Cornell University
Cooperative Extension
College of Human Ecology

Mark Pierce
Department of Design and Environmental Analysis
Cornell University
Ithaca, NY 14853

Telephone: 607-255-0431
Fax: 607-255-0305
E-Mail: mrp6@cornell.edu

Mold Information Sheet

Haunted by Mold
New York Times Magazine, August 12, 2001

Family Forced From Home Because of Toxic Levels of Mold
The Associated Press state and Local Wire
July 8, 2001

Black Mold: Creeping Destruction
CBS Evening News
Tuesday August 28, 2001

Introduction:
These are just a few examples of recent news stories that have dealt with the topic of mold. Many of these stories create the impression that mold is a killer organism that is lurking everywhere in the buildings we live, learn and work in. But just how accurate is that impression? Is mold invading our buildings to such an extent that indoor air is becoming loaded with toxic compounds? Are some molds truly killers? What are some of the typical health risks associated with exposure to mold? How can mold growth be prevented in buildings and what should be done if active fungal growth is discovered in your home? These are some of questions this Fact Sheet will examine.

Molds, rots, mildew. Most of us use these terms interchangeably to describe all types of fungal growth. Fungi experts usually refer to fungal colonies that produce fuzzy or wooly growths on surfaces like wood, paper or spoiled foods as mold. And mildew is the term used to refer to fungal growth on fabric. I will use the term's fungi and mold interchangeably in this Fact Sheet.

Most news stories about mold focus on the negative aspects of this organism. It is true that molds can cause problems for humans. They prematurely rot wooden structures. And exposure to high concentrations of any type mold can make people ill. But be aware that mold also provides many benefits for humans. Many of us enjoy eating mushrooms, the flowering portion of a type of mold. The yeast that we use to make bread or beer is another type of mold. Mold also performs an absolutely essential function in our ecosystem. Fungi are the principle agents that decay dead plant debris and thus return the nutrients locked into that plant material to the soil where nutrients become re-available to support new life. If it were not for the rotting abilities of mold we would soon be buried under piles of dead leaves, trees and other plant debris.

Fungal Organisms -Background Information
It is estimated that fungal organisms comprise approximately 25% of the earth's biomass. This gives you an indication of just how widespread fungi are in the environment. Most fungi consume dead plant and animals remains. In fact, fungi are one of the few organisms that can break down wood and wood based materials such as cardboard and paper into simple digestible compounds. And since most houses are constructed from wood and are full of wood furniture and cabinets, plus wood based materials such as books and newspapers, plenty of food sources are available in our homes for fungal organisms.

Besides a food source, sustained mold growth requires temperatures between 40 degrees F and 100 egrees·F and a significant source of moisture. As noted, houses provide plenty of food sources for fungi and the typical tempera-

ture range found in most homes is very conducive to fungal growth. The water content of the food source is the most critical factor determining if fungi can germinate and grow on a surface. Fungi prefer food materials to be very damp, 70% to 80% saturated or more. Condensation is the principle source of moisture that saturates food sources in residential buildings.

Fungi, like all living organisms create by-products in the process of breaking down food sources into usable nutrients. Fungal species release the following substances as by-products of the physical and chemical processes related to converting carbohydrates to energy.

- Carbon Dioxide (CO_2)
- Water
- Volatile Organic Compounds (mVOC[1])

VOCs released by molds are responsible for the musty smell associated with mold growth. Health impact of fungal produced VOCs has not been extensively studied (Burge 1997).

Mycotoxins:

In addition to the above by-products some fungal species also release secondary compounds called mycotoxins. Fungi produce mycotoxins as a way to protect their food source from competing organisms, bacteria and other species of fungi for example. Penicillin is an example of a mycotoxin released by some species of the Penicillium genus. Penicillin is extremely toxic to bacteria, so toxic in fact that humans have made use of this mold by-product to fight disease caused by bacterial organisms.

Some fungal mycotoxins are also toxic to mammals, including humans. Aflatoxin is an example. It is a mycotoxin produced by molds that commonly grow on spoiled foods, especially feed grains and peanuts. It is an extremely potent carcinogen, much more potent than many industrial chemical compounds. Tricothecene is another mold produced mycotoxin that is toxic to humans.

Fungi also produce and release massive numbers of spores. Spores are to fungi as seeds are to plants. They are the mechanism that fungi use to reproduce. Once released from the fungus the spores drift around in the air and if they come to rest in a place that has favorable environmental conditions, a moist space with a food source, they germinate and grow (see graphic on page 3 for more details).

Fungi and Health Problems

Exposure to fungi create health problems for humans in three basic ways:

- Allergic Reactions
- Fungal Infections
- Mycotoxicosis

What follows is an explanation of each.

Allergic Reactions

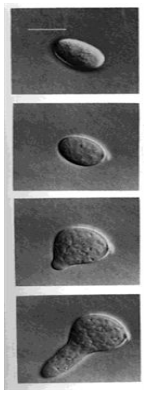
An allergy starts with exposure(s) to a substance that causes the individual to become sensitized. During this period the body's immune system is producing antibodies targeted to the sensitizing substance — the allergen. After sensitization has occurred, subsequent exposures to the allergen will cause physical symptoms, sneezing and coughing for example. The physical symptoms are not caused by the substance attacking the body, but by the chemicals released by the body's immune system in response to being exposed to the allergen. In fact, the definition of an allergy is an overreaction of the bodies immune system to substances that typically cause no reaction in most individuals (Asthma & Allergy Foundation of America).

[1] Noted as mVOC to indicate it is a microbiological volatile organic compound.

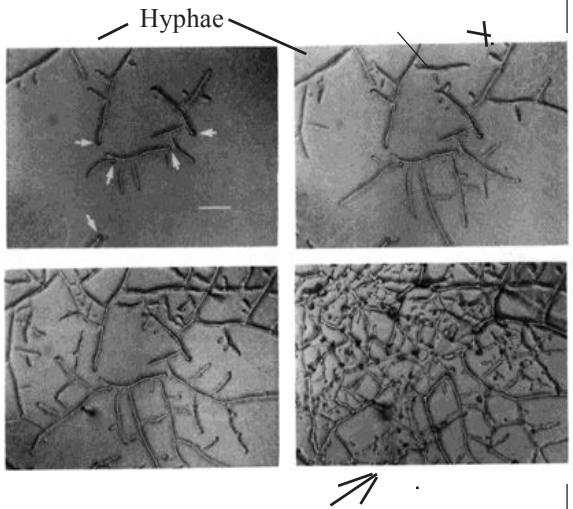
Fungi Life Cycle

Fungal spores are ubiquitious in outdoor and indoor air

When a spore lands on a surface and environmental conditions are favorable, germination takes place

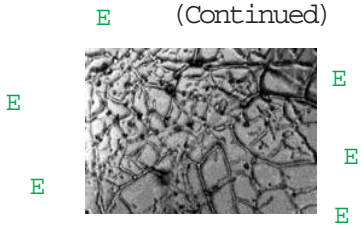


Under ideal environmental conditions, it rapidly develops hyphae. Hyphae are thin, tube-like structures filled with living matter. They are the basic component of fungal bodies.

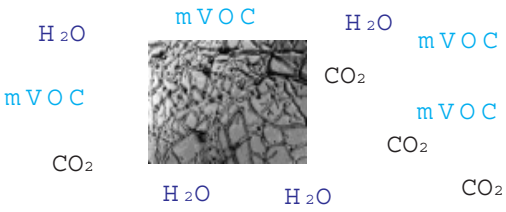


A mass of hyphae is called mycellium, the body of the fungus. In less than 10 hours mycellium is fully developed, branching across and penetrating the food source.

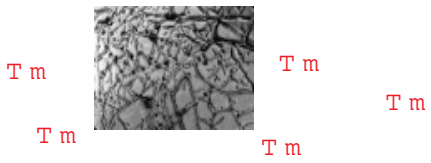
Fungi Life Cycle (Continued)



Mycellium releases enymes (E) onto food source to break down complex carbon compounds into simple sugars which are then absorbed into the mycellium. Fungal digestive process takes place completely exterior to the organism



Active fungal colonies release water (H2O), carbon dioxide (CO2) and volatile organic compounds (denoted as mVOC)



Stachybotrys and many other fungi also produce mycotoxins (Tm) as a defense mechanism to protect their food source from competing organisms. Mycotoxins are non-volatile, but can be released in an aerosol when ambient conditions are very moist. Also, if contaminated surfaces are disturbed, mycotoxins may become airborne. This is the suspected route of exposure for humans.

Fungal organisms develop fruiting bodies to produce spores

Under ideal conditions the newly established fungal colony has developed fruiting bodies, and is producing spores within hours of initial spore germination . Some species of fungi are capable of producing over 50 million spores per minute for each 10 square feet of area of fungal growth.

While it is well known that exposure to fungi can trigger respiratory allergies, studies indicate that the percentage of people likely to have an allergic response from exposure to mold is relatively small. Listed below are allergy related problems caused by mold exposure.

Rhinitis:
This type allergic reaction mimics the symptoms of a common cold; nasal congestion, runny nose, sneezing, nose and eye itching and tearing eyes. While unpleasant it is seldom life threatening, unless the individual experiencing the allergic reaction also has asthma. In that case exposure to any allergen can cause or exacerbate an asthma attack. Asthma attacks can be life-threatening situations.

Hypersensitivity Pneumonitis:
This is an allergic reaction to inhaled organic or chemical allergens. When caused by fungi it usually occurs after inhalation of very high levels of spores released from moldy agricultural products such as hay or silage. In fact another term often used for Hypersensitivity Pneumonitis is farmers lung. An acute form of this condition usually occurs after intense exposure to antigens. Symptoms include fever, chills, and labored breathing and generally go away 4 to 12 hours after exposure. However, symptoms will recur with re-exposure. And if future exposures to the allergen are not prevented, chronic lung disease can result.

Fungal Infections (Also called Mycosis)
When fungi actually use your body tissues as a food source you have a fungal infection. Athlete's Foot and Ringworm are two examples of fungal infections of the skin. There are also fungal infections that can invade the respiratory system and other internal organs. Aspergillosis is one example. It is caused by inhalation of spores from four species of fungi from the Aspergillus[2] genus. It is a very common fungi and it's spores are readily found in homes, offices and even hospitals. However, it only affects people with severe chronic lung disease and those with badly damaged immune systems, AIDS patients and people undergoing cancer treatments, for example. The typical person's immune system easily prevents any fungal infection of the respiratory system.

Mycotoxicosis
As noted earlier, many species of fungi produce mycotoxins as a way to protect their food source from competing organisms'. Think of it as fungal organisms form of biological warfare. Unfortunately, these mycotoxins can also be toxic to humans. Mycotoxicosis refers to illness that results from exposure to these mycotoxins. While Stachybotrys chartarum is most often, and incorrectly, mentioned in the news media as the toxic mold, some species of Cladosporium, Penicillium, Fusarium and Aspergillus are also known to produce mycotoxins. These four are also the most common airborne fungi found in both indoor and outdoor air. Therefore, exposure to any significant mold growth should be prevented.

How much of a health threat to humans do fungal mycotoxins pose? It is known that ingestion, eating food contaminated by mycotoxins, can make people ill. Several fatal epidemics occurred in Russia in the 1940s that were linked to eating wheat that was infected with tricothecene, a mycotoxin produced by several common species of fungi. A series of mold related poisonings also occurred in India in 1987.

---

[2] The four species are; Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger and Aspergillus terreus. Estimates are that A. fumigatus accounts for 75% of all human infections. Aspergillus can also infect the central nervous system, however this occurs far less frequently than respiratory infection. Again, it affects only those individuals with severely weakened immune systems.

Investigators determined those poisonings were caused by eating bread made from wheat that was contaminated with Aspergillus and Fusarium, two fungi known to produce trichothecene-based mycotoxins. Testing of the wheat also revealed that it was contaminated with several forms of trichothecene toxin. The illness ceased when individuals stopped using the contaminated wheat for making bread.

It is also known that inhalation of mycotoxins can create health problems for humans. A documented case of mycotoxin illness caused by inhalation of mold toxins occurred in Russia in the 1940s. A series of poisonings occurred that affected farm workers responsible for handling and transporting moldy hay. Symptoms included difficulty breathing, sore throat, bloody nose and severe skin rashes. Skin samples taken from affected individuals grew Stachybotrys chartarum when cultured. Samples taken from the hay also grew Stachybotrys chartarum. This confirmed the connection between exposure to the moldy hay and the farmers' illness. The condition, known as stachybotryotoxicosis, went away less than a week after exposure to the moldy hay ended.

The United States Centers for Disease Control (CDC) reports that cases of stachybotryotoxicosis are not rare in such industrial settings as cotton-seed oil mills, grain elevators and malt grain processing mills. But do mycotoxins produced by Stachybotrys chartarum and other toxin-producing molds reach concentrations high enough in homes, offices, or schools to cause mycotoxicosis?

There is currently no conclusive scientific evidence that they do[3]. However, it is best to error on the side of safety. And it is never healthy to be exposed to active mold growth and the millions of spores such a growth can generate. Therefore, mold growth in homes, offices, or schools should always be controlled.

Controlling Mold Growth:
Since mold spores are always present in both indoor and outdoor air, preventing mold growth in buildings may seem like a monumental task. But mold spores cannot germinate and begin developing into active mold colonies unless significant amounts of moisture are present. Therefore, the key to controlling mold growth is to maintain indoor moisture levels below what is required for fungal growth. And that is not difficult to do.

Control moisture by:
- Preventing condensation;
- Routinely inspecting for water leaking into your home, this includes plumbing leaks, roof leaks, leaky basements, etc. Get leaks fixed immediately;
- Clean water damage and dry wet materials from flooding accidents within 24 to 48 hours.

Preventing Condensation:
Mold growth in houses usually gets started when high humidity leads to condensation on cooler surfaces. The inside of exterior walls in a closet or behind furniture are common sites where this occurs, especially during the winter heating season. During hot, humid summer weather, condensation often forms on cooler basement walls and floors. You can prevent condensation in two ways.

1) Increase the temperature of surfaces:
Temperatures of the interior side of exterior surfaces (ie. walls, ceilings, floors,) can be increased in winter by making certain those surfaces are properly insulated (see Insulation Check-Up Fact Sheet). Increasing air flow within the house will also raise surface temperatures. Leaving closet doors open during the winter heating season will often allow heated air to get into those spaces and keep surface temperatures warm enough to prevent condensation.

[3] While there have been reports in some news stories that Stachybotrys mold was responsible for cases of severe lung bleeding that occurred in eight infants in Cleveland Ohio between January 1993 and November 1994, the Centers for Disease Control currently says that... to date, a possible association between acute idiopathic hemorrhage (lung bleeding) among infants and Stachybotrys has not been proved.. (http://www.cdc.gov/nceh/asthma/factsheets/molds/default.htm)

2) Decrease the amount of moisture in the air: Moisture generated within the house should be exhausted to the outdoors. Clothes dryers should be vented according to manufacturers' instructions; kitchens and bathrooms should be equipped with exhaust fans ducted to the outdoorss to ventilate moisture related to cooking and bathing. A general rule for reducing indoor moisture levels is to increase ventilation if outside air is cold and dry; and dehumidify if outdoor air is warm and humid.

Undetected plumbing leaks and leaking roofs or walls are often responsible for very large fungal growths in buildings. Develop and adhere to a routine maintenace check of your home to detect leaks before they become significant problems. At least once a year you should check the condition of your roof for cracked or missing shingles-more if your roof is older and showing signs of wear. Also check the underside of the roof by viewing it from your attic, and look for signs of leakage such as water stained roof boards, and wet or damp insulation. Make certain that roof gutters and downspouts are in good condition and not plugged. Periodically check basements, crawlspaces and under sinks for leaking pipes. Get leaks fixed immediately.

Never let basements or crawlspaces stay wet or damp, even if you do not use them as living space or seldom even enter them. Massive amounts of water, in vapor form, can migrate from a wet basement or crawlspace into the living areas of your home. To learn how to fix basement water problems, see the list of resources at the end of this paper.

Even in the best constructed and maintained building, flooding accidents can sometimes occur. A burst water pipe, or a severe rainstorm can quickly flood interior areas of a house. When flooding does occur, you must act quickly to remove the water, and clean affected areas and get materials dried out. The water damage should be addressed within 24 to 48 hours to prevent mold growth. Table 1 provides guidance for responding to heavy water damage in a home.

Relative Humidity and Condensation

Relative humidity is the ratio of the actual amount of water vapor in the air to the maximum amount of water vapor the air can hold at a given temperature. For example if the air temperature in a room is 75 degrees and the relative humidity is 40% that means that the air is holding 40% of the amount of water vapor it is capable of holding. If the amount of water vapor in the air were increased to 100%, the air would be completely saturated with vapor and some water would condense, or change to a liquid form. Warm air is capable of holding much more water vapor than cooler air. For example if the temperature in some parts of the room dropped from 75 to 60 degrees, and the actual amount of vapor suspended in the air remained the same, then the relative humidity of the 60 degree air would be 100%. The temperature at which water condenses from a vapor to a liquid is called the dew point temperature. The dew point temperature in this example is 60 degrees.

This is the reason that controlling indoor relative humidity levels is so important. For example, in a home with 70 degree indoor air and 55% relative humidity, the dew point temperature is 60 degrees. That means that liquid water will form on all surfaces at or below 60 degrees. So if outdoor temperatures are cold, the temperature on the inside surface of outdoor walls could easily be 60 degrees or cooler, especially in a poorly insulated house, or inside closed closets where warm air cannot reach. But if the relative humidity were only 35%, the dew point temperature would decrease to 54 degrees. Condensation would be less likely to occur with the lower relative humidity.

Table 1: How To Clean Water Damage To Prevent Mold Growth[1]

Water-Damaged Material*	Actions should be taken within 24-48 hours to prevent mold growth**
Books & Papers	• For non-valuable items, discard books and papers. • Photocopy valuable/important items, discard originals. • Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet & Backing-dry within 24-48 hours***	• Remove water with water extraction vacuum. • Reduce ambient humidity levels with dehumidifier. • Accelerate drying process with fans.
Ceiling Tiles	• Discard and replace.
Cellulose Insulation	• Discard and Replace
Concrete and cinder block surfaces	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass Insulation	• Discard and Replace
Hard surface, porous flooring § (Linoleum, ceramic tile, vinyl)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. Check to make sure sub-flooring is dry; dry sub-flooring if necessary.
Non-porous, hard surfaces (Plastics, metals)	• Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	• Remove water with water extraction vacuum. • Accelerate drying process with dehumidifiers, fans, and/or heaters. • May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	• May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. • Ventilate the wall cavity, if possible.
Window Drapes	• Follow laundering or cleaning instructions recommended by manufacturer
Wood Surfaces	• Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) • Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. • Wet paneling should be pried away from wall for drying.

*If a particular item(s) has high monetary or sentimental value, you may wish to consult with a restoration/water damage specialist.

**If mold growth has occurred or materials have been wet for more than 48 hours, consult Table 2 guidelines. Even if materials are dried within 48 hours, mold growth may have occurred. Items may be tested by professionals if there is doubt. Note that mold growth will not always occur after 48 hours; this is only a guideline. These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage or chemical or biological pollutants, then Personal Protective Equipment and containment are required by OSHA. An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.

***The subfloor under the carpet or other flooring material must also be cleaned and dried. See the appropriate section of this table for recommended actions depending on the composition of the subfloor.

---

[1] Adapted from *Mold Remediation in Schools and Commercial Buildings*. EPA publication 402-k-01-001, (http://www.epa.gov/mold/mold_remediation.html) Office of Air and Radiation Indoor Environments Division, March 2001.

What To Do if Mold Growth is Detected:
If you detect an active mold growth in your house and the mold covers a small area (less than 10 square feet) you can easily do the cleanup yourself. Use the information contained in Table 2 below to determine how to best clean the contaminated surfaces. If the affected area is greater than 10 square feet, you still may be able to do the cleanup yourself; however you must be very careful to protect yourself and contain the area being cleaned to prevent the spread of mold spores to non-affected areas. The United States Environmental Protection Agency guide, Mold Remediation in Schools and Commercial Buildings, provides specific clean-up and containment guidelines for cleaning larger areas of mold growth. You can obtain a free copy of the booklet by contacting the EPA Air Quality Information Clearing House at 800-438-4318. However, if you and other members of your family are prone to allergies or suffer from asthma, you may want to obtain the assistance of a professional to handle mold cleanup. If you do contract with an individual or firm to do the mold cleanup for you, be certain they follow mold cleanup guidelines from the EPA's Mold Remediation in Schools and Commercial Buildings. If you plan to contract with a firm to do the clean-up, you can obtain a copy of the publication, Hiring a Mold Remediation Contractor (see list of resources on page 10).

Table 2: Guidelines for Remediating Small Areas of Building Materials with Mold Growth Caused by Clean Water [1]

Material or Furnishing Affected	Cleanup Methods*	Personal Protective Equipment
Books and papers	3	N-95 respirator [2] gloves goggle
Carpet and backing	1,3	
Concrete or cinder block	1,3	
Hard surface, porous flooring (linoleum, ceramic tile, vinyl)	1,2,3	
Non-porous, hard surfaces (plastics, metals)	1,2,3	
Upholstered furniture & drapes	1.3	
Wallboard (drywall and gypsum board)	3	
Wood surfaces	1,2,3	

Cleanup Methods*

Method 1) Wet vacuum (in the case of porous materials, some mold spores/fragments will remain in the material but will not grow if the material is completely dried). Steam cleaning may be an alternative for carpets and some upholstered furniture.

Method 2) Damp-wipe surfaces with plain water or with water and detergent solution (for finished wood surfaces, you may want to use a wood floor cleaner) scrub as needed.

Method 3) High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose the contents of the HEPA vacuum in well-sealed plastic bags.

---

[1] Information contained in this Table was excerpted from Mold Remediation in Schools and Commercial Buildings. (2001) United States Environmental Protection Agency. View at: (http://www.epa.gov/mold/mold_remediation.html)

[2] A N-95 respirator covers the nose and mouth. It will filter out 95% of all particles greater than .3 microns in diameter that pass through the respirator (mold & mold spores range in size from 1 to 200 microns). They are available in most hardware stores. This is minimum respiratory protection to wear when cleaning small areas of mold. You must ask for and obtain a labeled N-95 respirator. Do not usea dust mask.

Mold in hidden areas

Active mold growths may not always be visible. For example, mold may be growing within a wall cavity behind gypsum wallboard or wood paneling, under wallpaper, or behind ceiling tiles.

Even if you cannot see mold growing in a building there are several clues that indicate its presence:

- If there is significant mold growth in a hidden area, chances are you will be able to smell it. Fungal growth has a strong distinctive "musty" odor.
- If high levels of moisture are present in a building, or if there is evidence of water damage, you can assume mold is present. Moisture problems in buildings are not difficult to detect. The air within the building will have a damp, clammy feeling. Heavily stained ceiling tiles, or gypsum wallboard are strong indications that that water from a plumbing or roof leak is saturating building materials within wall or ceiling cavities.

Investigating hidden mold growth often requires removing wall or ceiling coverings such as wallpaper or ceiling tiles. Sometimes wall board also needs to be removed to check underlying wood framing components. Since you cannot make a determination about how large an area hidden mold may cover until you investigate, take precautions to protect yourself in case of a very large growth. This means wearing PPE (personal protective equipment) during your investigation.

Should you have your home tested for mold?

Testing indoor air for the presence of mold is seldom recommended. Mold sampling is usually expensive and often requires the services of trained professionals (an Industrial Hygienist, for example). In addition, there is currently no uniform, agreed-upon standard to use for judging what is an acceptable/unacceptable concentration of mold. Also, determining if a mold problem is present seldom requires testing. If you can't see the mold, then usually you can smell it. Large mold infestations release lots of volatile organic compounds that are easily detected by the human nose. And if you cannot detect the actual presence of mold, it is still relatively easy to detect moisture problems that create mold growth. There are, however, some instances when testing may be useful. If a large mold infestation cleanup has been done in a home or building, testing may be useful in determining if the cleanup was successful. And medical doctors sometimes order mold testing of a home as a method to help identify allergens that may be causing health problems for patients.

While this Fact Sheet has focused on many of the health problems exposure to mold may cause, remember that properly maintained houses that are kept reasonably clean and dry will not be colonized by fungi. And if mold growth is discovered in a home, it can be cleaned up safely by following the guidelines listed in this Fact Sheet.

List of Resources:

Mold Remediation in Schools and Commercial Buildings. (2001) United States Environmental Protection Agency (EPA-402-K-01-001) You can obtain a copy of this 48 page booklet by contacting the U.S. Environmental Protection Agency at:
National Center for Environmental Publications (NSCEP)
P.O. Box 42419
Cincinnati, OH 42419
1-800-490-9198/(513) 489-8695 (fax)
or you can go to
http://www.epa.gov/iaq/molds/moldresources.html
and download a PDF file of this booklet.

List of Resources (continued from pg. 9)

You can also download the following publications at this website:

Introduction to Molds
Basic Mold Cleanup
Ten Things You Should Know About Mold
Asthma and Mold
Floods/Flooding
Health and Mold
Homes and Mold
Indoor Air Regulations and Mold
Large Buildings and Mold
Schools and Mold and Indoor Air Quality

(http://www.epa.gov/iaq/molds/moldresources.html)

Other Mold-Related Resources/Links

A Brief Guide to Mold, Moisture, and Your Home http://www.epa.gov/iaq/molds/moldguide.htmlf Human Ecology. Louisa

Hiring a Mold Remediation Contractor. (2007). Written by Joseph Laquatra, Cornell University College of Human Ecology and Claudette Reichel, Louisiana State University Ag Center. http://www.human.cornell.edu/dea/outreach/loader.cfm?csModule=security/getfile&PageID=47816

Home Moisture Problems - (publication EC1437) by D.M. Brook, (1995) Oregon State University Extension Service. You can download a PDF file of this fact sheet at: http://eesc.orst.edu/agcomwebfile/edmat/EC1437.PDF

Moisture Control Handbook, Principles and Practices for Residential and Small Commercial Buildings (1994) Lstiburek, J., Carmody, J. Van Nostrnd Reinhold,

References:

Burge, H. (1997). The fungi: how they grow and their effects on human health. HPAC. July, 69-74.

Page, E. & Trout, D. (2001). The role of stachybotrys mycotoxins in building-related illness. Journal of the American Industrial Hygiene Association. 62 (5) 644-648.

This Information Sheet written by Mark Pierce,
Extension Associate
Department of Design & Environmental Analysis
Cornell University, Ithaca New York
Revised May 2011