporting headaches, difficulty breathing, coughing, itchiness, and runny noses.

IAQ investigation findings and actions:

1. The building is two stories, and the concerns are isolated to the communications and development area located on the second floor.
2. An HVAC contractor inspected all units for the building and all pans are dry, vents are balanced, and filters are being changed quarterly
3. Employees state that their area is stuffy and that they get headaches in the afternoon
4. Maintenance employees conduct a walkthrough of the area and note that all building materials are dry with no evidence of water leaks. The building has never had past water incursions
5. The area is vacuumed and dusted weekly by a contact housekeeping service
6. Ventilation is set to "on" and returned air mixes with outdoor air. Unknown as to how much fresh air is mixed with return air

Action: HVAC technician monitors concerns and indoor temperatures over the day.

HVAC technician findings:

1. Temperature peaked at 81 degrees Fahrenheit (°F) in the afternoon. An inspection of the thermostat determined that it was set to 72°F, which indicated that the thermostat was not functioning correctly.

Action: Thermostat is replaced with a new unit.

Communication: Findings and repair are communicated to employees.

Follow up: Several days later, employees report improved symptoms. They noted that the area no longer feels stuffy and that they no longer get headaches.

Appendix 1: Indoor Air Quality Building Occupant Report-of-Concerns Form

Use this form to assist in documenting concerns related to indoor air quality and the general indoor environment. Indoor air quality problems include concerns with temperature, humidity, ventilation, odors, or air pollutants that may be causing health or discomfort symptoms. Collect this information via in-person interview, email, or phone interview.

Date:
Facility/Building name:
Address:
Room number/Location:
Name of building occupant: Phone:

Nature of the concern
What is the nature and location of the problem?

Symptoms
What kind of symptoms or discomfort are you experiencing?

Location
Where are you when you experience symptoms or discomfort? How long have you worked in this location?

Where else in the building do you frequent, where do you spend most of your time? Any changes or introduction of new materials/equipment in the work environment? If so, collect and review product information and/or safety data sheets (SDS).

Time
When was the problem first experienced?

When does it occur or when is it the worst (time of day, day of week, related to certain activities/events, seasons)?

When do the symptoms go away?

Additional information
Do you have any observations about the building conditions that might need attention or might help explain your symptoms? Do you have any other observations or comments?

Appendix 2: Phase I Interior Building Walk-Through and Assessment

Building history and information **Date of construction:** **Size of building:** **Type of construction:** **Type of ventilation:**			
Inspection observations	**OK**	**Not OK**	**Notes**
Air quality (odors, stuffiness)			
Signs of occupant discomfort (e.g., heaters, fans)			
Thermal conditions (excessively warm/cold)			
Thermostat setting appropriate for season			
Exhaust fans working and clean			
Air plenums, grills, and ducts (ducts connected, no excessive dirt, odors, no evidence of pests)			
Supply and return air diffusers, present, working, and clean (not blocked or dirty)			
Work area clean and meets housekeeping standards (e.g., minimal dust buildup, no overflowing trash)			
Evidence of pests, pets, stored food in desks, plants			
No moisture damage or visible mold growth			
Floors and carpet (wet, damaged, odors)			
Doors and windows (no leaks or gaps in weather stripping)			
Ceiling tiles (no stains, leaks)			
Drains clear and no standing water			
Chemicals, cleaning, and building material containers stored properly (not leaking, no odors)			
Recent changes in cleaning products			
New paint or other finishes, equipment, carpet of other materials in area			
The following areas are **clean, with no odors, leaks, condensation, moisture buildup on surfaces, visible mold growth, evidence of pests or unprotected openings to the outside**.			
Storage rooms			
Stairwells (e.g., no evidence of smoking, spills, leaks)			
Mechanical and equipment rooms (no leaks or odors; all equipment functioning)			
Other areas:			

List major thermal or contaminant sources in this space (e.g. outdoor sources, equipment, occupant activities, operation and maintenance activities, and housekeeping):

Appendix 3: Exterior building walkthrough and assessment

Building/Location: **Date:**

Exterior building and components	OK	Not OK	Notes
Roofs: Leaks, damage			
Walls: Excessive moisture, cracks, signs of damage			
Doors: Condition of weather stripping			
Windows: Good condition			
Rooftop and air handling units: Operating properly, appropriate filters in good condition, outdoor air mix working, fans and belts in good condition, no excessive dirt buildup or condensate pan leaks/biological growth			
Cooling tower: Water treated and no visible color or biological growth Leaks or excessive moisture from overspray on adjacent walls or vents			
Emergency generator: Stack not adjacent to building air intakes, leaks			
Odors: Noticeable odors from outdoors (e.g. roof tar, vehicle exhaust)			
Air intake: Obstructed, bird droppings, or nests			
Pollutant sources: No sources within 25 ft. of air intake (e.g., sanitary vents, loading dock, trash collection area)			
Bird screen(s): Obstructed; nests			