

A Toolkit For Improving Indoor Air Quality In Office Workplaces

LUNGS AT WORK



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St. Louis Community Air Project & EarthWays Center, a division of Missouri Botanical Garden

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www.LungsAtWork.org

“ We are the air. All of the molecules on this planet - including those in our air, in our water, in our food, in the bodies of all living things - circulate in space, over time.

Air doesn't stay within a little area that's mine and yours. When the air goes out of my nose, it goes straight up your nose! Air links us not only to each other, but to the past. We're breathing the same air that was once in the body of Jesus Christ, Mahatma Gandhi, Martin Luther King. The air we breathe today has molecules that were in dinosaurs sixty-five million years ago. The air I'm breathing is coming from the trees and it's coming from the animals, and it's going right back out to them again. We're all held together in a mesh of air.

When our breathing space is polluted, we can't continue to act as if air is something out there, when we are the air so whatever we do to it we do to ourselves. Air is a gift from all the green things on the planet and the only thing affecting air that we can manage is us. ”

Dr. David Suzuki

Canadian geneticist, author, and TV host

For more information visit www.davidsuzuki.org

Lungs At Work

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How's the air in your office?

Indoor air quality (IAQ) at work – Does it matter to you?

- Tenants in office buildings typically can't control factors that influence IAQ, such as cleaning procedures and air handling equipment
- When office building interior spaces are remodeled to suit tenants, reconfigured layouts can obscure sources of IAQ problems

Take this IAQ Pop Quiz

True or False

Americans today spend more than 90% of our time indoors

True or False

Indoor concentrations of pollutants are frequently 2 to 5 times greater than those outdoors

True or False

Improved workplace IAQ leads to improved attendance and overall health

True or False

Credible national standards are in use today to define and support workplace IAQ

True or False

Green Teams can help identify problems and improve IAQ at work

Indoor environments influence the occurrence of:

True or False

Allergy Issues

True or False

Communicable illnesses such as flu and colds

True or False

Asthma Issues

True or False

Job performance

Challenges To Office Environment IAQ

Bad news: The problems and the answers are all true!

Good news: Office IAQ can be improved – especially when you organize your efforts!

An office Green Team can effectively survey conditions relating to IAQ complaints, and can correct some causes of IAQ problems. For other problems, office Green Teams can contribute to effective communications with facility management, building owners or outside parties.

Resources for improving IAQ in all types of workplaces are listed at the end of this

guide. If you work in a non-office environment, such as industrial, retail, hospitality, health care and institutional situations, you can adapt the IAQ improvement methods offered in this toolkit to complement the efforts of your company's industrial hygiene or safety specialists.

No matter where you work, everyone breathes there, all day.

This toolkit can help everybody at work breathe easier – and go home healthier.

Use this toolkit to improve IAQ at work

Toolkit Overview

This toolkit offers ways for you and your office co-workers to address workplace indoor air quality (IAQ), in partnership with owners of your business and your building, and with maintenance and cleaning staff. The toolkit will help you:



You Can Improve IAQ

Learn about the causes of IAQ problems.

Gather information on IAQ issues.

Understanding some common causes of problematic IAQ can help you begin to target solutions. Educated co-workers can most effectively work with outside experts when such help is necessary.

This toolkit will give you basic background information on IAQ problems and problem-solving guidance from the U.S. Environmental Protection Agency (EPA) and other sources. More detailed information is available in the [Resources](#) section.

- **Learn about the issues**

- **Team up to address problems**

Team up to improve IAQ.

Start a new Green Team or expand existing activities – such as those of a recycling Green Team – to tackle IAQ.

Organize to educate co-workers and motivate participation in workplace IAQ improvements.

Educate your building's operational or facility managers.

Valuable resources for technical IAQ improvements are readily available from U.S. EPA and other agencies, including titles listed in this toolkit's [Resources](#) section.

- **Apply resources from the Green Building Industry**

Conduct IAQ research and organize information.

Green Team IAQ survey results will help track down causes of IAQ complaints.

Use LEED® to understand IAQ issues and options.

LEED® green building guidelines set standards for a healthy workplace.

Most of the indoor air pollution causes identified by the U.S. EPA are addressed by the U.S. Green Building Council's LEED® (Leadership in Energy and Environmental Design) standards.

LEED is used to formally certify green building projects. Even more importantly, LEED standards can be adapted as Best Practices to improve the physical working environment in any building.

Become familiar with IAQ criteria defined by LEED.

These national green building standards promote building performance, occupant comfort, health factors, individual and group productivity, economic savings, protection of natural resources and overall sustainability. LEED incorporates the concerns, interests and expertise of public and private sector business leadership. Recommendations for IAQ improvements based on LEED will have the weight of research by leading building professionals. Let LEED work for you!

How are you feeling?

Many people are concerned about outdoor air pollution. But are you aware of how IAQ affects the overall quality of our lives?

Have you ever caught a cold from someone on an airplane? Has your child gotten the flu from a classmate? Have you felt light-headed or nauseous when using strong cleaning products? Have you experienced headache or congestion in a freshly painted or carpeted room?

IAQ is a factor in all these situations, where germs or pollutants transmitted through the air cause various kinds of physical distress.

Air pollutants generally affect the respiratory system first, but they may also irritate the eyes or be absorbed through the skin and affect other organs. Some pollutants are even stored in body tissues, creating the potential for adverse health effects over time.

People who work in buildings with poor IAQ frequently experience health problems that the World Health Organization broadly defines as "Sick Building Syndrome."

Symptoms can include:

- Eye, nose or throat irritation
- A sensation of dry mucous membranes
- Dry skin or rashes
- Mental fatigue
- Headaches
- Nausea
- Dizziness
- Coughing
- Hoarseness
- Wheezing
- Itching
- Other hypersensitivity reactions

According to the U.S. EPA, health effects that have clearly been related to building occupancy include:

- Infectious diseases such as measles or flu
- Toxic syndromes resulting from exposure to carbon monoxide, pesticides or microbial toxins
- Hypersensitivity conditions like asthma, in which the body reacts severely to low levels of pollutants
- Specific diseases directly attributed to a building, such as Legionnaire's Disease

As air moves through an office...

Pollutants circulated through heating, cooling and ventilation (HVAC) systems can contaminate working spaces. Contaminants introduced through outdoor air circulation can become a problem when they are concentrated indoors.

Tenants in leased industrial and retail settings may be able to control ventilation in their workspaces to accommodate safety, operational and utility billing needs, but occupants in multi-tenant office buildings typically have minimal control over centralized HVAC operations, except for regulating some temperature zones.

Likewise, services that heavily impact IAQ in office buildings, such as cleaning,

maintenance and remodeling, are often contracted and overseen by property managers, so they are typically also out of office space occupants' immediate control.

Facility managers can accomplish a great deal to improve IAQ problems, but even skilled individuals may not have specialized training needed to address IAQ. In situations where an IAQ issue is persistent and aggravating, occupants may ultimately need to request that their building owner or property management firm hire a qualified environmental or HVAC consultant to evaluate and monitor IAQ complaint conditions, or deal with remediation.

U.S. EPA Reports

- **Americans today spend 90% of their time indoors**
- **Most adults spend a third or more of most days indoors in a workplace**

What's in the air where you work?



How old is the building you work in? The energy crunch of the early 1970s prompted widespread changes in building design and construction. For example, levels of air exchange were reduced from 20 to 5 cubic feet per minute per person.

Tighter structures began to make better use of energy for heating and cooling. However, they also trapped indoors many pollutants associated with building materials, furnishings, cleaning products and everyday work.

This happens in buildings we live in, too. A study conducted by the Walter Reed Army Institute of Research in Washington, D.C., found up to 50 percent higher incidence of upper-respiratory problems in recruits housed in newer, more energy-efficient buildings, compared with soldiers living in older, less air-tight structures. Details were reported in the *Journal of the American Medical Association* in 1988.

Air moves through a building from areas of higher pressure to lower pressure through any available openings. A building's HVAC system is generally the main pathway and driving force for movement of air through interior spaces. Airborne pollutants get around the same way! All of a building's components – including walls, ceilings, floors, doors and windows, HVAC equipment and even occupants – interact to affect the distribution of air, and airborne contaminants.

The U.S. EPA's excellent resource ***Building Air Quality – A Guide for Building Owners and Facility Managers*** (1991) defines many pollutants that commonly enter working environments as outdoor air is circulated. EPA also lists substances that can contaminate indoor air from inside.

If inside and outside pollution sources are not controlled, IAQ problems can result even if your building's HVAC systems are properly designed and maintained.

Visit the ***Tox Town*** website (see **Resources**, page 41) where interactive graphics show where pollutants can occur in an office building, as well as other settings.

Indoor air can contain multiple types of contaminants at concentrations that are far below any standards or guidelines for occupational exposure. With so many variables possible in a situation of poor IAQ, it's often difficult to relate specific health complaints to a specific pollutant, since such exposures may be to low levels of a pollutant or to pollutant mixtures.

Continual exposure to combined-pollutant problems can be detrimental even to very healthy people. Workplace IAQ problems can be especially hazardous for individuals with compromised respiratory health or chemical sensitivity.

You'll find a listing of ***Sources of Indoor Air Pollutants*** on page 43. Which ones could be affecting your workplace?



Air pollution affects us all: hourly, salaried, service and professional workers.

Maintain Healthy Indoor Air Quality

- Identify and remove obstructions to office airflow, such as boxes or desks placed over vents or in front of air return grilles
- Insist on professional maintenance of your building's HVAC system!

Team Up To Improve IAQ At Work!

Why teams?

A team approach to IAQ can:

- Keep the work of investigating and evaluating IAQ problems manageable by sharing the load
- Combine individual expertise in research, communications, engineering, etc. into group problem-solving power
- Sustain processes and improvements over time, and through changes in personnel

While it's true that employees can't resolve all workplace IAQ problems, workers can influence communication needed to improve IAQ. Employee insights and involvement can be critical to successes.

Green Team members can represent the interests of all workers, and can contribute

significantly to a healthy working environment for all.

A healthy workplace minimizes costs and contributes to profitability. A wise business owner will invest in workplace health improvements, such as IAQ, and support an efficient, dedicated Green Team's efforts to improve IAQ. Case studies in the **Tools** section (pages 28-33) describe cost-saving opportunities related to IAQ.

Individual workers often start initiatives to improve environmental conditions in the workplace, such as recycling, conserving energy or improving IAQ. Individual efforts are important, but they are at risk when that individual pulls back. Workers can sustain progress when they team up.

Get Green Team Power

1. Involve all stakeholder groups
2. Form a lean Green Team
3. Choose an IAQ champion to lead
4. Secure management support
5. Work with your facility manager

How to form your Green Team.

1. Involve all stakeholder groups

Recruit representatives of groups directly involved with decisions and activities that affect IAQ, as well as representatives of your general employee population. Ideally, Green Team participants should represent full-time, part-time and contractual employees. IAQ problems don't discriminate between salaried and hourly staff!

If possible, include someone responsible for purchasing and a member of your business management team. Involve a clerical or support person. If cleaning is an in-house function, definitely include a housekeeper or custodian. If your business handles any equipment maintenance, include a member of the maintenance crew.

2. Form a lean Green Team

Depending on the size of your workforce, a Green Team can consist of 3-8 members who care about clean air. Involve individuals with energy and enthusiasm. Don't recruit at random – and avoid having the boss assign Green Team activity as a job requirement.

If appropriate, expand existing environmental efforts to address IAQ. For example, individuals already involved with recycling may want to expand their environmental focus. Or add new participants to distribute Green Team tasks among several individuals.

3. Choose an IAQ champion to lead

Most IAQ issues can't be settled solely by Green Team members, because property owners or their facility managers often control factors affecting IAQ in office buildings. For efficiency's sake, select one person to represent your Green Team in interactions with building managers, IAQ specialists, your building's owner or a property management representative. IAQ information can be technical, so choose a Green Team leader with affinity for this subject. It's helpful if this individual also has the personality and skills to rally overall workplace support for IAQ.

4. Secure management support

Strong and vocal approval from the top management of your business is essential. This sends a clear message that your

organization is truly committed to IAQ improvement and protection. As efforts proceed, management should support IAQ goals by endorsing research into problem situations, communicating the importance of a healthy work environment and recognizing employee participation in an IAQ improvement process.

Business owners or other high-level leaders usually make decisions about building renovations or relocations. Educate these stakeholders about the importance of IAQ to motivate them to incorporate IAQ goals during planning for facility expansions or improvements. If your business rents space, encourage managers to advocate for IAQ in your workspace with building owners and property managers.

Make the case to management that employee experiences of health, comfort and satisfaction within the working environment have a significant impact on productivity and profits. Healthy workers will be on the job – not out sick – with the energy needed for productive collaboration!

5. Work with your facility manager

The most important relationship your Green Team can form outside of your own office will be with your building's facility

manager. A person in this position is an operations specialist, whose job includes keeping HVAC and other systems running effectively, and dealing with any hazardous conditions in their buildings.

Facility management professionals are increasingly knowledgeable about measures to achieve money-saving energy efficiency. It's a logical next step for them to understand and support IAQ goals, because HVAC efficiency concerns are closely linked to factors affecting IAQ.

Although the job of resolving an IAQ problem often falls to a facility manager, technical training for IAQ maintenance is often "pigeonholed" within the field of Industrial Hygiene, so this kind of information is not always included in facility management training regimens.

Your Green Team can help your building's facility manager build his or her IAQ resources by recommending materials listed in this toolkit, such as those offered by U.S. EPA (see [Resources](#), page 41).

- **The individual who oversees operation and maintenance of your building's air circulation systems can be an essential partner in a Green Team's office IAQ improvement process**

Facility Manager



A workplace Green Team can effectively address environmental concerns, such as IAQ.

Green Team steps to improve IAQ at work.

- Good data is necessary to find the source of a suspected IAQ problem

Track Down Facts

- Respect your co-workers!
- Keep all information from IAQ survey and diary forms confidential

1. Gather information on IAQ issues

This toolkit includes three data logging forms and an office walk-through guide designed for Green Team members to use with co-workers who are experiencing problems that may be related to IAQ. Photocopy these forms from **Tools**, pages 23-25, and distribute them as needed.

A. Conduct an IAQ walk-through of your workplace to identify possible IAQ trouble spots, using the **Detox Your Office IAQ Walk-Through Guide**. Use the **Workplace IAQ Survey Form** to interview co-workers who are reporting IAQ problems. Also interview all employees working in or around the physical area where an IAQ complaint has been identified. Be sure to note these survey responses factually and accurately.

B. Give the **Occupant Diary Form** to all individuals who suspect they are experiencing an IAQ problem. Ask them to log information about their physical symptoms on the form for an appropriate period of time. If mild or intermittent symptoms are involved, ask that this log be maintained for a few days to a couple of weeks. If a very troublesome condition is occurring, you may only be able to monitor this information for a short time.

C. Have a Green Team member keep an **Internal/External Data Log** of activities that might impact an IAQ condition in the affected area. For example, note information about cleaning routines. Note the performance of any non-routine services such as insecticide spraying, delivery of new furniture or fixtures, installation of new office plants, or on-site fertilizer or pesticide treatments applied to plants by co-workers or employees. Were several people ill or absent simultaneously because of respiratory ailments? Was any unusual cooking done at work? Note times and durations when windows are open or when doors are propped open.

D. Also track on the **Internal/External Data Log** factors such as outdoor temperature, precipitation and humidity conditions, and pollen and mold counts. Many cities have established partnerships between air quality advocacy agencies like the American Lung Association and local news media, to provide the public with information on air pollutants. Reports typically address levels of ozone and fine particulate matter. Check your local TV or newspaper weather reports for air quality forecasts, or look for this kind of information online.

E. Especially when dealing with a sudden IAQ problem flare-up, also note on the **Internal/External Data Log** the time, duration and nature of any pollution-related occurrences near your building, such as a fire or industrial accident. If your workplace is near a busy road or a major highway, note times when traffic is heaviest. Remember that outdoor air pollutants can become significantly concentrated in indoor spaces.

2. Analyze findings objectively - look for trends

As you analyze the information your co-workers have provided on this toolkit's forms, note whether IAQ complaints coincide with the presence of any obvious pollutant(s) into your workplace. Use this information as a guide to identifying cause-and-effect relationships. Do **Occupant Diary Form** complaints coincide with any internal or external circumstances when pollutants might have been introduced?

Assess the physical surroundings where complaints occur. Is clutter gathering dust? Are there sources of pollution outside windows or doors? Are there physical obstructions to healthy air flow? If furniture or stored items are blocking vents or air-return grilles, any pollutants introduced by indoor or outdoor activity will probably not be dissipated by normal HVAC flows, and may have concentrated in the affected area.

3. If possible, adjust the situation

- Clean up clutter! Give cleaning personnel adequate access to keep your workplace pollutant-free. Prevent accumulation of dust and dirt. Store items in cabinets or sealed boxes or on shelves that can be easily dusted during regular housekeeping routines.
- Keep air vents free of obstructions. Move furniture or stored items so nothing is blocking heating and cooling vents or cold air returns.
- Ask co-workers whose windows overlook a loading dock, busy intersection or highway ramp to keep their windows closed to keep out pollutants.
- Segregate the problem! Some adverse IAQ reactions will cease when an irritant or pollutant is segregated from an affected individual. If you find that a chemically sensitive person's workstation is located near the source of a substance that irritates them, remove the substance or try to move that individual away from the problem. Not every IAQ problem will lend itself to a reorganizing solution, but don't overlook basic options for physical movement.
- To prevent mold growth, catch water leaks in a bucket or pan until the leaks can be repaired. Dry out or remove any damp carpeting or furniture.
- Reduce use of hazardous chemicals. Read the labels on all chemical supplies, including janitorial products, paints, glues and fixatives, lubricants, etc. If you find the words *Danger*, *Poison*, *Warning* or *Caution*, you have found a possible contributor to IAQ problems.
- Work to replace as many toxic products in the workplace as possible with non-toxic or less-toxic alternatives, such as those recommended by Green Seal or GREENGUARD (see page 21).

4. Store and handle substances safely

If your business must use toxic chemicals for cleaning, printing and other functions, store them properly in airtight closets or cabinets, preferably in exhausted spaces away from normal working areas. Use such products only according to label directions, in proper concentrations, with appropriate ventilation and respiratory protection.

5. Refer to the IAQ standards within LEED and use them to advance IAQ "Best Practices" in your workplace

Review the LEED criteria for IAQ detailed in the next section of this toolkit. Are the complaints reported in your workplace related to any of the practices and products LEED recommends to maintain healthy IAQ? The cleaning practices and building material choices cited in LEED are specified because they are likely causes of IAQ problems unless green versions of these things are used.

The kinds of workplace IAQ improvement efforts this toolkit is designed to support will typically be able to address some – but not all - of the criteria defined by LEED. In this context, use LEED as a guideline for IAQ potentials, and as justification for addressing IAQ issues as they arise.

When you have successfully addressed an IAQ problem, such as fumes seeping from an improperly maintained storage area for cleaning chemicals, let that accomplishment leverage additional health promoting measures. For example, you might focus next on proactively working toward an upgrade of cleaning products and practices to LEED-level green standards.

If remodeling is being planned for your workplace, talk to project decision-makers and promote product choices based on LEED IAQ criteria, such as GREENGUARD-certified VOC-free paints, or Green Seal-certified carpeting or janitorial products.

Use case studies to make a business case for investing in the criteria for indoor environmental quality set forth by LEED. Many case studies are accessible on the U.S. Green Building Council's website (www.usgbc.org). Several case studies dealing with IAQ issues are included in this toolkit (see [Tools](#), pages 28-33).

You can obtain local green building case studies, perhaps including projects with IAQ issues like those in your business, through your local USGBC chapter, or other organizations listed in [Resources](#) (pages 41-42). Green building professionals, especially those working on LEED projects,



Get Things Moving

- If simple furniture or space adjustments might help solve the problem, make some moves!



Get Healthy Air

- Optimum ventilation and air circulation is needed for healthy IAQ
- Locate and unblock air vents throughout your working area

Respond To IAQ Complaints!

- Take co-worker complaints seriously when dealing with IAQ problems
- People are usually reacting to a real problem, whether or not they relate their symptoms to the actual cause

are usually more than willing to share information and resources that can help to improve health conditions for the occupants of any building.

6. Consult with environmental professionals when appropriate

Your Green Team's survey and interview findings may indicate that IAQ problems are originating outside your working space, perhaps in space occupied by other tenants. Pollutants may be circulating through the building HVAC system, or the system may not be functioning properly enough to maintain good air quality in your space.

In cases like these, talk to your building's facility manager. Document and describe the problem and share your findings. Be prepared to turn over the investigation to the facility manager, but ask that your Green Team be kept apprised of further findings and progress toward a solution. Offer to assist with further data tracking if appropriate. As you work with a facility manager, keep in mind that an IAQ issue originating outside of your workspace may be difficult to track to its source.

If a problem is severe or persistent, work with your business's management team and your building's owner or property management representative to arrange a consultation with an IAQ specialist, such as an industrial hygienist or an environmental testing and remediation firm.

7. Communicate!

Motivating building occupants to improve IAQ requires effective communication. Green Team members should be sure to:

- Establish an effective system for logging and responding to IAQ complaints
- Clarify responsibilities of all parties, including your company's staff and management, building management and contractors
- Provide accurate information about factors affecting IAQ. See the [Resources](#) section (page 43) for **Sources of Indoor Air Pollutants**, a descriptive and comprehensive listing provided by the U.S. EPA.

IAQ complaints should be handled promptly, with every incident given serious attention. Some complaints may be vague. For example, someone may report "an unusual odor" or may feel "sort of sick." Complaints might be very specific, blaming a particular material or activity as the cause of discomfort or health problems. Theories about an IAQ problem should be heard respectfully, weighed cautiously, and assessed along with observable evidence.

Remember that perception is a significant contributor to IAQ complaints. Once an IAQ problem is remedied, it's possible that people who experienced the adverse affects of the problem will react to triggers that make them think it's still occurring. One of the IAQ Case Studies included in this toolkit describes the aftermath of a serious mold issue in St. Louis' Parkway School District, where perception kept a problem alive even after it was technically solved (see **Parkway School District** in [Tools](#), page 30).

IAQ issues that can be resolved quickly and that involve small numbers of people can be handled matter-of-factly; for example, a situation where annoying but harmless odors are coming from an easily identified source. Responsive communication is most important when delays occur in identifying and resolving the problems, or when serious health concerns are involved.

8. Evaluate the Green Team process

Refer back to the steps summarized in the **Green Team Blueprint for Action** on page 22. What pieces should the team revisit? What new IAQ information does the team need? Who should be added to the team? Constantly evaluate your efforts for best impact on IAQ conditions.



Most importantly, respect co-worker confidentiality when dealing with IAQ issues!

9. Celebrate success and thank supporters

Resolving an IAQ problem can be a major accomplishment in the workplace. Persistence, cooperation and skill will surely have been applied. Have a member of your Green Team include a brief report on the outcome of your process and some form of recognition for the individuals involved in a staff meeting presentation or employee newsletter.

If outside help was required – from your building’s facility manager, the building owner or an IAQ specialist – send a formal thank-you letter to enhance relationships with these important IAQ guardians.

10. Incorporate IAQ awareness into business planning

Remind your boss to consider IAQ during planning for the growth of your business. Planning ahead to safeguard IAQ will usually cost less than dealing with IAQ problems as they arise.

It’s economically and practically most important to address IAQ concerns through planning when a business is anticipating office expansion or a move. Pay special attention to IAQ considerations during a real estate search or service-contract negotiation period. These factors include:

- HVAC system cleaning, modification, and maintenance specifications, in order to optimize air circulation and keep air pollutants out of the workplace
- Janitorial service specifications for use of Green Cleaning products and practices
- Pest-control service specifications for Integrated Pest Management techniques
- Selection of VOC-free paints, stains, fabrics, carpeting and other building and furnishing materials
- Adherence to an IAQ construction management plan during remodeling or building, to keep construction-related pollutants from accumulating in ductwork

- **Even simple measures can improve office IAQ**

Three levels of safeguarding workplace IAQ

1. Everyday

• Put plants to work for office greening

Did you know that some common indoor plants can remove pollutants from the air? Plants such as peace lilies, spider plants, golden pathos, and various types of ferns and philodendrons have been shown to filter certain chemicals from indoor air. Be sure to empty standing water from plant containers, to prevent allergy issues.

• Keep your workplace clutter-free

Messy areas that are hard to clean may be skipped during regular housekeeping. Clutter can become “storage” for office pollutants, and can block vents and grilles that are essential to healthy air circulation.

2. During contract negotiations

• Employ a Green Cleaning service

Solicit bids from janitorial companies that specialize in Green Cleaning. Ask for details on use of non-toxic cleaning products. Your office staff and your cleaning crew will all be healthier!

• Improve IAQ through regular building system maintenance

Ask about IAQ safeguards and IAQ maintenance expertise in leasing negotiations. Talk with your building’s Facility Manager about IAQ conditions, and offer to share resources from this toolkit.

• Specify materials that are VOC-free

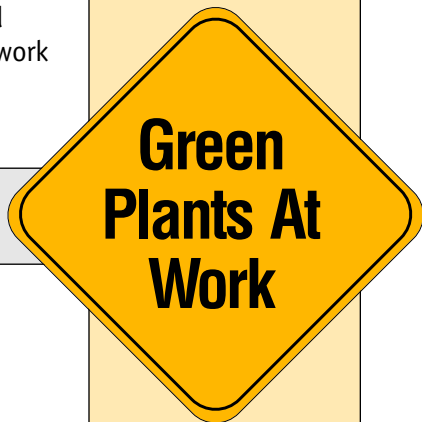
Insist that painting, decorating and building contractors use products and materials that emit no air pollutants during application, construction or everyday use.

3. When planning a move

• Use LEED whenever your business plans to build or remodel

Work with a design professional who is LEED Accredited to apply LEED standards to a new or updated space. Whether you seek LEED certification for your building or not, put the LEED standards to work as “Best Practices” in your business.

- **Growing common plants can help keep office air clean and healthy**



More Keys To Success

Use U.S. EPA resources to build in-house expertise.

A Green Team leader can learn a lot about IAQ issues and be a good resource person and a motivator for the rest of your workforce, but leaders can't get results alone. Facility managers – whether they work inside or outside of your company – are directly responsible for technical factors affecting IAQ in the building they oversee.

Facility managers are usually well trained and knowledgeable about their building's operation, but they may not have extensive experience with IAQ issues. Green Team leaders can recommend resources to help your facility manager build IAQ knowledge and skills. Discussion with a Green Team representative can provide important IAQ orientation and background on a specific issue, as well as referrals to practical resources for dealing with IAQ problems.

The U.S. EPA has developed comprehensive, technically advanced resources for use by building managers. One of these is the 1991 publication *Building Air Quality – A Guide For Building Owners and Facility Managers*, which includes extensive background on IAQ issues, specific information about mitigating pollutants like mold, asbestos and radon, and a toolkit of forms to use in managing IAQ issues. This guidebook can be downloaded in PDF form, or ordered in print from the EPA, at no charge.

EPA also offers *I-BEAM (IAQ Building Education and Assessment Model)*, an advanced guide for building professionals and a comprehensive, state-of-the-art resource for managing IAQ in commercial

buildings. *I-BEAM* is an interactive resource with text, animation/visual, and interactive/calculation components that can be used to perform tasks including:

- Conducting an IAQ building audit
- Diagnosing and resolving IAQ related health problems
- Establishing an IAQ management and maintenance program to reduce IAQ risks
- Planning IAQ-compatible energy projects
- Protecting occupants from exposures to construction and renovation contaminants
- Calculating the cost, revenue, and productivity impacts of planned IAQ activities

I-BEAM can be downloaded online or ordered from the EPA on CD-ROM.

Because they work continuously with issues in their buildings, facility managers tend to have little time for out-of-house training but they may be inclined to learn about issues like IAQ using self-guiding media. A facilities person can pursue information as their schedule permits using references like EPA's *I-BEAM* and *Building Air Quality*.

EPA offers a number of other free downloadable IAQ publications; many of these are also available at nominal cost in booklet form. As IAQ awareness grows, your Green Team may want to build an IAQ resource library.

Websites for these and other publications are listed in [Resources](#), page 41.



U.S. EPA Resources

- Free publications available at www.usepa.gov/iaq can help improve IAQ for homes and schools, as well as in the workplace

Establish a smoke-free workplace.

IAQ programs are insistent about keeping tobacco smoke out of the working environment. Smoking is now known to be a physical addiction, not just a habit. Breaking this kind of addiction is complicated by the need for smokers to modify routines they associate with smoking, such as taking a break for coffee or conversation while at work.

Businesses committed to fostering IAQ will do well to investigate options to support employees in behavioral or medical smoking cessation programs. This is a factor in which your workplace Green Team can join forces with Human Resources leadership to help support a healthier lifestyle as well as a healthier workplace environment for all.

Show how improving IAQ saves money.

Investigating IAQ issues takes time. But a modest amount of time invested by Green Team members in efficient action can prevent a variety of possible losses. IAQ problems can easily result in sick days, decreased individual or group productivity, and increased health insurance claims. As with many green improvements, reasonable investment up front can yield significant savings and benefits over time.

Consider the value of IAQ improvements in relation to what your business pays to occupy your working space. Commercial rent may average \$20 per square foot and utility costs may add another \$2 to \$5 per square foot. The U.S. Green Building Council estimates typical personnel costs at about \$200 per square foot. People are a business's biggest investment! If pollutants in your workplace are impacting employee health and productivity, your business will lose money to IAQ problems.

By contrast, a physically healthy working environment supports employee morale and is more likely to retain or even attract

talent. Employees who work together to solve a common environmental problem may transfer new skills to profitable business project problem solving.

To retain the support of your company's management, be efficient and systematic about investigations. Keep inquiries to the facts. Because co-workers are likely to be most candid and cooperative with one another, Green Team members can initially check into all IAQ issues. However, you must assess when an IAQ issue inquiry should be turned over to a qualified professional consultant. Recommend this additional investment to your superiors on the grounds that an expert can most cost-effectively complete a demanding inquiry and proceed with any necessary remediation measures.

Preventing problems is a wise cost control. Include IAQ improvement and protection strategies in remodeling plans, service contract negotiations and leasing agreements.

Track changes and document results.

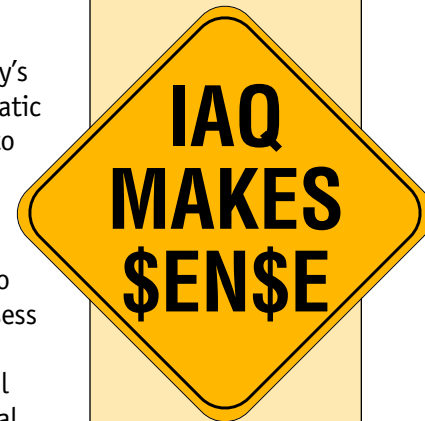
Tracking the outcomes of an IAQ improvement process can help make the case to the owners of your business for investing in more environmental health safeguards.

Are people feeling better? Are employees missing less work time? This kind of information is very valuable!

Write up a brief case study of your office IAQ improvement process. Ask a Human Resources professional to help formulate information to protect confidentiality.

USGBC and other organizations that advocate for healthy IAQ are actively seeking both qualitative and quantitative data on IAQ improvement measures.

- **Think of making IAQ a priority in your workplace as a kind of health insurance for your company's work force and working environment**



Commercial Costs (average, per sq ft)

- Rent: \$20**
- Utilities: \$2-5**
- Personnel: \$200**

- **Investment in IAQ invests in a healthy, productive work force!**

Your Green Team May Ask...

How can we convince co-workers to participate?

Everybody breathes! Salaried and hourly workers alike share the air. While some individuals may be more affected by contaminants than others, harmful IAQ conditions can eventually bother everyone.

Everyone is interested in feeling better. Perform the **Better Breathing Bureau Skit** (see **Tools**, page 34) as an employee lunch-and-learn, to introduce ideas about how healthier air helps people feel better.

What IAQ factors can employees affect?

- A Green Team in almost any workplace can research and effectively recommend measures to control environmental tobacco smoke and proper storage and use of many kinds of chemical pollutants.
- Skillful negotiators armed with good data and compelling case studies may influence cleaning contracts by making the health case for Green Cleaning and non-toxic pest control.

- Purchasing, remodeling and design decisions may be influenced to minimize the use of toxic or off-gassing substances by selecting low-emitting materials instead.

- Some basic modification or improved maintenance of air filtration media and air delivery systems may be accomplished through Green Team efforts.
- Businesses that employ an industrial hygienist or IAQ specialist may realize significant benefits from Green Team efforts when effective communications with other staff, research, and partnerships build the case for investing in IAQ improvements beyond those needed to meet minimum workplace health and safety standards.

- If your business owns and operates its own physical facility, your Green Team's influence over IAQ factors may be much greater than if your business rents space.

- Productivity impacts can be at least informally documented through periodic solicitation of targeted survey information. Formal tracking of health claims, absenteeism and other productivity factors may be possible in cooperation with your company's Human Resources Department.

A Green Team can be an asset to your company.



- Green Team leaders can help incorporate IAQ improvements into remodeling or moving plans, especially when they get involved at the initial planning stage.
- Management of IAQ during construction may be influenced to improve health conditions for construction workers and office staff.

While a workplace Green Team should expect resolution of IAQ issues, it's important to know when to turn a problem over to a facility manager or IAQ specialist. Then Green Team members should step back and support their efforts as needed.

**Expect
Results**

What about IAQ factors beyond our control?

The biggest challenge to employee success with IAQ issues probably comes when a business experiencing IAQ problems is renting space. This situation may be especially problematic in high-rise facilities with multiple tenants, where a property management firm operates the facility on behalf of non-resident owners, and tenants have little control over HVAC systems or cleaning contracts.

Significant ventilation improvements may be beyond your control if, in addition to ownership and management factors:

- You work in a building with few or no operable windows
- You work in a building that has undergone many internal renovations, in which air-handling channels have become too convoluted to track pollution sources without retaining specialized IAQ diagnostic services

Similarly, your Green Team's influence over renovation or redecorating material choices may be curtailed if improvements:

- Occurred before your business moved in
- Are being contracted by owner/manager teams dealing with multiple renovations

In situations where preventive IAQ decision-making is beyond your control, but problematic conditions exist, Green Team members will do well to pursue systematic information gathering through employee surveys. Be sure to track dates, times and specific locations and interactions where IAQ problems occur. Note trends in the occurrences. Then work with your management team to present your well-documented complaint to the property manager or building owner.

Reputable property management firms will respond to reasonable requests. It is in their best interest to consult with an environmental specialist in response to issues that seriously affect tenant health.

- **Time spent resolving IAQ problems can prevent more costly losses of time and money**



An IAQ Investment Pays!

How will we know if our efforts are working?

Ideally, improvements can be observed and complaints should cease, but IAQ problems can be complex. The EPA states, in ***Building Air Quality***, that two kinds of criteria can be used to judge the success of efforts to correct an indoor air problem:

- Reduced complaints
- Measurement of properties of the indoor air

Measurement of airflows, ventilation rates and air distribution patterns are the most reliable methods of assessing IAQ intervention success. Measurement of some pollutants, such as mold counts or radon levels, may be necessary. A facility manager or other qualified professional must conduct these assessments and use findings to evaluate whether or not an IAQ problem has been solved.

Part of the purpose of the Green Team approach to IAQ improvement is to involve workers in maintaining their healthy

workplace, so an evaluation should include reviewing the improvement process itself:

- Does management support the IAQ Green Team work?
- Do employees participate candidly and cooperatively?
- Is information handled factually and effectively?
- Are Green Team leaders clearly communicating needs and findings?
- After probable causes are identified, are steps being taken to solve the problem?
- Are successes being used to leverage further improvements?
- Are people feeling better physically?

If the answer to many or all of these questions is "Yes!" you can count your efforts as successful. People are aware of IAQ issues and opportunities. More work may be needed, but constructive processes are in place to maintain a healthy working environment.

IAQ problems can result in:

- **Sick days**
- **Decreased group and individual productivity**
- **Increased health insurance claims**

Green Building Guidelines LEED The Way

- Savings result where LEED has been applied to improve IAQ!

**LEED
Best
Practices
Save
\$\$\$**

What is LEED?

The U.S. Green Building Council (USGBC) has defined standards for health and sustainability in commercial buildings through its LEED® (Leadership in Energy and Environmental Design) rating and certification system. Businesses or building owners can register their building projects with USGBC and earn points toward LEED certification.

LEED certification has become a sought-after form of recognition in the business world, because green buildings generate operating cost savings, productivity increases and prestige. But it's important to note that the ultimate rewards of building green aren't about good P.R. or earning a plaque! They are the benefits provided by creating healthy, sustainable working environments.

To earn LEED's green building certification, standards addressing these five categories

of building design, construction and maintenance must be achieved:

1. Building site selection and site development
2. Water conservation
3. Energy efficiency and renewable energy use
4. Selection and handling of building materials
5. Safeguarding indoor environmental quality, including IAQ

As of 2007, LEED certification can be obtained for renovation and operation of existing commercial buildings and for new commercial construction projects. LEED certification is also being formulated to address sustainable development for entire neighborhoods, for individual homes and for commercial real estate developments intended to be leased or sold.

What are LEED's environmental quality strategies?

LEED defines a number of action-oriented strategies to improve indoor environmental quality. Any building project must incorporate several of these strategies in order to earn points sufficient for an award of LEED certification. LEED's IAQ strategies were developed to help building designers, owners and managers actively maintain healthy IAQ.

GOALS

- Reduce/eliminate pollutants at the source
- Manage pollutants to minimally impact building occupants
- Provide temperature, ventilation and humidity controls to individual work areas
- Provide daylight and views to workers

STRATEGIES

- Control tobacco smoke
- Use building and decorating materials that emit little or no air pollution
- Require use of Green Cleaning materials and practices
- Place air intakes away from pollution sources
- Monitor indoor air quality
- When possible, design building systems to allow for individual climate controls
- Whenever possible, configure working spaces to maximize use of natural light and window access

- A growing body of green building case studies document the benefits of healthy IAQ in the workplace

**Learn More
Visit
www.usgbc.org**

What does LEED insist on for environmental quality?

LEED green building certification can be based on many combinations of design, construction and ongoing operational strategies, but some factors are non-negotiable prerequisites.

These strategies are required to earn LEED certification. Ideally, they should be followed in every workplace, because they are such crucial safeguards of IAQ.

Minimum IAQ performance

Outdoor air – thoroughly circulated and appropriately mixed with conditioned indoor air – is essential to good IAQ. LEED requires that outdoor air ventilation distribution systems be designed, modified and maintained to supply minimum ventilation rates defined by ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers). These systems must be maintained according to U.S. EPA or SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) guidelines. Finally, all building exhaust systems - including bathroom, shower, kitchen, and parking areas - must be tested and maintained according to adequate building operation protocols.

Environmental tobacco smoke (ETS) control

Negative health effects of inhaling direct and second-hand smoke are widely recognized. Smoking is increasingly banned in many public places. However, smoking is still permitted in defined areas, indoors or outdoors, in many private workplaces.

LEED mandates elimination or strict mechanical control of workplace smoking areas. LEED offers two options:

1. Prohibit smoking in the building, including locating any exterior smoking areas at least 25 feet from entries, outdoor air intakes and operable windows.
2. Prohibit smoking indoors except in smoking area(s) designed to contain, capture and remove ETS from the building. Design measures can include construction and maintenance of a completely sealed, specially pressurized facility with air directly exhausted outdoors so ETS-contaminated air cannot be re-circulated indoors.

Asbestos removal or encapsulation and PCB removal

Asbestos was formerly widely used to insulate pipes and ductwork, in ceiling tile, and fire-proofing strategies. Asbestos often remains in older buildings. Polychlorinated Biphenyls (PCBs) are typically present in motor oils, fossil fuels, and vehicle or manufacturing exhaust. Asbestos particles pose an extreme respiratory hazard when they become airborne, and PCBs add to building hazards in the event of fire.

To reduce occupant exposure to these very toxic substances and prevent harmful effects, LEED mandates that a program must be in place to manage indoor asbestos and PCBs according to regulatory requirements, including maintaining an up-to-date survey of all asbestos and PCB locations.



**Let LEED
Work In
Your Office**

**In these
LEED Certified
buildings:**

- **Absenteeism has been reduced by 50% at Alberici Corporation in St. Louis, Missouri**
- **Day cleaning has cut energy bills by 8% and reduced janitorial related complaints by 70% at California EPA Headquarters, resulting in annual savings of over \$210,000**

LEED points add up to healthy workplace IAQ.

The current (2007) LEED rating systems for commercial buildings consist of multiple criteria, called "points," that define many ways to enhance the well-being of everyone who works in such spaces.

Even for businesses not seeking LEED certification, it can be profitable to understand and apply the methods LEED sets forth to safeguard healthy IAQ.

The LEED IAQ points include:

Monitoring outdoor air delivery

To sustain occupant comfort and health, a permanent carbon dioxide (CO₂) monitoring system should be installed and used by building managers to monitor levels of space ventilation and filtration.

Increasing ventilation

This action will provide high-level outdoor air ventilation necessary for occupant comfort, health and productivity. Functions will satisfy requirements set by ASHRAE for mechanically ventilated spaces or by CIBSE (Chartered Institution of Building Services Engineers) for naturally ventilated spaces. To earn this LEED point, 90% of occupied spaces must be ventilated by outdoor air.

Documenting productivity impacts

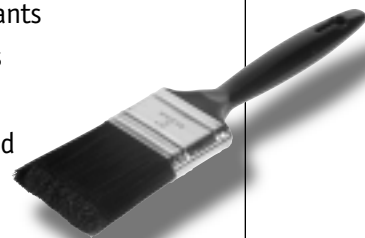
USGBC will award up to two LEED points to projects that document a history of factors such as absenteeism and health care claim costs, while also tracking changes over time in these and other productivity factors. The idea is to show how green buildings positively impact the health of people who work in them. Collecting and sharing such data helps make an economic case for investing in the green building practices defined by LEED.

Using building and decorating materials that emit little or no air pollution

Several LEED points may be earned by choosing building and furnishing materials that minimize air pollutants which are odorous, potentially irritating or otherwise harmful to occupant health.

Such materials include:

- Adhesives and sealants
- Paints and coatings
- Carpet systems
- Composite wood and laminate adhesives
- Office furnishings

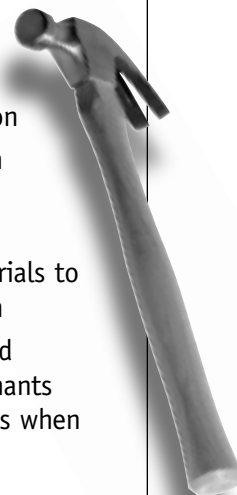


Rigorous criteria are detailed by LEED, and independent laboratories conduct tests and award green certifications for each of these types of materials, ensuring that product characteristics have been proven to safeguard IAQ.

Following an IAQ construction management plan

An IAQ construction management plan will help manage air quality factors during construction or renovation to prevent later development of IAQ problems. In order to earn this point, a plan must include:

- Attention to SMACNA guidelines for sheet metal and air conditioning design
- Use of high-performance air filters during construction
- Replacement of all filtration media immediately prior to building occupancy
- Protection of building materials to prevent moisture absorption
- Adherence to strictly defined options to remove contaminants from affected interior spaces when construction is complete



Controlling indoor chemical and pollutant sources

LEED points may be earned by reducing hazardous particle contaminants in the work environment through use and maintenance of high-performance filters on all outside air intakes and returns for re-circulation of inside air, and through strict isolation and exhausting of pollutants commonly generated by high-volume printing and copying areas.

Use and maintain entrance area doormats. Up to 80% of particulate contaminants are carried indoors on peoples' feet!

Green Means A Healthy Workplace

In any workplace, LEED IAQ guidelines can be good tools:

- To safeguard employee health
- To improve productivity
- To boost profitability
- To enhance employee satisfaction

Green Cleaning

The requirements for these LEED points are the most extensive of all the IAQ safeguards defined by LEED.

Why is cleaning so heavily emphasized in LEED strategies to maintain IAQ? It's because choice and use of cleaning practices, cleaning products and janitorial equipment - key to maintaining the physical space - are also crucial to good maintenance of everyone's health at work!

For example, have you ever used more of a cleaning product than the label recommends because you think more will work better? Think about the amount of dirt (and more serious pollutants) that can be kept out of your workplace in the first place, when good quality entry mats are used. Healthier pest-control options, called Integrated Pest Management (IPM), have been defined by U.S. EPA and other agencies. IPM protocols deal with insects and similar infestations without the use of toxic chemicals.

Multiple LEED Green Cleaning points are intended to maintain a clean environment while protecting both custodial and office workers. Green Cleaning reduces exposure to the hazardous chemical, biological and particle contaminants generated by cleaning products and practices.

The LEED Green Cleaning criteria include:

- Use of materials and other cleaning strategies for entryways and exterior walkways that prevent dust, dirt, pollen and other particles from getting in at building entry points
- Isolation and proper setup of all areas where cleaning chemical concentrates are mixed and where janitorial equipment is stored
- Implementation of a low environmental impact cleaning policy, including:
 - Use of sustainable cleaning products and systems, such as those tested and certified by the Green Seal laboratories (see page 21 and [Resources](#), page 41)
 - Use of chemical concentrates in appropriate dilutions
 - Proper training of cleaning personnel in hazards, use, maintenance and disposal of cleaning chemicals, dispensing equipment and packaging
 - Use of hand soaps without microbial agents, except as required by local health codes
- Development and maintenance of a low environmental impact pest control policy, such as use of an Integrated Pest Management system



- **Minimizes indoor air pollutants through use of non-toxic or less toxic cleaning products**
- **Reduces health risks for janitorial workers**



LEED's Best Practices safeguard the health of cleaning personnel as well as office workers.

- Development and implementation of a low environmental impact cleaning equipment policy, including:
 - Use of equipment that maximizes reduction of contaminants with minimal environmental impacts
 - Use of vacuum cleaners that meet standards set by the Carpet & Rug Institute's Green Label Program, which capture 96% of particulates 0.3 microns in size
 - Use of carpet extraction equipment that removes moisture, enabling carpets to dry completely in 24 hours or less, preferably incorporating dry foam extraction to reduce chemical usage as well as drying time
 - Use of powered equipment designed to capture fine particulates and operate with a sound level less than 70 decibels
 - Use of low-emission, high-efficiency engines in all propane-powered equipment, including automated scrubbing machines equipped with

- variable speed feed pumps to maximize use of cleaning fluids
- Use of environmentally preferable gel batteries in all battery powered equipment
- Use of active micro-fiber technology products to reduce cleaning chemical consumption and prolong the life of disposable cleaning pads
- Use of ergonomically designed cleaning equipment to minimize vibration, noise and user fatigue
- Use of rubber bumpers on cleaning equipment to minimize damage to building surfaces
- Maintenance of cleaning logs for powered housekeeping equipment and chemical use

Following an ongoing IAQ management program

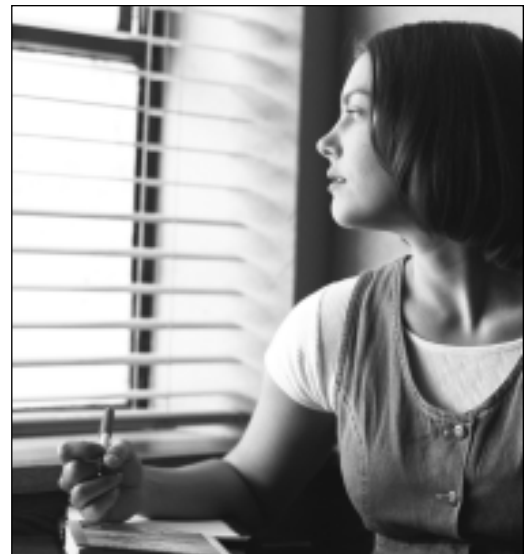
Comprehensive guidelines for maintaining healthy IAQ are provided by U.S. EPA's excellent free publication *Building Air Quality: A Guide For Building Owners And Facility Managers* (see [Resources](#), page 41).

Beyond IAQ: how does LEED enhance workplaces?

Addressing related environmental quality factors

In addition to LEED points that specifically address IAQ factors, three additional factors have been proven to significantly improve occupant health, productivity and well-being at work.

- **Systems controllability**
LEED points may be earned for design and operation of systems that provide individuals or groups sharing multi-occupant spaces with control of airflow, temperature and lighting conditions.
- **Thermal comfort**
LEED points may be earned for building systems that comply with specific ASHRAE standards for control of humidity, including permanent systems to monitor specified comfort criteria.
- **Daylight and views**
Studies demonstrate positive relationships between the health and



productivity of building occupants and the amounts of daylight in a working space, as well as whether occupants have direct visual access to the out-of-doors. LEED points may be earned by providing high levels of access to daylight and views, by reducing glare through window design and by maintaining daylight and views during renovations.

Green Product Certification

How do you know if a paint or stain will not contaminate the air by off-gassing volatile organic compounds? What determines whether a particular cleaning product is "green?" Two research organizations are recognized by USGBC for testing and certification of products that typically contain substances known to compromise IAQ. Green Seal and GREENGUARD monitor products containing substances that compromise IAQ.

Green Seal is an independent, non-profit organization that strives to achieve a healthier and cleaner environment by identifying and promoting products and services that cause less toxic pollution and waste, conserve resources and habitats, and minimize global warming and ozone depletion. Green Seal has no financial interest in the products that it certifies or recommends, or in any manufacturer or company. Green Seal's evaluations are based on state-of-the-art science and information using internationally recognized methods and procedures.

Green Seal's Product Standards and Certification program develops environmental standards for leadership products in specific categories, and certifies products that meet these standards. *Green Seal's Product Recommendations* program produces technical reports (*Choose Green Reports*) on products in a variety of categories giving specific brand recommendations of those that meet screening criteria.

Green Seal provides recommendations on:

- Carpeting
- Floor care products
- Wood finishes and stains
- Paper products
- Office furnishings
- Other types of products

For specific information, visit www.greenseal.org.

The **GREENGUARD Environmental Institute™** is an industry-independent, non-profit organization that oversees the *GREENGUARD Certification Program* for low-emitting products, including the establishment of acceptable standards for interior products and testing protocols. Access to the *GREENGUARD Product Guide*, an IAQ resource, is provided at no charge. Featured products are regularly tested to ensure that their chemical and particle emissions meet acceptable IAQ pollutant guidelines and standards. *GREENGUARD Certification* is a voluntary program available to all product manufacturers and their suppliers.

GREENGUARD product reviews include:

- Adhesives
- Fabrics
- Flooring
- Furniture
- Paints and coatings
- Wall finishes
- Other types of products

Learn more at www.greenguard.org.



- **These independent product testing and certification laboratories validate the claims of products designed to protect IAQ**



A team approach to IAQ can:

- Keep the work of investigating and evaluating IAQ problems manageable by sharing the load
- Combine individual expertise in research, communications, engineering, etc. into group problem-solving power
- Sustain processes and improvements over time, and through changes in personnel

How to form your Green Team

1. Involve all stakeholder groups
2. Form a lean Green Team
3. Choose an IAQ champion to lead
4. Secure management support
5. Work with your facility manager

Green Team steps to improve IAQ at work

1. Gather information on IAQ issues
 - Conduct an IAQ office walk-through
 - Collect data using Workplace IAQ Survey forms
 - Collect data using Occupant Diary forms
 - Keep Internal/External Data Logs
2. Analyze findings objectively – look for trends
3. If possible, adjust the situation
 - Clean up clutter
 - Keep air vents free of obstructions
 - Keep windows overlooking loading docks or roads closed
 - Segregate the problem
 - Catch and repair water leaks
 - Reduce use of hazardous chemicals
 - Replace toxic products with less or non-toxic alternatives

4. Store and handle substances safely
5. Refer to the LEED IAQ standards and use them as guidelines to advance Best Practices in your workplace
6. Consult with environmental professionals when appropriate
7. Communicate!
8. Evaluate the Green Team process
9. Celebrate success and thank supporters
10. Incorporate IAQ awareness into business planning

Three levels of safeguarding workplace IAQ**Everyday**

- Put plants to work for office greening
- Keep your workplace clutter-free

During contract negotiations

- Employ a Green Cleaning service
- Improve IAQ through regular building system maintenance
- Specify materials that are VOC-free

When planning a move

- Use LEED specifications to build or remodel

More keys to success

- Use U.S. EPA resources to build in-house expertise
- Establish a smoke-free workplace
- Show how improving IAQ saves money
- Track changes and document results

To be completed by individuals with physical complaints.

Thank you for providing this information as accurately and completely as possible!

Individuals responsible for reviewing information on this form will treat it as confidential, and will provide this information only to parties responsible for correcting IAQ problems.

Building and Occupant Information

Your Name _____ Title _____

Phone _____ Email _____

Your Workspace Location _____ Survey Date _____

Business Name _____ Building Name _____

Address _____

Symptom Patterns

What kind of symptoms or discomfort are you experiencing?

Are you aware of other people with similar symptoms or concerns? Yes No

If so, what are their names and working locations? _____

Please check if you have any of these conditions that may make you susceptible to air quality problems.

- | | | |
|--|---|---|
| <input type="checkbox"/> contact lenses | <input type="checkbox"/> chronic cardiovascular disease | <input type="checkbox"/> chronic respiratory disease |
| <input type="checkbox"/> allergies | <input type="checkbox"/> undergoing chemotherapy | <input type="checkbox"/> undergoing radiation therapy |
| <input type="checkbox"/> chronic neurological problems | <input type="checkbox"/> immune system suppressed
by disease or other causes | <input type="checkbox"/> asthma |
| | | <input type="checkbox"/> other _____ |

Timing Patterns

When did your symptoms start? _____

When are they generally worst? _____

Do they go away? If so, when? _____

Have you noticed that any events (such as weather events, temperature or humidity changes, or activities in the building) tend to occur around the same time as your symptoms?

Spatial Patterns

Where are you when you experience symptoms or discomfort? _____

Where do you spend most of your time in the building? _____

Additional Information

Please share any observations about conditions in your building that might help explain your symptoms.

For example: temperature, humidity, drafts, stagnant air, odors. _____

Have you sought medical attention for your symptoms? _____

Do you have any other comments? _____

Please use this form to track data related to your indoor air quality complaint. Thank you!

Name _____ Title _____

Phone _____ Email _____

Your Workspace Location _____

On the form below, please record each occasion when you experience a symptom of ill health or discomfort that you think may be linked to air quality, an environmental condition in your building.

It is important that you record the time and date and your location within the building as accurately as possible. This information will help to identify conditions that may be associated with your problem - for example, equipment operations that may introduce air pollution into your working area.

In the Severity and Duration columns, please describe the intensity of your symptoms (for example, "mild" or "severe") and the length of time they persist, for each occurrence you record.

Please note any other observations that you think may help in identifying the cause of the problem in the Comments section.

Date	Time	Location	Symptoms	Severity	Duration

Comments

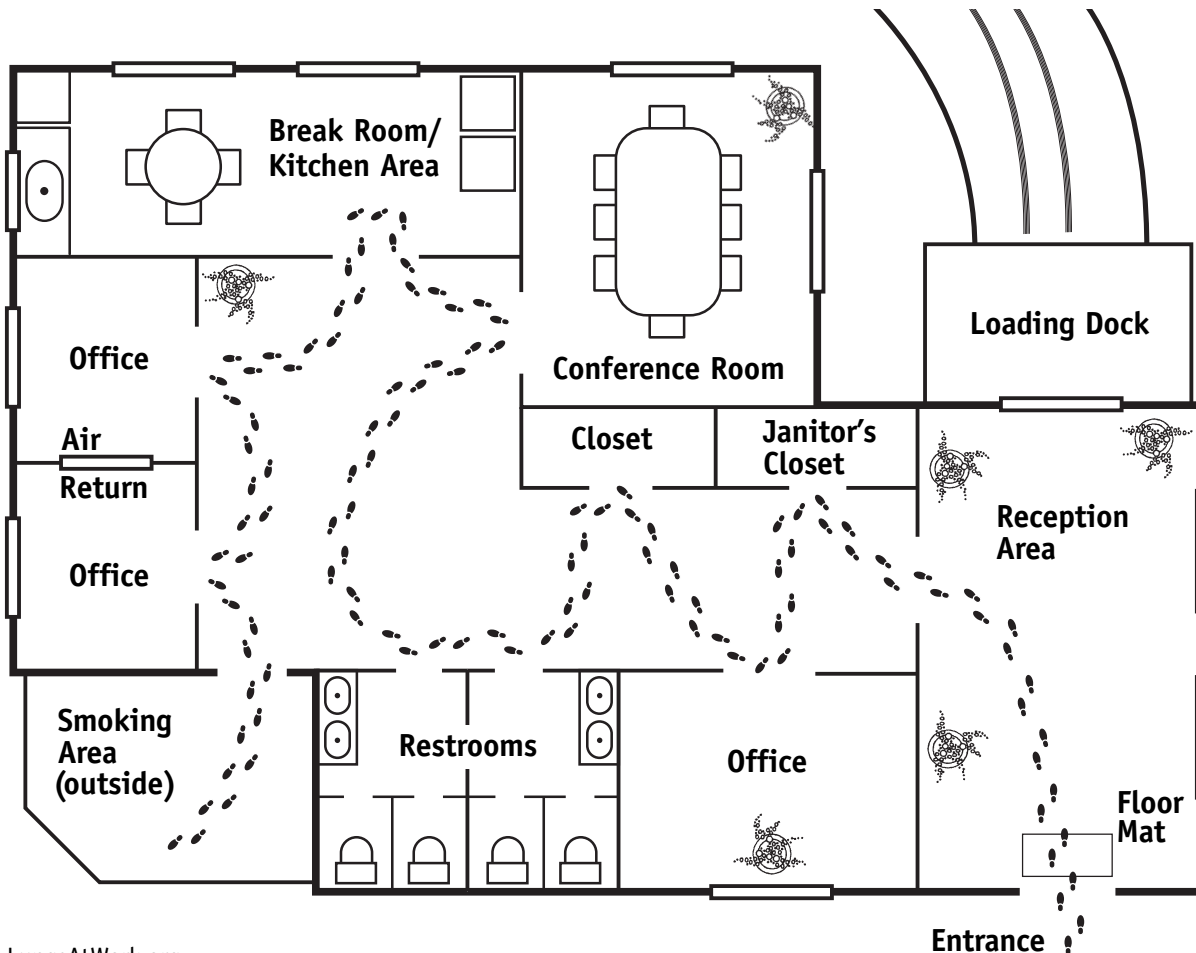
For use by Green Team members.

Business Name _____ Address _____
 Building Name _____ Floor or Suite _____
 Completed by _____ Title _____
 Phone _____ Email _____

Please use this form to record your observations of the HVAC system operations, maintenance activities and any other information about conditions inside your office that you think might be helpful in identifying the cause of the IAQ complaints in your workplace. Please report observations of physical conditions such as weather, moving or remodeling in nearby business spaces, or other external activities that you think may be related to the problems in question. Be as specific as possible and report completely and accurately. This information can help identify the cause of a suspected IAQ problem in your office. Feel free to attach additional pages to this form. **Thank you!**

Date/Time	Day of Week	Activity/Location	Observations/Comments

An IAQ Walk-Through Guide



www.LungsAtWork.org

Think about how much time you spend at work, indoors . . .

If the indoor air quality (IAQ) in your workplace is compromised by any of a number of toxic substances that can occur in office environments, your health and the health of your co-workers may be at risk.

Where Can IAQ Problems Start?

Some sources of indoor air pollution are relatively easy to track down and correct. The workplace IAQ toolkit *Lungs At Work* provides a strategy for addressing IAQ issues that can be adapted for use in any size and type of office workplace. Sometimes professional help is needed to identify and correct the cause of an office IAQ problem.

However, as *Lungs At Work* describes, individuals working in an office where an IAQ-related complaint occurs can begin to investigate and possibly resolve suspected IAQ problems. It makes good sense to check locations where pollutants are typically introduced or stored. Use this guide to walk through your office and identify possible sources of an IAQ problem.

Take A Pollution Prevention Tour Of Your Office

Take steps to keep an IAQ problem from developing! Use this form to walk through your office and make a survey of substances or situations that may be the source of an IAQ problem now, or that could compromise healthy IAQ in the future.

The resources in *Lungs At Work* will help you and your co-workers address any circumstances you find that may be affecting office IAQ, so everyone in your workplace can breathe easier!

Building Entrance - Reception Area

Particulate matter tracked in from outside can cause IAQ problems. Use good quality door mats at building entrances, and clean them regularly.

Janitor's Closet

Many commercial cleaning products contain ingredients known to be harmful to human health and the environment. Adopt a Green Cleaning program, to safeguard the health of office and housekeeping personnel. Store and use all cleaning products properly, according to label directions.

Offices - Plants Plus

Good news: many kinds of indoor plants clean the air by removing small amounts of toxics such as formaldehyde and carbon monoxide. Plants like philodendron, spider plant, peace lily and aloe vera are healthy office-mates! Be sure to drain excess water out of plant containers. Standing water can cause mold or other allergy issues, and cancel out the healthy impacts of live plants in the office.

Corners, Closets, Shelving

Dust and other particulate matter accumulates wherever clutter develops. Cluttered areas are difficult and time-consuming for housekeeping personnel to clean. Maintain a clutter-free workplace, and use closed containers for shelf and closet storage.

Rest Rooms

Many healthier options are available to replace toxic commercial products and practices used for cleaning and pest-control. How could Green Cleaning and Integrated Pest Management programs be integrated into your office operations?

Conference Room and Office Furnishings, Remodeling Materials

Volatile organic compounds (VOCs) are emitted from many sources common in office environments. These include wall paints and wood stains, desks and cabinets made from particleboard, synthetic fabrics used in wall coverings and upholstery, and flooring adhesives. Work with remodeling or construction planners to select VOC-free products and alternatives to synthetic or composite furnishing materials.

Break Room, Kitchen Areas

Products used for casual clean-up in break rooms and odors from areas where food is prepared can be a source of IAQ problems. Check product labels and replace potentially harmful products with non-toxic alternatives. If vent-fans are installed, keep them in good repair and use them regularly.

Cold Air Returns

Vents or grilles in walls or floors that don't seem to be "working" are designed to circulate air from room space back through the heating and cooling system. If air returns are blocked by furniture or clutter, air movement may be insufficient to remove pollutants from working areas.

Outside Air

Fresh air can be an asset in the office – or outside air can carry vehicle exhaust, tobacco smoke, and other pollutants indoors, where toxic substances can become harmfully concentrated. Depending on what's outside them, it may be healthier to keep windows closed. If this is true, check to make sure your office gets fresh air from a mechanical ventilation system.

Smoking Areas

Tobacco smoke has been shown to be a health hazard for anyone inhaling "secondhand" smoke, as well as for smokers themselves. Ideally, work toward establishing a smoke-free workplace. Locate designated smoking areas away from doorways and windows, to keep smoke out of working areas and normal office walkways.

Notes from your walk-through

Greening your building – and your bottom line.



The Joe Serna Jr. Cal/EPA Headquarters Building is recognized nationally as one of the most energy efficient and sustainable commercial office complexes in the country. It was developed as a public-private partnership between Thomas Properties Group, Inc. and the City of Sacramento. The 950,000 square foot office building was completed in early 2001. It is Sacramento's largest commercial high-rise real estate development project.

In 2004 Cal/EPA Headquarters became the first building certified at the Platinum level under LEED for Existing Buildings (LEED-EB).

Green Building Overview

As operators of this building, Thomas Properties Group (TPG) has incorporated state of the art green building practices. All janitorial and maintenance services, tenant improvements, and equipment replacements are carried out incorporating practices that improve air quality, reduce energy usage, and maximize resource reutilization, waste reduction, recycling and use of recycled materials. TPG has found this building to be a perfect laboratory to determine how these practices can work in a Class A office environment. In a pleasant surprise, after an initial data-tracking period, TPG documented significantly lower operational expenses compared to the operating costs typical of a comparable conventional building.

TPG invested \$500,000 to make efficiency upgrades exceeding standard capital improvements to equipment, operations and employee practices. These improvements paid for themselves in less than one year, subsequently generating \$610,000 in annual savings.

Cal/EPA is the sole tenant in this building. The mission statement for their headquarters centers on "reducing their environmental footprint in and around the building."

This single tenancy and mission combination makes it much easier to incorporate green building practices than would be the case in a multi-tenanted building.

Protecting Indoor Air Quality – Creating a Healthy Working Environment

IAQ has always been a big concern for TPG. Green operations include a commitment to avoid introducing chemicals that will affect air quality into the Cal/EPA building. Chemicals are only used if they emit low or zero VOC (Volatile Organic Compounds) and are non-odorous. Daily cleaning chemicals have been reduced to only three types, including one used 70% of the time. An integrated pest management program uses only baiting and trapping, avoiding all chemical pesticide applications.

Cal/EPA boasts an indoor environment free of smoke as well as chemicals with state-of-the-art ventilation and climate control systems. More than 80% of office space is filled with natural light. Wooded outdoor pathways provide employees with refreshing places to walk and eat lunch.

Green Cleaning Yields Energy Savings, Improves Employee Relations

The California energy crunch of 2000-2001 prompted TPG to explore ways to immediately reduce energy consumption. In the Joe Serna Jr. building, one solution was to shift janitorial staff cleaning operations into daytime hours, which dramatically reduced use of lights throughout the building at night. On this schedule the day crew comes in at 11 a.m. to begin dusting, cleaning, vacuuming (using silent equipment similar to types used in movie theaters), and removal of recycled materials. This work is completed around 5 p.m. From 5-6 p.m. cleaning crews remove wet garbage. From 6-8 p.m. they clean rest rooms using only essential lights.

At 6 p.m. all staff lighting is shut off. Interior restroom and corridor lights are left on to facilitate cleaning of these areas. Carpet cleaning and floor maintenance is performed by a five-person utility crew from 5:30 p.m. to 2 a.m., with this work typically focused on only one floor at a time so that lights are used only in areas where the crew is working.

These changes to typical night-cleaning routines have reduced energy consumption by 8% and reduced energy bills by more than \$100,000 annually.

Property managers know that the majority of tenant complaints are made about janitorial issues. Now that Cal/EPA employees see the janitorial staff working, janitorial complaints have dropped more than 70% – which equates to \$110,000 in savings on additional labor hours. The tenants have become the janitors' colleagues and supervisors, which has eliminated calls to property management regarding thefts. Furthermore, since the working hours are ending earlier, janitorial employees are able to put their children to bed at night – for the first time in many individuals' janitorial careers. This has significantly reduced staff turnover and eliminated costs associated with continuous training.

Water Conservation Saves Labor Too

In 2003 TPG introduced waterless urinals to the building. A ribbon-cutting ceremony was combined with an orientation program to educate the tenants about this green building technology. The pilot use of waterless urinals on four floors resulted in overall tenant satisfaction with equipment functions, with no smells reported. A related benefit was elimination of work orders for stuck valves and continuously running water, compared to 110 labor hours logged for engineers to repair urinals over the year prior to this installation. TPG estimated that implementation of this technology throughout the Serna building will save over 1,000,000 gallons of water annually.

Recycling Pays

The first green building practice rolled out in the Joe Serna Jr. building was the recycling program, called "Gone Today – Here Tomorrow – Recycle!" Normal staff trashcans were re-designated as paper recycling bins and each tenant received a small desktop-size garbage can. In addition to the individual desk paper bins, 210 three-in-one recycling collection stations were set up throughout the building to collect white and mixed paper, plastic and glass bottles and cans. Diverting these recyclables from the trash keeps about 202.7 tons of material out of landfills per year, which cuts annual trash disposal costs by about \$10,135.

Elimination of wet garbage from desk-side recycling containers eliminated the need for plastic trash can liners, which has annually removed approximately 1,700 cases of plastic bags from the building's waste stream for a cost savings of about \$65,000 per year. The use of reusable cloth bags in the centrally located recycling stations saves another \$27,000 per year.

Bottom-Line Benefits

TPG created an employee merit system called Employee Achievement Rewards System (E.A.R.S.) for contract employees, offering cash awards for quantifiable ideas for operational savings. After the first year of implementation, more than \$10,000 paid out in E.A.R.S. awards resulted in over \$100,000 of net operational savings.

Green Building practices have proven to be good for business as well as good for the environment within Cal/EPA. Economies resulting from TPG's green commitments translate into costs that are \$1.00 per square foot less than downtown Sacramento averages. This savings translates into \$1,000,000 per year; when a 7% capitalization rate is factored in, over \$14,000,000 of value has been added to the building. Health and comfort benefits provide a tremendous marketing asset, giving TPG the means to differentiate the values of their property from their competition in a stale real estate economy.

Cal/EPA Examples of Actual Savings

Building Operation	Cal/EPA 2003	Sacramento Downtown
Waste Removal	\$0.01	\$0.05
Cleaning Supplies	\$0.05	\$0.14
Electricity	\$0.99	\$1.59
Filters	\$0.03	\$0.06
Water	\$0.02	\$0.06
Landscape	\$0.05	\$0.09
Partial Total	\$1.15	\$1.99
Difference	\$0.84 per square foot annually	
Savings	\$807,500	

Labor Hours Reduction Savings

Janitorial	\$110,000
Engineering	\$50,000
EARS not noted above	\$40,000

To learn more about Green Building practices – and their cost-saving benefits – in the Joe Serna Jr. California EPA Headquarters, visit www.calepa.ca.gov/EPABldg/

Case Study – Parkway School District St. Louis, Missouri

Tools

How an exceptional environmental management program deals with IAQ challenges.



A handsome design feature of Parkway South High School, these exterior stone panels have been linked to multiple IAQ and remodeling problems.

The Parkway School District serves 6 suburban communities in western St. Louis County. More than 19,000 students attend school in 29 buildings with 4 administrative/support buildings. Parkway employs approximately 1250 teachers and administrative personnel and approximately 1000 support personnel. A long-standing district-wide commitment to environmental values in the classroom and in practice includes a multi-faceted recycling and waste reduction program, vigorous energy efficiency measures, and the ongoing efforts of two full-time experts to comply with a broad range of regulatory and preventative concerns, including maintenance of healthy indoor air quality. Parkway's environmental stewardship has been recognized with national, state and local awards. Businesses as well as other non-profit entities are frequent beneficiaries of the willing resource sharing of this school district's "green" champions.

Resource Conservation Manager Bill Guinther refers to Parkway's programs as an "in-house EPA." Having such extensive resources dedicated to environmental factors is unusual for a school district, a type of institution where time and money are often stretched beyond reasonable limits to meet basic needs. Parkway's environmental professionals meticulously document energy savings, income from commodities recycled, and related earnings and avoided costs in order to continually justify expenditures for personnel, equipment and other environmental program elements. Manager of Environmental Services Juliette Travous tackles planned and spontaneous environmental challenges associated with the maintenance and improvement of over 3.2 million square feet of Parkway building space.

Issues addressed by Parkway's Environmental Services Department include IAQ, lead based paint, underground storage tanks, hazardous materials/waste management, storm water permitting, spill prevention, air emissions

inventories, and other environmental regulatory compliance issues. Continually working to incorporate "green" into operations, the department manages pest control using Integrated Pest Management practices. The department manages Parkway's Workplace Safety Program, which ensures a safe working environment for all staff, students and visitors, and also works closely with the district's Health Services Department (school nurses) wherever environmental conditions could potentially impact staff or student health.

How Construction And Renovations Can Impact IAQ

Parkway South High School, the largest of the district's four secondary schools, provides a textbook example of how building renovations can affect indoor air quality issues, as well as building occupant perceptions about such issues. South High was built in 1975 with additions and internal renovations occurring through the present. Educational building design in that era favored open-air spaces, so the school featured large commons areas and partially partitioned clusters of class-size spaces. However, school personnel soon discovered that this type of spatial arrangement did not provide the kind of quiet classroom environment in which optimum teaching and learning can occur. Interior restructuring was begun within this building's first few years of use.

South High School also needed early exterior renovations. The school's stone paneled exterior walls were a very handsome design element, but they were not sealed or properly caulked when they were installed. Moisture persistently seeped into the building through those walls. The panels were removed and re-caulked and sealed in about 1995, but the caulking did not adhere correctly and the concrete spandrels between the stone panels were not sealed. Of course, water continued to infiltrate into the building around those stone panels and through the spandrels, as well as through various other sources such as roof leaks.

As renovations focused on building walls, the HVAC system - designed to serve open spaces - was not properly modified to accommodate changes in airflow through walled spaces. An HVAC system should maintain positive building air pressure. With this system's circulating capabilities impaired by the constantly changing interior configurations, it was only able to generate negative pressure levels, which sucked water through hairline cracks in exterior concrete as well as through the panels of the stone façade.

When Travous joined the Parkway staff in late 1999, her responses to complaints about discomfort in one part of the building revealed a series of structural problems that affected multiple areas, including IAQ issues. The extent to which building systems had been compromised over time would cost \$2.5 million to remediate. The ensuing renovation spanned parts of two school years and enormously intensified the district's construction workload over the two summers that were involved.

Allergy and asthma complaints were found to be concentrated in the English classroom area, which had originally been carpeted. Building occupants had thought the carpeting was causing the respiratory problems, but it had been removed prior to Travous' investigation because it was repeatedly saturated by water seeping through outside walls. With flooring ruled out as the cause of the problems, what was it?

Travous' discoveries cascaded. Throughout the school's overhead piping system, neither hot nor cold water pipes had been insulated when the school was built, so condensate had long been dripping onto ceiling tiles.

The ceiling tiles had become food for mold growth. Fan room walls were also coated with mold. Mold growth was found behind the walls adjacent to the exterior stone panels over square footage great enough to warrant that the remediation proceed in a containment situation. Two foreign language classes located along exterior walls at the school were moved to another location due to concerns about the mold behind the walls, although prior to this discovery, no health concerns were generated from these areas. Travous was sending air and swab samples to Global Environmental Laboratories, a consulting firm hired by Parkway to analyze air quality and assess the extent of South High's problems. One of Travous' air samples contained traces of *Stachybotrys*, a strain of black mold that is dense and heavy and has been linked to respiratory illnesses. Air sample analysis showed that this substance had become airborne in one area, indicating quantities in high enough concentration as to be detectable in air.

The remediation of the mold contaminated walls and the structural improvements occurred in two phases. All ceiling tiles in this high school had to be removed. An outside contractor was hired to clean the HVAC fan rooms and supply ducts and to spray a biocide-containing sealant throughout the school's ducts after they were cleaned.

Ultimately the HVAC system, including most of the ductwork, was replaced with a series of large blowers and cooling units configured for use in a traditionally compartmentalized building layout. Water pipes were completely insulated. New ceilings were installed throughout the school and the exterior panels were properly sealed.

Perception Of Problems Can Persist In Remediated Buildings

Today Parkway South High School serves over 2,000 students in a learning environment with healthy IAQ. However, the perceptions of building occupants about mold growth kept generating complaints and questions for some time after the clean-ups and renovations of 2000-2001 were complete. At that time, mold was just beginning to come to public attention as an environmental health hazard. Information about the project got into the newspapers and the mold in Parkway South High was hot news throughout summer 2000. Popular misconceptions circulated with facts, and coverage of this issue - as is often the case with environmental concerns - tended to convey the feeling of an insurmountable problem.

"Subjective feelings run high and perception of IAQ problems can be persistent, once people have experienced something like this," says Travous. "It's important to keep track of related conditions, to help people make connections between external and internal causes of complaints, and to help building occupants understand why it's important to avoid going off in pursuit of remedies that won't affect the source of a problem."

Travous diligently tracks mold and pollen counts in the St. Louis region, information that is readily available from government and media sources. She finds she receives the most IAQ complaints on days when outdoor conditions are most aggravating, particularly in fall and spring. Environmental data enables her to reassure her school constituents that building conditions are healthy even when they are experiencing problems, for example when an indoor mold count might be 120 compared to 50,000 outdoors.

She emphasizes that whether perception of IAQ problems is persistent or intermittent, it's important for a professional charged with safeguarding environmental health to be consistently thorough in response to complaints. Travous also continually educates Parkway's children and adults about ways to protect working and learning environments from many kinds of pollutants, irritants and their physical causes.

Use Your Senses - Use Common Sense And Learn From Experience!

De-cluttering space is first on the list of measures everyone is responsible for. School personnel are urged to store supplies of all kinds in plastic tubs with tight-fitting lids, not in cardboard boxes and especially not in open boxes. Travous points out that stored clutter accumulates dust, hair and all kinds of airborne irritants that will be released when someone eventually moves the items. Clutter also prevents housekeeping staff from completing effective cleaning routines in classrooms and other workspaces.

Parkway's environmental managers ask school staff members to frequently check air vents to make sure air is coming out of them. If a heating/cooling air vent or a cold-air return vent is blocked by a door or by items piled on or in front of it, school personnel learn the importance of moving such obstacles promptly.

Teachers and school administrators are asked to accurately track time-and-place details and look for patterns of circumstances that can be changed, to help resolve IAQ issues whenever a complaint occurs. For example, a Parkway

elementary teacher who reported that a student was having repeated asthma attacks thought there was a problem in her classroom. When times of those attacks were tracked it turned out they consistently followed recess periods and outdoor physical education classes, during a season when high concentrations of outdoor allergens were present. Modification of the student's activity was needed during periods of poor outdoor air quality.

When Travous needs to issue an IAQ directive, she tries to turn it into a learning opportunity. This was the case when a student experienced repeated respiratory reactions in a classroom where a hamster was kept. The student was tested by an allergist, who reported the boy was not allergic to hamsters. Shortly after this finding was confirmed, the student had another, serious attack after feeding the animal and cleaning its cage. Not realizing how subtle and interrelated IAQ factors can be, the teacher allowed this activity because she knew the boy wasn't allergic to hamsters, and the boy loved handling the hamster. Travous pointed out that something related to the animal was surely causing the reaction, such as its bedding or feces. Two options were offered to resolve the problem, that the animal be removed from the classroom, or at least that the boy should not handle it.

This situation showed how, while classroom animals can be a terrific learning resource, they are not appropriate when an individual in the class is sensitive to the animal itself or to something in its living environment.

Fragrance-based items can often cause IAQ problems, even when used with the best intentions. In another Parkway classroom, a teacher kept an oil-filled plug-in air freshener in one outlet. A student who was reporting respiratory illness was found to spend most of his day in that classroom, seated close to that outlet. The teacher was using the air-scenting device in good faith, as the kind of practice that is supposed to make a learning space feel more comfortable and inviting. However, something about that device – such as the strength of the scent itself or the chemicals producing the scent – was causing a severe reaction for one student. When the air-freshener was removed, the student's respiratory attacks stopped, and the incident was turned to good effect as another way to educate about IAQ protection.

Learn more about the Parkway School District at www.pkwy.k12.mo.us.

Case Study - Local Governments Validate Green Cleaning

Tools

Promoting cost-effective choices that safeguard worker health.

Local government purchasers around the U.S. are reporting positive outcomes from implementing Green Cleaning programs. Benefits attributed to the use of less- or non-toxic Green Cleaning products include comparable or better performance as well as equal or lower costs compared to their previous cleaners. Purchasers have also reported reductions in work related janitorial injuries and associated health claims. For example:

- Santa Monica, California, began buying low-toxicity cleaning products as part of an aggressive Green Purchasing Policy the city adopted in the early 1990s. These purchases have eliminated 3,200 pounds of hazardous materials annually from Santa Monica's municipal waste stream, while saving the city approximately 5% per year on cleaning product expenses.
- St. Paul, Minnesota, tested the performance of ten non-toxic cleaning products on typical office building surfaces, including glass, toilets, sinks, walls, floors and furniture. Testing occurred in the heavily trafficked City Hall Annex. The custodial staff reported that six of the ten alternative products worked as well as, or better than, the products they replaced. Custodians also noticed a reduction in product fumes they associated with physical sensations like light-headedness and tightening of the chest. Overall, the non-toxic products tested were also comparable in price to their more hazardous counterparts.

- Richmond, California, commissioned a study of janitorial injury compensation claims as part of the city's process of switching to a Green Cleaning purchasing program. Findings included claims costing an average of \$615 for each cleaning chemical accident requiring medical treatment (excluding long-term disability costs). This study also revealed that 1 out of 100 janitors had reported injuries attributable to the cleaning products they used. By switching to use of less toxic cleaning products, Richmond's janitorial contractors expect to reduce the number, severity and cost of cleaning-related accidents. The city also anticipates that Green Cleaning purchases will eliminate 3,000 pounds of hazardous material and associated disposal costs per year.

In addition to cost concerns, government purchasers are increasingly aware of how cleaning impacts environmental conditions - such as indoor air quality, water quality and waste management – as well as human health. These factors are motivating decision-makers at every level of government to adopt Green Cleaning standards for purchasing and everyday practice.

Demand From Government Purchasers Drives Product Availability And Diversity

Purchasers for school districts, public universities, and city, county and state governments are held publicly accountable for safety as well as spending. Public sector demand for Green Cleaning resources is boosting product availability and driving product diversification. The substantial purchasing power of public agencies is also helping to drive down the “premium” costs that are often associated with products offering environmental protection options.

Multnomah County, Oregon, experienced these processes. In 1999 the county issued a Request for Proposals that specified use of Green Cleaning products in custodial services. County officials got little bidder response to the specialized terms of their RFP. The county’s specifications included:

- non-solvent-based degreasers
- unscented floor wax
- non-acidic and non-alkaline toilet bowl cleaners
- water-based stainless steel polish
- non-alcohol-based and ammonia-free window cleaners
- non-solvent-based non-acidic non-alkaline liquid cleaners

County personnel worked with their contractors to source these kinds of products and try them in eight county health facilities. They tried different products as manufacturers expanded their “green” lines. Success of this pilot program led to a 2005 resolution mandating Green Cleaning for all Multnomah County facilities.

Developing Standards For Green Product Performance

Increased demand for safer products raises concerns about standards used to earn a “green” designation. Local governments have helped to validate Green Cleaning product claims.

In 2003, the non-profit Center for a New American Dream convened a nationwide working group of public sector buyers to examine standardization issues. This group’s work to develop consensus-based criteria for Green Cleaning product verification was funded by the U.S. EPA. Participants represented more than \$15 million in annual cleaning product purchases. Some of the first governments that had attempted to define and purchase safer cleaning products were involved, including Massachusetts and Minnesota, Washington State’s King County, and the City of Santa Monica.

The group dealt with standards for toxicity, carcinogens, reproductive toxins, skin and eye irritation, skin sensitization, combustibility, smog, ozone levels, indoor air quality, aquatic toxicity, eutrophication, aquatic biodegradability, concentrates, fragrances, and prohibited chemicals.

This group examined many existing standards and considered developing its own set before deciding that Green Seal’s standard for environmentally preferable institutional cleaners met their needs. The government working group’s consensus to adopt Green Seal as a national standard has made it much easier for purchasers to make reputable product choices when developing a Green Cleaning plan.

Local government efforts build on a purchasing policy foundation set in 1993, when the U.S. EPA’s Environmentally Preferable Purchasing (EPP) program became the standard for federal agencies. EPP included guidelines for choosing products ranging from paper supplies to cleaning products. EPP standards enabled government agencies to consider environmental impacts along with price, performance and other traditional factors when deciding what to buy. EPP defines environmentally preferable products and services as those that have reduced negative impacts on human health and the environment, compared with competing products or services that serve the same purpose. EPP includes Green Seal verification of Green Cleaning products. Federal procurement officials are required to give preference to products that meet EPP guidelines. Other public sector purchasers can choose to apply EPP to purchasing decisions.

Purchasing agents in any kind of business can draw on resources explored by government agencies to upgrade a cleaning program to verified “green” standards. This is true whether cleaning is an in-house or contracted function. Implementation of a Green Cleaning program provides a rare opportunity to simultaneously safeguard employee health, protect the environment and save money.

Sources: Center for New American Dream
www.newdream.org/clean/

U.S. EPA, Environmentally Preferable Purchasing
www.epa.gov/epp/

Better Breathing Bureau Skit

Tools

Use this skit to introduce Indoor Air Quality issues in your workplace. A humorous approach to serious issues can build motivation needed to bring IAQ problems into the open and foster teamwork to help resolve them.

Presentation tips:

- Give each player a copy of the script with his or her part(s) highlighted.
- Players can read their parts – no memorization is necessary.
- Think “radio theater” for the sound effects (SFX). They can easily be added by a person’s voice, or they can be produced using props available around the office.

- Have fun with the skit! Introduce it with a reference to the importance of understanding, problem-solving and maintaining healthy IAQ at work.
- After performing the skit, take time to facilitate a brief discussion of IAQ conditions in your office. Brief fellow workers on the process of addressing any problems, as detailed in *Lungs At Work*.

Scenario One

Narrator It’s a typical day in an office where Quality is an issue that’s always in the air...and protecting Indoor Air Quality is Job One for our hotline operators...

SFX *Phone Rings.*

Operator #1 Better Breathing Bureau! This is Ms. Wisp. How can I help you be healthier?

Caller #1 (*gasping*) I – I feel like there’s no air in my office! It’s so still in here – nothing’s moving-nothing ever moves except – WHOOPS! WHOAHHHH!

SFX *Loud thumps and whumps of a body falling, piles of books or file boxes falling as caller collides with workspace clutter.*

Caller #1 (*moaning*) Oh darn this stuff, it’s everywhere in here. Now where is that Tye-Dee Project folder? It was right on top of that pile this morning ... (*wheezing*) – Yow! Now there’s a cloud of dust in here. (*more gasping, wheezing, coughing, etc.*)

Operator #1 Ma’am! Pick yourself up, dust yourself off – and look around at your working area! By any chance, IS IT CLUTTERED?

Caller #1 Well....Um...Yes, I guess it’s kind of messy ... LOOK AT THAT! It’s that pearl earring I lost last spring, down in that metal grate thingie on the floor – how wonderffffff – FEW! (*sneezes*)

Operator #1 Ma’am, that “thingie” is the cold air return for your working area. It wasn’t by any chance blocked by that pile of files or boxes or whatever it was that you tripped over a moment ago, was it?

Caller #1 Why yes! I remember seeing that thing – like a heating duct - when I first moved in here, but no air ever came out of it so I used that corner for a little extra out-of-the way storage for ... (*coughs*)

Operator #1 And are you the ONLY person in your working area, or do you share space with others?

Caller #1 There are six of us in this cluster of cubicles.

SFX *Sneezes, gasping, coughing from somewhere near the caller’s phone,*

Caller #1 Oh dear, that cloud is still moving in here . . .

Narrator For healthier air in any workplace: CLEAN UP CLUTTER! Piles of stored flotsam can block air-return vents, inhibiting healthy air circulation. When dust accumulates on “open storage” areas, air-polluting particles are just waiting to fly into breathing space, whenever anyone moves or even passes close to these “dumping corners.” The first thing to do to safeguard healthy Indoor Air Quality is to pick up - clean up - remove obstructions so that indoor air can circulate. Store the stuff you rarely use in boxes, closets or drawers that can be easily closed and EASILY CLEANED.

Scenario Two

SFX *Liquid pouring into cup.*

Employee A Yes, thanks – I’ll take a cup of coffee too. Say, have you heard the news? We’re going to get our office painted again next month.

Employee B Great! I wonder what the new color scheme will be?

Employee A I can’t even think about that, I’m so worried about how I’ll feel when the work is going on.

Employee B What do you mean?

Employee A Last time we had remodeling done, my head ached and I felt dizzy every day they were painting. On the last day the painters were here, my sinuses were killing me!

Employee B Wow! Maybe you had a reaction to something in the paint. Let’s see, I know what that stuff is called: VOCs! Volatile organic compounds. They’re chemicals in the paint that are released into the air. Like air pollution, only indoors. More coffee?

Employee A No, thanks. It was air pollution all right. Worse than sitting in traffic with the car windows open. I don't want to go through that again! I hate to use up vacation days, but I don't think I can be here when the office is being painted. Even when the painters worked at night, I felt terrible the next day. I can't imagine how the painters tolerate those VOCs! They're like poison! I wish there was something I could do.

Employee B Say, do you think the boss picked out the new paint yet?

Employee A Maybe not, since the job's still a month away.

Employee B Well then, there is something we can do. I read about paint that's available now that won't emit VOCs or any other harmful chemicals into the air. Maybe it's not too late to suggest using this kind of paint. We can try!

Employee A Why would the boss care about this? She might say it's just my problem.

Employee B It'll be her problem if she has to pay you to take time off because you know the paint fumes will make you sick! Especially with the project deadlines we have coming up next month. The time you'd be off work will probably cost the business more than any special paint! Let's talk to the boss together. We'll go as a team – a Green Team! That way it won't seem like “just your problem.” Besides, other people might be affected by the paint fumes too, so we'll be helping to protect the air quality for everyone! And maybe we can get a look at the colors ...

Narrator Speaking up to safeguard air quality – and taking a Green Team approach to problem-solving – will benefit everyone in your workplace – and benefit your business at the bottom line! Substances like VOCs, the Volatile Organic Compounds in paint and other remodeling products – as well as the chemicals in cleaning products – introduce pollutants into the air. When employee health is compromised by air polluting substances, lost time and productivity will cost your business money. There's more to learn about IAQ – Indoor Air Quality – but one thing's certain: working together to maintain healthy indoor air quality makes good business sense!

Scenario Three

SFX *Phone rings.*

Operator #2 Thank you for calling the Better Breathing Bureau. Workplace Air Quality is our business!

Caller #2 *(whispering)* I'm calling from a business on the seventh floor. There's a man I've never seen before walking through our office. He's got a flashlight and he's looking into the air vents ... now he's doing something with the thermostats . . . should I call security?

Operator #2 No, you should introduce yourself to him. He sounds like your building's Facility Manager.

Caller #2 *(regular voice)* Facility Manager? I've never heard of such a person! What does he do?

Operator #2 Most people who work in multi-story buildings probably don't know their Facility Manager. He's the person responsible for keeping your building running, by maintaining things like the heating, air conditioning and ventilation system.

Caller #2 Ventilation! We've been having problems with the air in our office. It's been so stuffy in here, and the man who works across the aisle from me – he has asthma – has been saying he can barely breathe. We told the boss but he didn't seem to know what to do about it.

Operator #2 Well, it sounds like your boss figured out something he could do! He called your building's Facility Manager.

Caller #2 What can *he* do?

Operator #2 A Facility Manager can check out the equipment that circulates air through your working space, to make sure it's functioning properly. He'll make modifications or repairs if they are needed. Proper functioning of these kinds of building systems – called HVAC – is essential to maintaining a healthy working environment for building occupants like you and your co-workers.

Caller #2 What can *we* do to help?

Operator #2 If the problem persists, you can keep track of factors related to the complaints, to give your Facility Manager information that will help him find the source of the problem. Get a copy of ***Lungs At Work: An Indoor Air Quality Toolkit***. It's designed to give office workers important information about causes of air quality problems, and ways to help you and your colleagues address a problem like the one you describe.

Caller #2 No! Where can I get a copy?

Operator #2 From the St. Louis Community Air Project. Call them at 314-533-9104, ext. 205 or you can download this toolkit from www.lungsatwork.org. It's absolutely free!

Narrator It's important to resolve air quality problems when they arise in the workplace. Employees can learn how to take action on these issues, before they become a serious threat to people's health. ***Lungs At Work*** provides many resources, including steps you can take right away, and referrals to the kinds of technical information needed by Facility Managers. Get a copy of ***Lungs At Work*** for your office today – to safeguard indoor air quality because...

All Players Wherever you work...EVERYBODY BREATHE!

This Glossary includes terms used in *Lungs at Work* as well as other terms commonly associated with IAQ management and remediation. Use it to improve Green Team communications with facility managers and IAQ experts.

Sources: U.S. EPA *Building Air Quality – A Guide for Building Owners and Facility Managers* and various online sources.

ACGIH – American Conference of Governmental Industrial Hygienists.

ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

ASTM – American Society for Testing and Materials, a safety and performance certification agency.

Air Cleaning – An IAQ control strategy to remove various airborne particulates and/or gases from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption.

Air Exchange Rate – Used in two ways: 1) the number of times that the outdoor air replaces the volume of air in a building per unit time, typically expressed as air changes per hour; 2) the number of times that the ventilation system replaces the air in a room or area within the building.

Air Intake – Source points where fresh air is introduced into a building's HVAC system.

Antimicrobial – Agent that kills microbial growth. See "disinfectant," "sanitizer", and "sterilizer."

Biological Contaminants – Agents derived from or that are living organisms (for example, viruses, bacteria, fungi, and mammal and bird antigens) that can be inhaled and can cause many types of health effects including allergic reactions, respiratory disorders, hypersensitivity diseases, and infectious diseases. Also referred to as "microbiologicals" or "microbials."

Breathing Zone – Area of a room in which occupants breathe as they stand, sit, walk or lie down.

Building Envelope – Elements of the building, including all external building materials, windows, and walls, which enclose the internal space.

Building-Related Illness – Diagnosable illness whose symptoms can be identified and whose cause can be directly attributed to airborne building pollutants; for example, Legionnaire's disease, hypersensitivity pneumonitis.

CFM – Cubic feet per minute; a measurement of airflow that indicates how many cubic feet of air pass by a stationary point in one minute. The higher the number, the more air is being forced through the system.

CO – Carbon monoxide. An odorless, colorless, tasteless and toxic gas, produced by incomplete oxidation of carbon during combustion.

CO₂ – Carbon dioxide. An odorless, colorless gas produced by human and animal respiration and burning of fossil fuels.

Ceiling Plenum – Space above a suspended ceiling that accommodates the mechanical and electrical equipment and that is used as part of the air distribution system. The space is kept under negative pressure.

Commissioning – Start-up of a building that includes testing and adjusting HVAC, electrical, plumbing, and other systems to assure proper functioning and adherence to design criteria. Commissioning also includes the instruction of building representatives in the use of the building systems. These processes are key criteria for certification of green buildings under the U. S. Green Building Council's LEED rating system.

Conditioned Air – Air that has been heated, cooled, humidified, or dehumidified to maintain an interior space within the "comfort zone," sometimes referred to as "tempered" air.

Constant Air Volume Systems – Air handling system that provides a constant airflow while varying the temperature to meet heating and cooling needs.

Dampers – Controls that vary airflow through an air outlet, inlet, or duct. A damper position may be immovable, manually adjustable, or part of an automated control system.

Diffusers and Grilles – Components of a ventilation system that distribute and diffuse air to promote air circulation in the occupied space. Diffusers supply air and grilles return air.

Disinfectants – One of three groups of antimicrobials registered by the U.S. EPA for public health uses. EPA considers an antimicrobial to be a disinfectant when it destroys or irreversibly inactivates infectious or other undesirable organisms, but not necessarily their spores. EPA registers three types of disinfectant products based upon submitted efficacy data: limited, general or broad spectrum, and hospital disinfectant.

EPA – United States Environmental Protection Agency, the government agency responsible since 1970 for safeguarding human health and the health of the natural environment – air, water, land – upon which life depends.

ETS – Environmental tobacco smoke.

Environmental Agents – Conditions other than indoor air contaminants that cause stress, comfort, and/or health problems; for example, humidity extremes, drafts, lack of air circulation, noise, and overcrowding.

Ergonomics – Applied science that investigates the impact of people's physical environment on their health and comfort; for example, determining the proper chair height for computer operators.

Exhaust Ventilation – Mechanical removal of air from a portion of a building; for example, a piece of equipment, room, or general area.

Gas Sorption – Devices used to reduce levels of airborne gaseous compounds by passing the air through materials that extract the gases. The performance of solid sorbets is dependent on the airflow rate, concentration of the pollutants, presence of other gases or vapors, and other factors.

HEPA – High efficiency particulate arrestance, a designation applied to air filters.

HVAC – Heating, ventilation, and air conditioning system.

Hypersensitivity Diseases – Diseases characterized by allergic responses to animal antigens. The hypersensitivity diseases most clearly associated with indoor air quality are asthma, rhinitis, and hypersensitivity pneumonitis. Hypersensitivity pneumonitis is a rare but serious disease that involves progressive lung damage as long as there is exposure to the causative agent.

IAQ – Indoor air quality.

IPM – Integrated pest management, processes offering alternatives to pest control using toxic chemical pesticides.

Indicator Compounds – Chemical compounds, such as carbon dioxide, whose presence at certain concentrations may be used to estimate certain building conditions; for example, airflow or presence of pollutant sources.

LEED® – A voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Developed by USGBC, LEED (Leadership in Energy and Environmental Design) is currently being applied to projects in new commercial construction (**LEED-NC**), and the renovation of commercial interiors (**LEED-CI**) and existing commercial buildings (**LEED-EB**); LEED standards for homes (**LEED-H**), core-and-shell development (**LEED-CS**) and the sustainable development of entire neighborhoods (**LEED-ND**) are in pilot stages as of 2007. LEED is a registered trademark of USGBC.

Legionnaire's Disease – A bacterial infection much like pneumonia, spread by contaminated airborne mist, which was first identified when many people became ill while attending an American Legion Convention.

MSDS – Material safety data sheet. OSHA-mandated document prepared by a product supplier or manufacturer, clearly stating hazardous nature, ingredients, precautions to follow, health effects and safe handling/storage information.

Make-up Air – Air brought into a building from the outdoors through the ventilation system that has not been previously circulated through the system.

Microbiologicals – See “Biological Contaminants.”

Multiple Chemical Sensitivity – A condition in which a person is considered to be sensitive to a number of chemicals at very low concentrations. There are a number of views about the existence, potential causes, and possible remedial actions regarding this phenomenon.

NIOSH – National Institute for Occupational Safety and Health, a part of the federal Centers for Disease Control.

NTIS – National Technical Information Service. This U.S. Department of Commerce Web site, www.ntis.gov, is a central resource for government-funded scientific, technical, engineering and business related information.

Negative Pressure – Condition that exists when less air is supplied to a space than is exhausted from the space, so the air pressure within that space is less than that in surrounding areas.

OSHA – Occupational Safety and Health Administration. A Federal agency under the Department of Labor, which publishes and enforces safety and health regulations for most businesses and industries in the United States.

Ozone – A nearly colorless, gaseous form of oxygen with a characteristic odor like chlorine. Its formula is O₃. Ozone in the stratosphere shields the earth from ultraviolet radiation; ozone concentrated in the lower atmosphere is a pollutant.

PEL – Permissible Exposure Limit is a legal limit in the United States, set by OSHA, for personal exposure to a substance, usually expressed in parts per million (ppm), or sometimes in milligrams per cubic meter (mg/m³). Exposure is defined as a time-weighted average (TWA). This means that, for limited periods, a worker may be exposed to concentrations that are higher than the PEL, so long as the average concentration over eight hours remains lower.

Particulate Matter (PM) – Fine particles of a solid (like smoke, dust and pollen) or a liquid (aerosol) suspended in a gas such as oxygen. Particulates range in size from less than 10 nanometers to more than 100 micrometers in diameter. PM that are inhaled can cause respiratory health problems.

Plenum – Air compartment connected to a duct or ducts.

Positive Pressure – Condition that exists when more air is supplied to a space than is exhausted, so the air pressure within that space is greater than that in surrounding areas.

Psychosocial Factors – Psychological, organizational, and personal stressors that could produce symptoms similar to poor indoor air quality.

RELs – Recommended exposure limits. Limits on levels of worker exposure to toxic substances, based on human and animal studies and recommended by NIOSH; usually more conservative than TLVs.

Radiant Heat Transfer – Occurs when there is a large difference between the temperatures of two surfaces that are exposed to each other, but are not touching; for example, the sun heating the earth or surfaces in an office heated by direct sunlight. Coatings on windows and proper insulation can moderate this transfer, facilitating efficient control of indoor environmental quality.

Re-entrainment – Situation that occurs when the air being exhausted from a building is immediately brought back into the system through the air intake and other openings in the building envelope.

Sanitizer – One of three groups of antimicrobials registered by EPA for public health uses. EPA considers an antimicrobial to be a sanitizer when it reduces but does not necessarily eliminate all the microorganisms on a treated surface. To be a registered sanitizer, the test results for a product must show a reduction of at least 99.9% in the number of each test microorganism over the parallel control.

Short-circuiting – Situation that occurs when supply air flows to exhaust registers before entering the breathing zone. To avoid short-circuiting, the supply air must be delivered at a temperature and velocity that results in mixing throughout the space.

Sick Building Syndrome – Term sometimes used to describe situations in which building occupants experience acute health and/or comfort effects that appear to be linked to time spent in a particular building, but where no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be spread throughout the building.

Soil Gases – Gases that enter a building from the surrounding ground; for example, radon, volatile organics, pesticides.

Stack Effect – Pressure-driven airflow produced by convection as heated air rises, creating a positive pressure area at the top of a building and a negative pressure area at the bottom of a building. The stack effect can overpower a mechanical system and disrupt ventilation and circulation in a building.

Static Pressure – Condition that exists when an equal amount of air is supplied to and exhausted from a space. At static pressure, equilibrium has been reached.

Sterilizer – One of three groups of antimicrobials registered by EPA for public health uses. EPA considers an antimicrobial to be a sterilizer when it destroys or eliminates all forms of bacteria, fungi, viruses, and their spores. Because spores are considered the most difficult form of a microorganism to destroy, EPA considers the term sporicide to be synonymous with “sterilizer.”

TLVs – Threshold Limit Values. Annually updated guidelines defined by the industry and governmental members of ACGIH, TLV’s are recommended values, not legal limits. They do not guarantee protection to all workers and are not intended to define community exposure. They are not the fine line between safe and unsafe; rather, TLVs are values that should not be exceeded. The goal is to minimize workers’ exposure to hazardous concentrations as much as possible.

TVOCs – Total volatile organic compounds, a measure representing the sum of all VOCs present in the air to provide an approximate indication of pollutant levels. Indoor air typically contains hundreds of different VOCs in very low concentrations, some of which can have additive effects when present in combinations.

Toxics – Poisonous substances. This term applies to natural substances, such as those found in poisonous mushrooms or in a snake’s venom; to poisonous artificial products introduced into the environment due to human activity, such as industrial waste products and pesticides; also to harmful substances located on a property, which may include asbestos, lead, or oil residue.

Tracer Gases – Compounds, such as sulfur hexafluoride, which are used to identify suspected pollutant pathways and to quantify ventilation rates. Tracer gases may be detected qualitatively by their odor or quantitatively by air monitoring equipment.

USGBC – The U.S. Green Building Council, a non-profit organization working to promote buildings that are environmentally responsible, profitable and healthy places to live and work. USGBC’s national and chapter members represent all fields in the building industry.

VAV – Variable air volume system. A mechanical HVAC system capable of serving multiple zones, which conditions the air to a constant temperature, varies outside airflow and controls the temperature maintained in a zone by controlling the amount of heated or cooled air supplied to the zone to ensure thermal comfort.

VOCs – See “Volatile Organic Compounds.”

Ventilation Air – Defined as the total air, which is a combination of the air brought into a building system from the outdoors and the air that is being recirculated within the building. Sometimes, however, used in reference only to the air brought into the system from the outdoors.

Volatile Organic Compounds (VOCs) – Compounds that evaporate from the many housekeeping, maintenance, and building products made with organic chemicals. These compounds are released from products that are being used and that are in storage. In sufficient quantities, VOCs can cause eye, nose, and throat irritations, headaches, dizziness, visual disorders, memory impairment; some are known to cause cancer in animals; some are suspected of causing, or are known to cause, cancer in humans. At present, not much is known about what health effects occur at the levels of VOCs typically found in public and commercial buildings.

WHO – World Health Organization, an agency of the United Nations founded in 1948 to promote technical cooperation for health among nations, carry out programs to control and eradicate disease, and strive to improve the quality of human life.

Questions about indoor air quality

What is good IAQ?

Good indoor air quality includes:

- Proper temperature and humidity control
- Air free from odors, dust and other particulate matter, chemical pollutants and other contaminants
- Sufficient circulation to prevent stuffiness without causing drafts

What causes IAQ problems?

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems. These sources can include:

- Improper operation of HVAC or high volume copying equipment
- Cleaning materials and procedures
- Pollutants emitted during building or remodeling from substances such as
 - Adhesives
 - Paints and other coatings
 - Fabrics
 - Composite wood products

Human activities such as smoking, cooking and use of odorous cosmetic or air-treatment products can also impact indoor air quality.

Inadequate ventilation can increase indoor pollutant levels by not bringing in enough outdoor air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of a building. High temperature and humidity levels can also increase concentrations of some pollutants.

How does ventilation affect IAQ?

If too little outdoor air circulates through a building, pollutants can accumulate to levels that can pose health and comfort problems.

Indoor air quality began to decline in the 1970's after the energy crisis of that era prompted the building of air-tight houses and office buildings. When exterior leaks, including spaces around doors and windows, began to be vigilantly sealed, interior air circulation was diminished. The introduction of fresh "makeup" air through air handling systems many times became reduced or even eliminated to save the cost of the

energy to heat or cool this fresh air. Pollutants are trapped in such tightly constructed buildings, becoming much more concentrated than they would be outdoors or in well-ventilated indoor spaces.

For healthy IAQ, it's important to balance a tight building with sufficient fresh air that is efficiently circulated by a well-maintained HVAC system.

How does outdoor air enter a building?

Outdoor air enters and leaves a building by: infiltration, natural ventilation, and mechanical ventilation.

In the process known as infiltration, outdoor air flows into a building through openings such as windows and doors, and through spaces like exterior joints and cracks around building openings.

In natural ventilation, air moves through a building when windows and doors are intentionally opened. Air movement associated with infiltration and natural ventilation is caused by air temperature differences between indoors and outdoors and by wind.

Finally, there are a number of mechanical ventilation devices, from outdoor-vented fans that intermittently remove air from a single room, such as bathrooms or a kitchen, to air handling systems that use fans and duct work to continuously remove indoor air and distribute filtered and conditioned outdoor air through a building.

The rate at which outdoor air replaces indoor air is described as the air exchange rate. When there is little infiltration, natural ventilation, or mechanical ventilation, the air exchange rate is low and pollutant levels can increase.

How does humidity affect IAQ?

Elevated relative humidity at a surface – 70 percent or higher – can lead to problems with mold, corrosion, decay and other moisture related deterioration. When relative humidity reaches 100 percent, condensation can occur on surfaces leading to a whole host of additional problems. An elevated relative humidity in carpet and within fabrics can lead to dust mite infestation and mildew (mildew is mold growing on fabrics).

Low relative humidity can lead to physical discomfort, shrinkage of wood floors and wood furniture, cracking of paint on wood trim and static electricity discharges.

Indoor humidification should be high enough to be comfortable, but low enough to avoid moisture problems associated with mold, corrosion, decay, and condensation.

Are some individuals at greater risk from indoor air pollution than others?

Yes, individuals who spend the longest periods of time indoors are often those most susceptible to the adverse effects of indoor air pollution. This at-risk population includes many people who work in office environments, especially those with chronic illnesses, such as respiratory or cardiovascular disease.

How does indoor air pollution affect your health?

Health effects can include irritation of the eyes, nose, and throat, headache, dizziness, fatigue, and allergy-type symptoms. Usually these symptoms are short-term, and disappear when the person is away from the source.

More serious symptoms such as asthma, hypersensitivity pneumonitis, and humidifier fever can also affect some individuals after exposure to certain indoor air pollutants.

There is a tremendous amount of variation in the sensitivity among individuals to indoor air pollutants. Some people may never experience any symptoms while others may truly suffer.

What are some of the major indoor air pollutants that might be found in an office building?

Typical pollutants include:

- Environmental Tobacco Smoke
- Biologicals – Bacteria, mold and mildew, viruses, animal dander, pollen, dust mites. These are more likely to be a problem in buildings with high humidity, or water-damage.
- Carbon Monoxide – From unvented gas appliances, leaking furnaces, vehicle exhaust entering windows or doors. Low levels can cause headaches, flu-like symptoms. High levels can be fatal.

- Respirable Particles – From construction, combustion of fuels, or substances tracked in from outdoors.
- Organic Gases – From products including paints and other coatings; paint strippers and other solvents; wood preservatives; aerosol sprays; cleansers and disinfectants; air fresheners; improperly stored or mixed janitorial or printing/copying chemicals; art supplies; dry-cleaned clothing.
- Formaldehyde – Used to manufacture pressed wood products (hardwood plywood paneling, particle board, fiberboard) and furniture made with pressed wood products; or urea-formaldehyde foam insulation.
- Pesticides – Used to kill insect or rodent pests, in building spaces or on indoor plants.

How can you identify the cause of an IAQ problem?

Because many symptoms brought on by an IAQ problem may be difficult to distinguish from viruses or allergies, care must be taken to identify details and patterns associated with an IAQ complaint.

For example, are symptoms worse while an affected individual is in a particular building space? Do they dissipate when a person is away for several days? What kinds of activities that could affect IAQ are taking place in the affected situation? Examples of such activities are smoking, cleaning, remodeling, or operation of construction, printing or cleaning equipment.

Detailed, accurate tracking of this kind of circumstantial data and analysis of observable patterns can sometimes help co-workers alleviate a problem with office IAQ. Collection of this kind of data can also significantly assist outside professionals, such as facility managers of multi-tenant buildings or environmental specialists, if a situation warrants calling in such resources to resolve suspected IAQ issues.

Sources: U.S. EPA, *The Inside Story: A Guide to Indoor Air Quality* (1995)

Texas Department of State Health Services, *Indoor Air Quality Program Branch* (2001)

www.dshs.state.tx.us

Centers for Disease Control and Prevention (CDC)

Information on health-related topics including environmental and occupational health.

www.cdc.gov
(800) 311-3435

National Institute of Health (NIH)

Part of the U.S. Department of Health and Human Services.
www.nih.gov

National Institute for Occupational Safety and Health (NIOSH)

Part of the Centers for Disease Control providing health and safety information with a workplace orientation, including an IAQ Fact Sheet available in Spanish and English.

www.cdc.gov/niosh
(800) 35-NIOSH (800-356-4674)

Occupational Safety & Health Administration (OSHA)

Information on worker and workplace safety.

www.osha.gov
(800) 321-OSHA (800-321-6742)

Office of the Federal Environmental Executive (OFEE)

Provides guidelines for environmentally preferable janitorial products and services.

www.ofee.gov/gp/greenjanitorial.html

Tox Town

Presented by the National Medical Library and National Institutes of Health, this interactive website details sources of pollution at home, at work and in the community and gives links to preventative and problem-solving resources.
http://toxtown.nlm.nih.gov/index.html

U.S. Consumer Product Safety Commission

Conducts testing and provides resources promoting public safety.

www.cpsc.gov

U.S. Environmental Protection Agency IAQ Home Page

www.epa.gov/iaq

U.S. EPA IAQ Information Clearinghouse

This clearinghouse maintains indoor air-related documents, listing of state IAQ contacts and regional EPA contacts, and provides answers to IAQ questions.

Phone: (800) 438-4318 or (703) 356-4020

Fax: (703) 821-8236

Email: iaqinfo@aol.com

U.S. EPA IAQ Publications

Access downloadable versions and order print or CD copies (formats vary by title) www.epa.gov/iaq/pubs

Resources available through this site include:

IAQ Building Education and Assessment Model (I-BEAM)

An Office Building Occupant's Guide to IAQ

Building Air Quality – A Guide for Building Owners and Facility Managers

Building Air Quality Action Plan (for Commercial Buildings)

Indoor Air Pollution: An Introduction for Health Professionals

The Inside Story: A Guide to Indoor Air Quality

Mold Remediation in Schools and Commercial Buildings

Building And Product Certification Resources

Air Quality Sciences

A GREENGUARD testing and certification partner.
www.aqs.com

Carpet and Rug Institute (CRI)

www.carpet-rug.com
(800) 882-8846

GREENGUARD Environmental Institute

www.greenguard.org
(800) 427-9681

Green Seal

www.greenseal.org
(202) 872-6400

U.S. Green Building Council (USGBC)

National non-profit providing LEED®, an independent third-party green building certification program, plus diverse professional development resources for the building industry.

www.usgbc.org

American College of Occupational and Environmental Medicine (ACOEM)

Referrals to physicians who have experience with environmental exposures.
www.siouxland.com/acoem/
 (847) 818-1800

American Industrial Hygiene Association (AIHA)

Information on industrial hygiene and IAQ issues, including downloadable consumer education brochures.
www.aiha.org
 (703) 849-888

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc (ASHRAE)

Information on engineering issues and IAQ.
www.ashrae.org
 (800) 527-4723

Building Owners and Managers Association (BOMA)

Professional resources, including IAQ information and local BOMA contacts, are available through this website.
www.boma.org

Indoor Air Quality Association

Provides education, research and resources for a multi-disciplinary professional audience.
www.iaqa.org

International Facility Management Association (IFMA)

Professional resources, including IAQ information and local IFMA contacts, are available through this website.
www.ifma.org

International Sanitary Supply Association (ISSA)

Education and training on cleaning and maintenance.
www.issa.com
 (800) 225-4772

Sheet Metal & Air Conditioning Contractors' National Association (SMACNA)

Technical information on topics such as air conditioning and air ducts.
www.smacna.org
 (703) 803-2980

Other Resource Organizations

American Institute of Architects (AIA) Committee on the Environment

This special focus within a national professional association integrates design quality with environmental performance in buildings.
www.aia.org/cote_default/

American Lung Association (ALA)

National and state offices of this organization provide resources to improve respiratory health and air quality, including focus on IAQ and smoking cessation.
www.lungusa.org
 (800) LUNG-USA (800-586-4872)

ALA of Virginia

This state association's Breathe Easy Office models a healthy office environment for their employees, volunteers and guests.
www.lungusa2.org/breatheasyoffice/

Environmental Health and Safety Online

Links to multiple free online resources on IAQ plus other topics.
www.ehso.com/ehshome/indoorairqualitypubs

GreenBiz.Com

Offers articles, links, newsletters oriented to align environmental responsibility with business success; a program of the National Environmental Education and Training Foundation.
www.greenbiz.com

www.LungsAtWork.org

Greener Buildings

Provides technical facility management information, including the book *Green Office Buildings: A Practical Guide to Development*.
www.greenerbuildings.com

Healthy Buildings International

Promotes healthy buildings – healthy people.
www.hbiamerica.com

Healthy Building Network

National network of environmental professionals and advocates, working to promote healthier building materials as a means to improve public health and preserve the global environment.
www.healthybuilding.net

National Safety Council

Non-profit membership-based public service organization providing educational materials, training and other resources for on-the-job health and safety.
www.nsc.org
 (630) 285-1121

Unified Green Cleaning Alliance (UGCA)

Promotes use of sustainable cleaning formulations into industry and the marketplace.
www.zerowaste.org/ugca.htm

World Health Organization (WHO)

Provides a global perspective on health issues, including IAQ.
www.who.int/topics/air_pollution_indoor/en/

Sources outside a building

Contaminated outdoor air

- pollen, dust, fungal spores
- industrial pollutants

Emissions from nearby sources

- loading docks
- odors from dumpsters
- exhaust from vehicles on nearby roads, in parking lots or garages
- re-entrained (drawn back into building) exhaust from the building itself or from neighboring buildings
- unsanitary debris near the outdoor air intake

Soil gas

- leakage from underground fuel tanks
- radon
- contaminants from previous site uses
- pesticides

Moisture or standing water promoting excess microbial growth

- rooftops after rainfall
- crawlspaces

Equipment

HVAC system

- dust or dirt in ductwork or other components
- refrigerant leaks
- microbiological growth in drip pans, humidifiers, ductwork, coils
- improper use of biocides, sealants and/or cleaning compounds

Non-HVAC equipment

- emissions from office equipment such as copiers, printers (volatile organic compounds, ozone)
- supplies (solvents, toners, ammonia)
- emissions from shops, labs, cleaning processes
- elevator motors and other mechanical systems

Human activities

Personal activities

- smoking
- body odor
- cooking
- cosmetic odors

Housekeeping activities

- cleaning materials and procedures
- emissions from stored supplies or trash
- use of deodorizers and fragrances
- dust or dirt circulated by sweeping and vacuuming

Maintenance activities

- microorganisms in mist from
- airborne dust or dirt improperly maintained cooling towers
- pesticides from pest control activities
- volatile organic compounds (VOC's)
- emissions from stored supplies from use of paint, caulk, adhesives and other products

Building components and furnishings

Locations that produce or collect dust or fibers

- textured surfaces such as carpeting, curtains, other textiles
- open shelving
- old or deteriorated furnishings
- materials containing damaged asbestos

Unsanitary conditions and water damage

- microbiological growth on or in soiled or water-damaged furnishings
- microbiological growth in areas of surface condensation

- standing water from clogged or poorly designed drains
- dry traps that allow the passage of sewer gas

Chemicals released from building components or furnishings

- volatile organic compounds
- inorganic compounds

Other sources

Accidental events

- spills of water or other liquids
- microbiological growth due to flooding or to leaks from roofs, piping
- fire damage (soot, PCBs from electrical equipment, odors)

Special use areas and mixed use buildings

- smoking lounges
- laboratories
- print shops, art rooms
- exercise rooms
- beauty salons
- food preparation areas

Redecorating/remodeling/repair activities

- dust and fibers from demolition
- emissions from new furnishings
- odors and volatile organic and inorganic compounds from paint, caulk, adhesives
- microbiologicals released from demolition or remodeling activities

Source: U.S. EPA, *Building Air Quality – A Guide for Building Owners & Facility Managers* (December 1991)

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www.LungsAtWork.org