

Mold Information

All information provided by the USEPA @:
<http://www.epa.gov/mold/moldresources.html>
http://www.epa.gov/mold/append_b.html



Ten Things You Should Know About Mold:

1. Potential health effects and symptoms associated with mold exposures include allergic reactions, asthma, and other respiratory complaints.
2. There is no practical way to eliminate all mold and mold spores in the indoor environment; the way to control indoor mold growth is to control moisture.
3. If mold is a problem in your home or school, you must clean up the mold and eliminate sources of moisture.
4. Fix the source of the water problem or leak to prevent mold growth.
5. Reduce indoor humidity (to 30–60%) to decrease mold growth by: venting bathrooms, dryers, and other moisture-generating sources to the outside; using air conditioners and de-humidifiers; increasing ventilation; and using exhaust fans whenever cooking, dishwashing, and cleaning.
6. Clean and dry any damp or wet building materials and furnishings within 24–48 hours to prevent mold growth.
7. Clean mold off hard surfaces with water and detergent, and dry completely. Absorbent materials such as ceiling tiles, that are moldy, may need to be replaced.
8. Prevent condensation: Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, roof, or floors) by adding insulation.
9. In areas where there is a perpetual moisture problem, do not install carpeting (i.e., by drinking fountains, by classroom sinks, or on concrete floors with leaks or frequent condensation).
10. Molds can be found almost anywhere; they can grow on virtually any substance, providing moisture is present. There are molds that can grow on wood, paper, carpet, and foods.

If you have IAQ and mold issues in your school, you should get a copy of the [IAQ Tools for Schools](#) Action Kit. Mold is covered in the IAQ Reference Guide under [Appendix H – Mold and Moisture](#).

Asthma and Mold

Molds can trigger asthma episodes in sensitive individuals with asthma. People with asthma should avoid contact with or exposure to molds. Read more about asthma triggers on EPA's [Asthma Website](#)

Additional Asthma Resources:

- [Allergy & Asthma Network/Mothers of Asthmatics \(AAN/MA\)](#) EXIT Disclaimer (800) 878-4403
- [American Academy of Allergy, Asthma & Immunology \(AAAAI\)](#) EXIT Disclaimer For information, see www.aaaai.org/global/contact-us.aspx EXIT Disclaimer
- [American Lung Association](#) EXIT Disclaimer (800) LUNG-USA (586-4872); See also www.lung.org/healthy-air/ EXIT Disclaimer
- [Asthma & Allergy Foundation of America](#) EXIT Disclaimer (800) 7ASTHMA (727-8462)
- Canada Mortgage & Housing Corporation "[Fighting Mold – The Homeowner's Guide](#)" EXIT Disclaimer
- U.S. Dept. of Health and Human Services, National Institute of Health, [National Institute of Allergy and Infectious Diseases](#) (866) 284-4107/(301) 496-5717
- [National Jewish Medical and Research Center](#) EXIT Disclaimer (800) 222-LUNG (5864)

Floods/Flooding

[Information on Flood Cleanup](#)

[EPA's Natural Disasters and Weather Emergencies](#)

Emergency Preparedness at <http://www.ready.gov/>

For information regarding Hurricane Sandy Response and Recovery, see www.epa.gov/sandy

Mold growth may be a problem after flooding. EPA's Fact Sheet: [Flood Cleanup: Avoiding Indoor Air Quality Problems \(PDF\)](#) (2 pp, 67 K, [about PDF](#)) discusses steps to take when cleaning and repairing a home after flooding. Excess moisture in the home is cause for concern about indoor air quality primarily because it provides breeding conditions for microorganisms. This fact sheet provides tips to avoid creating indoor air quality problems during cleanup. U.S. EPA, EPA Document Number 402-F-93-005, August 1993.

Additional Flood Resources:

- [Federal Emergency Management Agency \(FEMA\)](#): (800) 480-2520, See [Flood information](#)
- U.S. Dept. of Health and Human Services (HHS), Centers for Disease Control and Prevention's (CDC) [Emergency Preparedness and Response page](#) and [Key Facts About Hurricane Recovery](#)
- University of Minnesota, [Department of Environmental Health and Safety](#) EXIT Disclaimer [Flood Information](#) EXIT Disclaimer

Health and Mold

How do molds affect people?

Some people are sensitive to molds. For these people, exposure to molds can cause symptoms such as nasal stuffiness, eye irritation, wheezing, or skin irritation. Some people, such as those with

serious allergies to molds, may have more severe reactions. Severe reactions may occur among workers exposed to large amounts of molds in occupational settings, such as farmers working around moldy hay. Severe reactions may include fever and shortness of breath. Some people with chronic lung illnesses, such as obstructive lung disease, may develop mold infections in their lungs.

EPA's publication, [*Indoor Air Pollution: An Introduction for Health Professionals*](#), assists health professionals (especially the primary care physician) in diagnosis of patient symptoms that could be related to an indoor air pollution problem. It addresses the health problems that may be caused by contaminants encountered daily in the home and office. Organized according to pollutant or pollutant groups such as environmental tobacco smoke, VOCs, biological pollutants, and sick building syndrome, this booklet lists key signs and symptoms from exposure to these pollutants, provides a diagnostic checklist and quick reference summary, and includes suggestions for remedial action. Also includes references for information contained in each section. This booklet was developed by the American Lung Association, the American Medical Association, the U.S. Consumer Product Safety Commission, and the EPA, 1994.

Allergic Reactions – excerpted from [*Indoor Air Pollution: An Introduction for Health Professionals*](#) section on: [Animal Dander, Molds, Dust Mites, Other Biologicals](#).

"A major concern associated with exposure to biological pollutants is allergic reactions, which range from rhinitis, nasal congestion, conjunctival inflammation, and urticaria to asthma. Notable triggers for these diseases are allergens derived from house dust mites; other arthropods, including cockroaches; pets (cats, dogs, birds, rodents); molds; and protein-containing furnishings, including feathers, kapok, etc. In occupational settings, more unusual allergens (e.g., bacterial enzymes, algae) have caused asthma epidemics. Probably most proteins of non-human origin can cause asthma in a subset of any appropriately exposed population."

Damp Buildings and Health

For information on damp buildings and health effects, see the 2004 Institute of Medicine Report, *Damp Indoor Spaces and Health*, published by The National Academies Press in Washington, DC. You can read a description of the report and purchase a copy at http://www.nap.edu/catalog.php?record_id=11011 

The Center for Disease Control and Prevention (CDC's) [National Center for Environmental Health \(NCEH\)](#)
(800) CDC-INFO (232-4636), cdcinfo@cdc.gov

- Frequent Questions on Mold – www.cdc.gov/mold/faqs.htm
- *Stachybotrys chartarum* and health effects – www.cdc.gov/mold/stachy.htm

Homes and Molds

The EPA publication, "[A Brief Guide to Mold, Moisture, and Your Home](#)", is also available in PDF (**English** ([PDF](#), 20 pp., 257 K) and **Spanish** ([PDF](#), 20 pp., 796 K)). This Guide provides information and guidance for homeowners and renters on how to clean up residential mold problems and how to prevent mold growth.

Biological Pollutants in Your Home – This document explains indoor biological pollution, health effects of biological pollutants, and how to control their growth and buildup. One third to one half of all structures have damp conditions that may encourage development of pollutants such as molds and bacteria, which can cause allergic reactions — including asthma — and spread infectious diseases. Describes corrective measures for achieving moisture control and cleanliness. This brochure was prepared by the American Lung Association and the U.S. Consumer Product Safety Commission. The publication was updated by CPSC in 1997 www.cpsc.gov/cpsc/pub/pubs/425.html

Moisture control is the key to mold control, the Moisture Control Section from *Biological Pollutants in Your Home* follows:

Moisture Control

Water in your home can come from many sources. Water can enter your home by leaking or by seeping through basement floors. Showers or even cooking can add moisture to the air in your home. The amount of moisture that the air in your home can hold depends on the temperature of the air. As the temperature goes down, the air is able to hold less moisture. This is why, in cold weather, moisture condenses on cold surfaces (for example, drops of water form on the inside of a window). This moisture can encourage biological pollutants to grow.

There are many ways to control moisture in your home:

- Fix leaks and seepage. If water is entering the house from the outside, your options range from simple landscaping to extensive excavation and waterproofing. (The ground should slope away from the house.) Water in the basement can result from the lack of gutters or a water flow toward the house. Water leaks in pipes or around tubs and sinks can provide a place for biological pollutants to grow.
- Put a plastic cover over dirt in crawlspaces to prevent moisture from coming in from the ground. Be sure crawlspaces are well-ventilated.
- Use exhaust fans in bathrooms and kitchens to remove moisture to the outside (not into the attic). Vent your clothes dryer to the outside.
- Turn off certain appliances (such as humidifiers or kerosene heaters) if you notice moisture on windows and other surfaces.
- Use dehumidifiers and air conditioners, especially in hot, humid climates, to reduce moisture in the air, but be sure that the appliances themselves don't become sources of biological pollutants.
- Raise the temperature of cold surfaces where moisture condenses. Use insulation or storm windows. (A storm window installed on the inside works better than one installed on the outside.) Open doors between rooms (especially doors to closets which may be colder than

the rooms) to increase circulation. Circulation carries heat to the cold surfaces. Increase air circulation by using fans and by moving furniture from wall corners to promote air and heat circulation. Be sure that your house has a source of fresh air and can expel excessive moisture from the home.

- Pay special attention to carpet on concrete floors. Carpet can absorb moisture and serve as a place for biological pollutants to grow. Use area rugs which can be taken up and washed often. In certain climates, if carpet is to be installed over a concrete floor, it may be necessary to use a vapor barrier (plastic sheeting) over the concrete and cover that with sub-flooring (insulation covered with plywood) to prevent a moisture problem.
- Moisture problems and their solutions differ from one climate to another. The Northeast is cold and wet; the Southwest is hot and dry; the South is hot and wet; and the Western Mountain states are cold and dry. All of these regions can have moisture problems. For example, evaporative coolers used in the Southwest can encourage the growth of biological pollutants. In other hot regions, the use of air conditioners which cool the air too quickly may prevent the air conditioners from running long enough to remove excess moisture from the air. The types of construction and weatherization for the different climates can lead to different problems and solutions.

Moisture On Windows

Your humidistat is set too high if excessive moisture collects on windows and other cold surfaces. Excess humidity for a prolonged time can damage walls especially when outdoor air temperatures are very low. Excess moisture condenses on window glass because the glass is cold. Other sources of excess moisture besides overuse of a humidifier may be long showers, running water for other uses, boiling or steaming in cooking, plants, and drying clothes indoors. A tight, energy efficient house holds more moisture inside; you may need to run a kitchen or bath ventilating fan sometimes, or open a window briefly. Storm windows and caulking around windows keep the interior glass warmer and reduce condensation of moisture there.

Humidifiers are not recommended for use in buildings without proper vapor barriers because of potential damage from moisture buildup. Consult a building contractor to determine the adequacy of the vapor barrier in your house. Use a humidity indicator to measure the relative humidity in your house. The American Society of Heating and Air Conditioning Engineers (ASHRAE) recommends these maximum indoor humidity levels.

Outdoor Recommended Indoor Temperature Relative Humidity

Temperature Outdoors	Indoor Relative Humidity
+20° F.	35%
+10° F.	30%
0° F.	25%
-10° F.	20%
-20° F.	15%

Source: Anne Field, Extension Specialist, Emeritus, with reference from the

How to Identify the Cause of a Mold and Mildew Problem

Mold and mildew are commonly found on the exterior wall surfaces of corner rooms in heating climate locations. An exposed corner room is likely to be significantly colder than adjoining rooms, so that it has a higher relative humidity (RH) than other rooms at the same water vapor pressure. If mold and mildew growth are found in a corner room, then relative humidity next to the room surfaces is above 70%. However, is the RH above 70% at the surfaces because the room is too cold or because there is too much moisture present (high water vapor pressure)?

The amount of moisture in the room can be estimated by measuring both temperature and RH at the same location and at the same time. Suppose there are two cases. In the first case, assume that the RH is 30% and the temperature is 70°F in the middle of the room. The low RH at that temperature indicates that the water vapor pressure (or absolute humidity) is low. The high surface RH is probably due to room surfaces that are "too cold." Temperature is the dominating factor, and control strategies should involve increasing the temperature at cold room surfaces.

In the second case, assume that the RH is 50% and the temperature is 70°F in the middle of the room. The higher RH at that temperature indicates that the water vapor pressure is high and there is a relatively large amount of moisture in the air. The high surface RH is probably due to air that is "too moist." Humidity is the dominating factor, and control strategies should involve decreasing the moisture content of the indoor air.

[Should You Have the Air Ducts in Your Home Cleaned?](#) – excerpt on duct cleaning and mold follows, please review the entire document for additional information on duct cleaning and mold.

You should consider having the air ducts in your home cleaned if:

There is substantial visible mold growth inside hard surface (e.g., sheet metal) ducts or on other components of your heating and cooling system. There are several important points to understand concerning mold detection in heating and cooling systems:

- Many sections of your heating and cooling system may not be accessible for a visible inspection, so ask the service provider to show you any mold they say exists.
- You should be aware that although a substance may look like mold, a positive determination of whether it is mold or not can be made only by an expert and may require laboratory analysis for final confirmation. For about \$50, some microbiology laboratories can tell you whether a sample sent to them on a clear strip of sticky household tape is mold or simply a substance that resembles it.
- If you have insulated air ducts and the insulation gets wet or moldy it cannot be effectively cleaned and should be removed and replaced.

- If the conditions causing the mold growth in the first place are not corrected, mold growth will recur.

Additional Resource

- U.S. Dept. of Agriculture, Food Safety and Inspection Service fact sheet – [Safe Food Handling–Molds on Foods: Are They Dangerous?](#) September 2005
- [A Brief Guide to Mold in the Workplace](#), U.S. Dept. of Labor, Occupational, Safety and Health Administration, Safety and Health Bulletin 03–10–10

Indoor Air Regulations and Mold

Standards or Threshold Limit Values (TLVs) for airborne concentrations of mold, or mold spores, have not been set. Currently, there are no EPA regulations or standards for airborne mold contaminants.

Large Buildings and Mold

EPA has a number of resources available, you can start with the Indoor Air Quality Building Evaluation and Assessment Model (I-BEAM). I-BEAM updates and expands EPA's existing Building Air Quality guidance and is designed to be comprehensive state-of-the-art guidance for managing IAQ in commercial buildings. This guidance was designed to be used by building professionals and others interested in indoor air quality in commercial buildings. I-BEAM contains text, animation/visual, and interactive/calculation components that can be used to perform a number of diverse tasks. See www.epa.gov/iaq/largebldgs/i-beam/index.html.

See also "[Building Air Quality: A Guide for Building Owners and Facility Managers](#)".

Excerpt from the *Building Air Quality: A Guide for Building Owners and Facility Managers*, [Appendix C – Moisture, Mold and Mildew](#):

How to Identify the Cause of a Mold and Mildew Problem.

Mold and mildew are commonly found on the exterior wall surfaces of corner rooms in heating climate locations. An exposed corner room is likely to be significantly colder than adjoining rooms, so that it has a higher relative humidity (RH) than other rooms at the same water vapor pressure. If mold and mildew growth are found in a corner room, then relative humidity next to the room surfaces is above 70%. However, is the RH above 70% at the surfaces because the room is too cold or because there is too much moisture present (high water vapor pressure)?

The amount of moisture in the room can be estimated by measuring both temperature and RH at the same location and at the same time. Suppose there are two cases. In the first case, assume that the RH is 30% and the temperature is 70°F in the middle of the room. The low RH at that temperature indicates that the water vapor pressure (or absolute humidity) is low. The high surface RH is

probably due to room surfaces that are "too cold." Temperature is the dominating factor, and control strategies should involve increasing the temperature at cold room surfaces.

In the second case, assume that the RH is 50% and the temperature is 70°F in the middle of the room. The higher RH at that temperature indicates that the water vapor pressure is high and there is a relatively large amount of moisture in the air. The high surface RH is probably due to air that is "too moist." Humidity is the dominating factor, and control strategies should involve decreasing the moisture content of the indoor air.

Schools and Mold and Indoor Air Quality

The Agency's premier resource on this issue is the *Indoor Air Quality Tools for Schools* kit. Our schools-related resources on the web start at: www.epa.gov/iaq/schools.

The asthma companion piece for the *IAQ Tools for Schools* Action kit, is *Managing Asthma in the School Environment* – www.epa.gov/iaq/schools/managingasthma.html. This publication has a section entitled *Clean Up Mold and Moisture Control*: An excerpt follows:

Common Moisture Sources Found in Schools

Moisture problems in school buildings can be caused by a variety of conditions, including roof and plumbing leaks, condensation, and excess humidity. Some moisture problems in schools have been linked to changes in building construction practices during the past twenty to thirty years. These changes have resulted in more tightly sealed buildings that may not allow moisture to escape easily. Moisture problems in schools are also associated with delayed maintenance or insufficient maintenance, due to budget and other constraints. Temporary structures in schools, such as trailers and portable classrooms, have frequently been associated with moisture and mold problems.

Suggestions for Reducing Mold Growth in Schools

Reduce Indoor Humidity

- Vent showers and other moisture-generating sources to the outside.
- Control humidity levels and dampness by using air conditioners and de-humidifiers.
- Provide adequate ventilation to maintain indoor humidity levels between 30–60%.
- Use exhaust fans whenever cooking, dishwashing, and cleaning in food service areas.

Inspect the building for signs of mold, moisture, leaks, or spills

- Check for moldy odors.
- Look for water stains or discoloration on the ceiling, walls, floors, and window sills.
- Look around and under sinks for standing water, water stains, or mold.
- Inspect bathrooms for standing water, water stains, or mold.
- Do not let water stand in air conditioning or refrigerator drip pans.

Respond promptly when you see signs of moisture and/or mold, or when leaks or spills occur

- Clean and dry any damp or wet building materials and furnishings within 24–48 hours of occurrence to prevent mold growth.
- Fix the source of the water problem or leak to prevent mold growth.
- Clean mold off hard surfaces with water and detergent, and dry completely.
- Absorbent materials such as ceiling tiles, that are moldy, may need to be replaced.
- Check the mechanical room and roof for unsanitary conditions, leaks, or spills.

Prevent moisture condensation

- Reduce the potential for condensation on cold surfaces (i.e., windows, piping, exterior walls, roof, or floors) by adding insulation.

Floor and carpet cleaning

- Remove spots and stains immediately, using the flooring manufacturer’s recommended techniques.
- Use care to prevent excess moisture or cleaning residue accumulation and ensure that cleaned areas are dried quickly.
- In areas where there is a perpetual moisture problem, do not install carpeting (i.e., by drinking fountains, by classroom sinks, or on concrete floors with leaks or frequent condensation).

Mold Remediation in Schools and Commercial Buildings

Appendix B – Introduction to Molds

[Appendix C – Communication with Building Occupants](#)

[PDF version](#) (56 pp., 1.6 M, [about PDF](#))

- [Molds in the Environment](#)
- [Health Effects and Symptoms Associated with Mold Exposure](#)
 - [Allergic Reactions](#)
 - [Asthma](#)
 - [Hypersensitivity Pneumonitis](#)
 - [Irritant Effects](#)
 - [Opportunistic Infections](#)
- [Mold Toxins \(Mycotoxins\)](#)
 - [Toxic Molds](#)
- [Microbial Volatile Organic Compounds \(mVOCs\)](#)

- [Glucans or Fungal Cell Wall Components](#)
- [Spores](#)

Molds in the Environment

Molds live in the soil, on plants, and on dead or decaying matter. Outdoors, molds play a key role in the breakdown of leaves, wood, and other plant debris. Molds belong to the kingdom Fungi, and unlike plants, they lack chlorophyll and must survive by digesting plant materials, using plant and other organic materials for food. Without molds, our environment would be overwhelmed with large amounts of dead plant matter.

Molds produce tiny spores to reproduce, just as some plants produce seeds. These mold spores can be found in both indoor and outdoor air, and settled on indoor and outdoor surfaces. When mold spores land on a damp spot, they may begin growing and digesting whatever they are growing on in order to survive. Since molds gradually destroy the things they grow on, you can prevent damage to building materials and furnishings and save money by eliminating mold growth.

Moisture control is the key to mold control. Molds need both food and water to survive; since molds can digest most things, water is the factor that limits mold growth. Molds will often grow in damp or wet areas indoors. Common sites for indoor mold growth include bathroom tile, basement walls, areas around windows where moisture condenses, and near leaky water fountains or sinks. Common sources or causes of water or moisture problems include roof leaks, deferred maintenance, condensation associated with high humidity or cold spots in the building, localized flooding due to plumbing failures or heavy rains, slow leaks in plumbing fixtures, and malfunction or poor design of humidification systems. Uncontrolled humidity can also be a source of moisture leading to mold growth, particularly in hot, humid climates.

Health Effects and Symptoms Associated with Mold Exposure

When moisture problems occur and mold growth results, building occupants may begin to report odors and a variety of health problems, such as headaches, breathing difficulties, skin irritation, allergic reactions, and aggravation of asthma symptoms; all of these symptoms could potentially be associated with mold exposure.

All molds have the potential to cause health effects. Molds produce allergens, irritants, and in some cases, toxins that may cause reactions in humans. The types and severity of symptoms depend, in part, on the types of mold present, the extent of an individual's exposure, the ages of the individuals, and their existing sensitivities or allergies.

Potential Health Effects Associated with Inhalation Exposure to Molds and Mycotoxins

[Allergic Reactions](#) (e.g., rhinitis and dermatitis or skin rash); [Asthma](#); [Hypersensitivity Pneumonitis](#);
Other Immunologic Effects

Research on mold and health effects is ongoing. This list is not intended to be all-inclusive.

The health effects listed above are well documented in humans. Evidence for other health effects in humans is less substantial and is primarily based on case reports or occupational studies.

Specific reactions to mold growth can include the following:

- **Allergic Reactions**

Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic reactions to mold are common – these reactions can be immediate or delayed. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Mold spores and fragments can produce allergic reactions in sensitive individuals regardless of whether the mold is dead or alive. Repeated or single exposure to mold or mold spores may cause previously non-sensitive individuals to become sensitive. Repeated exposure has the potential to increase sensitivity.

- **Asthma**

Molds can trigger asthma attacks in persons who are allergic (sensitized) to molds. The irritants produced by molds may also worsen asthma in non-allergic (non-sensitized) people.

- **Hypersensitivity Pneumonitis**

Hypersensitivity pneumonitis may develop following either short-term (acute) or long-term (chronic) exposure to molds. The disease resembles bacterial pneumonia and is uncommon.

- **Irritant Effects**

Mold exposure can cause irritation of the eyes, skin, nose, throat, and lungs, and sometimes can create a burning sensation in these areas.

- **Opportunistic Infections**

People with weakened immune systems (i.e., immune-compromised or immune-suppressed individuals) may be more vulnerable to infections by molds (as well as more vulnerable than healthy persons to mold toxins). *Aspergillus fumigatus*, for example, has been known to infect the lungs of immune-compromised individuals. These individuals inhale the mold spores which then start growing in their lungs. *Trichoderma* has also been known to infect immune-compromised children.

Healthy individuals are usually not vulnerable to opportunistic infections from airborne mold exposure. However, molds can cause common skin diseases, such as athlete's foot, as well as other infections such as yeast infections.

Mold Toxins (Mycotoxins)

Toxic Molds

Some molds, such as *Aspergillus versicolor* and *Stachybotrys atra* (*chartarum*), are known to produce potent toxins under certain circumstances. Although some mycotoxins are well known to affect humans and have been shown to be responsible for human health effects, for many mycotoxins, little information is available, and in some cases research is ongoing. For example, some strains of *Stachybotrys atra* can produce one or more potent toxins. In addition, preliminary reports from an investigation of an outbreak of pulmonary hemorrhage in infants suggested an association between pulmonary hemorrhage and exposure to *Stachybotrys chartarum*. Review of the evidence of this association at CDC resulted in a published clarification stating that such an association was not established. Research on the possible causes of pulmonary hemorrhage in infants continues. Consult the Centers for Disease Control and Prevention (CDC) for more information on pulmonary hemorrhage in infants. (See [Resources list](#) for CDC contact and other information.)

Molds can produce toxic substances called mycotoxins. Some mycotoxins cling to the surface of mold spores; others may be found within spores. More than 200 mycotoxins have been identified from common molds, and many more remain to be identified. Some of the molds that are known to produce mycotoxins are commonly found in moisture-damaged buildings. Exposure pathways for mycotoxins can include inhalation, ingestion, or skin contact. Although some mycotoxins are well known to affect humans and have been shown to be responsible for human health effects, for many mycotoxins, little information is available.

Aflatoxin B₁ is perhaps the most well known and studied mycotoxin. It can be produced by the molds *Aspergillus flavus* and *Aspergillus parasiticus* and is one of the most potent carcinogens known. Ingestion of aflatoxin B₁ can cause liver cancer. There is also some evidence that inhalation of aflatoxin B₁ can cause lung cancer. Aflatoxin B₁ has been found on contaminated grains, peanuts, and other human and animal foodstuffs. However, *Aspergillus flavus* and *Aspergillus parasiticus* are *not* commonly found on building materials or in indoor environments.

Much of the information on the human health effects of inhalation exposure to mycotoxins comes from studies done in the workplace and some case studies or case reports.

* Many symptoms and human health effects attributed to inhalation of mycotoxins have been reported including: mucous membrane irritation, skin rash, nausea, immune system suppression, acute or chronic liver damage, acute or chronic central nervous system damage, endocrine effects, and cancer. More studies are needed to get a clear picture of the health effects related to most mycotoxins. However, it is clearly prudent to avoid exposure to molds and mycotoxins.

Some molds can produce several toxins, and some molds produce mycotoxins only under certain environmental conditions. The presence of mold in a building does not necessarily mean that mycotoxins are present or that they are present in large quantities.

Note: Information on ingestion exposure, for both humans and animals, is more abundant — wide range of health effects has been reported following ingestion of moldy foods including liver damage, nervous system damage, and immunological effects.

Microbial Volatile Organic Compounds (mVOCs)

Some compounds produced by molds are volatile and are released directly into the air. These are known as microbial volatile organic compounds (mVOCs). Because these compounds often have strong and/or unpleasant odors, they can be the source of odors associated with molds. Exposure to mVOCs from molds has been linked to symptoms such as headaches, nasal irritation, dizziness, fatigue, and nausea. Research on MVOCs is still in the early phase.

Glucans or Fungal Cell Wall Components (also known as β -(1 \rightarrow)-D-Glucans)

Glucans are small pieces of the cell walls of molds which may cause inflammatory lung and airway reactions. These glucans can affect the immune system when inhaled. Exposure to very high levels of glucans or dust mixtures including glucans may cause a flu-like illness known as Organic Dust Toxic Syndrome (ODTS). This illness has been primarily noted in agricultural and manufacturing settings.

Spores

Mold spores are microscopic (2–10 μ m) and are naturally present in both indoor and outdoor air. Molds reproduce by means of spores. Some molds have spores that are easily disturbed and waft into the air and settle repeatedly with each disturbance. Other molds have sticky spores that will cling to surfaces and are dislodged by brushing against them or by other direct contact. Spores may remain able to grow for years after they are produced. In addition, whether or not the spores are alive, the allergens in and on them may remain allergenic for years.