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Facts About Mold: A Consumer Focus

Fact Sheet

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The U.S. Centers for Disease Control and Prevention, the Institute of Medicine of the U.S. National Academy of Sciences, the American Academy of Allergy Asthma and Immunology, Health Canada, and the World Health Organization all agree that living or working in a building with mold-damaged building materials results in an increased risk of respiratory diseases such as asthma.

The American Industrial Hygiene Association (AIHA) has worked to translate the advice from these public health and medical authorities into state-of-the-art inspection and sampling protocols. These protocols are captured in AIHA's second edition of the *Recognition, Evaluation and Control of Indoor Mold* publication, also known as the Green Book. These methods are suitable for assessing visible and hidden mold contamination, and for developing a mold remediation plan.

Assessments and reports based on the Green Book protocols are useful for industrial hygiene, occupational medicine, and allergy and respiratory medicine as well as the owners and engineers tasked with repairing and/or remediating buildings with mold growth. The information in this document represents a carefully reviewed summary of potentially useful information on the management and remediation of mold and dampness in buildings.

When extensive mold damage has occurred, it is recommended that business and homeowners seek professional guidance before attempting to clean large amounts of contaminated materials. Industrial hygienists and other safety and health professionals can anticipate health and safety concerns, and they can design solutions to prevent exposures using guidelines established by government agencies and recognized authorities such as relevant professional associations. A list of useful guidelines and other publications is found at the end of this document.

Based on more than 25 years of AIHA experience studying the mold and dampness problem, this publication addresses general information about management of mold and dampness in buildings, with a special focus on residential housing.

What is mold?

The term *mold* is a colloquial term for fungi that are commonly found on food or wet materials. This includes the green *Penicillium* mold that produces penicillin, the fungi (or mold) that spoil our bread, fruit, cheese and crops, and most importantly, the mold that recycles dead organic matter, including wood from fallen trees and leaves.

The molds that grow on damp building materials are most often found naturally in the soil. There are thousands of species of mold, and they can be any color. Besides different "food" preferences, molds are adapted to thrive under different moisture conditions ranging from soaking wet to just damp. Many times, mold growth can be detected by a musty odor in some areas, for example, a basement or a crawl space.

Live spores act like seeds, forming new growth (colonies) under the right conditions. All of us are exposed to a variety of fungal spores daily in the air we breathe, both outdoors and indoors. In outdoor air, the most commonly found fungi are those that live on the surfaces of leaves as well as mushroom spores. These fungi are not generally found on damp building materials. In a clean, properly ventilated, and well-maintained building, the fungal species in a building should be similar to those found in outdoor air.

Who is affected by exposure to mold?

Living or working in building with mold and moisture damage can increase the relative risk for respiratory disease and asthma in the general population. Although individual response is dependent on a



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number of variables, including duration and extent of mold and moisture damage as well as individual health status, at particular risk are people who are allergic to mold or are genetically predisposed to allergy. For those people who are already sensitized to mold, inhaling fungal fragments can cause allergic reactions, including sneezing, runny nose, red eyes, and skin rash. People with serious mold allergies may have more severe reactions, including shortness of breath.

There is a wide variability in how people are affected by airborne mold spore exposure. People who may be affected more severely and quickly than others include:

- individuals with respiratory conditions, allergies, or asthma
- infants and children
- the elderly and infirm
- pregnant women

People with symptoms commonly associated with mold exposure and who have been informed that they have been living or working in a building with serious mold damage should consult their doctor. In particular, allergists are best positioned to address specific concerns. Symptoms believed to be from mold exposure may be due to other causes, such as bacterial or viral infections or other allergies.

All agencies or professional groups working in public or occupational health in the United States and Canada agree that living or working in a building with active mold growth can affect respiratory health. These effects include making asthma worse in mold-sensitive asthmatics as well as increased risk of allergic and upper-respiratory disease. All of the guidelines referenced in the appendix state that if you see visible mold growth, this should be addressed promptly. Based on extensive research conducted all over the

world, the authorities and guidelines acknowledge that the risk of mold-related health effects is somehow proportional to the extent of mold and moisture damage. Hence the risk, as well as the complexity of managing a mold and dampness problem, is proportional to the nature and extent of mold growth.

A few square inches of visible mold on, for example, a window frame should be cleaned up as described by the Environmental Protection Agency (EPA) and other agency's guidelines. If extensive mold growth or mold-related damage is discovered, the risk of exposure, including during the removing and cleaning of these moldy building materials, is a serious matter. In these cases, it is recommended that the remediation should be handled by someone qualified and experienced in this area of practice.

However, regardless of the amount of growth and related damage, the underlying moisture problem must be addressed. After the moisture problem is resolved, and any mold growth or damage is removed, the space must be given a thorough cleaning to remove fine particles. This can normally be accomplished with a good-quality vacuum cleaner equipped with a high-efficiency particulate air (HEPA) filter and damp wiping of hard surfaces.

What causes the health effects?

The health effects of mold generally relate to breathing fragments of the mixture of fungi that inevitably occur on a damp surface. Experience has shown that it is never one species of mold on these damp surfaces. The fragments get into the air when the moisture dries and by the movement of air across a surface. If there is carpet present, the fungal fragments will accumulate and then will be resuspended by normal room activity.

Molds can also produce a number of biochemicals. There is a broad consensus that allergic reactions



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associated with mold exposures in buildings are mainly due to mold glucan (a component of fungal cell walls), allergens (parts of mold that cause allergic reactions), and other mold proteins.

Some molds can also produce mycotoxins under certain conditions. The news media and some contractors often refer to “black mold” or “toxic black mold.” This usage is typically associated with *Stachybotrys*, a greenish-black fungus always associated with water-saturated building materials. In the United States and Canada, extensive damage by *Stachybotrys* is much less common than, for example, the *Penicillium* species.

Stachybotrys can produce mycotoxins, but the known health effects from exposure to *Stachybotrys* are similar to those caused by other molds, except in occupational exposures such as have occurred in agriculture. The fungi that produce mycotoxins on food and feed do not grow on damp building materials, so these exposures seldom, if ever, occur in buildings. An exception is if remediation is carried out without appropriate precautions.

Mold damage in houses

Apart from floods, there are four major causes of mold damage in residences: leaks in the building envelope (e.g., around window frames, roof); condensation; unattended plumbing leaks; and so-called “household mold” (e.g., mold growth on kitchen and bathroom surfaces, on window frames, in basements). Common causes of excessive indoor moisture that can lead to mold problems include:

- insufficient or improper insulation
- condensation on cold surfaces
- flooding from surface waters (e.g., overflowing rivers) or from severe storms

- roof leaks from damaged or missing roofing materials, ice dams, or blocked gutters
- storm-driven rain through window frames, exterior walls, or door assemblies
- leaking pipes, sewer backups or overflows
- damp basements or crawl spaces

How can I prevent mold growth?

The key to preventing and stopping indoor mold growth is to control excessive moisture and condensation. Keeping susceptible areas in the home clean and dry is critical. In general, mold will not grow indoors without water, dampness, or excessive moisture. Other things that can be done are to clean and repair gutters regularly; make sure the ground slopes down and away from the home’s foundation; and keep air conditioner drip pans and drain lines clean.

In the case of floods or leaking pipes, any standing water should be promptly removed, and water-damaged materials should either be dried out and cleaned or removed and replaced. Porous materials that are wet for more than 48 hours are likely to produce mold growth and should normally be discarded. In instances where the water damage is extensive, it is recommended that professional help, such as a qualified commercial restoration company, be consulted.

For mold growth in the walls from floods or unnoticed leaks around windows, it is often hard to open up walls around floors that have been subject to a flood that seems to recede quickly, and where the occupied space has dried according to FEMA and related guidelines. However, normally it is necessary to open up the bottom of the wall cavity to ensure the inside actually dries. Another source of hidden mold is slow leaks in plumbing inside walls and sometimes around window frames if they were not



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properly sealed when installed or if the caulking has failed with time.

Whether in cold climates during the heating season or in climates that require air conditioning, condensation is often a major issue in homes. Condensation can lead to mold growth on window frames, which is easily seen, but can also be a problem in carpets and areas that are not easily seen, such as behind bookshelves or other items of furniture beside a cold wall.

In the course of daily living, the average family generates more than 100 pounds of water vapor per day into the air from cooking, showers, and cleaning. In the summer, absent air conditioning, outdoor air is a source of humidity, which can become an issue in cool basements. Usually, the major reason for condensation leading to mold growth is inadequate or improper ventilation. Even if mold growth is in a basement used for storage or laundry, fragments of the mold will find their way upstairs.

There are three main factors that contribute to condensation of water on building surfaces:

- **Poor Ventilation.** Indoor relative humidity can build up if there is not enough ventilation, there is an inadequate exchange of indoor and outdoor air, or the air is not properly conditioned. Where there is little or no air movement, such as behind dressers and cabinets, surfaces can remain cooler than surrounding areas. This can lead to increased condensation and mold growth. It is recommended that the area of concern be ventilated, and that the occupants use exhaust fans (vented to the outdoors) to remove moisture from high-humidity areas, particularly in bathrooms, kitchens, and laundry areas. Furniture should be moved slightly away from walls so that air can freely pass behind it.
- **Humidity Control.** Where possible, localized sources of humidity, such as clothes dryers, should be directly vented to the outdoors. To lower indoor

humidity during warm, humid weather, it is recommended that air conditioners and/or dehumidifiers be used, where practical. In chronically damp areas, such as basements or crawl spaces, it is often recommended that dehumidifiers be used to maintain humidity levels below 60%.

- **Temperature.** Warm air holds more moisture than cold air. Condensation occurs when warm humid air comes into contact with a cold surface and the moisture condenses into water. This can often be seen on single-pane windows, where the water condenses and then runs down, causing the wood frames and sills to rot and the wall under the windows to blister. If left unattended, mold growth around the frame can be seen. If there is condensation around windows, this can mean there is condensation elsewhere, in less visible places. In addition, condensation can occur on exterior walls, particularly north-facing walls, if they are not properly insulated. Other chronically cold surfaces, such as cold-water pipes, should be covered with insulation to help prevent condensation.

What should I do if I see or smell mold in my home?

The most important step is to identify the source(s) of moisture which have resulted in mold growth and to make the necessary repairs to stop them. If you only clean up the mold and do not stop the source of moisture, it is most likely that the mold growth will recur. If the source of the moisture is related to a building failure or fault, such as a burst pipe or leaking roof, it is recommended that a professional and qualified contractor be consulted.

In instances where the moisture source does not appear to be related to leaks, floods, structural faults, or rising dampness, it is most likely due to condensation. If you do not see mold growth but smell a musty odor, mold may be growing underneath or behind



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water-damaged materials, such as walls, carpeting, or wallpaper.

If possible, once the source of the moisture has been identified and fixed, decide if removing the mold from the affected areas is something that can be done without professional assistance. If the mold growth was caused by sewage backup or other contaminated water, potential pathogens may be present. In these circumstances, the work should be performed by a professional contractor that has previous work experience in cleaning buildings or houses damaged by contaminated water.

In the case where the mold growth is due to condensation or a small-scale leak and is limited to a small area (less than 10 square feet), you can probably do the work yourself following guidelines such as those prepared by the EPA, Health Canada, and AIHA. On hard surfaces, such as countertops and wood furniture, it is recommended to use detergent and water to wipe the mold off and then dry the surface completely.

The use of biocides or chemical disinfectants (such as chlorine bleach) is not recommended as these may be hazardous to occupants. They also may not kill or render inert the suspect microorganisms and their associated toxins. Moldy porous or absorbent materials, such as ceiling tiles, wallboard, and carpeting, should be removed and replaced.

Persons cleaning mold should wear suitable gloves, goggles, and an approved respirator to protect against breathing airborne spores (an N-95 respirator would be appropriate for most simple cleanup projects). If you have health concerns, such as asthma, you should consult your doctor before doing any mold cleanup.

How do I know if there is hidden mold?

Hidden mold damage usually prompts complaints when fragments of the mold find their way into occu-

piated space, often around electrical outlets and other cracks. This happens because wind and sun on the outside of the wall can make air pressure inside the wall cavity higher than indoor air. Fungal fragments can accumulate in dusts and people can be exposed this way. Active mold growth produces odors, which also will find their way into the building.

Investigators detect mold in wall cavities in several ways. First, they ask the occupant for any history of floods and get as much information as possible about how often the mold is found and the location of the mold growth. They also will inspect baseboard areas including the electrical outlets very carefully for any sign of previous water damage. If inspection and possibly sampling provide evidence that there might be a significant amount of mold in the wall cavity, they may ask permission to cut small holes and investigate. There are detailed protocols for doing this in a safe manner.

Should I test my home for mold or mycotoxins?

No. This is seldom useful in homes and some agencies (e.g., Health Canada) specifically recommend against testing of any kind in homes as a priority. Looking for evidence of water damage and visible mold growth, particularly when moldy odors are detected must be your first step. Testing for mold is expensive, and you should have a clear reason for doing so prior to hiring a consultant.

In addition, there are no standards for “acceptable” levels of mold in the indoor environment. When air testing is done, it is used to compare the types of mold spores found inside the home with those found outdoors. If you know you have a mold problem, it is more important to spend time and resources solving the moisture problem and getting rid of the mold than to spend it on sampling.



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In the absence of an informed inspection, air sampling alone cannot support any path forward. Also, air, bulk, and swab sampling for mold spores does not evaluate potential health risks for the occupants in a building or house with mold damage.

What about mold in nonindustrial workplaces and schools?

Some of the reasons why mold damage occurs in the nonindustrial workplace are the same as in homes: floods, leaks in the building envelope, and condensation from inadequate ventilation. However, there are important differences between three broad categories of buildings mentioned: homes, offices, and schools. These include the nature and complexity of the heating, ventilation and air-conditioning (HVAC) systems and the very different array of moisture generating activities in such buildings. Investigating mold and dampness problems in these three categories of buildings requires a different toolbox for each. The AIHA Green Book has extensive descriptions on the acceptable range of practice of mold and dampness investigations for each building type, together with information on appropriate testing and documentation.

Are there standards for assuring the space is safe for occupancy?

Yes. For almost 30 years, the standard of care for mold remediation has had three main elements.

- First, the space must be properly investigated to locate and understand the cause of the mold damage in the building, and this must be documented properly.
- Second, a qualified remediator must remove the mold damage using defined protocols from appropriate professional organizations. The underlying cause of the water or condensation must be addressed before any build-back is initiated.
- Third, the mold-contaminated portion of the building must have a thorough cleaning with a vacuum cleaner equipped with a HEPA filter to remove fine particles. Importantly, this process should be monitored or evaluated by the indoor air professional who did the investigation. Unless the building owner has specifically agreed to use employees of the remediation company for this inspection, it should be done by an independent expert.

Unlike many other contaminants, there are no sampling-based methods that are used to assure that the space has been properly remediated from a health perspective. There are two reasons for this. The sampling methods that exist outside research studies are not able to quantitatively determine exposure. The second and very important issue is that people vary a great deal in their response to mold exposures. As noted above, if you are allergic to mold, your response is likely to be much more immediately severe than that of someone who is not allergic.

Who do I contact to investigate mold growth in a building?

If mold damage has been reported or a mold-related complaint has been made by occupants, it may be time to seek outside help. As a general rule, you should seriously consider calling a qualified and experienced industrial hygienist if any of the following statements are true:

- In-house efforts have not solved the problem; that is, occupant reports of health symptoms or discomfort continue, and it is believed to be due to unresolved mold contamination. Therefore, the problem has not been resolved. An expert in this field may be able to assist with a thorough investigation.
- The problem is too serious to delay response. If there is suspected mold contamination that is not visible because it is inside walls or above ceilings,



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you will need outside resources. In addition, if the health complaints are widespread and persistent, the situation must be resolved in a rapid and professional manner.

- There is mistrust between occupants and the building management. Mold concerns can escalate to the point where independent investigation is needed to develop a credible diagnosis and recommendations.
- Litigation claims are likely. When problems are not addressed and resolved early, minor occupant discomfort or illness may become more serious. Increasing numbers of occupants are willing to initiate legal actions if mold problems persist. Retain a qualified expert as early as possible if litigation is likely to occur.
- There is a need for specialized equipment or expertise. If the initial investigation has produced a hypothesis that the cause of occupant discomfort or health symptoms was potentially harmful mold contamination, then you will need outside resources such as a consultant to test this hypothesis. Verification might require special sampling media and equipment as well as people who are qualified to collect, analyze, and interpret such samples correctly.

An industrial hygienist who practices in this area (i.e., mold investigation and remediation) is usually qualified and experienced to deal with this kind of situation and has access to current best-practice guidelines. If you use an outside professional, make sure that expert has pertinent work experience addressing mold issues in buildings.

Many individuals and companies represent themselves as mold experts. Some may be certified in various aspects of mold investigation and remediation, but it is important to note that not all “certifications” are equal. For example, someone who has taken a one- or two-week training course in mold investiga-

tion and remediation can be far less qualified than a Certified Industrial Hygienist (CIH) with extensive mold investigation and remediation experience.

Most CIHs have a graduate degree, have taken specialized courses, and have passed a written exam after an apprenticeship. If you hire a consultant to help identify your problem, or a contractor to perform the cleanup in your home, make sure that the individual has specific work experience in dealing with, and cleaning up, mold. It is always recommended that you check consultants’ references before hiring them to provide technical assistance.

The following are suggested steps based on AIHA’s *Guidelines for Selecting an Indoor Air Quality Consultant* to assist in selecting a qualified mold consultant:

First, verify that the consultant has appropriate training and project experience. Ask for references and contact clients to verify that the consultant has helped them solve their mold problem. Find out whether the most experienced personnel will be on-site or in direct contact with the site investigation staff.

Be wary of consultants who may overstep the bounds of their expertise or who have a financial stake in the outcome of the investigation, such as ownership in a mold remediation firm or laboratory. Also, you should be aware of applicable state or federal certification and/or training requirements, and make sure that the consultant has fulfilled these requirements.

Second, clearly define what you expect from the consultant you hire. It helps to define the scope of services upfront; however, mold investigations may not always be simple or predictable. Your proposed scope may be modified based on question-and-answer sessions with prospective consultants. The scope of the project may not be definable until more information is obtained through inspection and (if necessary) testing.



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Third, solicit proposals and interview candidates if time permits. A telephone interview is usually sufficient; however, it may be necessary to have the consultant perform a preliminary site visit to fully understand the problem and generate an appropriate scope of work. Ask the consultant for his or her general approach to resolving the problem. A general but systematic approach based on a thorough visual inspection is usually more effective than relying on extensive air, bulk, or swab testing.

Proposals should indicate the estimated consulting fees and expenses for the specified phase of the project. Pay attention to the project approach and ask questions if some of the scope items do not make sense to you. Find out how decisions for testing or remediation will be made and what potential follow-up investigation activities may cost.

Fourth, for larger projects involving extensive mold growth, draw up a request for proposal (RFP) or contract specifications. This may take time, but it helps avoid surprises. The contract may specify the following (at a minimum):

- the project scope, specifying activities to be included, such as sampling
- the frequency of status reports and meetings
- the work product, such as drawings, reports, tables, and supporting information
- quality control procedures
- project budget estimates and fee schedules
- a reasonable schedule that is agreeable to all parties

AIHA provides a Consultants Listing at <https://www.aiha.org/public-resources/consultants-listing> where indoor air quality consultants may be found. However, note that AIHA does not recommend specific consultants.

Useful Reference Materials

American Industrial Hygiene Association

Disaster Response Resource Center. <https://aiha.org/public-resources/consumer-resources/disaster-response-resource-center>

FAQs About Spore Trap Air Sampling for Mold for Direct Examination. <https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/FAQs-About-Spore-Trap-Air-Sampling-for-Mold-for-Direct-Examination-Guidance-Document.pdf>

Health and Safety Guidelines for Selecting an Indoor Air Quality Consultant. <https://eec.ky.gov/Environmental-Protection/Air/Documents/GuidelinesforSelectingAnIndoorAirQualityConsultant.pdf>

Health and Safety in Natural Disasters (publication). <https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Health-and-Safety-Issues-in-Natural-Disasters-Guidance-Document.pdf>

Health and Safety Issues in Natural Disasters (website). <https://aiha.org/public-resources/consumer-resources/disaster-response-resource-center/health-and-safety-issues-in-natural-disasters>

Mold and Dampness in the Built Environment Position Statement. <https://aiha-assets.sfo2.digitaloceanspaces.com/AIHA/resources/Mold-and-Dampness-in-the-Built-Environment-Position-Statement.pdf>

Mold Resource Center (website). <https://www.aiha.org/public-resources/consumer-resources/disaster-response-resource-center/mold-resource-center>

Canadian Centre for Occupational Health and Safety

OSH Answer Fact Sheets: Indoor Air Quality – Moulds and Fungi. https://www.ccohs.ca/oshanswers/biohazards/iaq_mold.html



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Centers for Disease Control and Prevention

Homeowner's and Renter's Guide to Mold Clean-up After Disasters. https://www.cdc.gov/mold/pdfs/homeowners_and_renters_guide.pdf

Mold After a Disaster. <https://www.cdc.gov/disasters/mold/index.html>

Environmental Protection Agency

A Brief Guide to Mold, Moisture, and Your Home. <https://www.epa.gov/mold/brief-guide-mold-moisture-and-your-home>

Federal Emergency Management Agency

After the Flood. https://www.fema.gov/media-library-data/20130726-1511-20490-0446/after_a_flood.pdf

Dealing With Mold & Mildew in Your Flood Damaged Home. https://www.fema.gov/pdf/rebuild/recover/fema_mold_brochure_english.pdf

Health Canada

Residential Indoor Air Quality Guidelines: Moulds. <https://www.canada.ca/content/dam/canada/health-canada/migration/healthy-canadians/publications/healthy-living-vie-saine/mould-moisissure/alt/mould-moisissures-eng.pdf>

National Institute for Occupational Safety and Health

NIOSH Recommendations for the Cleaning and Remediation of Flood-Contaminated HVAC Systems: A Guide for Building Owners and Managers. <https://www.cdc.gov/niosh/topics/emres/Cleaning-Flood-HVAC.html>

Occupational Safety and Health Administration

OSHA Fact Sheet: Fungi Hazards and Flood Clean-up. https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin3.pdf



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