# Mold Awareness

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**United Food and Commercial Workers Union**

**Coalition of Black Trade Unionists**

**American Federation of Teachers**

**American Federation of Government Employees**

**United American Nurses**

**University of Cincinnati, Department of Environmental Health**

**Greater Cincinnati Occupational Health Center**

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# Tab 1

**Table 1** presents strategies to respond to water damage within 24-48 hours. These guidelines are designed to help avoid the need for remediation of mold growth by taking quick action before growth starts. If mold growth is found on the materials listed in **Table 1**, refer to **Table 2** for guidance on remediation. Depending on the size of the area involved and resources available, professional assistance may be needed to dry an area quickly and thoroughly.

| **Table 1: Water Damage - Cleanup and Mold Prevention** | |
|---|---|
| Guidelines for Response to Clean Water Damage within 24-48 Hours to Prevent Mold Growth[*] | |
| **Water-Damaged Material[†]** | **Actions** |
| *Books and papers* | • For non-valuable items, discard books and papers.<br>• Photocopy valuable/important items, discard originals.<br>• Freeze (in frost-free freezer or meat locker) or freeze-dry. |
| **Carpet and backing - dry within 24-48 hours[§]** | • Remove water with water extraction vacuum.<br>• Reduce ambient humidity levels with dehumidifier.<br>• Accelerate drying process with fans. |
| **Ceiling tiles** | • Discard and replace. |
| **Cellulose insulation** | • Discard and replace. |
| **Concrete or cinder block surfaces** | • Remove water with water extraction vacuum.<br>• 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.<br>• Check to make sure underflooring is dry; dry underflooring 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.<br>• Accelerate drying process with dehumidifiers, fans, and/or heaters.<br>• 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**<br>(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.<br><br>• · Ventilate the wall cavity, if possible. |
| **Window drapes** | • · Follow laundering or cleaning instructions recommended by the manufacturer. |
| **Wood surfaces** | • • Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.)<br><br>• • Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry.<br><br>• · Wet paneling should be pried away from wall for drying. |
| [*]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. Please note that Tables 1 and 2 contain general guidelines. Their purpose is to provide basic information for remediation managers to first assess the extent of the damage and then to determine whether the remediation should be managed by in-house personnel or outside professionals. The remediation manager can then use the guidelines to help design a remediation plan or to assess a plan submitted by outside professionals.<br><br>[†]If a particular item(s) has high monetary or sentimental value, you may wish to consult a restoration/water damage specialist.<br><br>[§]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. | |

Source: USEPA, *Mold Remediation in Schools and Commercial Buildings.*

| Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water* | |
|---|---|
| Material or Furnishing Affected | Cleanup Methods† |
| **SMALL - Total Surface Area Affected Less Than 10 square feet ($ft^2$)** | |
| Books and papers | 3 |
| 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 |
| **MEDIUM - Total Surface Area Affected Between 10 and 100 $ft^2$** | |
| Books and papers | 3 |
| Carpet and backing | 1,3,4 |
| 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 | 1,3,4 |
| Wallboard (drywall and gypsum board) | 3,4 |
| Wood surfaces | 1,2,3 |
| **LARGE - Total Surface Area Affected Greater Than 100 $ft^2$ or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant** | |
| Books and papers | 3 |
| Carpet and backing | 1,3,4 |
| Concrete or cinder block | 1,3 |
| Hard surface, porous flooring (linoleum, ceramic tile, vinyl) | 1,2,3,4 |
| Non-porous, hard surfaces (plastics, metals) | 1,2,3 |
| Upholstered furniture & drapes | 1,3,4 |
| Wallboard (drywall and gypsum board) | 3,4 |
| Wood surfaces | 1,2,3,4 |

**Table 2, continued**

*Consult Table 1 if materials have been wet for less than 48 hours, and mold growth is not apparent. These guidelines are for damage caused by clean water. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

# Tab 2

OSHA QUICK CARD™

# Mold

Molds are microscopic organisms found everywhere in the environment, indoors and outdoors. When present in large quantities, molds have the potential to cause adverse health effects.

## Health Effects of Mold Exposure

- Sneezing
- Runny nose
- Eye irritation
- Cough and congestion
- Aggravation of asthma
- Dermatitis (skin rash)

## People at Greatest Risk of Health Effects

- Individuals with allergies, asthma, sinusitis, or other lung diseases.
- Individuals with a weakened immune system (e.g., HIV patients).

## How to Recognize Mold

- Sight – Usually appear as colored woolly mats.
- Smell – Often produce a foul, musty, earthy smell.

## Preventing Mold Growth

- Remove excess moisture with a wet-dry vacuum and dry out the building as quickly as possible.
- Use fans to assist in the drying process.
- Clean wet materials and surfaces with detergent and water.
- Discard all water damaged materials.
- Discard all porous materials that have been wet for more than 48 hours.

## General Mold Cleanup Tips

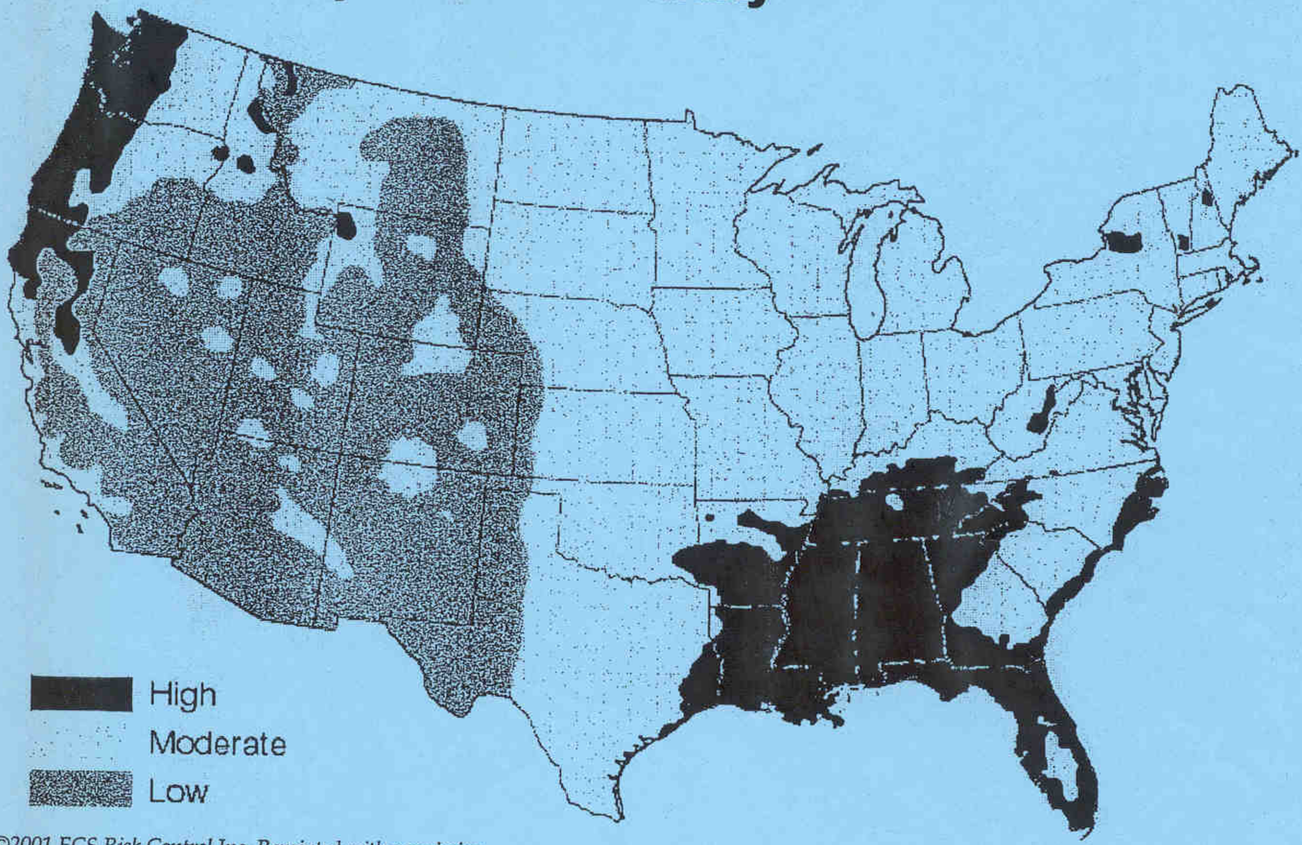
- Identify and correct moisture problem.
- Make sure working area is well ventilated.
- Discard mold damaged materials in plastic bags.
- Clean wet items and surfaces with detergent and water.
- Disinfect cleaned surfaces with 1/4 to 1 1/2 cup household bleach in 1 gallon of water. **CAUTION: Do not mix bleach with other cleaning products that contain ammonia.**
- Use respiratory protection. A N-95 respirator is recommended.
- Use hand and eye protection.

**For more complete information:**

OSHA Occupational Safety and Health Administration
**U.S. Department of Labor**
www.osha.gov (800) 321-OSHA

OSHA 3263-09N-05

## Regional Weather Conditions: Mold Risk Based on Precipitation & Humidity



Molds and Fungi

# Standards

There are currently no specific OSHA Standards or Directives for molds and fungi. However, Indoor Air Quality (IAQ) hazards are addressed in specific standards for general and construction industries. This page highlights OSHA standards, federal registers (rules, proposed rules, and notices), and national consensus standards related to the molds and fungi.

**OSHA**

Section 5(a)(1) of the OSH Act, often referred to as the General Duty Clause, requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees". Section 5(a)(2) requires employers to "comply with occupational safety and health standards promulgated under this Act". In addition to the specific OSHA standards listed below, there are national consensus standards which OSHA could consider referencing in a general duty clause citation.

> **Note:** Twenty-six states have OSHA-approved State Plans and have adopted their own standards and enforcement policies. For the most part, these States adopt standards that are identical to Federal OSHA. However, some States have adopted different standards applicable to this topic or may have different enforcement policies.

*Highlighted Standards*

General Industry

- 1910.94, Ventilation

Construction Industry

- 1926.57, Ventilation

*Federal Registers*

- Indoor Air Quality. Notice 66:64946, (2001, December 17). OSHA withdrew its Indoor Air Quality proposal and terminated the rulemaking proceeding.
- Indoor Air Quality. Proposed Rules 59:15968-16039, (1994, April 5). OSHA proposed to adopt standards that addressed indoor air quality in indoor work environments.
- Respiratory Protection. Final Rules 63:1152-1300, (1998, January 8). Justified the use of respirators to prevent the inhalation of harmful airborne contaminants that are alive or were released from a living organism. Respirators protect against bacterial infections resulting from inhalation of bacteria and their products that cause a range of diseases.

**National Consensus and Industry Standards and Guidelines**

Note: These are NOT OSHA regulations. However, they do provide guidance from their originating organizations related to worker protection, and may be referenced by OSHA inspectors for informational purposes.

*American National Standards Institute*

- *Standard 62-2001*, Ventilation for Acceptable Indoor Air Quality. Sets minimum ventilation rates and other requirements for commercial and institutional buildings.

*Institute of Inspection, Cleaning and Restoration Certification (IICRC)*

- *IICRC S500*, Standard and Reference Guide for Professional Water Damage Restoration. Institute of Inspection, Cleaning and Restoration, 1999. The IICRC S500 provides a specific set of practical standards for water damage restoration. It does not attempt to teach comprehensive water damage restoration procedures; rather it provides the foundation for basic principles of proper restoration practices.
- *IICRC S520*, Mold Remediation Standard. S520 establishes mold contamination definitions, descriptions and conditions (1, 2, 3), and general guidance, which, when properly applied, can assist remediators and others in determining criteria that trigger remediation activities or confirm remediation success.

Excessive exposure to molds can lead to adverse health issues for humans. The affects of human exposure to mold is not a new, emerging problem but has been manifested for many years. Documentation of mold growth indoors dates back **as far as the Old Testament:**

*From Leviticus Chapter 14, verses 33-57*

- On the 7th day the priest shall return to inspect the house. If the mildew has spread on the walls, he is to order that the contaminated stones be torn out and thrown into an unclean place outside the town. He must have all the inside walls of the house scraped and the material that is scrapped off dumped into an unclean place outside the town. Then they are to take other stones to replace these and take new clay and plaster the house
- If the mildew reappears in the house after the stones have been torn out and the house is scraped and plastered the priest is to go and examine it and, if the mildew has spread in the house, it is a destructive mildew: the house is unclean. It must be torn down – its stones, timbers and all the plaster – and taken out of the town to an unclean place.
- Anyone who goes into the house while it is closed up will be unclean till evening.
- Anyone who sleeps or eats in the house must wash his clothes…..

# Mycology - the study of fungi

## Fungi are master absorbers

- They don’t photosynthesize
- They don’t engulf food
- They can only absorb it
- Their body plan suits this lifestyle – hyphae

## Two modes of nutrition

- Saprophytic - feed on dead and decaying material (especially wood)
- Parasitic - feed on living hosts, usually without killing them

## Example of fungal parasite

- *Entomophthora* - parasitizes flies
- Forces fly to crawl as high as possible
- Produces many spores to infect new flies

## Fungal structure

- Hyphae - long filaments that make up the body
- Sporocarp - "mushroom"
- Mycelium - term for the whole body
- Chitin in cell walls
- No flagella - no motility

## Four main divisions of fungi

(Phylum)

Based on mode of sexual reproduction

- Chytridiomycota **(chytrids)**
- Zygomycota **(bread molds)**
- Ascomycota **(yeasts and sac fungi)**
- Basidiomycota **(club fungi).**

Two extra groups

- Deuteromycota
- Lichens

- Not fungi:
- Slime molds
- Water molds

## It is important to distinguish between Mold and Bacteria because:

All can grow in moist conditions.

All can be disease-causing agents

## In order for mold to grow it needs five (5) things:

- ❖ Air
- ❖ Food source
- ❖ Surface for growth
- ❖ Desirable Temperature
- ❖ Moisture

## There are six characteristics of Mold Spores:

1) Septation
2) Points of Attachment
3) Shape
4) Color
5) Ornamentation
6) Size

## The fascinating Fungi Kingdom
## Mold, mildew, yeast, mushrooms, and lichens

Molds and their relatives are part of an intriguing Kingdom.

If you're a baby boomer like me, you probably studied in school about the Two Kingdoms of Life: Plant and Animal. Mold was classified in the Plant Kingdom.

In 1978 a new classification system was introduced. It included Five Kingdoms of Life:

- **Monera** - bacteria and blue-green algae.
- **Protista** - one-celled organisms like algae (except blue green), the amoeba, also seaweed and kelp.
- **Plantae** - plants.
- **Animalia** - animals.
- **Fungi** - Fungi rules its own mysterious Kingdom. From morel mushrooms and truffles to powdery mildew; from single celled yeast to coral mushrooms, fungi are fascinating.

Fungi are a classification of organisms including mold, yeast, mildew, mushrooms, and lichens. A single species is called a fungus.

The terms "fungus," "mold," and "yeast" are often used interchangeably by the medical community, as are "mold," and "mildew" in the home environment.

In humans, fungi can cause athletes foot, ringworm, Canidiasis (yeast infections and thrush), and chronic fungal sinusitis. Histoplasmosis and aspergillosis are fungal diseases that affect the lungs. Animals as well as fish and fowls can be stricken with fungal disease.

Plant diseases caused by fungi include mildew, blight, Dutch elm disease, brown rot, smuts, and rusts.

Fungi secrete digestive enzymes that digest the food they are growing on, and then they are able to absorb the food through their cell walls. This accounts for the damage or breakdown they cause to material on which they grow.

Lichens are especially interesting. They are formed by a union between fungi and algae. Though both fungi and algae thrive best alone, under certain conditions they fail to thrive, and need each other.

One theory is that, when they join, the fungi breaks down the material on which it grows to absorb minerals and water. It feeds this to the algae which turns the minerals and water back into nutrients and feeds it to the fungus.

Lichens are often seen growing on bare rocks or tree bark.

## Economically important fungi

- Penicillium - produces penicillin - the first discovered antibiotic
- Edible fungi
- Aspergillus niger — citric acid
- Saccharomyces cerevisiae — makes bread and wine, protein supplement
- Trichoderma — cellulase - makes jeans soft
- Enteromorphaga — kills gypsy moth caterpillars
- Candida oleophila — protects fruit from harmful molds
- Phytophthora infestans — potato blight
- Cryphonectria parasitica — chestnut tree blight
- Ceratocystis ulmi — dutch elm disease

# Forms of Moisture

**Water** is an abundant substance on Earth. It exists in many forms, such as sea, rain, and rivers : water is continuously flowing through a cycle of evaporation, precipitation and runoff.

All known forms of life need water. Humans consume "drinking water", i.e. water with qualities compatible with our metabolism. This natural resource becomes scarce with growing world population, and its availability is on the agenda of many governmental organizations.

**Ice** is the solid form of water. The phase transition occurs when liquid water is cooled below 0 ?C (273.15 K, 32 ?F) at standard atmospheric pressure. Ice can be formed at higher temperatures in pressurized environments, and water will remain a liquid or gas until -30 ?C at lower pressures. Ice formed at high pressure has a different crystal structure and density than ordinary ice.

**Fog** is cloud in contact with the ground. It occurs when moisture form the surface of the Earth evaporates; as this evaporated moisture moves upward, it cools and condenses into the familiar phenomenon of fog. Fog differs from clouds in that fog touches the surface of the Earth, while clouds do not. It can form in a number of ways, depending on how the cooling that caused the condensation occurred:

**Frost**, like snow, is the result of deposition of water vapor in saturated air. If solid surfaces in contact with the air are chilled below the deposition point (see frost point), then speckles of ice grow out from the solid surface. The size of the crystals is a matter of time and the amount of water vapor available.

**Condensation**: Air is composed of many gases.   One of these is water in a gaseous from, called water vapor.  The amount of water vapor that air can hold is a function of temperature.  When the air comes in contact with an object at a temperature where water vapor will change to a liquid, it is known as the dewpoint temperature.  This process is called condensation.   Condensation is not a property unique to water vapor alone; most other gases behave in a similar manner.  Unlike other gases, water vapor condenses in the temperature ranges which we find in buildings.

**Humidity** is the amount of moisture in the air. It can be expressed as ***absolute humidity***, which is the mass of water in a specified volume or mass of air, or more commonly as ***relative humidity***, which is the absolute humidity divided by that absolute humidity that would make dew form at the same temperature.

In physical chemistry and in engineering, **steam** refers to vaporized water. It is a pure, invisible gas (for mist see below), which at standard atmospheric pressure has a temperature of around 100 degrees Celsius, and occupies about sixteen hundred times the volume of liquid water. **Superheated steam** is steam heated well beyond its boiling point at standard pressure. A steam engine uses the expansion of steam to drive a piston or turbine and so to perform mechanical work. In other industrial applications steam is used as a repository of energy, which is introduced and extracted by heat transfer, usually through pipes. Steam is a capacious reservoir for energy because of water's high heat of vaporization. The ability to return condensed steam as water-liquid to the boiler at high pressure with relatively little expenditure of pumping power is also important. Engineers use an idealised thermodynamic cycle, the Rankine cycle, to model the behaviour of steam engines.

In meteorology, **precipitation** is any kind of water that falls from the sky as part of the weather. This includes snow, rain, sleet, freezing rain, hail, and virga. Precipitation is a major part of the hydrologic cycle, and is responsible for depositing most of the fresh water on the planet. Precipitation is generated in clouds, which reach a point of saturation; at this point larger and larger droplets (or pieces of ice) form, which then fall to the earth under gravity. It is possible to 'seed' clouds to induce precipitation by releasing a fine dust or appropriate chemical (commonly silver nitrate) into a cloud, encouraging droplets to form, and increasing the probability of precipitation.

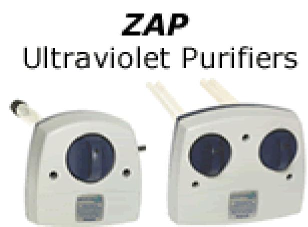
## Dirty Sock Syndrome: *UV Treatment Systems Can Help*

**If you have a smelly Heat Pump, there is a cure...**

"Dirty Sock Syndrome" is caused by the growth of mold and bacteria on the indoor coil and the drain pan of the Heat Pump. All Summer long, moist cooling coils can serve as an ideal breeding ground for mold. But why is it only with Heat Pumps?

When heating season starts, hot air furnaces have a heat exchanger which puts out enough heat to kill the microbes that thrived on the damp evaporator coil and drain pan. Heat Pumps on the other hand, put out much lower temperatures. Just warm enough to heat up the organic debris which releases the spores and toxins into the air and produces the so-called "Dirty sock smell".

Having the coils, drain pan, and drain line cleaned regularly may help solve this problem but installing a UV System is the best answer. Ultraviolet Air Treatment Systems zap airborne germs and prevent mold spore growth on air conditioning coils.




Honeywell, among other companies, offers several models to choose from. See below.

## About Ultraviolet radiation (UV-C)

The Sun has been nature's Outdoor Air Purifier for years. Scientists have known that one of the most effective air purifiers is natural sunlight. Not the light we see when we look out the window, but the invisible "C" band, ultraviolet rays that make up part of the sun's light spectrum. The sun's UV-C rays act as a natural outdoor air purification system, inhibiting the growth and reproduction of bacteria,viruses, fungi & molds. However, this natural process does not occur indoors.

Ultraviolet radiation (UV-C) replicates the natural outdoor purification system of the sun by destroying the allergy and disease-causing microbes living and multiplying in indoor air. By itself, or in combination with a quality filter, it is the most effective way to reduce airborne bacteria and the health risks they represent.

With tighter building construction, in recent years, the quality of indoor air has declined dramatically. The air circulating in the ductwork of the average home or office can be concentrated with contaminants including molds, bacteria, yeasts, dust mites, and viruses. We fill our lungs up to 20,000 times each day. Over time, these contaminants can cause allergies, inflammation of the mucous membrane, upper respiratory problems, asthmatic conditions, headaches and flu-like symptoms.

Indoor air in a typical residential forced-air HVAC system will be recirculated over 50 times a day. With a UV generating lamp mounted in the HVAC duct, cumulative exposure can be very effective in controlling indoor bacteria. UV rays will also kill germs that breed in drain pans and A/C coils. Properly positioned, an ultraviolet system can significantly reduce indoor air contamination and prevent the growth of new microorganisms.

The treatment of indoor air with ultraviolet radiation has been successful in health care facilities, food processing plants, schools, laboratories and other applications. It is a safe, silent, and proven method of improving indoor air quality.

## Mold and what you need to know about it

Mold can wreak havoc with human health. A 1999 Mayo Clinic study found that mold was the culprit in nearly all chronic sinus infections. Other recent studies have implicated mold as a factor linked to a tripling of the asthma rate over the past 20 years. In our homes, we trap pollutants, such as the chemicals released from carpets and cleaning products, radon gas, auto exhaust, emissions from combustion appliances, and more. Indoor humidity levels that are too high, or too low, also can affect the well-being of occupants, and the durability of the home or building itself.

Today's homes are built tighter and insulated better than ever. They keep us warm and cozy in winter and save money on heating bills. But the construction methods and materials that keep modern homes more energy-efficient than older, draftier houses can have a troublesome side effect: Many of today's houses are too airtight. Without adequate air circulation and dehumidification, moisture can build up in a home's hidden places; inside walls, under floors, above ceilings, behind shower walls, allowing mold to form.

## Honeywell UV Air Treatment Systems

UV air treatment systems kills a high percentage of airborne bacteria and surface mold passing by the light.

**UV100A1000**
Single Lamp Return

**UV100A1018**
Dual Lamp Return

**UV100A1059**
Coil Plus Model

**Features**

- UV-C light kills airborne and surface bacteria.
- Continuously emits ultraviolet energy.
- UV lamp does not produce ozone.
- Sealed unit design prevents accidental installer and homeowner contact with the voltage and with the ultraviolet rays.
- Safe design prevents lamps from lighting unless the base is correctly mounted on the HVAC duct.
- Light pipe to safely view the lamp operation.
- Power cord that plugs into 120 Vac electrical outlet.
- Quick and easy lamp replacement.
- Easy lamp maintenance.
- AIRWATCH™ Indicator can be installed to remind customers when to change the lamp.
- To capture and minimize microorganism pass-through in residential heating, ventilation and air conditioning (HVAC) systems, combine the Ultraviolet Air Treatment System with a high-efficiency air filtration system that includes an electronic air cleaner.

## Dirty Sock Syndrome Solved with UV-Aire™

*(Snow Hill, NC)*

Dirty Sock Syndrome erupted in the fall of 1999 at Greene County High School in Snow Hill, North Carolina, following the installation of new, wall mounted heating and air conditioning units. Students and teachers were literally getting sick from the smell, which was compared to that of a dead animal.

Melton Meacomes, HVAC Technician for Greene County Schools said, "For months we crawled in and around the units looking for the problem, even digging through the insulation because we suspected dead animals. That is how terrible the odor was." Meacomes suspected "Dirty Sock Syndrome" and used biocides to clean the ac coils to try to kill any bacteria or molds that could be causing the problem. The chemicals worked for a couple of days and then the odor returned. Next, he called the manufacturer of the heating and air conditioning system.

System experts visited the school to investigate the cause of the odor and could find nothing wrong with the unit itself, and there didnÍt appear to be any foreign matter causing the smell. So, they concluded that the odor was being generated by airborne contaminants. Ultraviolet air purification systems were researched: The UV-Aire, Sanuvox and SterileAir. "Field Controls UV-Aire was chosen because of the UV output of its bulb, simple design and adaptability. Plus, it was the easiest to install," says Meacomes. After installing the UV-Aire in two units, the school "smelled" immediate results.

"It was really amazing," said Meacomes. "Within minutes, the odor was gone. We installed the UV-Aire in August and tested them through the air conditioning and heating seasons. The dirty sock problem was solved."

## What causes the "dirty sock" smell in air handling systems?

The cause of the problem is the growth of mold and bacteria in the drain pan and on the coils. Popular, energy-saving heat pumps are particularly susceptible to this syndrome because their heating cycles are not hot enough to kill the microbes that multiply during the cooling cycle and when the unit is idle. The smell comes from the rich brew of microorganisms that breed on the cooling coil and in the drain pan water. The slow warming of this contaminated water releases a plethora of spores and toxins -- and the nasty smell -- into the air.

http://www.iaqenergysolutions.com/faq.html#dirty

## How a Mold Reproduces – It’s Life Cycle:

When the appropriate conditions for growth exist:  presence of moisture, nutrients, temperature,  etc, the mold begins to reproduce via it’s life cycle.

**Hyphal Growth:** Hyphae are the thread-like filamentous cells that release enzymes which degrade and absorb nutrients from a substrate (ie. oganic debris, cellulose, wood, almost any carbon containing material including human skin). Upon obtaining it’s nutrition, the hyphae will grow into a mycelium, the main body of the fungus which is also the visible portion.

**Spore Formation:** Spores form on the ends of some hyphael cells.  The formation of spores is dependent on a variety of environmental factors including light, oxygen levels, temperature, and nutrient availability.

**Spore Dispersal:** After the spores are formed, they are released into the air and carried elsewhere to begin the process of germination and growth all over again. Mold spores are highly resistant and durable.  They can remain dormant for years in even hot and dry environments.

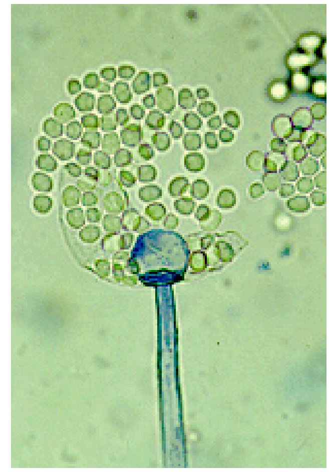
**Spore Germination:** Once the spore is dispersed to a new area and when the appropriate conditions exist, moisture and nutrient availability, the spore will begin to germinate into a new hyphael

Oregon OSHA

# FACT SHEET Plus

## Mold

### Mold



Mold belongs to a group of organisms called fungi. Because mold is found indoors and outdoors, exposure to molds and other fungi and their spores is unavoidable. Mold can trigger allergic reactions or asthma attacks and may produce toxins and irritants — important reasons to prevent mold growth and clean up indoor mold contamination. Mold growth should be considered unacceptable because of potential health effects on building occupants and damage to buildings. Those who investigate, clean up, and repair mold damage should avoid exposing themselves and others to mold-laden dust.

### Evaluating Buildings for Mold Growth

Check building materials and spaces for visible mold and signs of moisture damage indicating a history of water leaks and high humidity and condensation levels. Building ventilation systems should also be inspected. Basic precautions should be taken when investigating and evaluating mold and moisture problems.

- Do not touch mold or moldy items with bare hands.
- Do not get mold or mold spores in your eyes.
- Do not breathe mold or mold spores; use personal protective equipment (PPE). At a minimum, use an N-95 NIOSH-approved respirator, gloves, and eye protection.
- Contain or bag debris.

### Sampling

Sampling is usually not necessary when visible signs of mold growth are present. However, the American Industrial Hygiene Association (AIHA) indicates that in cases where health concerns are an issue, litigation is involved, or the source(s) of contamination is unclear, sampling may be considered. Professionals experienced with mold issues and familiar with current guidelines should conduct sampling and interpret results, as no threshold or exposure limits have been established. As a general guideline, the types and concentrations of mold in indoor air samples should be similar to those found in the local outdoor air. Samples should be analyzed by a laboratory that participates in proficiency testing such as the Environmental Microbiology Proficiency Analytical Testing Program, EMPAT.

### Remediation

Mold remediation prevents further human exposure and damage to building materials and furnishings. You must clean up and remove mold contamination, not just kill the mold. Dead mold is still allergenic; some are potentially toxic. Mold gradually destroys what it grows on; to grow, it needs an organic substrate, moisture, and oxygen. If mold growth is not addressed promptly, materials may be damaged and cleaning cannot restore appearance or integrity. Mold can generally be removed from nonporous (hard) surfaces by wiping or scrubbing with water or water and detergent. The use of disinfectant chemicals (biocides), including chlorine bleach, is not recommended as a routine practice. Biocides are of limited use in mold remediation and are not a substitute for thorough cleaning. Mold-contaminated porous material such as damp insulation in ventilation systems, moldy ceiling tile, and mildewed carpet may need to be removed and discarded.

Remediate means to fix a problem. The first step in mold remediation is to fix the water or humidity problem that contributed to mold growth. Thoroughly clean up mold and dry water-damaged areas, using appropriate cleaning and drying methods. Mold remediation requires some level of isolation of materials or containment and the use of appropriate personal protective equipment (PPE). Remediation decisions should be based on the scope of contamination, size of the area of growth, and potential for occupant exposure or building contamination in the absence of containment. Professional expertise and conservative methods may be needed when the chance of mold becoming airborne is high or mold-sensitive individuals are present.

Mold

**Web site:**
www.orosha.org

Salem Central Office
350 Winter St. NE, Rm. 430
Salem, OR 97301-3882

Phone: (503) 378-3272
Toll-free: (800) 922-2689
Fax: (503) 947-7461

OREGON OSHA

EPA's pamphlet, **Mold Remediation in Schools and Commercial Buildings**, can help remediators develop a remediation plan. It provides clean-up methods and remediation techniques and discusses precautions and the impact of mold on HVAC systems. Its guidelines are based on total surface area contamination and potential for remediator and occupant exposure. See the simplified example taken from EPA's Table 2: **Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water**. If a water source is contaminated with sewage or other pollutants, additional measures may be required. Professional judgment should always play a key role in remediation decisions, especially in selecting contractors and workers knowledgeable in mold-remediation procedures.

**Example**

| Surface area | PPE* | Containment | Cleanup method** |
|---|---|---|---|
| ***Small –*** less than 10 sq. ft. | 1) **Minimum** | *None required* | ***Example***: Carpet and backing. Wet vacuum. Use high-efficiency particulate air (HEPA) vacuum when thoroughly dry. |
| ***Medium –*** 10 -100 sq. ft. | 2) **Limited or full** | 4) *Limited* | ***Example:*** Concrete or cinder block. Wet vacuum. Use HEPA vacuum when thoroughly dry. |
| ***Large –*** greater than 100 sq. ft. or has potential for significant exposure. | 3) **Full** | 5) *Full* | ***Example:*** Drywall or gypsum. Use HEPA-vacuum after thoroughly dry. Remove and discard damaged material. HEPA vacuum area. |

1) **Minimum** – N-95 respirator, gloves, and goggles/eye protection.
2) **Limited** – N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection.
3) **Full** – Gloves, disposable full-body clothing, headgear, foot covering, full-face respirator with HEPA filter.

**** NOTE: Compliance with 1910.134, Respiratory Protection, is required for respirator users.***

4) *Limited* – Use polyethylene sheeting, ceiling to floor, around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA-filtered fan unit. Block air supply and return vents within containment area.
5) *Full* – Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA-filtered fan unit. Block air supply and return vents within containment area.

***** NOTE: Conventional vacuums should not be used because of contaminant transfer to the air.***

Mold-contaminated building materials and furnishings that are not salvageable should be double bagged or covered with polyethylene sheeting and sealed with duct tape within the containment area to minimize the dispersion of mold spores. These materials can usually be discarded as ordinary construction waste.

Images: Mycology Online www.mycology.adelaide.edu.au/

## Resources

Most of this information is excerpted from the Environmental Protection Agency and the American Industrial Hygiene Association publications. Mold remediation can be complicated. One should become thoroughly familiar with the subject prior to initiating remediation procedures. These and the following sources may be helpful.

**EPA:** www.epa.gov/iaq/molds/mold_remediation.html

**EPA:** www.epa.gov/iaq/pubs/airduct.html

**AIHA:** www.aiha.org/SplashPages/html/topic-mold.htm

**OSHA:** www.osha.gov/SLTC/molds/index.html#Control

**OCOEM:** www.acoem.org/position/statements.asp?CATA_ID=52

**CROET:** www.croetweb.com/links.cfm?topicID=24

**ASSE:** www.asse.org/ps0803spear.pdf

**OR-OSHA:** www.cbs.state.or.us/external/osha/pdf/rules/division_2/1910-134.pdf

**OR-OSHA:** www.cbs.state.or.us/external/osha/pdf/techman/tecman2.pdf

**For Immediate Release** August 26, 2005

****TROPICAL STORM/HURRICANE INFORMATION SHEET ****

## DEPARTMENT OF HEALTH CAUTIONS FLORIDIANS ABOUT MOLD IN WATER-DAMAGED BUILDINGS

**TALLAHASSEE** — As Floridians clean and repair their storm damaged homes and buildings, the Florida Department of Health (DOH) urges the public to take precautionary measures to avoid indoor air quality problems. Moisture that enters buildings from leaks or flooding accelerates mold growth. Molds can cause disease, trigger allergic reactions and continue to damage materials long after the storm. Failure to control moisture and mold can present short and long- term health risks.

**TO PROTECT AGAINST HEALTH RISKS ASSOCIATED WITH MOLD:**

- Remove standing water from your home or office.
- Remove wet materials.
- If mold growth has already occurred, carefully remove or clean the moldy material.
- Consider using personal protective equipment when cleaning or removing mold – gloves, goggles and an N-95 particle respirator (found at most local hardware stores). Check with a health care provider before wearing a respirator. Do not use a respirator if you have heart disease or chronic lung disease such as asthma or emphysema.
- Individuals with known mold allergies or asthma should not clean or remove moldy materials.

Remember to not mix cleaners and disinfectants, as hazardous gases may produce hazardous chemical reactions. Read and follow label instructions carefully. Open windows and doors to provide plenty of fresh air.

For more information about indoor air quality and mold growth, contact your local county health department, the Florida Department of Health's Indoor Air Toxics Hotline at 800-543-8279 or visit the Department of Health Web site at www.doh.state.fl.us and select “mold” from the subject list.

Florida Emergency Information Line: 1-800-342-3557

Public Information Emergency Support Function: 850-921-0384

###

*Fact Sheet*

# Mold . . .
# A Growing Threat

## FLOODED HOMES MAY HARBOR MOLD PROBLEM

Mold growth is likely to occur in homes after flooding. It's very important to clean and thoroughly dry any areas of the home that have gotten wet from floodwaters. Failure to remove contaminated materials and to reduce moisture and humidity can present serious long-term health risks, according to the Office of Indoor Air Quality at the Environmental Protection Agency.

**Mold - What Is It?**

Molds are simple microscopic organisms found virtually everywhere, indoors and outdoors. When molds are present in large quantities they can cause allergic symptoms similar to those caused by plant pollen.

**Should I Be Concerned About Mold In My Home?**

Yes, if the contamination is extensive. When airborne mold spores are present in large numbers they can cause allergic reactions, asthma episodes, infections, and other respiratory problems.

**Who Is At Greatest Risk When Exposed To Mold?**

The following individuals are at higher risk for adverse health affects from molds:

- Infants, children and the elderly
- Immune compromised individuals (people with HIV infection, liver disease, in chemotherapy, etc)
- Pregnant women
- Individuals with existing respiratory conditions such as allergies, multiple chemical sensitivity, and asthma

*People with these conditions should consult a physician if they are experiencing health problems.*

Typical symptoms reported from mold exposure include respiratory problems (like wheezing and asthma attacks), burning or watery eyes, nose or throat irritations, skin irritations like rashes or hives, and nervous system disorders like headaches, memory loss and mood changes.

**What Can I Save? What Should I Toss?**

Porous materials can trap molds. Items such as paper, rags, wallboard, and rotten wood should be thrown out. Harder materials such as glass, plastic and metal can be kept after they are cleaned and disinfected.

**Removing Moldy Materials**

- Wear a filter mask and gloves to avoid contact with the mold.
- Remove porous materials (ex: ceiling tiles, drywall, carpeting, wood products.)
- Carpeting can be a difficult problem - drying does not remove the dead spores. If there is heavy mold, disposal of the carpet should be considered.
- Allow areas to dry 2 to 3 days before replacing damaged materials
- If dry wall, or wallboard, is flooded, remove all drywall to at least 12 inches above the high water mark.

**General Mold Clean-Up Procedures**

- Identify and correct the moisture source. Remove all water and fix any leaks before cleaning.
- Clean, disinfect, and dry the moldy area.
- Bag and dispose of any material that has moldy residue, such as rags, paper, leaves or debris.

**Soap Cleanup**

- Wear protective gloves and a filter mask.
- Use non-ammonia soap or detergent, or a commercial cleaner in hot water. Scrub the entire area affected by the mold.
- Use a stiff brush or cleaning pad.
- Rinse with clean water.

**Disinfect Surfaces**

- Wear a filter mask and protective gloves when using disinfectants.
- After thorough cleaning and rinsing, disinfect the area with household bleach (1/4 cup bleach per gallon of water).
- Never mix bleach with ammonia - the fumes are toxic!
- Let disinfected areas dry naturally overnight to kill all the mold.

Be aware that exposure to mold can occur during cleanup. To minimize exposure, consider using a breathing mask or respirator, wear rubber gloves and take breaks in a well-ventilated area.

# Molds in the Environment

## What are molds?

Molds are fungi that can be found both indoors and outdoors. No one knows how many species of fungi exist but estimates range from tens of thousands to perhaps three hundred thousand or more. Molds grow best in warm, damp, and humid conditions, and spread and reproduce by making spores. Mold spores can survive harsh environmental conditions, such as dry conditions, that do not support normal mold growth.

## What are some of the common indoor molds?

- *Cladosporium*
- *Penicillium*
- *Alternaria*
- *Aspergillus*

## 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.

## Where are molds found?

Molds are found in virtually every environment and can be detected, both indoors and outdoors, year round. Mold growth is encouraged by warm and humid conditions. Outdoors they can be found in shady, damp areas or places where leaves or other vegetation is decomposing. Indoors they can be found where humidity levels are high, such as basements or showers.

## How can people decrease mold exposure?

Sensitive individuals should avoid areas that are likely to have mold, such as compost piles, cut grass, and wooded areas. Inside homes, mold growth can be slowed by keeping humidity levels between 40% and 60%, and ventilating showers and cooking areas. If there is mold growth in your home, you should clean up the mold and fix the water problem. Mold growth can be removed from hard surfaces with commercial products, soap and water, or a bleach solution[1] of 1 cup of bleach in 1 gallon of water.

Specific Recommendations:

- Keep the humidity level in the house between 40% and 60%.
- Use an air conditioner or a dehumidifier during humid months.
- Be sure the home has adequate ventilation, including exhaust fans in kitchen and bathrooms.
- Add mold inhibitors to paints before application.
- Clean bathrooms with mold killing products.
- Do not carpet bathrooms and basements.
- Remove or replace previously soaked carpets and upholstery.

## What areas have high mold exposures?

- Antique shops
- Greenhouses
- Saunas
- Farms
- Mills
- Construction areas
- Flower shops
- Summer cottages

## I found mold growing in my home; how do I test the mold?

Generally, it is not necessary to identify the species of mold growing in a residence, and CDC does not recommend routine sampling for molds. Current evidence indicates that allergies are the type of diseases most often associated with molds. Since the susceptibility of individuals can vary greatly either because of the amount or type of mold, sampling and culturing are not reliable in determining your health risk. If you are susceptible to mold and mold is seen or smelled, there is a potential health risk; therefore, no matter what type of mold is present, you should arrange for its removal. Furthermore, reliable sampling for mold can be expensive, and standards for judging what is and what is not an acceptable or tolerable quantity of mold have not been established.

## A qualified environmental lab took samples of the mold in my home and gave me the results. Can CDC interpret these results?

Standards for judging what is an acceptable, tolerable, or normal quantity of mold have not been established. If you do decide to pay for environmental sampling for molds, before the work starts, you should ask the consultants who will do the work to establish criteria for interpreting the test results. They should tell you in advance what they will do or what recommendations they will make based on the sampling results. The results of samples taken in your unique situation cannot be interpreted without physical inspection of the contaminated area or without considering the building's characteristics and the factors that led to the present condition.

## What type of doctor should I see concerning mold exposure?

You should first consult a family or general health care provider who will decide whether you need referral to a specialist. Such specialists might include an allergist who treats patients with mold allergies or an infectious disease physician who treats mold infections. If an infection is in the lungs, a pulmonary physician might be recommended. Patients who have been exposed to molds in their workplace may be referred to an occupational physician. CDC is not a clinical facility. CDC does not see patients, diagnose illness, provide treatment, prescribe medication, or provide referrals to health care providers.

## My landlord or builder will not take any responsibility for cleaning up the mold in my home. Where can I go for help?

If you feel your property owner, landlord, or builder has not been responsive to concerns you've expressed regarding mold exposure, you can contact your local board of health or housing authority. Applicable codes, insurance, inspection, legal, and similar issues about mold generally fall under state and local (not federal) jurisdiction. You could also review your lease or building contract and contact local or state government authorities, your insurance company, or an attorney to learn more about local codes and regulations and your legal rights. CDC does not have enforcement power in such matters, nor can we provide you with advice. You can contact your county or state health department about mold issues in your area to learn about what mold assessment and remediation services they may offer. You can find information on your state's Indoor Air Quality program at http://www.cdc.gov/nceh/airpollution/indoor_air.htm.

## I'm sure that mold in my workplace is making me sick.

If you believe you are ill because of exposure to mold in the building where you work, you should first consult your health care provider to determine the appropriate action to take to protect your health. Notify your employer and, if applicable, your union representative about your concern so that your employer can take action to clean up and prevent mold growth. To find out more about mold, remediation of mold, or workplace safety and health guidelines and regulations, you may also want to contact your local (city, county, or state) health department.

You should also read the U.S. Environmental Protection Agency (EPA) Guidelines, Mold Remediation in Schools and Commercial Buildings, at http://www.epa.gov/iaq/molds/mold_remediation.html.

## I am very concerned about mold in my children's school and how it affects their health.

If you believe your children are ill because of exposure to mold in their school, first consult their health care provider to determine the appropriate medical action to take. Contact the school's administration to express your concern and to ask that they remove the mold and prevent future mold growth. If needed, you could also contact the local school board.

CDC is not a regulatory agency and does not have enforcement authority in local matters. Your local health department may also have information on mold, and you may want to get in touch with your state Indoor Air Quality office. Information on this office is available at http://www.cdc.gov/nceh/airpollution/indoor_air.htm.

You can also read the U.S. Environmental Protection Agency (EPA) guidelines, *Mold Remediation in Schools and Commercial Buildings*, at http://www.epa.gov/iaq/molds/mold_remediation.html. Also, see these Web sites for more indoor air quality tools for schools:

- http://www.epa.gov/iaq/schools/tfs/guidtoc.html
- http://www.epa.gov/iaq/schools/tfs/guideh.html
- http://www.healthyschools.org/guides_materials.html

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[1] If you choose to use bleach to clean up mold:

- Never mix bleach with ammonia. Mixing bleach and ammonia will produce dangerous, toxic fumes.
- Open windows and doors to provide fresh air.
- Wear non-porous gloves and protective eye wear.
- If the area to be cleaned is more than 10 square feet, consult the U.S. Environmental Protection Agency (EPA) guide titled *Mold Remediation in Schools and Commercial Buildings*. Although focused on schools and commercial buildings, this document also applies to other building types. You can get it free by calling the EPA Indoor Air Quality Information Clearinghouse at (800) 438-4318, or by going to the EPA web site at http://www.epa.gov/mold/mold_remediation.html.
- Always follow the manufacturer's instructions when using bleach or any other cleaning product.



DEPARTMENT OF HEALTH AND HUMAN SERVICES
CENTERS FOR DISEASE CONTROL AND PREVENTION
SAFER • HEALTHIER • PEOPLE™

# Dealing With

# MOLD & MILDEW

# IN YOUR

# FLOOD DAMAGED HOME

Before

After

FEMA
MITIGATION DIVISION
REGION 10

# THE PROBLEM WITH MOLD

Mildew and molds are fungi - simple microscopic organisms that thrive anywhere there is a moist environment. Molds are a necessary part of the environment; without them, leaves would not decay and aspects of soil enrichment could not take place. It is their ability to destroy organic materials, however, that makes mold a problem for people - in our homes and in our bodies.

Mildew (mold in early stage) and molds grow on wood products, ceiling tiles, cardboard, wallpaper, carpets, drywall, fabric, plants, foods, insulation, decaying leaves and other organic materials.

Mold growths, or colonies, can start to grow on a damp surface within 24 to 48 hours. They reproduce by spores - tiny, lightweight "seeds"- that travel through the air. Molds digest organic material, eventually destroying the material they grow on, and then spread to destroy adjacent organic material. In addition to the damage molds can cause in your home, they can also cause mild to severe health problems. See the HEALTH section to check for possible mold-related health problems.

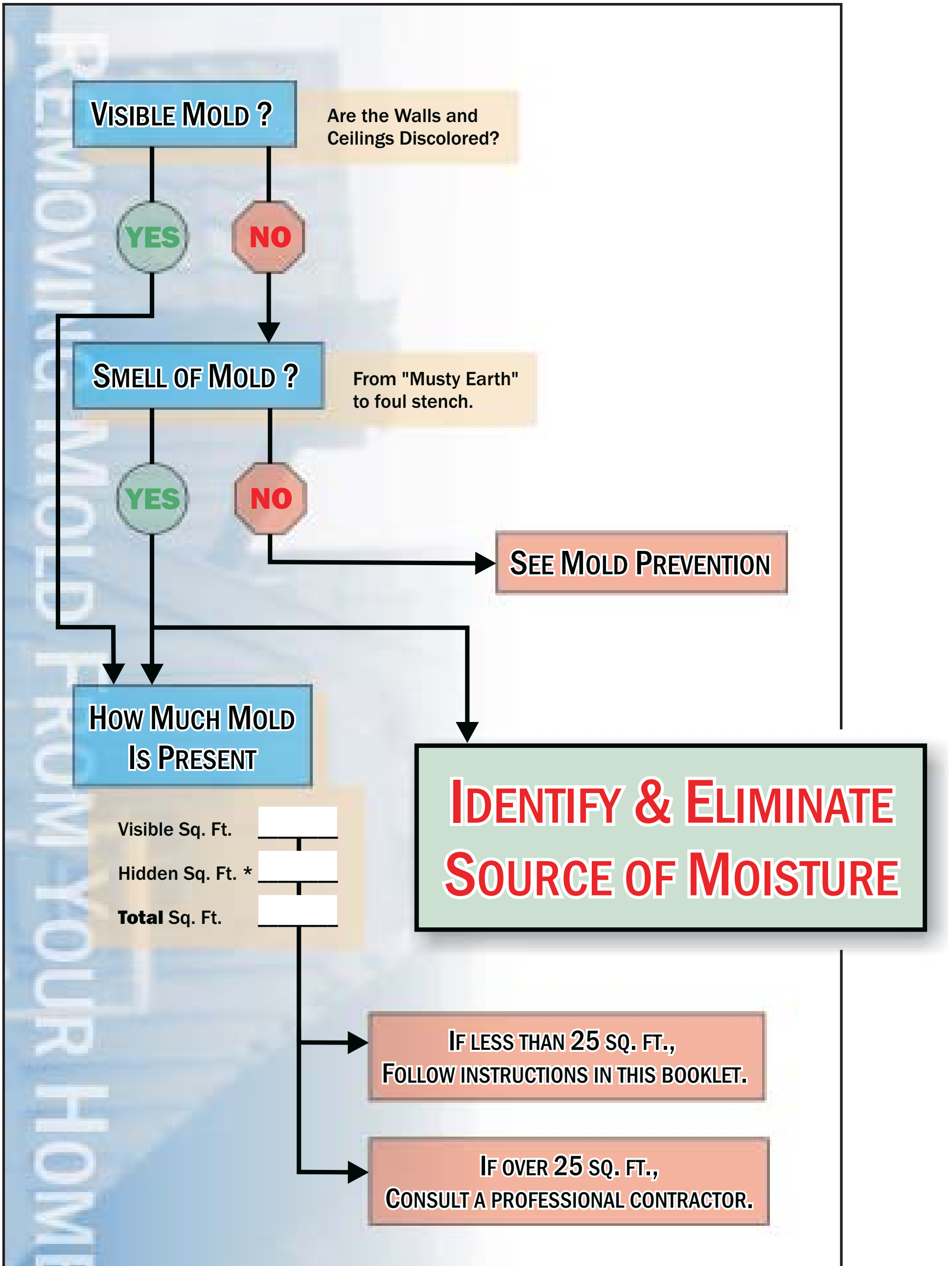
# MOLD IN YOUR HOME?

If your home has **water damage** due to -

- * flooding,
- * sewage back-up from flooding in the area,
- * plumbing or roof leaks,
- * damp basement or crawl space,
- * overflows from sinks or bathtub, or
- * high humidity: steam cooking, dryer vents, humidifiers,

**mildew and mold will develop** within 24-48 hours of water exposure. Even worse, it will continue to grow until steps are taken to eliminate the source of moisture, and effectively deal with the mold problem.

Use the diagram on the facing page to assess the extent of mold in your home. Then refer to the SOLUTION section for steps you need to take to remedy the problem. Also refer to the PREVENTION section for tips on keeping mold out of your home in the future.




* Hidden sources may be air ducts, attics, basements, and wall cavities.

# SOLUTIONS TO MOLD PROBLEMS

## MATERIALS YOU WILL NEED

**Gloves** (latex, rubber)
**Buckets**
**Scrub brush**
**Broom, mop**
**Mask** (painter's or respirator)
**Trash bags**
**Wet-Dry shop vacuum**
**Sponges, rags**
**Non-ammonia detergent**, **soap or commercial cleaner** (phenolic or pine-oil based)
**Disinfectant Chlorine bleach –** a 10% solution = 1 1/4 Cup bleach to a gallon water

## DRY OUT A WATER OR MOLD DAMAGED HOUSE

**T**urn off main power if wiring is wet or moldy. Have electrician check the house's electrical system before turning power on again.
**O**pen the house to fresh air when the humidity is lower outside than inside.
**U**se fans and dehumidifiers to remove excess moisture unless mold has already started to grow (fans may spread existing mold).
**U**se the furnace *only* if the ducts have *not* been inundated (any forced air central heating ducts that have come in contact with water or mold should be professionally checked).
**R**emove *all* wet items such as furniture, rugs, bedding, toys, and carpeting. ***Discard soaked or moldy carpeting!*** Clean and disinfect other items .
**D**iscard all possibly contaminated food products - anything not in a water tight container.
Interior walls and Ceilings: Remove all wet or contaminated porous materials such as ceiling tiles, drywall, wood by-products. If wallboard is soaked, remove to a foot above the water mark and discard. Drain walls by removing baseboard and drilling holes near floor. Dry panel-type wall by pulling the bottom edge out from studs. Check interior of the wall for hidden mold.
Floors and Exterior walls:
***Remove all wet insulation.***
Discard all but rigid insulation, which can be reinstalled after disinfecting and drying.

## CLEANING AND DISINFECTING

**Before you begin -**
**M**ake sure the working area is well ventilated.
**W**ear gloves, mask, and protect eyes.
**I**f mold is present, clean a small test patch. If you feel your health is adversely affected, consider hiring a professional to carry out the work.
**D**isinfectants are intended to be applied to *already cleaned* materials
.

<u>**H**ard surfaces:</u> Wash items such as metal, glass, solid wood, plastic, and other non-porous materials with a non-ammonia detergent and hot water.
Use a stiff brush on rough surface materials such as concrete.
Use a Wet-Dry shop vacuum to remove water and clean items such as studs or exposed wood framing.
Disinfect all cleaned surfaces with a 10% bleach solution. Let the solution stay on the surface for at least 10 minutes before rinsing with clear water or allowing to dry.

<u>**P**orous materials</u>: This includes upholstered furniture, rugs, bedding, clothing, curtains, books and papers, and furniture made of pressed particle materials. Deciding whether or not to keep contaminated item? Remember, ***when in doubt, throw it out.*** If an item has been wet for less than 48 hours, it *may* be able to be cleaned, disinfected with a phenolic or pine-oil cleaner. It should then be completely dried and monitored for several days for any fungal growth and odors– if any mold develops, discard the item.

**Allow the wet or contaminated area to dry completely (usually two to three days) before beginning to rebuild, replace or return items. See MOLD PREVENTION section for tips on rebuilding, replacing.**

## SOME GENERAL CAUTIONS

- Exercise caution in cleaning and disinfecting molds because they release mold spores when disturbed.
- Never mix bleach with ammonia; fumes from the combination are toxic.
- When discarding items that are mold contaminated, use extreme caution, or hire a professional.

# Adverse HEALTH Problems

We are all exposed to many kinds of mold both inside and outside the house.The exposure is greater in damp or wet conditions, especially when timely drying out does not have a chance to occur.

Of the thousands of molds that exist, some are known allergens (aggravating or causing skin, eye, and respiratory problems), and a few molds produce harmful mycotoxins that can cause serious problems. But all molds, in the right conditions and high enough concentrations, are capable of adversely affecting human health.

The potential for health problems occurs when people inhale large quantities of the airborne mold spores. For some people, however, a relatively small number of mold spores can cause health problems. Infants, children, immune-compromised patients, pregnant women, individuals with existing respiratory conditions, and the elderly are at higher risks for adverse health effects from mold.

Typical symptoms reported from mold exposure include:

- **Respiratory problems -** wheezing, asthma attacks, etc
- **Nasal and sinus congestion or dry, hacking cough**
- **Eye irritation -** burning, watery, redness
- **Nose or throat irritation -** sneezing fits, bloody noses
- **Skin irritations -** rashes or hives
- **Nervous system -** headaches, memory loss, mood changes
- **Aches and pains**

The more serious health problems have been associated with the toxic black mold, *Stachybotrys atra*. The mold is greenish-black and slimy, resembling tar or black paint. Stachybotrys typically grows only on repeatedly wetted materials that contain cellulose - from paper to ceiling tiles, and any kind of wood. In most cases, this mold can be removed by a thorough cleaning with a 10% bleach solution. Severe mold infestations may require the assistance of a professional with experience in dealing with Stachybotrys.

If mold exposure is unavoidable, sensitive people should wear tight-fitting masks or respirators.

# MOLD PREVENTION

There is no practical way for you to eliminate *all* of the molds and mold spores in the indoor environment. But there are many ways to help *control* moisture and mold growth in your home. Here is a partial list:

### Stop the water

- Fix leaks in pipes, and any damp areas around tubs and sinks, so that biological pollutants don't have growing environments.
- Rebuild, or retrofit, with water-resistant building materials such as tiles, stone, deep-sealed concrete, galvanized or stainless steel hardware, indoor/outdoor carpeting, waterproof wallboard, water-resistant glues, and so on.
- Prevent seepage of water from outdoors into your house. Rain water from gutters or the roof needs to drain away from the house. Ground around the house needs to slope away to keep basement and crawlspace dry.
- Cover dirt in crawlspaces with plastic to prevent moisture from coming from the ground. Ventilate the area as much as possible.

### Keep it clean

- Clean fabrics often and keep them dry. Soil promotes mildew growth. Store clean fabric items in well ventilated areas.
- Consider having air ducts cleaned if you suspect mold exists on the duct's inside surface, or if duct insulation has been wet.

### Keep it dry

- Reduce the moisture in the air with dehumidifiers, fans, and open windows or air conditioners, especially in hot weather. Do NOT use fans if mold may already exist.
- Try to keep the humidity in your home below 40%.
- In moisture prone areas, choose carpets of man-made fibers.
- Reduce potential for condensation on cold surfaces by insulating.

### Disinfect it

- Routinely check potential problem spots (eg. Bathroom, laundry, mechanical room, etc) for moldy odors, and disinfect often with a 10% solution of bleach – 1 1/4-1 1/2 cup bleach to a gallon water, or with a commercial disinfectant.

# More INFORMATION on Mold

An excellent publication from the American Red Cross and FEMA is ***Repairing Your Flooded Home.*** This source of comprehensive information is available free from

FEMA Publications
P.O.Box 70274
Washington, DC 20024

Local information and/or assistance is available through your County or City. Contact any of these Agencies or Departments: Health, Social Services, Environmental Health, or Housing.

There are numerous internet sites that provide useful information about mold. Here is a sampling:

New York City's ***Guidelines on Assessment and Remediation of Fungi in Indoor Environments*** is available at http://www.ci.nyc.ny.us/html/doh_ Click on the A-Z index and scroll down to Mold.

The Environmental Protection Agency (EPA) has an extensive listing of resources on mold and indoor air quality in general. www.epa.gov/iaq Click on Mold Resources.

California's new legislation regarding the remediation of mold, as well as several other helpful documents can be found at http://www.cal-iaq.org//iaqsheet.htm#mold

# What You Need To Know About Mold

Nathan Yost, MD
Joseph Lstiburek, Ph.D, P.Eng.
Terry Brennan, MS

## What Is Mold?

Mold, one type of fungus, is different from plants, animals and bacteria. Molds are decomposers of dead organic material such as leaves, wood and plants. Molds sometimes can infect living plants and animals. The spores and hair-like bodies of individual mold colonies are too small for us to see without a microscope. When a lot of mold is growing on a surface, it often appears black or green. The color of mold is influenced by the nutrient source and the age of the colony. If mold is growing behind vinyl wallpaper, colorful pink or purple splotches may appear. Mold growing on fabric is called mildew.

## What Does Mold Need to Grow?

Mold needs water to grow; without water mold cannot grow. Mold also needs food, oxygen and a temperature between 40 degrees and 100 degrees F. Since mold decomposes dead organic (once living) material it can grow on wood, the paper facing on gypsum board (drywall) and other materials made from wood. Molds secrete digestive fluids that decompose the substrate, making nutrients available. Mold can also digest some synthetic materials such as adhesives, pastes and paints. While mold cannot get nutrients from inorganic material such as concrete, glass and metal, it can grow on the dirt present on these surfaces. Molds prefer damp or wet material. Some molds can get moisture from the air when the air is very damp, that is when the relative humidity is above 80%. The high humidity makes surfaces damp enough for mold to grow.

## How Does Mold Spread?

Mold can grow by extension of hyphae that are like tiny root hairs. In this way, a small colony of mold can expand to cover many square feet of material. Mold can also make spores that are like very small seeds. Spores can survive conditions that are too sunny, hot, cold, dry or wet for mold to grow. When spores are released they can be carried by air or water to new locations. Some spores are so small that they are more affected by air currents than by gravity. When spores land on a damp surface that has food and oxygen available, and if the temperature suits them, they will start to grow. It is important to realize that mold spores are present everywhere, in outside air as well as indoor air – unless very special precautions are taken to remove or kill them.

Wherever there is decaying organic material (leaves, mulch, wood) mold and mold spores are also present. Everyday we are exposed to airborne mold spores from outdoor sources, sometimes at high concentrations. It is almost impossible to create a mold free space or to keep a space mold free. What we can do – and should do – is control the amount of mold in our indoor environments.

## Why Do I Need To Know Anything About Mold?

Too much mold can affect the health of you and your family. In addition, mold can damage or destroy building materials such as the wood or gypsum board in our homes.

## What Are The Health Effects of Exposure To Mold?

Most people are not affected by exposure to mold, unless they are exposed to a lot of mold. Unfortunately, we are not quite sure what "a lot of mold" means. Furthermore we don't know if "a lot" of exposure to mold for "a brief time" is worse than "not so much" exposure for a longer time. We're also not sure what "not so much" means. Each person is different; what amounts to a "lot of exposure" for some people is "not so much" for others. Remember, mold is everywhere; we are all exposed to mold every day.

Exposure to mold can cause allergy in susceptible people, but we don't know how much exposure is necessary to start the development of allergy. If you have asthma, exposure to mold can cause an asthma attack or make your chronic asthma get worse. At this point we do not know if exposure to mold, especially early in life, can lead to the development of asthma. Although exposure to "enough" mold can cause allergy to mold in susceptible people, accurately diagnosing the allergy can be difficult. Unfortunately, doctors can test for allergy to only a very few of the thousands of species (kinds) of molds that exist.

Only a few molds seem to be able to sometimes cause an infection in healthy people; fortunately these molds do not usually grow in buildings. However, people with a suppressed immune system are much more susceptible to fungal (mold) infections and many of these fungi do grow in wet buildings.. Individuals with AIDS, certain types of cancer and those with organ (heart, kidney) transplants on certain drugs are much more susceptible to fungal infections.

Molds sometimes make powerful chemicals called mycotoxins. We think that molds make these mycotoxins to decrease the growth of other molds and bacteria. Penicillin is a mycotoxin that we use because it can kill certain bacteria. Unfortunately some of these mycotoxins make people sick. Mycotoxins can cause illness when they are inhaled, absorbed through skin or ingested (swallowed). Presently we do not know all that much about the health effects of most mycotoxins on humans. Most of what we know about mycotoxins comes from exposure of farm animals to moldy grain or hay. We do not have any tests that can determine whether mycotoxins are the cause of someone's illness. We cannot easily or reliably measure the level of mycotoxins in air samples to determine exposure levels.

## How Can I Prevent Mold From Growing In My Home?

The answer is simple: **keep your home dry.** If mold does not have moisture it cannot grow. Remember mold spores are everywhere so you cannot completely keep them out of your house. Since our houses are built with wood products and paper faced drywall, food for mold is always present. Mold can also thrive on dust, cockroach and dust mite feces, skin flakes and food particles. Oxygen is available in the air so we cannot prevent mold growth by eliminating oxygen. Therefore, controlling moisture is the only effective strategy for preventing mold growth in our homes.

## How Do I Keep My House Dry?

First, prevent excessive moisture levels in the air in the house by using the exhaust fans in bathrooms and kitchens where moisture is often generated. Make sure the air from your clothes dryer exhausts from the house. Avoid using a humidifier. If you think that you need a humidifier, first measure the relative humidity inside your home. A device called a **hygrometer** can measure the relative humidity. Try to keep the relative humidity (RH) below 60%. There is rarely a reason to use a humidifier if the RH is above 25%. If you feel you must use a humidifier, measure the relative humidity in the area receiving the humidified air. Never let the humidifier raise the relative humidity above 35%.

Second, look for areas of dampness or wet spots. Roofs, windows, basement walls and plumbing pipes sometimes leak. If a leak happens suddenly, dry the wet materials as quickly as possible. Mold spores begin to grow 24-48 hours after a water leak. Dry the house quickly and mold will not be a problem.

Small recurring or continuous leaks that are hidden in walls, ceilings or floors present a different challenge since mold growth could be extensive before it is detected. Be alert for dampness in areas such as under sinks, in bathrooms and in ceilings below bathrooms or other plumbing. If you notice dampness in one of these areas or if you notice a strong musty smell in one of these areas, contact your builder.

## What Should I Do If I Suspect I Have Mold In My House?

First and foremost, do not panic. Remember mold is everywhere. Even if you do have more than “normal” amounts of mold in your house, you have not necessarily been exposed to it. Exposure means that the mold or mold spores or toxins have gotten inside your body by inhalation (breathing), ingestion (eating) or absorption through your skin. If mold is inside a wall in your home but it does not get into the air, you have not been exposed. The mold has to get from the wall cavity into the air in the house before you can be exposed to it. However, that does not mean that it’s good to ignore the mold if you know you have it somewhere in your house. The mold will continue to grow (as long as it has water), eventually damage the building and increase the chances that you will be exposed.

## How Do I Get Rid of Mold In My House?

That depends on how much mold is present and where it is located. If there is only a small amount of mold, such as in a bathroom or kitchen, scrub the moldy area with soapy water, rinse thoroughly and allow to dry. If you have asthma or severe allergies or a weakened immune system, get someone else to do the clean-up.

If you have mold on a wall, floor or ceiling, the first question is “where did the water come from?” Remember, mold has to have water to grow. There is no point trying to remove the mold if you do not also correct the moisture problem that led to the mold. If the moisture problem remains, mold will quickly grow back after the initial cleanup. If mold is present in just one corner of a closet scrub it with soapy water, rinse and thoroughly dry. Don’t store boxes right up against that corner. Do something to keep that corner warmer such as leaving a light on in the closet.

If you have mold growing under a window that leaked or somewhere else that probably is due to a leak, you should have someone with experience dealing with mold in buildings evaluate the building. Why? Again, you need to fix the underlying moisture problem. And more importantly you can release a lot of mold from inside a wall cavity if you don’t do the work properly. You can turn a “little bit” of exposure into a “lot of” exposure very quickly.


## What are Molds?

Molds are microscopic fungi that live on plant or animal matter. No one knows how species of fungi may exist, but estimates range from tens of thousands to perhaps 300,000 or more. Most are filamentous (threadlike) organisms and the production of spores is characteristic of fungi in general. These spores can be transported by air, water, or insects.

Unlike bacteria that are one-celled, molds are made of many cells and can sometimes be seen with the naked eye. Under a microscope, they look like skinny mushrooms. In many molds, the body consists of:

- Root threads that invade the food it lives on,
- A stalk rising above the food, and
- Spores that form at the ends of the stalks.

The spores give mold the color you see. When airborne, the spores spread the mold from place to place like dandelion seeds blowing across a meadow.

Molds have branches and roots that are like very thin threads. The roots may be difficult to see when the mold is growing on food and may be very deep in the food. Foods that are moldy may also have invisible bacteria growing along with the mold.

## Are Some Molds Dangerous?

Yes, some molds cause allergic reactions and respiratory problems. And a few molds, in the right conditions, produce “mycotoxins,” poisonous substances that can make you sick.

## Are Molds only on the surface of Food?

No, you only see part of the mold on the surface of food—gray fur on forgotten bologna, fuzzy green dots on bread, white dust on cheddar, coin-size velvety circles on fruits, and furry growth on the surface of jellies. When a food shows heavy mold growth, “root” threads have invaded it deeply. In dangerous molds, poisonous substances are often contained in and around these threads. In some cases, toxins may have spread throughout the food.

## Where are Molds Found?

Molds are found in virtually every environment and can be detected, indoors and outdoors, year round. Mold growth is encouraged by warm and humid conditions. Outdoors, they can be found in shady, damp areas or places where leaves or other vegetation are decomposing. Indoors, they can be found where humidity levels are high.

Molds form spores which, when dry, float through the air and find suitable conditions where they can start the growth cycle again.

## What Are Some Common Food borne Molds?

Molds most often found on meat and poultry are Alternaria, Aspergillus, Botrytis, Cladosporium, Fusarium, Geotrichum, Monilia, Manoscus, Mortierella, Mucor, Neurospora, Oidium, Oosproa, Penicillium, Rhizopu and Thamnidium. These molds can also be found on many other foods.

## What Are Mycotoxins?

Aflatoxin is a cancer-causing poison produced by certain fungi in or on foods and feeds, especially in field corn and peanuts. They are probably the best known and most intensively researched mycotoxins in the world. Aflatoxins have been associated with various diseases, such as aflatoxicosis in livestock, domestic animals, and humans throughout the world. Many countries try to limit exposure to aflatoxin by regulating and monitoring its presence on commodities intended for use as food and feed. The prevention of aflatoxin is one of the most challenging toxicology issues of present time.

## How Does the U.S. Government Control Aflatoxins?

Aflatoxins are considered unavoidable contaminants of feed and feed, even where good manufacturing practices have been followed. The U.S. Food and Drug Administration and the USDA monitor peanuts and field corn for aflatoxin and can remove any food or feed with unacceptable levels of it.

## Is Mushroom Poisoning Caused by Molds?

No, it is due to the toxin produced by the fungi, which are in the same family as molds. Mushroom poisoning is caused by the consumption of raw or cooked mushrooms, which are higher-species of fungi. The term “toadstool” (from the German “Todesstuhl”—death’s stool) is commonly given to poisonous mushrooms, but there is no general rule of thumb for distinguishing edible mushrooms from poisonous toadstools. The toxins that cause mushrooms poisoning are produced naturally by the fungi. Most mushrooms that cause human poisoning cannot by made safe by cooking, canning, freezing, or any other processing. The only way to avoid poisoning is not to eat poisonous mushrooms.

## Are Any Food Molds Beneficial?

Yes, molds are used to make certain kinds of cheeses and can be on the surface of cheese or be developed internally. Blue veined cheese such as Roquefort, blue, Gorgonzola, and Stilton are created by the introduction of P. roqueforti or Penicillium roqueforti spores. Cheeses such as Brie and Camembert have white surface molds. Other cheeses have both an internal and a surface mold. The molds used to manufacture these cheeses are safe to eat.

## Why Can Mold Grow in the Refrigerator?

While most molds prefer warmer temperatures, they can grow at refrigerator temperatures, too. Molds also tolerate salt and sugar better than most other food invaders. Therefore, molds can grow in refrigerated jams and jelly and on cured, salty meats – ham, bacon, salami, and bologna.

## How Can You Minimize Mold Growth?

Cleanliness is vital in controlling mold. Mold spores from affected food can build up in your refrigerator, dishcloths, and other cleaning utensils.

- Clean the inside of the refrigerator every few months with 1 tablespoon baking soda dissolved in a quart of water. Rinse with clear water and dry. Scrub visible mold (usually black) on rubber casings using 3 teaspoons of bleach in a quart of water.
- Keep dishcloths, towels, sponges, and mops clean and fresh. A musty smell means they’re spreading mold around. Discard items you can’t clean or launder.
- Keep the humidity level in the house below 40%

## Don’t Buy Moldy Foods

Examine food well before you buy it. Check food in glass jars, look at the stem areas on fresh produce, and avoid bruised produce. Notify the store manager about mold on foods!

Fresh meat and poultry are usually mold free, but cured and cooked meats may not be. Examine them carefully. Exceptions: some salamis – San Francisco, Italian, and Eastern European types – have a characteristic thin, white mold coating which is safe to consume; however, they shouldn’t show any other mold. Dry-cured country hams normally have surface mold that must be scrubbed off before cooking.

## Must Homemade Shelf-Stable Preserves by water-bath Processed?

Yes, molds can thrive in high-acid foods like jams, jelly, pickles, fruit, and tomatoes. But these microscopic fungi are easily destroyed by heat processing high-acid foods at a temperature of 212 degrees (F) in a boiling water canner for the recommended length of time. For more information about processing home-canned foods, go to the National Center for Home Food Preservation at: www.uga.edu/nchfp/.

## How Can You Protect Food from Mold?

- When serving food, keep it covered to prevent exposure to mold spores in the air. Use plastic wrap to cover foods you want to stay moist – fresh or cut fruits and vegetables, and green and mixed salads.
- Empty opened cans of perishable foods into clean storage containers and refrigerate them promptly.
- Don’t leave any perishables out of the refrigerator more than 2 hours.
- Use leftovers within 3 to 4 days so mold doesn’t have a chance to grow.

## How Should You Handle Food with Mold on It?

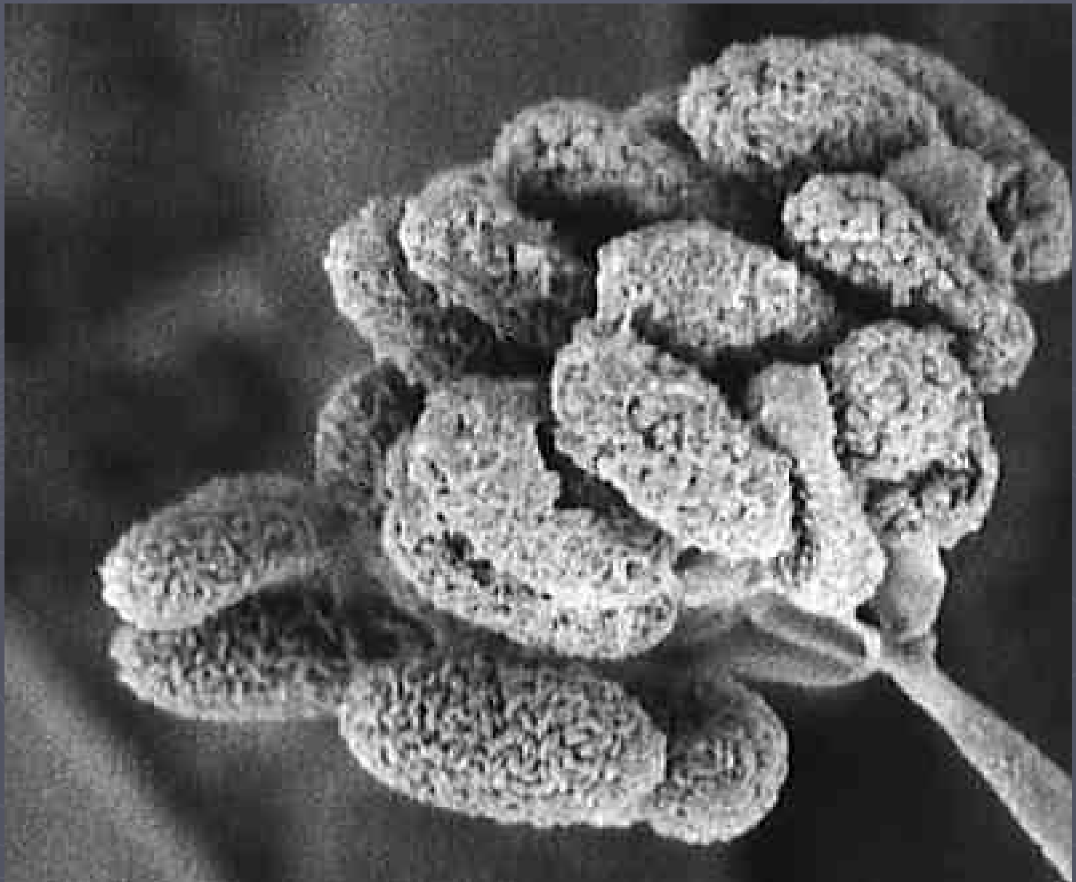
Buying small amounts and using food quickly can help prevent mold growth. But when you see moldy food:

- Don’t sniff the moldy item. This can cause respiratory trouble.
- If food is covered with mold, discard it. Put it into a small paper bag or wrap it in plastic and dispose in a covered trash can that children and animals can’t get into.
- Clean the refrigerator or pantry at the spot where the food was stored.
- Check nearby items the moldy food might have touched. Mold spreads quickly in fruits and vegetables.
- See the attached chart “moldy food:
- When to use, when to Discard.”

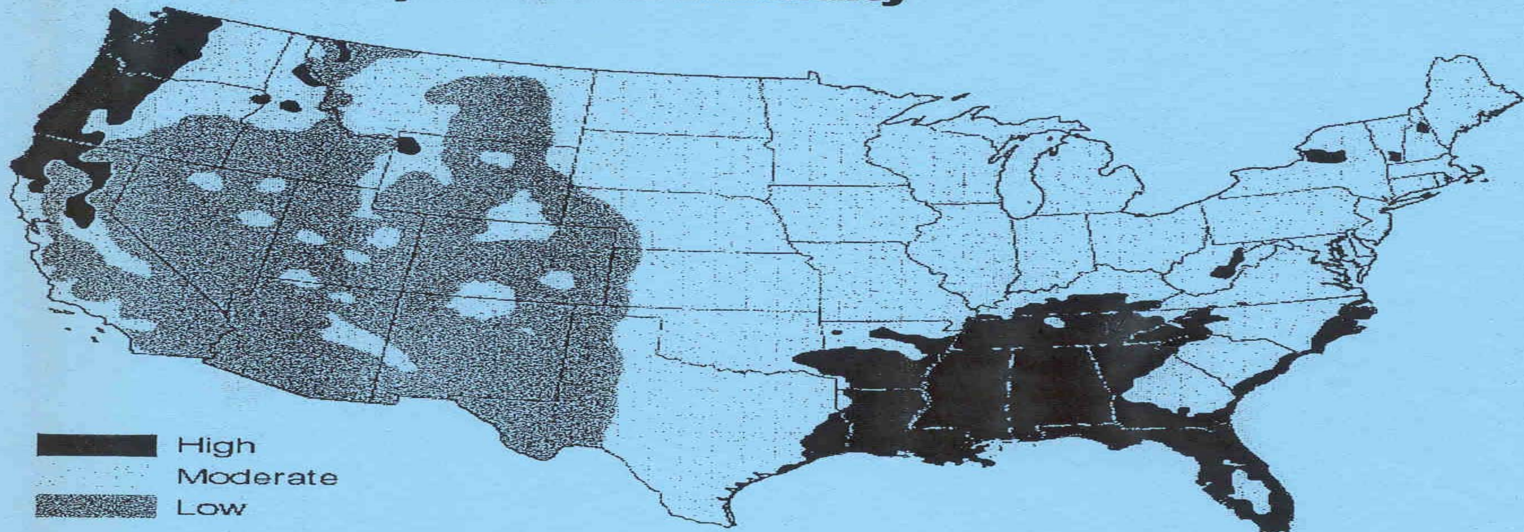
| FOOD | HANDLING | REASON |
|---|---|---|
| **Luncheon meats, bacon, or hot dogs** | Discard | Food with high moisture content can be contaminated below the surface. Moldy foods may also have bacteria growing along with the mold. |
| **Hard salami and dry-cured country hams** | Use, Scrub mold off surface. | It is normal for these shelf-stable products to have surface mold. |
| **Cooked leftover meat and poultry** | Discard | Food with high moisture content can be contaminated below the surface. Moldy foods may also have bacteria growing along with the mold. |
| **Cooked casseroles** | Discard | Food with high moisture content can be contaminated below the surface. Moldy foods may also have bacteria growing along with the mold. |
| **Cooked grain and pasta** | Discard | Food with high moisture content can be contaminated below the surface. Moldy foods may also have bacteria growing along with the mold. |
| **Hard Cheese (not cheese where mold is part of the processing)** | Use. Cut off at least 1 inch around and below the mold spot (keep the knife out of the mold itself so it will not cross-contaminate other parts of the cheese.) After trimming off the mold, recover the cheese in fresh wrap. | Mold generally cannot penetrate deep into the product. |
| | | |

| | | |
|---|---|---|
| **Cheese made with mold (such as Roquefort, Blue, Gorgonzola, Stilton, Brie, Camembert)** | Discard soft cheeses such as Brie and Camembert if they contain molds that are not a part of the manufacturing process. If surface mold is on hard cheeses such as Gorgonzola and stilton, cut off mold at least 1 inch around and below the mold spot and handle like hard cheese (above). | Molds that are not a part of the manufacturing process can be dangerous. |
| **Soft cheese (such as cottage, cream cheese, Neufchatel, chevre, Bel Paese, etc.) Crumbled, shredded, and sliced cheeses (all types)** | Discard | Foods with high moisture content can be contaminated below the surface. Shredded, sliced, or crumbled cheese can be contaminated by the cutting instrument. Moldy soft cheese can also have bacteria growing along with the mold. |
| **Yogurt and sour cream** | Discard | Foods with high moisture content can be contaminated below the surface. Moldy foods may also have bacteria growing along with the mold. |
| **Jams and Jellies** | Discard | The mold could be producing a mycotoxins. Microbiologists recommend against scooping out the mold and using the remaining condiment. |
| **Fruits and vegetables, soft (such as cucumbers, peaches, tomatoes, etc.)** | Discard | Fruits and vegetables with high moisture content can be contaminated below the surface. |
| **Bread and baked goods** | Discard | Porous foods can be contaminated below the surface. |
| **Peanut butter, legumes and nuts** | Discard | Foods processed without preservatives are at high risk for mold |

# Mold



## Regional Weather Conditions: Mold Risk Based on Precipitation & Humidity



# mold is ubiquitous

(everywhere)

# How long has Mold been around?

•Longer than humans have

Some of the oldest documentation of mold outbreaks were in the Bible

Book of Leviticus


Nearly everyone has seen mold growth - *millions of mold cells* growing together

# What is Mold?

# Back to the basics of Biology: 5 Kingdoms of Life

*** KINGDOM (animals)**

*** KINGDOM (plants)**

*** KINGDOM (protozoans, slime molds, unicellular & multicellular algae)**

*** KINGDOM (bacteria)**

*** KINGDOM FUNGI (mold)**

Fungi are heterotrophic and most fungi are multi-cellular.

Reproduce by means of spores with cell walls similar to plants

# Mold:

A fungus that produces a superficial growth on various kinds of damp or decaying organic matter

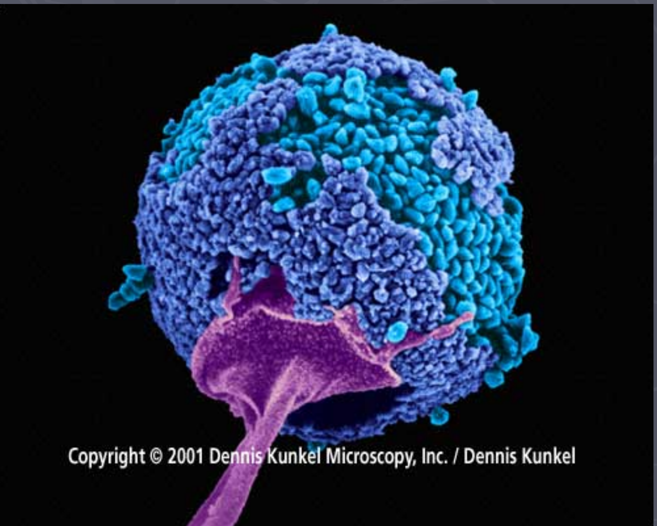



# Spores

**spore**

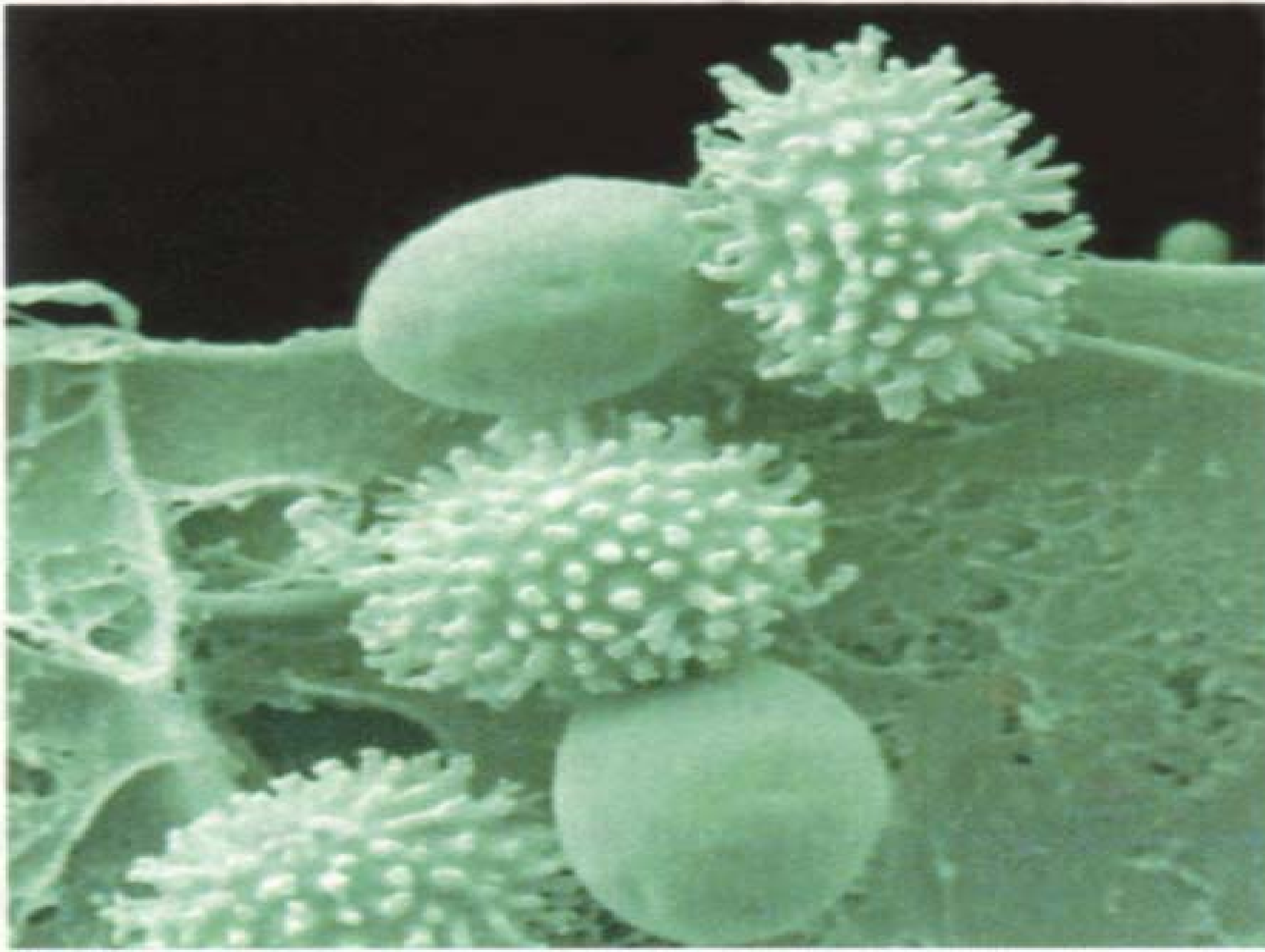
A small reproductive body capable of growing into a new organism.  A dormant non-reproductive body formed by certain bacteria in response to adverse environmental conditions

***Rhizopus***




***Penicillium***


***Aspergillus***



**Mycology:**

the branch of botany that studies fungi

**building mycology:**

mycology that deals with the study of fungi associated with buildings

Why is it important to distinguish between Mold and Bacteria

All can grow in moist conditions.

All ***can*** be disease-causing agents.

**Viruses, are also good to understand but a viruses would need a host to grow**

# Fungal Spore Identification:

There is very limited knowledge of the species of spores.

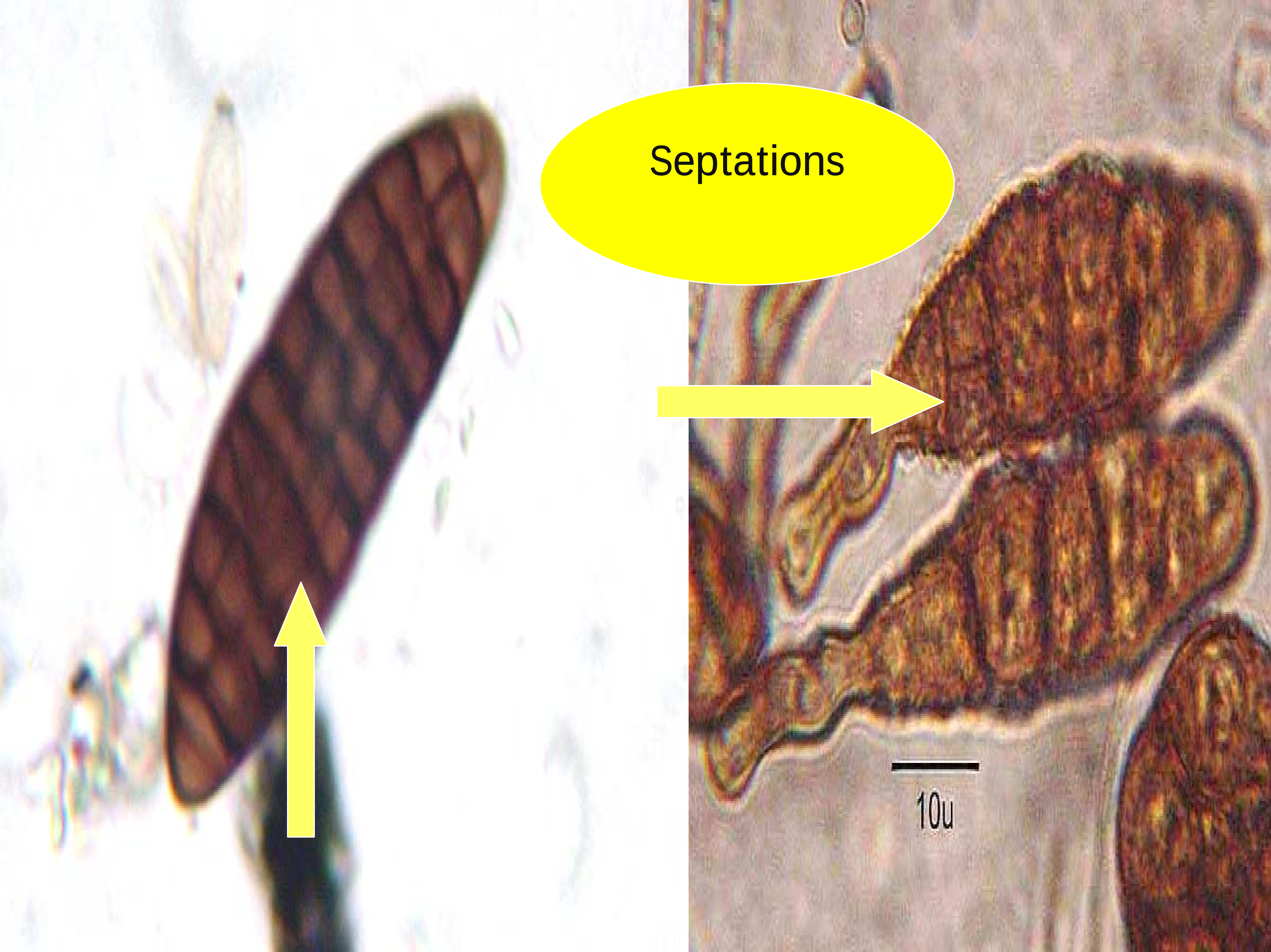
It is estimated that less than 1% of mold spores have been identified.

The best we can do is group unknown spores by their phylum (4 known phylum).

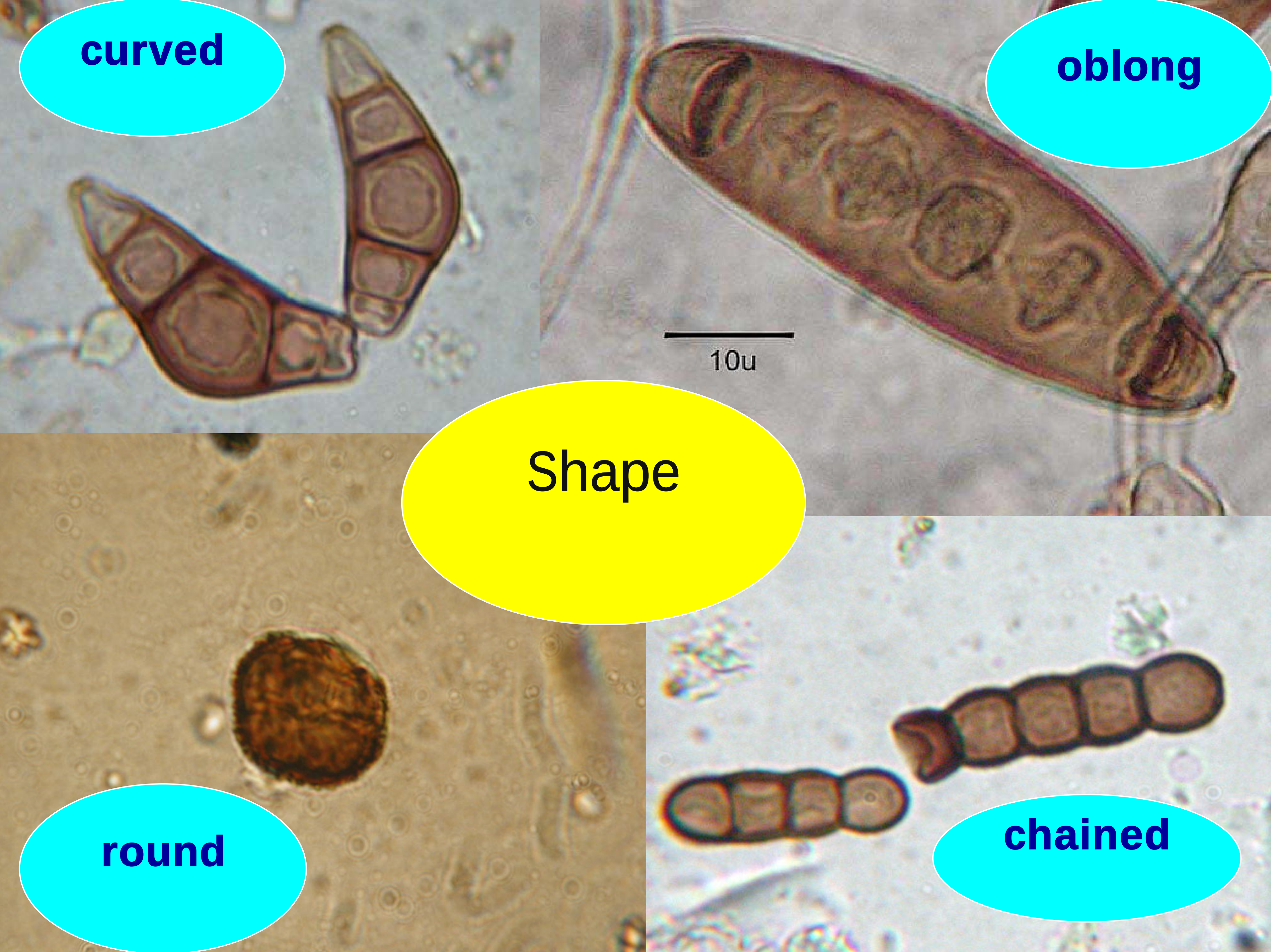
Mycologists do this by characteristics to describe the spores under the microscope.

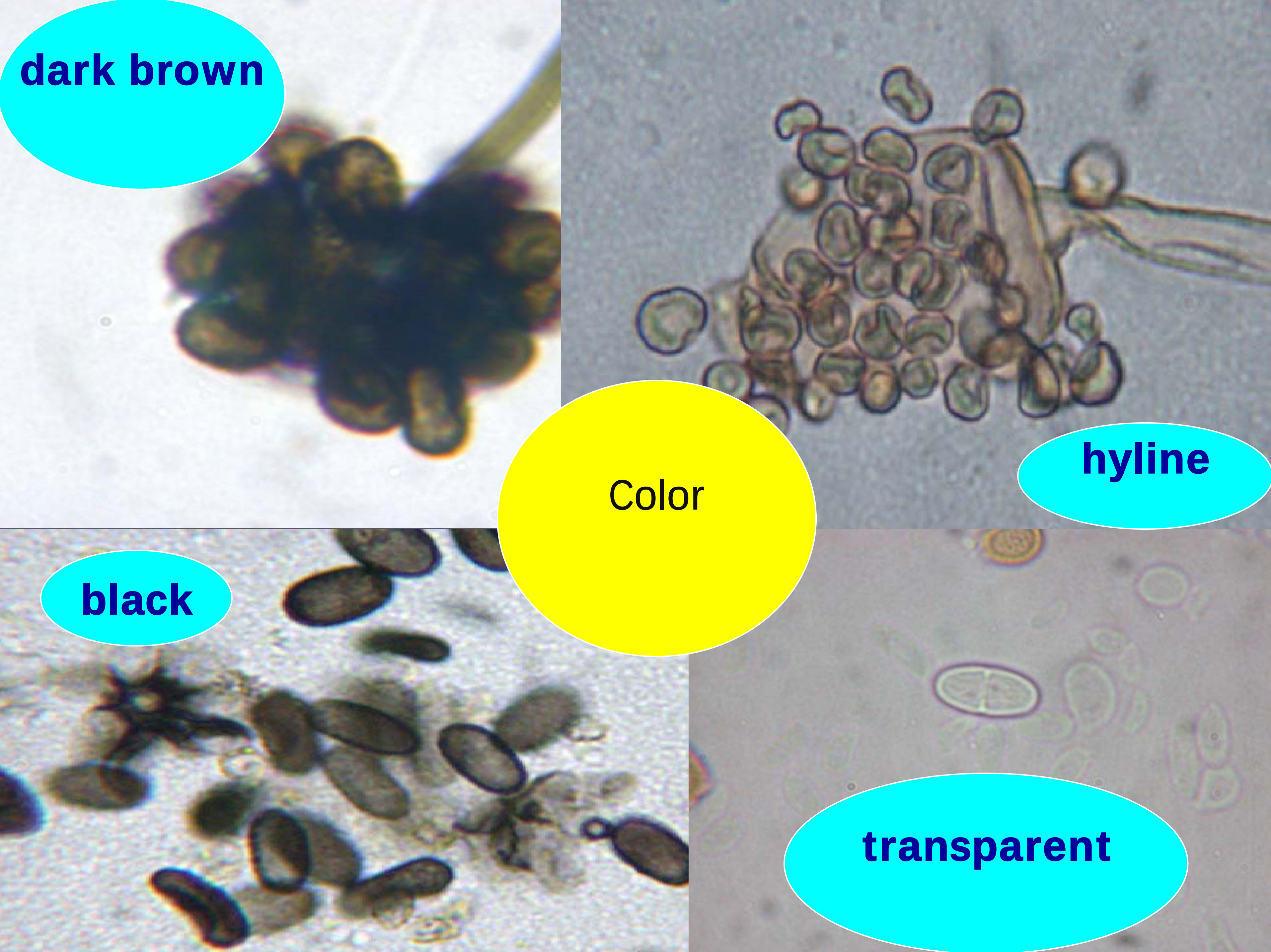
# 6 Characteristics of Mold Spores

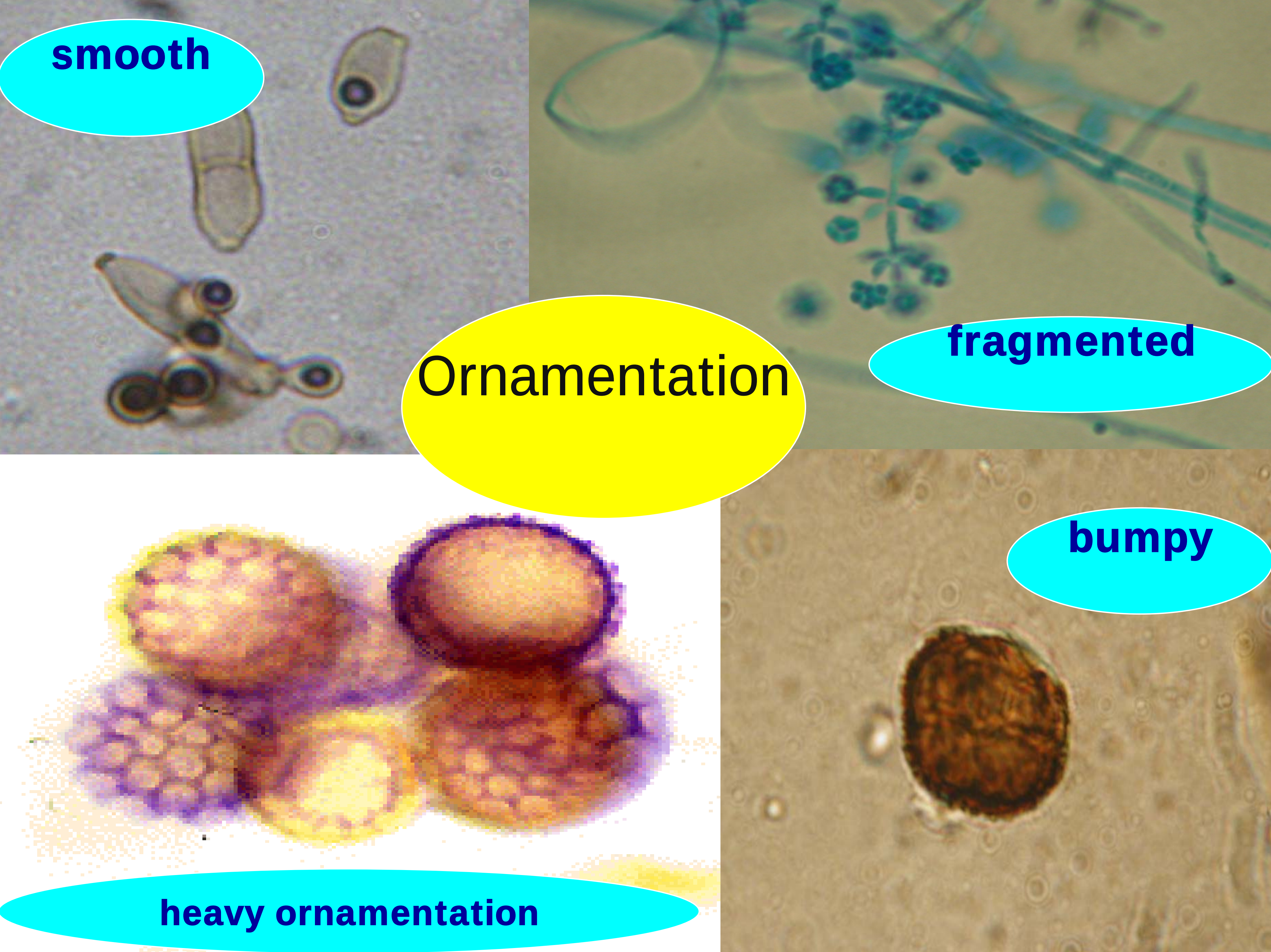
1. Septation
2. Points of Attachment
3. Shape
4. Color
5. Ornamentation
6. Size

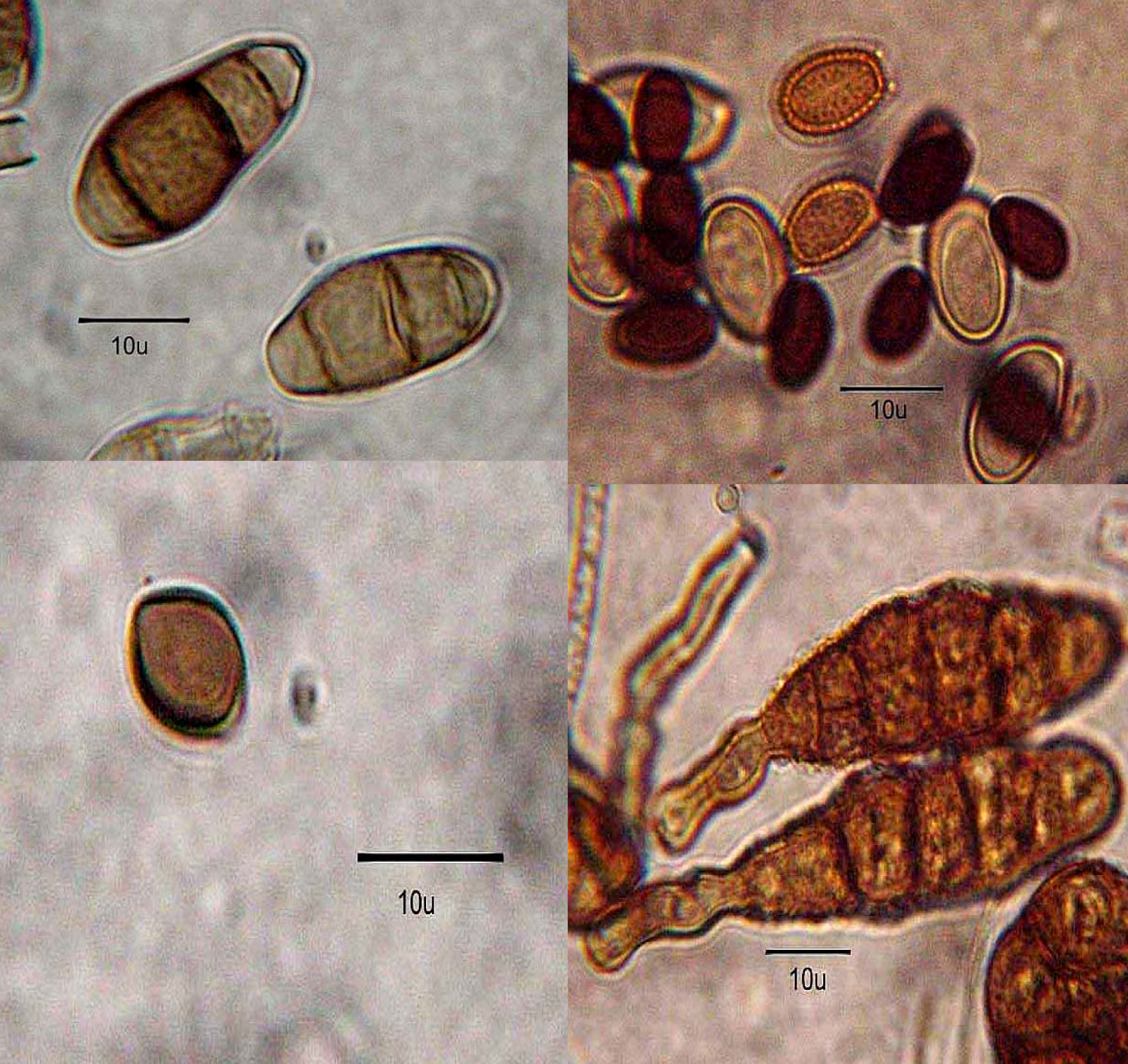

Septations
10u

Points of Attachment


Shape
curved
oblong
10u
round
chained


Color
dark brown
hyline
black
transparent


Ornamentation
smooth
fragmented
bumpy
heavy ornamentation




S
I
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Mold spores only need
5 things to live and grow:

1) Air

2) Food Source

3) Surface for Growth

4) Desirable Temperature

5) **Moisture**

Once mold has found a **WATER** source it starts to grow **very rapidly (within 24-48 hours)**

A growth of mold spores is referred to as a **CFU (Colony Forming Unit)**

# Favorable Conditions for Mold Growth

An Organic Source of Food (wood, plant, paper)

Relative Humidity (Moisture in Air): 50% - 90%

Warm Temperatures: 60 - 90° F

Stagnant Air

Different types of mold prefer different types of conditions

# Favorable Wood Moisture Conditions for Mold Growth

Moisture content of **Wood**:

8-12% normal moisture content

>15% moisture content can result in mold growth

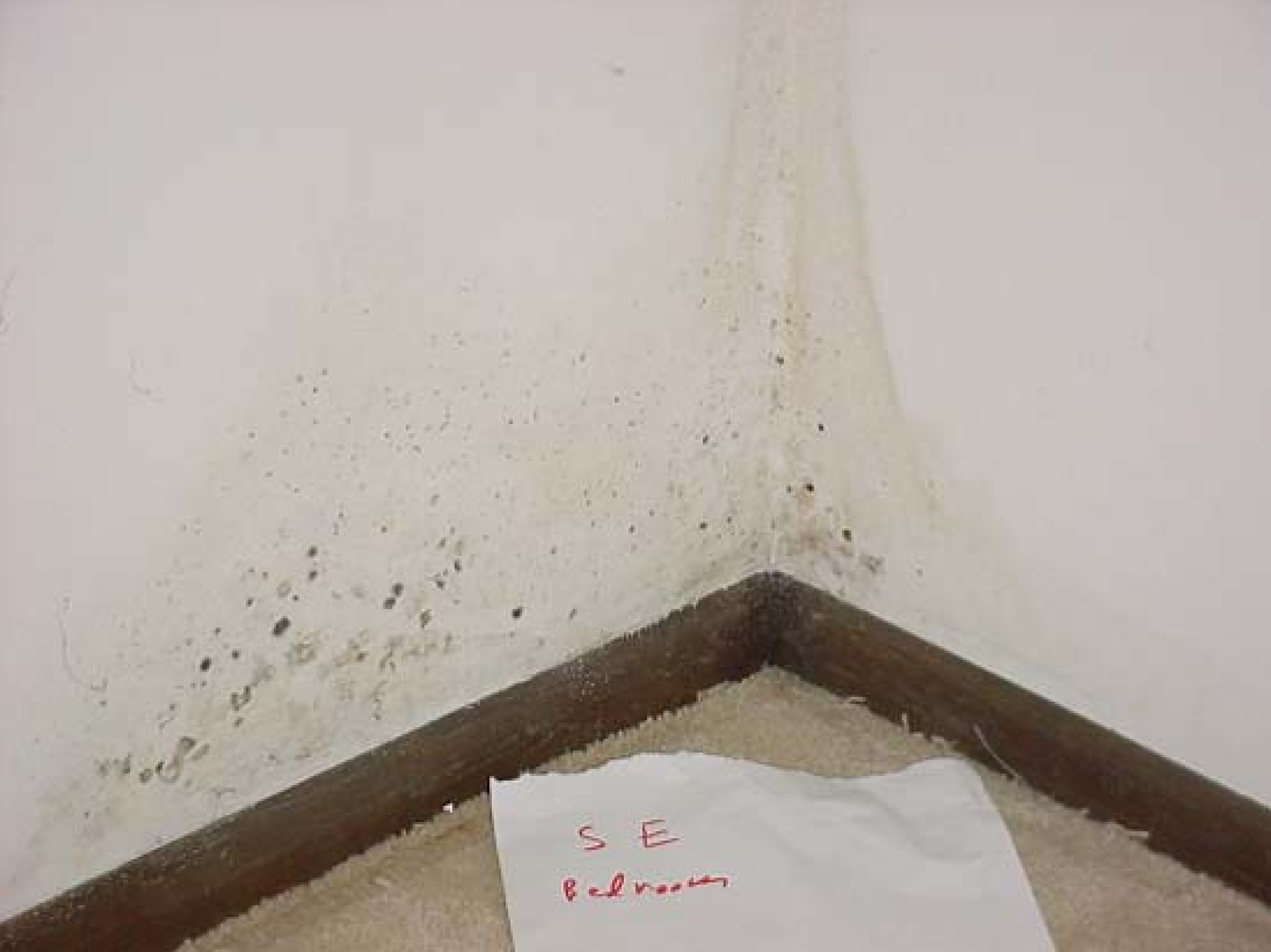
>20% can result in dry rot

A severe case of dry rot

# Favorable Construction Materials for Mold Growth

Natural and Organic in nature
- Wood
- Plasters
- Drywall
- Fiberboard
- Concrete

New Building Materials
- Tyvek
- Plastics
- Sealing Compounds


S E
Bedroom


Darker
to
Lighter

# Unattended water leak

**Plumbing Backup -** This photo was taken from a project where the bathroom overflowed in an empty apartment. The leak was not discovered for weeks until odors were obvious

# Different Forms of Moisture

Liquid

flooded basements

Gaseous

cooking vapors

ice build up on roof

# Any Questions?

# Small group activity

# What is Mold
# Small Group Activity

1. Are there any current federal regulation standards for mold regulations?

2. Mold belongs to what kingdom?

3. Mycology is the study of what?

4. What does mold have in common with and bacteria?

5. What are the five things that mold needs to grow?

6. What are some of the favorable conditions for mold growth?

7. How soon should water damage be dried up to prevent mold?

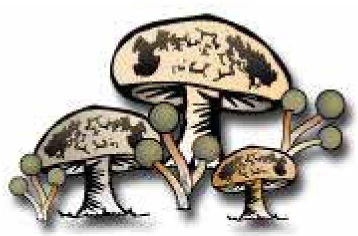
8. What are the six characteristics that are used to identify mold spores?

9. What are some different types of moisture to look for?

# Tab 3

# ASTHMA & ALLERGY PREVENTION

Several molds that grow both indoors and outdoors, produce allergenic substances. These allergens can be found in mold spores and other fungal structures (e.g. hyphae). There is no definite seasonal pattern to molds that grow indoors. However outdoor molds are seasonal, first appearing in early spring and thriving until the first frost.



Indoor molds are found in dark, warm, humid and musty environments such as damp basements, cellars, attics, bathrooms and laundry rooms. They are also found where fresh food is stored, in refrigerator drip trays, garbage pails, air conditioners and humidifiers.

Outdoor molds grow in moist shady areas. They are common in soil, decaying vegetation, compost piles, rotting wood and fallen leaves.

Preventive Strategies

- Use a dehumidifier or air conditioner to maintain relative humidity below 50% and keep temperatures cool.
- Vent bathrooms and clothes dryers to the outside, and run bathroom and kitchen vents while bathing and cooking.
- Regularly check faucets, pipes and ductwork for leaks.
- When first turning on home or car air conditioners, leave the room or drive with the windows open for several minutes to allow mold spores to disperse.
- Remove decaying debris from the yard, roof and gutters.
- Avoid raking leaves, mowing lawns or working with peat, mulch, hay or dead wood. If you must do yard work, wear a mask and avoid working on hot, humid days.

For further information about asthma, contact:

webcenter@niehs.nih.gov
National Institute of Environmental Health Sciences
Office of Communications
P.O. Box 12233
Research Triangle Park, N.C. 27709
919-541-3345

AMERICAN COLLEGE OF OCCUPATIONAL AND ENVIRONMENTAL MEDICINE

**ACOEM Evidence-based Statement** **October 27, 2002**

# Adverse Human Health Effects Associated with Molds in the Indoor Environment



In recent years, the growth of molds in home, school, and office environments has been cited as the cause of a wide variety of human ailments and disabilities. So-called "toxic mold" has become a prominent topic in the lay press and is increasingly the basis for litigation when individuals, families, or building occupants believe they have been harmed by exposure to indoor molds. This evidence-based statement from the American College of Occupational and Environmental Medicine (ACOEM) discusses the state of scientific knowledge as to the nature of fungal-related illnesses while emphasizing the possible relationships to indoor environments. Particular attention is given to the possible health effects of mycotoxins, which give rise to much of the concern and controversy surrounding indoor molds. Food-borne exposures, methods of exposure assessment, and mold remediation procedures are beyond the scope of this paper.

The fungi are eukaryotic, unicellular, or multicellular organisms that, because they lack chlorophyll, are dependent upon external food sources. Fungi are ubiquitous in all environments and play a vital role in the Earth's ecology by decomposing organic matter. Familiar fungi include yeasts, rusts, smuts, mushrooms, puffballs, and bracket fungi. Many species of fungi live as commensal organisms in or on the surface of the human body. "Mold" is the common term for multicellular fungi that grow as a mat of intertwined microscopic filaments (hyphae). Exposure to molds and other fungi and their spores is unavoidable except when the most stringent of air filtration, isolation, and environmental sanitation measures are observed, eg, in organ transplant isolation units.

Molds and other fungi may adversely affect human health through three processes: 1) allergy; 2) infection; and 3) toxicity. One can estimate that about 10% of the population has allergic antibodies to fungal antigens. Only half of these, or 5%, would be expected to show clinical illness. Furthermore, outdoor molds are generally more abundant and important in airway allergic disease than indoor molds — leaving the latter with an important, but minor overall role in allergic airway disease. Allergic responses are most commonly experienced as allergic asthma or allergic rhinitis ("hay fever"). A rare, but much more serious immune-related condition, hypersensitivity pneumonitis (HP), may follow exposure (usually occupational) to very high concentrations of fungal (and other microbial) proteins.

Most fungi generally are not pathogenic to healthy humans. A number of fungi commonly cause superficial infections involving the feet *(tinea pedis)*, groin *(tinea cruris)*, dry body skin *(tinea corporus)*, or nails *(tinea onchomycosis)*. A very limited number of pathogenic fungi — such as *Blastomyces, Coccidioides, Cryptococcus*, and *Histoplasma* — infect non-immunocompromised individuals. In contrast, persons with severely impaired immune function, eg, cancer patients receiving chemotherapy, organ transplant patients receiving immunosuppressive drugs, AIDS patients, and patients with uncontrolled diabetes, are at significant risk for more severe opportunistic fungal infection.

Some species of fungi, including some molds, are known to be capable of producing secondary metabolites, or mycotoxins, some of which find a valuable clinical use, eg, penicillin, cyclosporine. Serious veterinary and human mycotoxicoses have been documented following ingestion of foods heavily overgrown with molds. In agricultural settings, inhalation exposure to high concentrations of mixed organic dusts — which include bacteria, fungi, endotoxins, glucans, and mycotoxins — is associated with organic dust toxic syndrome, an acute febrile illness. The present alarm over human exposure to molds in the indoor environment derives from a belief that inhalation exposures to mycotoxins cause numerous and varied, but generally nonspecific, symptoms. Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in the home, school, or office environment.

## Allergy and other hypersensitivity reactions

Allergic and other hypersensitivity responses to indoor molds may be immunoglobulin E (IgE) or immunoglobulin G (IgG) mediated, and both types of response are associated with exposure to indoor molds. Uncommon allergic syndromes, allergic bronchopulmonary aspergillosis (ABPA), and allergic fungal sinusitus (AFS), are briefly discussed for completeness, although indoor mold has not been suggested as a particular risk factor in the etiology of either.

1. *Immediate hypersensitivity:* The most common form of hypersensitivity to molds is immediate type hypersensitivity or IgE-mediated "allergy" to fungal proteins. This reactivity can lead to allergic asthma or allergic rhinitis that is triggered by breathing in mold spores or hyphal fragments. Residential or office fungal exposures may be a substantial factor in an individual's allergic airway disease depending on the subject's profile of allergic sensitivity and the levels of indoor exposures. Individuals with this type of mold allergy are "atopic" individuals, ie, have allergic asthma, allergic rhinitis, or atopic dermatitis and manifest allergic (IgE) antibodies to a wide range of environmental proteins among which molds are only one participant. These individuals generally will have allergic reactivity against other important indoor and outdoor allergens such as animal dander, dust mites, and weed, tree, and grass pollens. Among the fungi, the most important indoor allergenic molds are *Penicillium* and *Aspergillus* species.[1] Outdoor molds, eg, *Cladosporium* and *Alternaria*, as well as pollens, can often be found at high levels indoors if there is access for outdoor air (eg, open windows).

   About 40% of the population are atopic and express high levels of allergic antibodies to inhalant allergens. Of these, 25%, or 10% of the population, have allergic antibodies to common inhalant molds.[2] Since about half of persons with allergic antibodies will express clinical disease from those antibodies, about 5% of the population is predicted to have, at some time, allergic symptoms from molds. While indoor molds are well-recognized allergens, outdoor molds are more generally important.

   A growing body of literature associates a variety of diagnosable respiratory illnesses (asthma, wheezing, cough, phlegm, etc.), particularly in children, with residence in damp or water-damaged homes (see reviews [3-5]). Recent studies have documented increased inflammatory mediators in the nasal fluids of persons in damp buildings, but found that mold spores themselves were not responsible for these changes.[6,7] While dampness may indicate potential mold growth, it is also a likely indicator of dust mite infestation and bacterial growth. The relative contribution of each is unknown, but mold, bacteria, bacterial endotoxins, and dust mites can all play a role in the reported spectrum of illnesses, and can all be minimized by control of relative humidity and water intrusion.

2. *Hypersensitivity pneumonitis (HP)*: HP results from exaggeration of the normal IgG immune response against inhaled foreign (fungal or other) proteins and is characterized by: 1) very high serum levels of specific IgG proteins (classically detected in precipitin tests performed as double diffusion tests); and 2) inhalation exposure to very large quantities of fungal (or other) proteins.[8] The resulting interaction between the inhaled fungal proteins and fungal-directed cell mediated and humoral (antibody) immune reactivity leads to an intense local immune reaction recognized as HP. As opposed to immediate hypersensitivity (IgE-mediated) reactions to mold proteins, HP is not induced by normal or even modestly elevated levels of mold spores. Most cases of HP result from occupational exposures, although cases have also been attributed to pet birds, humidifiers, and heating, ventilating, and air conditioning (HVAC) systems. The predominant organisms in the latter two exposures are thermophilic Actinomyces, which are not molds but rather are filamentous bacteria that grow at high temperatures (116°F).

   The presence of high levels of a specific antibody — generally demonstrated as the presence of precipitating antibodies — is required to initiate HP, but is not diagnostic of HP.[9] More than half of the people who have occupational exposure to high levels of a specific protein have such precipitin antibodies, but do not have clinical disease.[8] Many laboratories now measure IgG to selected antigens by using solid phase immunoassays, which are easier to perform and more quantitative than precipitin (gel diffusion) assays. However, solid phase IgG levels that are above the reference range do not carry the same discriminatory power as do results of a precipitin test, which requires much greater levels of antibody to be positive. Five percent of the normal population have levels above the reference value for any one tested material. Consequently, a panel of tests (eg, 10) has a high probability of producing a false-positive result. Screening IgG antibody titers to a host of mold and other antigens is not justified unless there is a reasonable clinical suspicion for HP and should not be used to screen for mold exposure.[10]

3. *Uncommon allergic syndromes: Allergic bronchopulmonary aspergillosis (ABPA) and allergic fungal sinusitis (AFS).*[11] These conditions are unusual variants of allergic (IgE-mediated) reactions in which fungi actually grow within the patient's airway. ABPA is the classic form of this syndrome, which occurs in allergic individuals who generally have airway damage from previous illnesses leading to bronchial irregularities that impair normal drainage, eg, bronchiectasis.[12,13] Bronchial disease and old cavitary lung disease are predisposing factors contributing to fungal colonization and the formation of mycetomas. *Aspergillus* may colonize these areas without invading adjacent tissues. Such fungal colonization is without adverse health consequence unless the subject is allergic to the specific fungus that has taken up residence, in which case there may be ongoing allergic reactivity to fungal proteins released directly into the body. Specific criteria have been recognized for some time for the diagnosis of ABPA.[14,15] As fungi other than *Aspergillus* may cause this condition, the term "allergic bronchopulmonary mycosis" has been suggested.

   It has more recently become appreciated that a similar process may affect the sinuses — allergic fungal sinusitis (AFS).[16] This condition also presents in subjects who have underlying allergic disease and in whom, because of poor drainage, a fungus colonizes the sinus cavity. *Aspergillus* and *Curvularia* are the most common forms, although the number of fungal organisms involved continues to increase. As with ABPA, the diagnosis of AFS has specific criteria that should be used to make this diagnosis.[17-19]

**Recommendations**

- Individuals with allergic airway disease should take steps to minimize their exposure to molds and other airborne allergens, eg, animal dander, dust mites, pollens. For these individuals, it is prudent to take feasible steps that reduce exposure to aeroallergens and to remediate sources of indoor mold amplification. Sensitized individuals may need to keep windows closed, remove pets, use dust mite covers, use high-quality vacuum cleaners, or filter outdoor air intakes to minimize exposures to inhalant allergens. Humidification over 40% encourages fungal and dust mite growth, so should be avoided. Where there is indoor amplification of fungi, removal of the fungal source is a key measure to be undertaken so as to decrease potential for indoor mold allergen exposure.

- ABPA and AFS are uncommon disorders while exposure is ubiquitous to the fungal organisms involved. There is no evidence to link specific exposures to fungi in home, school, or office settings to the establishment of fungal colonization that leads to ABPA or AFS.

- Once a diagnosis of HP is entertained in an appropriate clinical setting and with appropriate laboratory support, it is important to consider potential sources of inhaled antigen. If evaluation of the occupational environment fails to disclose the source of antigens, exposures in the home, school, or office should be investigated. Once identified, the source of the mold or other inhaled foreign antigens should be remediated.

- Appropriate measures should be taken in industrial workplaces to prevent mold growth, eg, in machining fluids and where stored organic materials are handled such as in agricultural and grain processing facilities. Engineering controls and personal protective equipment should be used to reduce aerosol generation and minimize worker exposures to aerosols.

Although it is not relevant to indoor mold exposure, it should be mentioned that there is a belief among some health practitioners and members of the public regarding a vague relationship between mold colonization, molds in foods, and a "generalized mold hypersensitivity state." The condition was originally proposed as the "Chronic Candida Syndrome" or "Candida Hypersensitivity Syndrome," but now has been generalized to other fungi. Adherents may claim that individuals are "colonized" with the mold(s) to which they are sensitized and that they react to these endogenous molds as well as to exposures in foods and other materials that contain mold products. The proposed hypersensitivity is determined by the presence of any of a host of non-specific symptoms plus an elevated (or even normal) level of IgG to any of a host of molds. The claim of mold colonization is generally not supported with any evidence, eg, cultures or biopsies, to demonstrate the actual presence of fungi in or on the subject. Instead, proponents often claim colonization or infection based on the presence of a wide variety of nonspecific symptoms and antibodies detected in serologic tests that represent no more than past exposure to normal environmental fungi. The existence of this disorder is not supported by reliable scientific data.[20,21]

## Infection

An overview of fungi as human pathogens follows. Exposure to molds indoors is generally not a specific risk factor in the etiology of mycoses except under specific circumstances as discussed below for individual types of infection.

1. *Serious fungal infections:* A very limited number of pathogenic fungi such as *Blastomyces, Coccidioides, Cryptococcus,* and *Histoplasma* infect normal subjects and may cause a fatal illness. However, fungal infections in which there is deep tissue invasion are primarily restricted to severely immunocompromised subjects, eg, patients with lymphoproliferative disorders including acute leukemia, cancer patients receiving intense chemotherapy, or persons undergoing bone marrow or solid transplantation who get potent immunosuppressive drugs.[22] Uncontrolled diabetics and persons with advanced AIDS are also at increased risk. Concern is greatest when patients are necessarily in the hospital during their most severe immunocompromise, at which time intense measures are taken to avoid fungal, bacterial, and viral infection.[23] Outside the hospital, fungi, including *Aspergillus*, are so ubiquitous that few recommendations can be made beyond avoidance of known sources of indoor and outdoor amplification, including indoor plants and flowers because vegetation is a natural fungal growth medium.[24,25] *Candida albicans* is a ubiquitous commensal organism on humans that becomes an important pathogen for immunocompromised subjects. However, it and other environmental fungi discussed above that are pathogens in normals as well (eg, *Cryptococcus* associated with bird droppings, *Histoplasma* associated with bat droppings, *Coccidioides* endemic in the soil in the southwest US) are not normally found growing in the office or residential environment, although they can gain entry from outdoors. Extensive guidelines for specific immunocompromised states can be found at the Centers for Disease Control and Prevention (CDC) web site at www.cdc.gov.

2. *Superficial fungal infections:* In contrast to serious internal infections with fungi, superficial fungal infections on the skin or mucosal surfaces are extremely common in normal subjects. These superficial infections include infection of the feet *(tinea pedis)*, nails *(tinea onychomycosis)*, groin *(tinea cruris)*, dry body skin *(tinea corporis),* and infection of the oral or vaginal mucosa. Some of the common organisms involved, eg, *Trychophyton rubrum*, can be found growing as an indoor mold. Others, such as *Microsprum canis* and *T. mentagrophytes* can be found on indoor pets (eg, dogs, cats, rabbits, and guinea pigs). As a common commensal on human mucosal surfaces, *C. albicans* can be cultured from more than half of the population that has no evidence of active infection. *C. albicans* infections are particularly common when the normally resident microbial flora at a mucosal site are removed by antibiotic use. Local factors such as moisture in shoes or boots and in body creases and loss of epithelial integrity are important in development of superficial fungal infections.

   *Pityriasis (Tinea) versicolor* is a chronic asymptomatic infection of the most superficial layers of the skin due to *Pityriasis ovale* (also known as *P. orbiculare* and *Malassesia furfur*) manifest by patches of skin with variable pigmentation. This is not a contagious condition and thus is unrelated to exposures, but represents the overgrowth of normal cutaneous fungal flora under favorable conditions.

**Recommendations**

- Only individuals with the most severe forms of immunocompromise need be concerned about the potential for opportunistic fungal infections. These individuals should be advised to avoid recognizable fungal reservoirs including, but not limited, to indoor environments where there is uncontrolled mold growth. Outdoor areas contaminated by specific materials such as pigeon droppings should be avoided as well as nearby indoor locations where those sources may contaminate the intake air.

- Individuals with *M. canis* and *T. mentagrophytes* infections should have their pets checked by a veterinarian. No other recommendations are warranted relative to home, school, or office exposures in patients with superficial fungal infections.

# Toxicity

Mycotoxins are "secondary metabolites" of fungi, which is to say mycotoxins are not required for the growth and survival of the fungal species ("toxigenic species") that are capable of producing them. The amount (if any) and type of mycotoxin produced is dependent on a complex and poorly understood interaction of factors that probably include nutrition, growth substrate, moisture, temperature, maturity of the fungal colony, and competition from other microorganisms.[26-30] Additionally, even under the same conditions of growth, the profile and quantity of mycotoxins produced by toxigenic species can vary widely from one isolate to another.[31-34] Thus, it does not necessarily follow from the mere presence of a toxigenic species that mycotoxins are also present.[35-38]

When produced, mycotoxins are found in all parts of the fungal colony, including the hyphae, mycelia, spores, and the substrate on which the colony grows. Mycotoxins are relatively large molecules that are not significantly volatile;[39,40] they do not evaporate or "off-gas" into the environment, nor do they migrate through walls or floors independent of a particle. Thus, an inhalation exposure to mycotoxins requires generation of an aerosol of substrate, fungal fragments, or spores. Spores and fungal fragments do not pass through the skin, but may cause irritation if there is contact with large amounts of fungi or contaminated substrate material.[41] In contrast, microbial volatile organic compounds (MVOCs) are low molecular weight alcohols, aldehydes, and ketones.[42] Having very low odor thresholds, MVOCs are responsible for the musty, disagreeable odor associated with mold and mildew and they may be responsible for the objectionable taste of spoiled foods.[42,43]

Most descriptions of human and veterinary poisonings from molds involve eating moldy foods.[41,43-46] Acute human intoxications have also been attributed to inhalation exposures of agricultural workers to silage or spoiled grain products that contained high concentrations of fungi, bacteria, and organic debris with associated endotoxins, glucans, and mycotoxins.[47,48] Related conditions including "pulmonary mycotoxicosis," "grain fever," and others are referred to more broadly as "organic dust toxic syndrome" (ODTS).[49] Exposures associated with ODTS have been described as a "fog" of particulates[50] or an initial "thick airborne dust" that "worsened until it was no longer possible to see across the room."[51] Total microorganism counts have ranged from $10^5$-$10^9$ per cubic meter of air[52] or even $10^9$-$10^{10}$ spores per cubic meter,[53,54] extreme conditions not ordinarily encountered in the indoor home, school, or office environment.

"Sick building syndrome," or "non-specific building-related illness," represents a poorly defined set of symptoms (often sensory) that are attributed to occupancy in a building. Investigation generally finds no specific cause for the complaints, but they may be attributed to fungal growth if it is found. The potential role of building-associated exposure to molds and associated mycotoxins has been investigated, particularly in instances when *Stachybotrys chartarum (*aka *Stachybotrys atra)* was identified.[55-58] Often referred to in the lay press by the evocative, but meaningless terms, "toxic mold" or "fatal fungus," *S. chartarum* elicits great concern when found in homes, schools, or offices, although it is by no means the only mold found indoors that is capable of producing mycotoxins.[35,36,59,60]

Recent critical reviews of the literature[35,61-67] concluded that indoor airborne levels of microorganisms are only weakly correlated with human disease or building-related symptoms and that a causal relationship has not been established between these complaints and indoor exposures to *S. chartarum*.

A 1993-1994 series of cases of pulmonary hemorrhage among infants in Cleveland, Ohio, led to an investigation by the CDC and others. No causal factors were suggested initially,[68] but eventually these same investigators proposed that the cause had been exposures in the home to *S. chartarum* and suggested that very young infants might be unusually vulnerable.[69-71] However, subsequent detailed re-evaluations of the original data by CDC and a panel of experts led to the conclusion that these cases, now called "acute idiopathic pulmonary hemorrhage in infants,"[72] had not been causally linked to *S. chartarum* exposure.[73]

If mycotoxins are to have human health effects, there must be an actual presence of mycotoxins, a pathway of exposure from source to susceptible person, and absorption of a toxic dose over a sufficiently short period of time. As previously noted, the presence of mycotoxins cannot be presumed from the mere presence of a toxigenic species. The pathway of exposure in home, school, and office settings may be either dermal (eg, direct contact with colonized building materials) or inhalation of aerosolized spores, mycelial fragments, or contaminated substrates. Because mycotoxins are not volatile, the airborne pathway requires active generation of that aerosol. For toxicity to result, the concentration and duration of exposure must be sufficient to deliver a toxic dose. What constitutes a toxic dose for humans is not known at the present time, but some estimates can be made that suggest under what circumstances an intoxication by the airborne route might be feasible.

Experimental data on the *in vivo* toxicity of mycotoxins are scant. Frequently cited are the inhalation $LC_{50}$ values determined for mice, rats, and guinea pigs exposed for 10 minutes to T-2 toxin, a trichothecene mycotoxin produced by *Fusarium* spp.[74,75] Rats were most sensitive in these studies, but there was no mortality in rats exposed to 1.0 mg T-2 toxin/$m^3$. No data were found on T-2 concentrations in *Fusarium* spores, but another trichothecene, satratoxin H, has been reported at a concentration of $1.0 \times 10^{-4}$ ng/spore in a “highly toxic” *S. chartarum* strain s. 72.[31] To provide perspective relative to T-2 toxin, 1.0 mg satratoxin H/$m^3$ air would require $10^{10}$ (ten billion) of these s. 72 *S. chartarum* spores/$m^3$.

In single-dose *in vivo* studies, *S. chartarum* spores have been administered intranasally to mice[31] or intratracheally to rats.[76,77] High doses ($30 \times 10^6$ spores/kg and higher) produced pulmonary inflammation and hemorrhage in both species. A range of doses were administered in the rat studies and multiple, sensitive indices of effect were monitored, demonstrating a graded dose response with $3 \times 10^6$ spores/kg being a clear no-effect dose. Airborne *S. chartarum* spore concentrations that would deliver a comparable dose of spores can be estimated by assuming that all inhaled spores are retained and using standard default values for human subpopulations of particular interest[78] – very small infants,[†] school-age children,[††] and adults.[†††] The no-effect dose in rats ($3 \times 10^6$ spores/kg) corresponds to continuous 24-hour exposure to $2.1 \times 10^6$ spores/$m^3$ for infants, $6.6 \times 10^6$ spores/$m^3$ for a school-age child, or $15.3 \times 10^6$ spores/$m^3$ for an adult.

That calculation clearly overestimates risk because it ignores the impact of dose rate by implicitly assuming that the acute toxic effects are the same whether a dose is delivered as a bolus intratracheal instillation or gradually over 24 hours of inhalation exposure. In fact, a cumulative dose delivered over a period of hours, days, or weeks is expected to be less acutely toxic than a bolus dose, which would overwhelm detoxification systems and lung clearance mechanisms. If the no-effect $3 \times 10^6$ spores/kg intratracheal bolus dose in rats is regarded as a 1-minute administration ($3 \times 10^6$ spores/kg/min), achieving the same dose rate in humans (using the same default assumptions as previously) would require airborne concentrations of $3.0 \times 10^9$ spores/$m^3$ for an infant, $9.5 \times 10^9$ spores/$m^3$ for a child, or $22.0 \times 10^9$ spores/$m^3$ for an adult.

In a repeat-dose study, mice were given intranasal treatments twice weekly for three weeks with “highly toxic” s. 72 *S. chartarum* spores at doses of $4.6 \times 10^6$ or $4.6 \times 10^4$ spores/kg (cumulative doses over three weeks of $2.8 \times 10^7$ or $2.8 \times 10^5$ spores/kg).[79] The higher dose caused severe inflammation with hemorrhage, while less severe inflammation, but no hemorrhage was seen at the lower dose of s. 72 spores. Using the same assumptions as previously (and again ignoring dose-rate implications), airborne *S. chartarum* spore concentrations that would deliver the non-hemorrhagic cumulative three-week dose of $2.8 \times 10^5$ spores/kg can be estimated as $9.4 \times 10^3$ spores/$m^3$ for infants, $29.3 \times 10^3$ spores/$m^3$ for a school-age child, and $68.0 \times 10^3$ spores/$m^3$ for adults (assuming exposure for 24 hours per day, 7 days per week, and 100% retention of spores).

The preceding calculations suggest lower bound estimates of airborne *S. chartarum* spore concentrations corresponding to essentially no-effect acute and subchronic exposures. Those concentrations are not infeasible, but they are improbable and inconsistent with reported spore concentrations. For example, in data from 9,619 indoor air samples from 1,717 buildings, when *S. chartarum* was detected in indoor air (6% of the buildings surveyed) the median airborne concentration was 12 CFU/$m^3$ (95% CI 12 to 118 CFU/$m^3$).[80]

**Recommendations**

- The presence of toxigenic molds within a home, school, or office environment should not by itself be regarded as demonstrating that mycotoxins were present or that occupants of that environment absorbed a toxic dose of mycotoxins.

- Indoor air samples with contemporaneous outdoor air samples can assist in evaluating whether or not there is mold growth indoors; air samples may also assist in evaluating the extent of potential indoor exposure. Bulk, wipe, and wall cavity samples may indicate the presence of mold, but do not contribute to characterization of exposures for building occupants.

- After the source of moisture that supports mold growth has been eliminated, active mold growth can be eliminated. Colonized porous materials, eg, clothing or upholstery, can be cleaned using appropriate routine methods, eg, washing or dry cleaning clothing, and need not be discarded unless cleaning fails to restore an acceptable appearance.

- When patients associate health complaints with mold exposure, treating physicians should evaluate all possible diagnoses, including those unrelated to mold exposure, ie, consider a complete appropriate differential diagnosis for the patient's complaints. To the extent that signs and symptoms are consistent with immune-mediated disease, immune mechanisms should be investigated.

- The possibility of a mycotoxicosis as an explanation for specific signs and symptoms in a residential or general office setting should be entertained only after accepted processes that are recognized to occur have been appropriately excluded and when mold exposure is known to be uncommonly high. If a diagnosis of mycotoxicosis is entertained, specific signs and symptoms ascribed to mycotoxins should be consistent with the potential mycotoxins present and their known biological effects at the potential exposure levels involved.

## Summary

Molds are common and important allergens. About 5% of individuals are predicted to have some allergic airway symptoms from molds over their lifetime. However, it should be remembered that molds are not dominant allergens and that the outdoor molds, rather than indoor ones, are the most important. For almost all allergic individuals, the reactions will be limited to rhinitis or asthma; sinusitis may occur secondarily due to obstruction. Rarely do sensitized individuals develop uncommon conditions such as ABPA or AFS. To reduce the risk of developing or exacerbating allergies, mold should not be allowed to grow unchecked indoors. When mold colonization is discovered in the home, school, or office, it should be remediated after the source of the moisture that supports its growth is identified and eliminated. Authoritative guidelines for mold remediation are available.[81-83]

Fungi are rarely significant pathogens for humans. Superficial fungal infections of the skin and nails are relatively common in normal individuals, but those infections are readily treated and generally resolve without complication. Fungal infections of deeper tissues are rare and in general are limited to persons with severely impaired immune systems. The leading pathogenic fungi for persons with nonimpaired immune function, *Blastomyces, Coccidioides, Cryptococcus,* and *Histoplasma*, may find their way indoors with outdoor air, but normally do not grow or propagate indoors. Due to the ubiquity of fungi in the environment, it is not possible to prevent immune-compromised individuals from being exposed to molds and fungi outside the confines of hospital isolation units.

Some molds that propagate indoors may, under some conditions, produce mycotoxins that can adversely affect living cells and organisms by a variety of mechanisms. Adverse effects of molds and mycotoxins have been recognized for centuries following ingestion of contaminated foods. Occupational diseases are also recognized in association with inhalation exposure to fungi, bacteria, and other organic matter, usually in industrial or agricultural settings. Molds growing indoors are believed by some to cause building-related symptoms. Despite a voluminous literature on the subject, the causal association remains weak and unproven, particularly with respect to causation by mycotoxins. One mold in particular, *Stachybotrys chartarum*, is blamed for a diverse array of maladies when it is found indoors. Despite its well-known ability to produce mycotoxins under appropriate growth conditions, years of intensive study have failed to establish exposure to *S. chartarum* in home, school, or office environments as a cause of adverse human health effects. Levels of exposure in the indoor environment, dose-response data in animals, and dose-rate considerations suggest that delivery by the inhalation route of a toxic dose of mycotoxins in the indoor environment is highly unlikely at best, even for the hypothetically most vulnerable subpopulations.

Mold spores are present in all indoor environments and cannot be eliminated from them. Normal building materials and furnishings provide ample nutrition for many species of molds, but they can grow and amplify indoors only when there is an adequate supply of moisture. Where mold grows indoors there is an inappropriate source of water that must be corrected before remediation of the mold colonization can succeed. Mold growth in the home, school, or office environment should not be tolerated because mold physically destroys the building materials on which it grows, mold growth is unsightly and may produce offensive odors, and mold is likely to sensitize and produce allergic responses in allergic individuals. Except for persons with severely impaired immune systems, indoor mold is not a source of fungal infections. Current scientific evidence does not support the proposition that human health has been adversely affected by inhaled mycotoxins in home, school, or office environments.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† 5th percentile body weight for 1-month-old male infants, 3.16 kg; respiratory rate for infants under 1 year of age, 4.5 $m^3$/day[78]
†† 50th percentile body weight for 6-year-old boys, 22 kg; respiratory rate for children age 6-9, 10.0 $m^3$/day[78]
††† 50th percentile body weight for men aged 25-34 years, 77.5 kg; respiratory rate for men age 19-65, 15.2 $m^3$/day[78]

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# Health Effects of Mold

Mold health effects, and human experiences of mold exposure, have the potential of creating various maladies, the most common of which are mold allergies.

We live in a veritable "mold soup", with mold spores constantly around us and in the air that we breath. Under normal circumstances, natural cleansing mechanisms in our bodies and in the indoor and outdoor environments control the concentration of mold to acceptable levels. However, water leaks that occur in homes and offices that are not cleaned up promptly, or correctly, almost invariably become breeding grounds for mold. This is why interstitial walls, attics, and floor underlayment may be found to contain higher concentrations of mold.

All molds have the potential to cause health effects. These health effects generally fall into three categories:

1) Allergenic

Most molds fall into this category. Though these molds can be very irritating to those who are allergic to them, they can be potentially dangerous to those with depressed immune systems, the elderly and children. Broadly, the EPA considers them safe to those who don't have sensitivities.

**Warning Signs of Exposure!**

1. Constant or out-of-season allergies.
2. Recurring sinus problems.
3. Headaches.
4. Progressively worsening asthma

2) Infectious/Pathogenic

Pathogenic molds have the ability to cause disease. Children, the elderly, those with immune disorders, and pets should not be exposed to pathogenic substances on a regular basis. Normally, healthy people can also suffer adverse health reactions due to exposure to pathogens.

**Warning Signs of Exposure!**

1. Chronic sinus infections
2. Constant or out-of-season allergies.
3. Headaches.
4. Chronic bronchitis.
5. Diaherra.
6. Lethargy

3) Toxic

Toxins are poisons! Toxic molds can be extremely dangerous to everyone, but especially people with existing health problems. Repairs of homes with toxic molds should only be handled by certified biohazard contractors. Toxic molds can only be identified by laboratory analysis.

**Warning Signs of Exposure!**

1. Severe allergies
2. Chronic sinus infections
3. Headaches
4. Extreme respiratory problems
5. Diahrrea
6. Lethargy
7. Memory or cognitive problems

The severity of the effects experienced by human beings is based on a combination of the health of the persons immune system, the type of mold, and the concentration of the mycotoxins produced by the mold.

# Mold: Causes, Health Effects and Clean-Up

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## Mold

Mold requires water. No water, no mold. Mold is the result of a water problem. Fix the water problem. Clean up the mold. And you have fixed the mold problem.

To avoid mold problems, avoid water problems. Design and build in a manner that reduces water problems.

Mold also requires food. The food it likes best is cellulose – the more processed the better. Mold really likes wet paper. It kind of likes wet wood, but not as much as it likes wet paper. It likes processed wood better than it likes real wood. So mold likes oriented strand board (OSB) better than plywood and plywood better than a stud or a joist. Mold also likes the feces of cockroaches and dust mites, as well as some pastes, paints and adhesives.

Just because something gets wet, it doesn't mean it will get moldy. It needs to be wet for a while. Wet paper needs to be wet for a couple of days. Wet wood, for a couple of weeks. And it also needs to be warm. Warm, wet paper that is wet for a while is a problem. Because it usually takes time for mold to grow, promptly drying the building after a water event will prevent a mold problem from developing. Of course, make certain that the underlying problem that caused the water problem is also corrected.

There are always going to be water problems. But if you fix the water problems quickly enough you won't have mold problems. You want to be able to see a water problem right away if you have one so that you can fix it right away.

Water problems that you can't see for a long time are the type of problems that lead to bad mold problems. For example, wet paper faced gypsum board that you can't see is a problem. Like from a small plumbing leak. Especially in an exterior insulated wall. Why an insulated wall? The insulation reduces the ability of the water to drain and leak out so that you can see it. Also, the insulation reduces energy flow across the wall thereby reducing the rate at which the wall dries out. Also, a pipe in an exterior wall is more likely to have condensation on it especially in the south, and pipes in exterior walls freeze and break – even in the south.

One cavity insulation versus another doesn't matter much from a mold risk perspective. Cellulose insulation is paper based, but it is also treated with chemicals (borates) that suppress mold growth. Fiberglass does not support mold growth, but it gets dirty, and the dirt grows mold ,and it is often paper faced and this paper grows mold. In addition some fiberglass insulation contains urea based binders that do support mold growth. Fiberglass tends to concentrate the water locally whereas the cellulose insulation distributes it more. You need less water to cause a mold problem in a fiberglass insulated wall than you do in a cellulose insulated wall because of this concentration effect. However, the fact that cellulose distributes the water better also makes it harder to spot a leak. So which to use? From a mold risk perspective it doesn't matter one way or the other. The best thing to do is not put pipes in the exterior walls.

What about rainwater leaks and the type of insulation? With a little bit of rainwater leakage, cellulose works better than fiberglass because it absorbs the rainwater, redistributes it and then lets the wall dry in a controlled way (assuming you have designed the wall to dry). With a lot of rainwater leakage, fiberglass works better than cellulose because you see the water sooner and realize that you have to fix the leak. Rainwater leakage is different from pipe leakage because rainwater leakage is more intermittent – that makes it less of a problem than a constantly leaking pipe from a mold perspective. Cellulose is nice with a little bit of rainwater leakage if the wall is designed to dry. Fiberglass is nice with a lot of rainwater leakage. But what does a little bit or a lot mean? It's best not to have rainwater leakage get into wall cavities. That's why you need drainage planes (building papers, housewraps, or foam sheathing) to direct water from window and cladding leaks down and out of walls.

You shouldn't choose your above grade cavity insulation based on a mold risk perspective. However, all of this changes below grade. Don't use fiberglass or cellulose below grade on the inside of basement or crawl space assemblies. Use only rigid foams that are semi-permeable (no foil facings). Why the difference below grade? You can't dry to the outside below grade and the surfaces are a lot cooler both in the summer and in the winter

Leaky windows are also a problem. If a small leak into a cavity that you can't see continues over a long period of time a problem will develop if the cavity can't dry quickly. It's even worse if the wall isn't designed to dry at all. That's why you need pan flashings. Same for doors – doors leak too. Pan flashings under doors and windows collect water from window leaks and safely direct the water away from the wall assembly.

Leaky windows are more of a problem than leaky roofs. Why? Roofs don't often leak into small-enclosed cavities (i.e. walls). And you typically see a roof leak right away, so you can fix it before mold has time to grow.

## Health Effects and Risk

Mold, especially mold spores are everywhere outside. Mold is on everything we build with and everything we bring into a building. Remember we build outside. We turn a piece of the "outside" into the inside as the construction process progresses. Therefore mold will also be inside. And remember it's often wet outside. What's worse is that construction is also a wet process. It is not possible or practical to have a mold free building. Just like it is not possible to have a mold free outside. We just don't want a lot of mold inside and we don't want any mold that is actively growing. We especially don't want a lot of mold or mold that is growing where you can breathe it.

We're not sure what "a lot" means, but we are pretty clear about the "growing" part. We're also not sure about the "where you can breathe it" part either because we don't know where that is with certainty.

We humans share the planet with mold. They were here before us and they will likely be here after us. We pretty much have gotten along reasonably well with mold these past 100,000 years we humans have been around. So what has changed recently? Why the mold hysteria and why now?

We notice things more now. And we expect and demand more. Fewer of us are dying in wars and from disease and hunger. When you are starving and are in fear of getting your village burned and pillaged you don't worry about mold. In North America we've conquered most of the really bad diseases like smallpox, typhoid fever, cholera, malaria and bubonic plague. We're now working on the lesser diseases like heart disease, cancer, allergy and asthma.

We've always had some moldy buildings. But more recently we are building with different materials in different ways that lead to more mold and different mold. We use paper faced gypsum board instead of plaster and lath. We use OSB instead of wood boards or plywood. We use much more insulation. We have air conditioning. We stick ceramic tile on green colored paper-faced gypsum in bathrooms. We have wall-to-wall carpets. For these reasons we not only have more mold in buildings, but we also are more likely to notice that mold. The typical person also spends more time indoors now than 50 years ago.

Allergy to some molds is clearly a problem for individuals with a predisposition (tendency) to developing allergy. We do not know how much exposure to mold is necessary to initiate the allergic response to mold. Once the allergy has developed, however, exposure to very small amounts of mold (the allergen) can cause symptoms. Some people with allergy to mold only have problems with itchy eyes, runny nose and sore throat; others also have asthma and can develop breathing difficulties when exposed to mold.

Asthma affects lots of people, and some molds are triggers for asthma. The mold-asthma connection is really the heart of most of the mold worries. What is not proven is whether exposure to mold can lead to the development of asthma. The more we study asthma and mold, the more we discover about how mold affects us. It is beginning to look as if some of these mold effects are not particularly nice. We're not quite sure yet if it's really bad, or just a little bad for many of us. Clearly some individuals tolerate exposure to high levels of mold without any apparent adverse health effects.

If mold were as bad as some say we would have to ban farming; all composting would be a superfund site; you couldn't cut your grass without a respirator; and most of us would already be dead. On the other hand there is something clearly behind the mold issues from at least the circumstantial evidence side. At present though, the science is really quite thin and we mostly have stories – anecdotal evidence.

In addition to allergic disease, mold can cause infectious disease in some people. Most of these people are more susceptible to infections because their immune (defense) system has been weakened by other diseases such as cancer or HIV (AIDS) or by medical treatment. Transplant recipients (heart, lung, kidney) receive medicines to prevent rejection of the transplanted organ that also weakens their immune system. These individuals are at increased risk for acquiring fungal infections; the mold can actually grow inside their bodies. In some cases, fungal samples taken from the patient's body were identical to fungal samples taken from the hospital room occupied by the patient. In these unusual, fortunately rare cases, we can be fairly certain that the patient became infected by the fungus growing in the hospital. In most cases of disease allegedly cause by mold, no such conclusive evidence is available. There also are a few fungi that can cause infections in healthy people, but these fungi rarely grow inside buildings.

Some molds also make powerful chemicals called mycotoxins that are released under special circumstances. We think that these mycotoxins are directed against other types of mold and bacteria. For example, we use the drug penicillin to fight certain bacterial infections; penicillin is a mycotoxin produced by Penicillium mold. Another mycotoxin, cyclosporin, is a power immune suppressant that we use to treat patients who have received transplanted organs. There are many other mycotoxins that we know much less about. Some of these have been implicated as the cause of illness in people who have lived in very moldy houses. The press has reported stories about individuals who allegedly died or were made very sick from mold; powerful mycotoxins have been implicated. However, we currently do not have the technology that allows us to measure mycotoxin levels in blood or tissue. Therefore we can neither measure exposure nor say with certainty what is responsible for the symptoms or disease.

Unfortunately there is too much about mold and its possible effects on human health that we do not know. We do not know what constitutes "a lot of mold" or whether a short brief exposure to "a lot of mold" is worse than chronic exposure to "a small amount of mold." This is complicated by difficulties in determining exposure levels when mold is definitely present in a building. Just because you have mold in a house doesn't mean that you have been exposed to the mold. And when we mean exposed we mean that mold or a piece of that mold or mold spores or mycotoxin has gotten into your body by inhalation (breathing) or ingestion (eating) or absorption through your skin. The mere presence of mold in a house does not constitute exposure to that mold. And even if some mold has gotten into your body it doesn't mean your going to get sick. And if you do get sick it doesn't mean you are going to stay sick. Or that you are going to be permanently affected.

Even if you have symptoms that are consistent with exposure to mold that does not definitely mean that you have actually been exposed to mold. Your symptoms could be due to lots of other things besides mold. The fact that you have a disease diagnosed clinically (by a real doctor) caused by mold and that you live in a house with that particular type of mold does not mean that you got sick because of exposure to the mold in the house you live in. It could have happened somewhere else. Of course if you have lots of that type of mold all over your house in locations where it easy to breathe a lot of it and you have a clinically diagnosed disease linked to that particular type of mold the probability is pretty high that you got sick because of exposure in your home – but we couldn't absolutely positively say for sure.

Most mold disease stories are just stories at this particular time. The science is really thin at this time. Over time the science is going to get pretty tight. Science will probably say that yes lots of some bad molds can make some people really sick. We will get pretty good ideas at how much of what type of mold in what type of person is bad. We don't know this yet. We will actually get medical tests that will say this person was exposed to this type of mold. We don't have these types of tests yet – except under extremely limited situations (we find the mold growing inside of someone).

Now even if the science on the medical side gets good, we still have huge uncertainties. The problem of assessing actual exposure is also quite difficult.. It is almost impossible to track mold or prove that mold has gone from a specific location into your body. We can find mold on a surface. We can find mold in the air – sometimes. But we can't prove that the mold on a surface got into the air and then once in the air it got in your nose. And even if we could show that the mold in the air got in your nose, it's almost impossible to show that the mold in the air or in your nose has a toxin or enough of a toxin to make any difference.

The press has widely reported on the couple in the Pacific Northwest who burned their house down after settling their law suit for water damages to the building only. There was no money for "pain and suffering" and health effects. This house had really stupid construction problems. It had a wet crawl space containing leaky ductwork. It also had leaky ductwork in the attic. The leaky ductwork in the crawl space and in the attic caused the house to have a huge negative air pressure – it sucked. It sucked the moisture and mold out of the crawl space and into the house. Also the roof leaked, the walls leaked, and the roof was not vented. We were surprised that the house could actually be burned because it was so wet. Were the people sick because of mold in their house? Were they in fact sick? It's hard to tell. Do we believe it? In this case we do because we are familiar with the house. But we certainly couldn't prove it.

That big expensive Texas mold law suit is particularly instructive. The judge would not allow testimony on the causal relationship between mold and health effects because the information relating to mold and health effects would not pass the Dalbert test ("junk science" test). No scientific consensus exists at present on the health effects of mold. The Texas case involved a huge expensive house that had a leaking pipe that for really stupid reasons did not get fixed and the house got really moldy and really wet. The money went to rebuild the house to get rid of the mold, not to the couple who owned the house because they were sick. The jury also punished the insurance company for not fixing the water problem promptly and cleaning up the mess.

How did the court decide that the house was moldy? Easy, you could see the mold on everything and you could smell it. The costs were based on what it would cost to throw out the moldy stuff and replace it with stuff that was not moldy. Plus a quantity of money to punish the big bad insurance company – or at least get their attention.

Bottom line, living in a moldy house is not a good idea. We wouldn't do it. Your customers shouldn't live in moldy houses. But most of the health effects are uncertain and unproven. And there are no standards for mold levels or consensus on risk. How do we know if a house is moldy? If you can see it or smell it. How do you know when you are clean? You can't see it or smell it.

Prudent avoidance is the best course of action. Build houses to minimize the likelihood of water problems. When water intrusions or leaks occur, dry the building quickly to prevent subsequent mold growth. Fix the underlying problem that caused the water problem. If mold is detected, clean it up quickly and safely; then fix the water problem that caused the mold.

## Strategies

What we want to prevent is having mold germinate, grow or amplify inside. We want to prevent mold reservoirs from becoming established inside. And most importantly, if we have a reservoir inside, we don't want the mold, or pieces of mold migrating from the reservoir throughout the house.

Generally, but not always it is better to have less mold inside than outside. The problem is that in the winter there is usually no mold outside (it's cold, mold doesn't like cold) and it is really difficult to measure or decide what "more" or "less" is.

Also, it is desirable to have the same types of mold inside as you have outside and in the same percentages. But it is difficult to measure percentages and even more difficult to decide when the percentages are really statistically (meaningfully) different.

In general most people think it's bad to have more mold inside than outside and to have this inside mold different from the mold you find outside.

## Risk Areas

(In order of decreasing risk)

Leaky Plumbing

- Don't put pipes of any kind in exterior walls. Not supply pipes, not waste pipes.
- Get rid of green board (paper faced gypsum board with green paper) in wet areas – use cement board.
- Don't ever put water heaters in attics or on the second floor. Put water heaters on a concrete slab – in a basement, in a garage or inside on a slab-on-grade near a drain with the floor sloping to the drain.
- Install a condensate drain under air handlers to collect water that drips from the coils. The best location for air handlers is inside the conditioned space on a slab near a drain just like the water heater.
- The same goes for the clothes washer. Don't put clothes washers on the second floor. Those rubber hose connections are awful. Expect a leak. Drain the water that will inevitably leak with a floor drain in a laundry. Locate a water shut off for the clothes washer than can be accessed easily without having to move the clothes washer. Same thing for the water heater. Dishwashers leak. Drain them with a drain pan. Assume everything can and might leak, sooner or later.

Site Grading

- Drain/slope grade away from building.

- Drain/slope driveways, decks, porches, patios away from building.

Crawl Spaces

- Don't build crawl spaces. If you must build a crawl space build it in a conditioned manner like a "mini-basement". Insulate the perimeter with rigid insulation, don't insulate between the floor joists. Install a sealed continuous ground cover. The best crawl space is one filled with concrete and called a slab.

- Don't vent crawl spaces to the outside. Since crawl spaces communicate with the rest of the house, treat them as part of the house. They should be conditioned and dry.

Ductwork in Slabs

- Ducts leak. Don't put ductwork in slabs or under slabs. Pipes in slabs or under slabs leak allowing soil gases to get into the pipes. You can never fix them. In the summer they condense air.

Sand Over Poly Under Slabs

- Don't put sand or pea gravel over polyethylene under a concrete slab. Always put the concrete in direct contact with the polyethylene. Sand becomes a reservoir. Pea gravel becomes a plenum negating the value of the polyethylene.

Insulated Basement Foundations

- Insulate on the outside if possible. If you insulate on the inside use only rigid semi-permeable foam. Don't insulate with "blanket" insulation or polyethylene covered insulation in stud walls. These walls can only dry to the inside; impermeable materials such as polyethylene prevent drying.
- Don't use fibrous insulation below grade. Garden apartments are the biggest concern. Interior air gets behind the insulation and condenses in the summer time.

Leaky Windows and Doors

- Pan flash all openings. For slab-on-grades depress the slab at door openings.

Interior Vapor Barriers

- No polyethylene interior vapor barriers except in very cold climates (8,000 heating degree days or greater).
- No foil faced reflective insulation on the interior of masonry walls (this is a Florida issue). Use semi-permeable foam on the inside of masonry walls.

Leaky Walls

- Drainage planes under all cladding systems in all climates except with masonry walls (i.e. Florida).
- Two layers of material under all stucco walls (foam and a paper; or two layers of paper).
- Brick veneers need through-wall flashing at bay windows.

Leaky Roofs

- Flash, flash and flash. Inspect, inspect and inspect.

HVAC Leaky Ducts

- Don't put ducts in exterior walls or in vented attics or vented crawl spaces.
- Don't put air handlers in garages. If you ignore our advice and still put them in vented attics or in garages, always test ducts for tightness (i.e. test every installation so that it leaks less than 5 percent of the total air flow provided by the air handler.)

Internally Insulated Ducts (ductboard)

- Don't use ductboard. You can never clean ductboard. It gets dirty and it gets wet and it grows mold.

Window Condensation

- Get rid of single glazed aluminum non-thermally broken windows except in south Florida.
- Use double-glazed vinyl frames. Stay away from wood frames unless clad with aluminum or vinyl.
- Add controlled mechanical ventilation to all houses (outside air duct to return side of air handler).
- Install fans in all bathrooms and toilet rooms and vent them to the exterior.
- Install kitchen range fans that are vented to the exterior. Do not install recirculating range fans.

General

- Use foam sheathings – they don't absorb water. Use borate treated OSB for wall sheathing (not necessary for roof or floor sheathing) – stay away from CCA treated products. For treated plates, use borate treated plates, avoid CCA. Back prime all wood trim. Seal end cuts. Back prime all wood based siding. Get rid of as much exterior wood trim and wood siding as possible. Get rid of wood siding unless you are going to back prime and back vent it. Go to aluminum, molded plastics, fiber cement, etc.

## Mold Testing

Don't test for mold. If you see it or smell it you have it. You don't need to know what species it is to deal with it. You should deal with all mold exactly the same way. Fix the water problem that caused it. Replace the water damaged materials. Clean up the mold, dust and mold spores.

If for some inexplicable reason you decide to test for mold insist that the report contains only the following things:

- Who did the test and when?
- Where were the samples taken and how?
- How were the samples analyzed?
- What the results of the analysis are?

The report should contain absolutely no interpretation.

It should not say the results are good or that the results are bad. It should not say what molds are bad or what molds are good. It should not say anything except what is noted above. There are no standards addressing acceptable levels or unacceptable levels. There are no standards that say this is clean or this is dirty.

How do you know if you have cleaned up well enough? Common sense. You can't see the mold anymore on the surfaces that were originally moldy. Then do the white glove test for everything else. No dust. Clean everything else for dust and everything else will be clean of mold.

## Mold Clean Up

Follow the New York City guidelines for buildings that are occupied or for buildings that are closed in and have carpet but are not yet occupied. Read those guidelines.

For everything else, use soap and water and elbow grease. If the mold doesn't wash off of gypsum board, remove the contaminated area. But, tape plastic over it before you cut it out. For rotted wood, cut it out. For moldy wood, clean it with soap and water and elbow grease. Do not sand it. If you have to sand it to clean it, it's not mold, it's rot. If it's rot, cut it out and get rid of it. Put everything in plastic as you cut it out. Don't carry material throughout the house unless it is bagged. Wood may be permanently stained (discolored) after you've cleaned it. It this bothers you, paint it with latex paint (because latex paint breathes).

We want to avoid spreading mold spores and mold body parts during the clean up. Think of mold spores and mold body parts as ultra-fine drywall dust. Keep the dust down. Keep it contained. Bag the stuff and toss it out. Turn off the furnace or air conditioner before you do anything.

For areas that are more than 10 square feet (approximately) hang some plastic sheets to contain mold and dust in the immediate area. Do this the same way you would do a renovation involving lots of plaster cutting and sanding. Except do it carefully. And wear a mask. And use gloves. Use a N95 mask. You can get it at most home improvement stores.

To be real slick, get a small saw with a vacuum attachment and hang the vacuum out a window. Or get a vacuum with a HEPA filter.

When you clean, vacuum everything with a HEPA filter equipped vacuum. Damp wipe with one time use rags. Get rid of the dust. If you are unsure about the carpet, toss it out and replace it. Put it in a bag first before you drag it through the house.

Do not sand wood in an attempt to remove mold: use soap and water and elbow grease.

Bleach is NOT recommended as part of the clean-up. Why? Remember, clean-up means mold removal. To remove the mold, it is not necessary to kill the mold. Bleach is an irritant to eyes, skin and the respiratory tract (nose, throat and lungs).

Develop a policy and train your people. The policy should have a couple of components:

- How to handle mold during construction before a house is closed in.
- How to handle mold during construction after a house is closed in but before interior finishes such as carpet are installed.
- How to handle mold during construction after a house has interior finishes such as carpet but before it is occupied.
- How to handle mold after a house is occupied.
- How to respond to customers concerns and questions about mold.

## References


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# Mold Exposure During Pregnancy.

There are many anecdotal accounts linking mold exposure at work or home during pregnancy to birth defects and miscarriage, but there are not yet any published health studies on that likely link between mold exposure and pregnancy problems. "The seeds of allergy are actually sown during pregnancy. Atopic dermatitis, asthma, and other atopic conditions often get their start while an individual is still in uterus," reported John O. Warner, MD, Professor of Child Health, School of Medicine, University of Southampton, Southampton, United Kingdom It is now becoming increasingly evident that the development of atopic disease is influenced by a combination of both inherited genetic factors and environmental exposures [such as exposure to mold]. The word "dermatitis" means inflammation of the skin.

"Atopic" refers to a group of diseases where there is often an inherited tendency to develop other allergic conditions, such as asthma and hay fever. In atopic dermatitis [known popularly as eczema], the skin becomes extremely itchy. Scratching leads to redness, swelling, cracking, "weeping" clear fluid, and finally, crusting and scaling. In most cases, there are periods of time when the disease is worse (called exacerbations or flares) followed by periods when the skin improves or clears up entirely (called remissions). Atopic dermatitis is very common. It affects males and females and accounts for 10 to 20 percent of all visits to dermatologists (doctors who specialize in the care and treatment of skin diseases). Although atopic dermatitis may occur at any age, it most often begins in infancy and childhood. Scientists estimate that 65 percent of patients develop symptoms in the first year of life, and 90 percent develop symptoms before the age of 5. Onset after age 30 is less common and is often due to exposure of the skin to harsh or wet conditions. Atopic dermatitis is a common cause of workplace disability. People who live in cities and in dry climates appear more likely to develop this condition.

"Recent studies have confirmed what scientists have suspected for years: that asthma is an immune system reaction to dust, pollution and other allergens [e.g., airborne mold spores] in the environment, which trigger spasms and tightening of the airways of some people who also have a genetic predisposition. Now they're zeroing in on the genetic vulnerability. The new thinking is that asthma isn't simply a matter of having the wrong genes. Instead, at some point in early childhood, or possibly in the womb, an event takes place that turns a person into a lifetime asthmatic. Scientists think the fetus or infant is somehow exposed to a critical dose of pollutants that cause the immune system to overreact, permanently narrowing the airways and making them more sensitive to irritants. It might be possible to inoculate children against the condition before this even occurs, preventing asthma entirely."---from "Waiting to Inhale," ***NEWSWEEK***, March 14, 2005.

# <u>Diagnostic Checklist</u>

- **When did the symptoms or complaint begin?**
- **Does symptoms or complaint exist all the time, or does it come and go? Is it associated with times of day, days of week, or seasons of the year?**
- **If so, are you usually in a particular place at those times?**
- **Does the problem abate or cease, either immediately or gradually, when you leave there? Does it recur when you return?**
- **What is your work? Have you recently changed employers or assignments, or has your employer recently changed location?**
- **If not, has the place where you have been redecorated or refurnished, or have you recently started working with new or different materials or equipment? (these may include pesticides, cleaning products, craft supplies)**
- **What is the smoking policy at your workplace? Are you exposed to environmental tobacco smoke at work, school, home, etc?**
- **Describe your work area.**
- **Have you recently changed your place or residence?**
- **If not, have you made any recent changes in, or additions to, your home?**
- **Have you, or has anyone else in your family, recently started a new hobby or other activity?**
- **Have you recently acquired a new pet?**
- **Does anyone else in your home have a similar problem? How about anyone with whom you work? (this may suggest either a common source or a communicable condition)**

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# Farmer's Lung: Causes and Symptoms of Mold and Dust Induced Respiratory Illness

*by Robert Grisso, Susan Gay, Glen Hetzel, and Bruce Stone**

Farmers account for more than 30 percent of adults disabled by respiratory illness. Yet, a large percentage of farmers are nonsmokers. If smoking is not to blame for these ailments, then what is? The answer is farmer's lung.

Farmer's lung is one of the more serious respiratory hazards to which farmers are exposed. Unfortunately, the number of farmers affected by farmer's lung has been increasing in recent years. This is likely the result of a growing awareness among farmers about their health and a subsequent increase in the frequency of doctor visits by farmers.

## What Is Farmer's Lung?

Farmer's lung is a noninfectious allergic disease that is caused by inhaling **mold spores** in the dust from moldy hay, straw, or grain. This debilitating disease disrupts the normal function of the lungs, where oxygen enters and carbon dioxide exits the bloodstream. Many farmers are forced to leave the occupation due to the physical limitations caused by farmer's lung.

## What Are Mold Spores and Why Are They so Dangerous?

Just as plants produce seeds for reproduction, molds produce tiny spores. These spores are less than 4 microns in size – so small that as many as 250,000 spores can fit on the head of a pin. On the farm, molds tend to grow in stored hay, grain, or silage when moisture content is high (30 percent) and storage areas are poorly ventilated.

Mold spores attach themselves to airborne dust particles when farmers move or work with hay, grain, or silage materials in which mold spores have grown. As a result, farmers inhale both dust particles and mold spores. In fact, a farmer can inhale up to 750,000 of these spores per minute.

The body has natural defense mechanisms (such as coughing and sneezing) that help prevent dust and other particles from entering the lungs. However, mold spores can often bypass these defenses because of their small size and overwhelming numbers.

Mold spores move into, accumulate, and settle into the lower lungs. Since most gas exchange takes place in the lower lungs, toxins produced by the spores travel through the bloodstream with the oxygen. The body's

**You need to know about respiratory illnesses if you are engaged in the following tasks:**

- working in dusty fields or buildings
- handling hay
- working in silos
- feeding or working with feedstuffs
- working in corn silage
- uncapping silos
- cleaning silos or grain bins
- working around animal feathers, hair, fur, or droppings
- working around fish meal
- applying agricultural chemicals (e.g., fertilizers and pesticides)
- working with toxic paints or solvents

*Extension Engineer, Extension Engineer, and Retired Farm Safety Specialist, Biological Systems Engineering, Virginia Tech, and Safety Manager, Virginia Farm Bureau Insurance Services, Richmond, respectively.

reaction to the toxins causes permanent scarring of the lung tissue, which affects the lungs' ability to transfer oxygen into the bloodstream. Each exposure to mold spores increases the damage. The body's last defense against these spores is to develop an allergic reaction that causes cold- or pneumonia-like symptoms.

## Symptoms of Farmer's Lung and State of Illness

Farmers will develop specific symptoms of farmer's lung based on the amount of dust and spores to which they have been exposed or the intensity of their body's reaction to the dust and spores. Farmers are also likely to develop an increased sensitivity to mold exposure over time and will have more severe reactions with lighter exposures. In all cases, each additional exposure will aggravate the problem.

The symptoms of farmer's lung may be most severe for a 12 to 48 hour period after exposure to mold spores. However, the symptoms may remain for as long as two weeks. Acute farmer's lung is the short-term form of the disease. Farmers typically develop chronic farmer's lung due to repeated exposure to mold spores over time, usually because they continue to ignore the symptoms of acute farmer's lung. However, it is possible to develop chronic farmer's lung even after one acute attack.

Delaying medical treatment for farmer's lung often worsens the situation. Permanent damage has often occurred by the time a farmer sees a doctor. In some cases scar tissue (pulmonary fibrosis) has already developed, which further interferes with normal lung function.

## How to Tell if You have Farmer's Lung

Do not self-diagnose. Always check with your doctor if you suspect you have farmer's lung. Contact your doctor immediately, if you have any of the following symptoms:

- sudden illness that develops a few hours after you handled moldy crop material
- chronic cough
- general feeling of tiredness or depression

## Medical Treatment

Your doctor may not be familiar with farmer's lung and may mistake your symptoms for a cold, asthma, flu, or even pneumonia. Therefore, you must work with your doctor so he can make a correct diagnosis. Make sure to tell your doctor that you are a farmer and whether you have been exposed to moldy crop material. Also, be sure to inform him of the types of chemicals and/or dusts to which you are exposed.

During your visit, the doctor may do one or more of the following to confirm or disprove a diagnosis:

- take a blood test
- take a chest x-ray

### Acute State

This condition usually begins four to eight hours after exposure to mold spores. Most farmers ignore the symptoms because they are so similar to those of the common cold.

#### Typical Symptoms:

- severe shortness of breath with any exertion
- headache
- irritating cough

### Subacute State

This condition is more serious because the symptoms will be more severe and will last longer even with no further exposure to mold spores.

#### Typical Symptoms:

- progressively increasing severe shortness of breath with any exertion
- chronic coughing
- physical weakness
- occasional fever and sweating at night
- appetite depression
- general aches and pains

### Chronic State

This condition is the most serious because of its gradual onset and its long-lasting debilitation. In the chronic state, the disease becomes irreversible.

#### Typical Symptoms:

- progressively increasing severe shortness of breath with any exertion
- chronic coughing
- physical weakness
- occasional fever and sweating at night
- appetite depression
- general aches and pains

- administer a breathing capacity test
- administer an inhalation challenge
- examine lung tissue
- perform an immunological investigation
- perform a lung function test
- review your clinical history

Farmer's lung *can be controlled* in many ways. For example, your doctor may write a prescription for medication that relieves the symptoms of farmer's lung. Unfortunately, farmer's lung **cannot** be cured.

## How to Prevent or Control Farmer's Lung

Farmers can control or even minimize the possibility of getting farmer's lung by complying to the following preventative measures:

- identify contaminants in the work environment
- minimize the amount and type of contaminants in the work environment
- avoid exposure to contaminants and mold spores and dust from decayed grains and forages
- limit exposure to all contaminants
- operate within a controlled environment whenever possible (e.g., cab, control room, etc.)
- use mechanical controls to remove air contaminants (e.g., fans, exhaust blowers, filters etc.)
- maximize ventilation in dusty areas
- move work outside whenever possible
- avoid dusty work in confined areas
- wear respirators, masks, or other protective equipment

If you decide to use some form of respiratory protection, make sure to select the appropriate device for the task. For example, most farmers wear dust masks to protect themselves from farmer's lung. However, these will not work if you are exposed to extremely high levels of mold spores or you already have developed farmer's lung.

If you have farmer's lung, talk to your doctor about the type of equipment that will offer the most protection because every exposure increases the risk of serious permanent lung damage. Furthermore, make sure the personal protection equipment fits well and is properly maintained. For more information about respiratory equipment, see your local Extension office or *Respiratory Protection in Agriculture*, Virginia Cooperative Extension publication 442-601.

## More Information about Farmer's Lung

The chances of acquiring farmer's lung are greatest in late winter and early spring. This is mainly because farmers feed hay and grain materials, which are likely to contain mold spores. Farmers also tend to feed baled hay inside during the colder months. This increases the likelihood of inhaling mold spores because they are more concentrated in a confined space such as a barn.

Mold spore inhalation may be a problem when you are cleaning out grain bins or opening new silos. Mold spores may be released from the top layer of silage.

### Management to Prevent Mold Spore Growth

- use mold inhibitors
- bale hay, ensile crops, and harvest and store grain at recommended moisture contents
- dry grain properly before storage
- properly ventilate storage buildings
- adequately ventilate crops to cool them down
- always use a plastic sheet to cap open silos (not plant material) holding down the edges with heavy weights (e.g., tires)

### When You Must Work with Moldy Material

- wet down feed before transferring it to minimize dust
- convert to mechanical or automated feeding or feed-handling systems
- wet down the top of the silo before uncapping ensiled material
- use some wetting techniques when cleaning out grain bins or other dusty areas
- use respiratory protection when handling moldy or dusty materials.

## Additional Reading Material

Grisso, R.D., S. Gay, G. Hetzel, and B. Stone. 2004. *Respiratory Protection in Agriculture*. Virginia Cooperative Extension publication 442-601, Virginia Tech, Blacksburg, Va.

## Acknowledgements

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While testing has shown that a large percentage of airborne spores are non-viable, it's very important to recognize that spores retain their ability to cause allergic reactions and health problems regardless of their ability to reproduce.

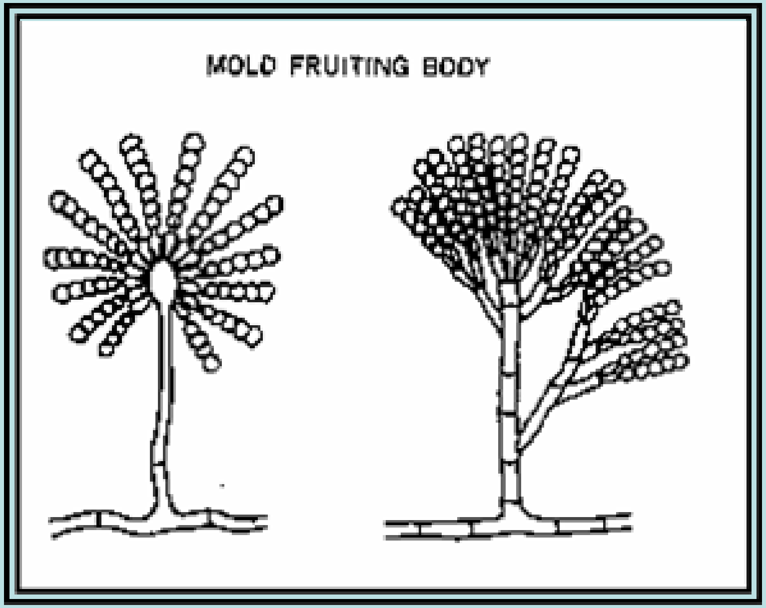
**In other words, they can still make you sick even if dead or of inability to reproduce.**

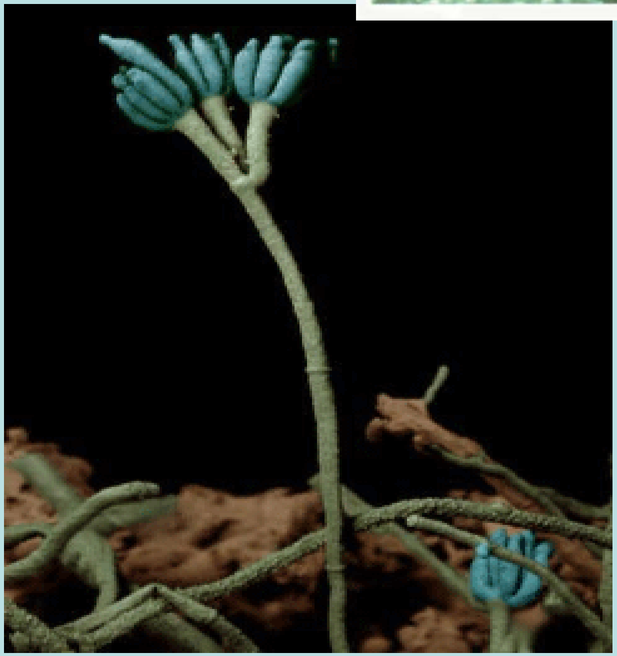
# Health Effects of Mold Exposure

- Allergies
- Asthma
- Irritation
- Infection

# Mold parts that may cause symptoms

1. **Spores** (viable or non-viable)
2. **Roots**
3. **Mycotoxins** (odorless poisons)




ALLERGIES
ASTHMA
MOLD SPORES

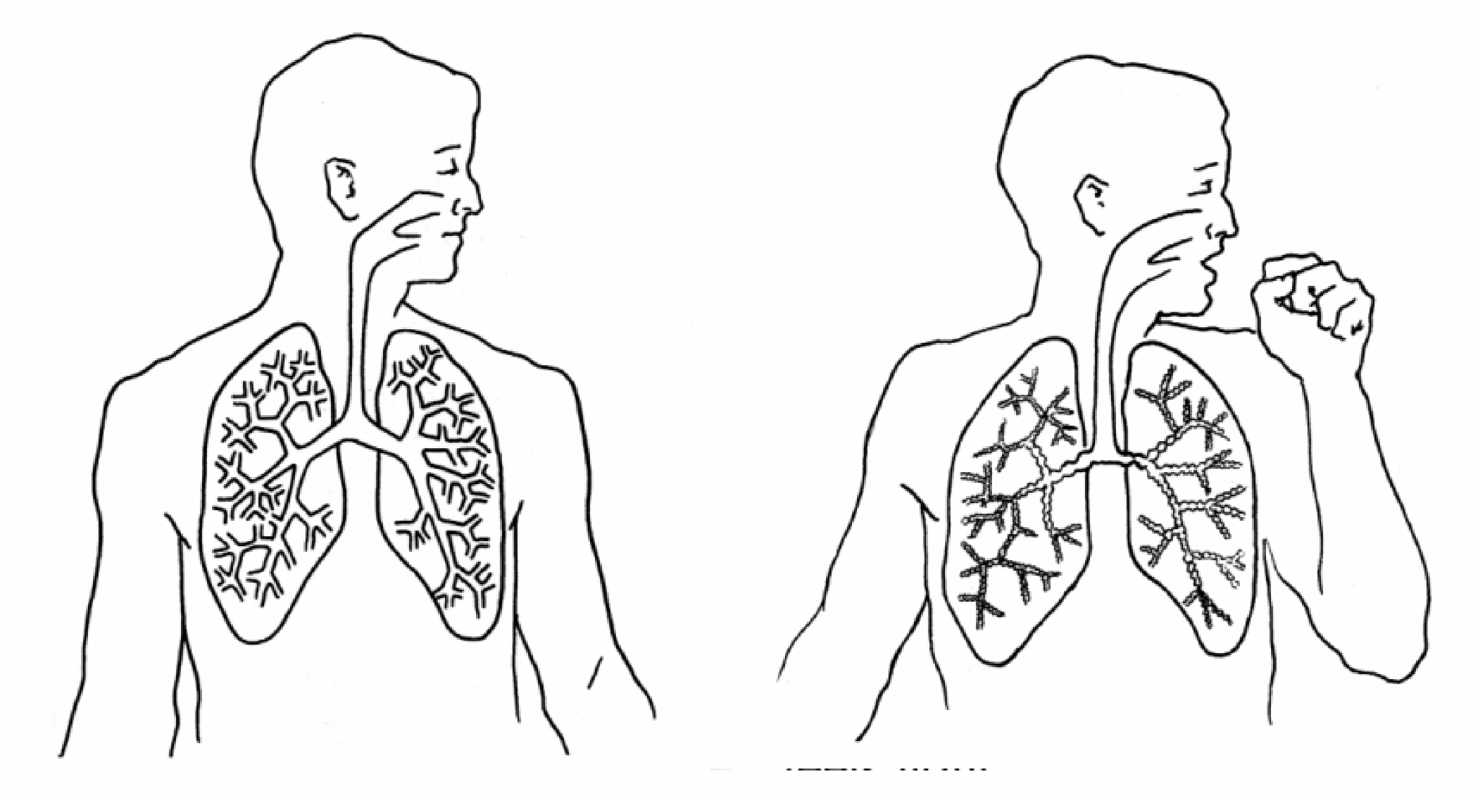
# Risk Factors
# for Development of Allergies and Asthma

- **Genetic characteristics**
- **Environmental exposures**
- **Contributing factors**

# What Is Asthma?

- **A chronic disease of the airways that may cause**
  - **Wheezing**
  - **Breathlessness**
  - **Chest tightness**
  - **Nighttime or early morning coughing**

# Pathology of Asthma

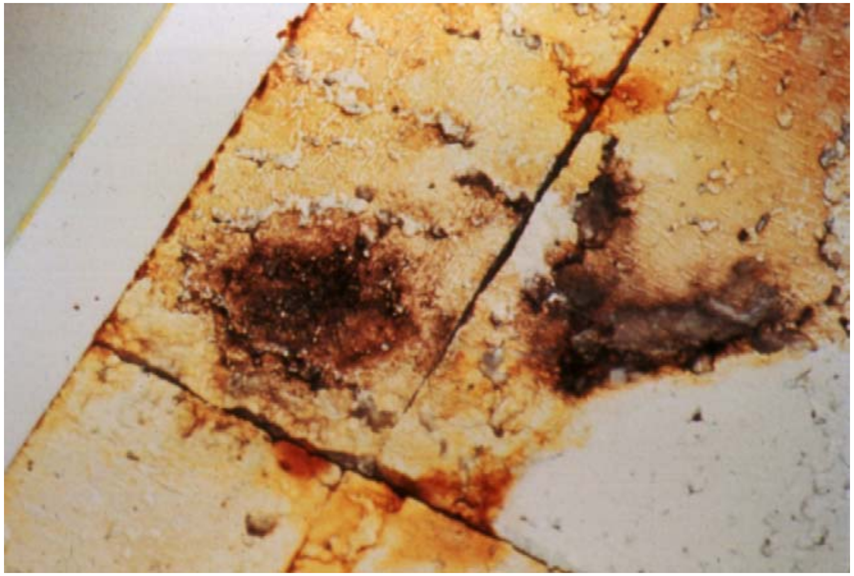


**Normal Lungs** **Asthma**

# Diagnosing Asthma: Patient Checklist

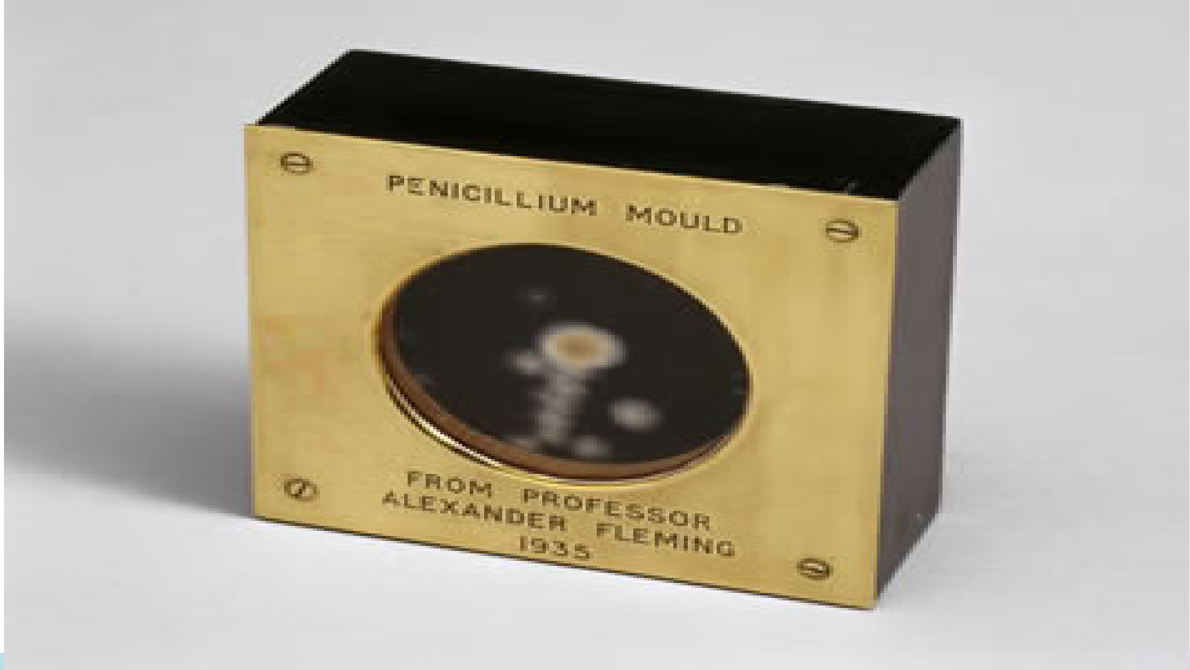
- **Troublesome cough, particularly at night**
- **Awakened by coughing**
- **Coughing or wheezing after physical activity**
- **Breathing problems during particular seasons**
- **Coughing, wheezing, or chest tightness after exposure to allergens**
- **Colds that last more than 10 days**
- **Relief when medication is used**

# Reducing Exposure to Mold



**Eliminating mold may help control asthma exacerbations**

# MVOC's and Irritation Symptoms


This sample marks the transformation of penicillin from an interesting phenomenon to a potential drug.

Discovering in 1928 that a strain of penicillium mould exuded a substance which killed certain bacteria, Alexander Fleming did not immediately think of it as a medicine. However, when the German firm IG Farben announced the first general-purpose bacteria-killing drug, Prontosil, Fleming changed his views. He gave this sample of mould to a colleague at St Mary's Hospital after a conversation about Prontosil and its possible application to ward off infection.

Penicillin was eventually isolated in Oxford in 1939, and from 1942 became an important drug.

Economically important fungi

Penicillium - produces penicillin - the first discovered antibiotic

Edible fungi

Aspergillus niger — citric acid

Saccharomyces cerevisiae — makes bread and wine, protein supplement

Trichoderma — cellulase - makes jeans soft

Enteromorphaga — kills gypsy moth caterpillars

Candida oleophila — protects fruit from harmful molds

Phytophthora infestans — potato blight

Cryphonectria parasitica — chestnut tree blight

Ceratocystis ulmi — dutch elm disease

# Size Matters

Dimensions of mold spores are typically expressed in micrometers or **microns**(millionths of a meter)

Most range from 1-100 microns
Many between 2- 20 microns

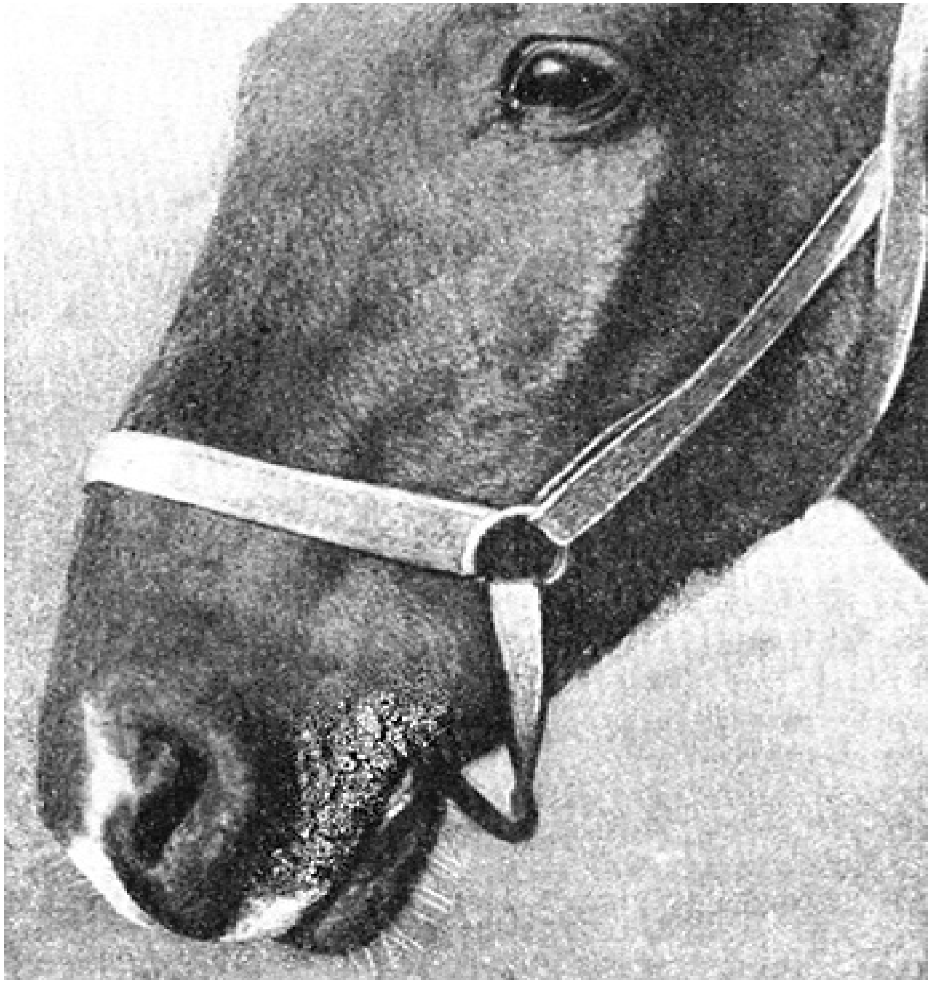
(People with good vision can see only 80-100 microns unaided.)

*Aspergillus* **in a normal child**

This figure, drawn in 1890, illustrates the appearances of the trachea and main bronchi at autopsy in a 3 year old child. She had little else wrong at autopsy other than a minor degree of tuberculosis. She is the first recorded case of *Aspergillus* tracheobronchitis in the literature and illustrates well that this disease can affect previously well non-inimmunocompromised people. The full case is reported in Wheaton SW.

Case primarily of tubercle, in which a fungus (*Aspergillus*) grew in the bronchi and lung, simulating actinomycosis. Transactions of the Pathological Society of London 1890; 41:34-37.


©Gary Munkvold



Hyperplastic dermatitis on a horse four days after feeding on straw infested with *S. chartarum*. Notice the scaly appearance of the upper lip area. Photograph reprinted from Sarkisov, A. Kh. 1954. Mikotoksikozi (Gribkovye otravleniia). Moscow. 216 pp.

# Toxicology of Mold
# Small Group Activity

1. Toxicology is the study of what?

2. What are mycotoxins?

3. What are four health effects or symptoms of microbial growth?

4. What are the Routes of Entry of Mold?

5. What is the difference between Viable and Non-Viable?

6. Can dead mold spores still give off mycotoxins?

7. Who is most susceptible to effects of mold?

8. What is the difference between Acute and Chronic health effects?

# GLOSSARY

Absorption- Taking in through the skin, as in a gas, liquid, etc.

Acute Exposure- A one-time or infrequent exposure to a relatively high concentration of a hazardous substance.

Allergens- A substance, such as pollen, that causes an allergy.

Aspergillus sp.- A type of mold spore.

Biological Warfare- The use of disease-producing microorganisms, toxic biological products, or organic biocides to cause death or injury to humans, animals, or plants.

Carcinogenic- A cancer-causing substance or agent.

Cerebral Aspergillosis- Bleeding of the brain caused by Aspergillus.

Chronic Exposure- Repeated or prolonged exposure to a substance.

Endocarditis- Inflammation of the lining of heart

Immune-suppressive- Suppresses the immune system

Immunosuppressed- Suppression of the immune response, as by drugs or radiation, in order to prevent the rejection of grafts or transplants or to control autoimmune diseases. Also called immunodepression.

Ingestion- To take into the body by the mouth for digestion or absorption.

Inhalation- The act or an instance of inhaling.

Leukemia- Any of various acute or chronic neoplastic diseases of the bone marrow.

# GLOSSARY
## (For Toxicology)

Lymphatic system- The interconnected system of spaces and vessels between body tissues and organs by which lymph circulates throughout the body.

Meningitis- Inflammation of the meninges of the brain and the spinal cord.

Metabolism- The chemical processes occurring within a living cell or organism that are necessary for the maintenance of life.

Microbial growth- A minute life form; a microorganism.

Microbial Volatile Organic Compounds (MVOCs)- Gaseous waste by-product produced during fungal metabolism.
Distinct odors: earthy, musty, weedy, nutty.

Microns- Millionths of a meter

Mold- Any of various fungi that often cause disintegration of organic matter.

Mycotoxins- Poisons used by mold to defend itself and compete for access to a water source.

Myocarditis- Infection of the heart

Nephrotoxic- toxic to kidneys

Non-viable- Spores that can never grow into mold phase.
(Roughly 75% of all spores in any given area)

Pathological- Relating to or caused by disease.

Penicillium marneffei- A species of the mold Penicillium.

# GLOSSARY
## (For Toxicology)

Penicillium spp- Any of various characteristically bluish-green fungi of the genus *Penicillium* that grow as molds on decaying fruits and ripening cheese and are used in the production of penicillin

PPE- Personal Protective Equipment

Pulmonary aspergillosis- Aspergillosis affecting the lungs

Sick Building Syndrome- An illness affecting workers in office buildings, characterized by skin irritations, headache, and respiratory problems, and thought to be caused by indoor pollutants, microorganisms, or inadequate ventilation. Also called building sickness.

Sinusitis- Inflammation of the sinuses or a sinus, especially in the nasal region.

Spores- A small, usually single-celled reproductive body that is capable of growing into a new organism, produced especially by certain bacteria, fungi, algae, and nonflowering plants.

Stachybotrys sp.- A deuteromycetous fungal genus including one species which forms a toxin in moldy hay that may cause a serious illness.

Synergism- When an exposure involves two toxic substances, the combined effect of the substances is much more harmful than the expected effect of adding two together.

Toxigenic- Produces poisons

Toxicology- The study of the effects of hazardous substances on the body.


# GLOSSARY
## (For Toxicology)

Viable- Spores that have the ability to germinate given the right conditions. (Roughly 25% of all spores in any given area.)

Yellow Rain- (Suspected attacks in Southeast Asia in the 1970s) A powdery, poisonous, yellow substance reported as dropping from the air in southeast Asia and found to be the excrement of wild honeybees contaminated by a fungal toxin.

# Tab 4

| EVENT | HOW MUCH OF A ISSUE | | | | HOW MUCH OF RISK | | | | | PREPAREDNESS | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HIGH | MED | LOW | NONE | LIFE THREAT | HEALTH/ SAFETY | HIGH DISRUP-TION | MOD DISRUP-TION | LOW DISRUP-TION | POOR | FAIR | GOOD | |
| SCORE | 3 | 2 | 1 | 0 | 5 | 4 | 3 | 2 | 1 | 3 | 2 | 1 | |
| Drainage outside | | | | | | | | | | | | | |
| Drain's inside | | | | | | | | | | | | | |
| Windows condition | | | | | | | | | | | | | |
| Roofing condition | | | | | | | | | | | | | |
| Gutters | | | | | | | | | | | | | |
| Condition of Walls | | | | | | | | | | | | | |
| Floors | | | | | | | | | | | | | |
| Ventilation | | | | | | | | | | | | | |
| Cleanliness | | | | | | | | | | | | | |
| Crawl space | | | | | | | | | | | | | |
| Standing water outside | | | | | | | | | | | | | |
| Dampness | | | | | | | | | | | | | |
| Basement walls | | | | | | | | | | | | | |
| Caulks | | | | | | | | | | | | | |
| Chemical monitoring | | | | | | | | | | | | | |
| Combustion appliances | | | | | | | | | | | | | |
| Structural Damage | | | | | | | | | | | | | |
| smells, Mold, mildew, chemical | | | | | | | | | | | | | |
| Outdoor air intakes | | | | | | | | | | | | | |
| Building history (examples: age) | | | | | | | | | | | | | |

| EVENT | HOW MUCH OF A ISSUE | | | | HOW MUCH OF RISK | | | | | PREPAREDNESS | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HIGH | MED | LOW | NONE | LIFE THREAT | HEALTH/ SAFETY | HIGH DISRUP-TION | MOD DISRUP-TION | LOW DISRUP-TION | POOR | FAIR | GOOD | |
| SCORE | 3 | 2 | 1 | 0 | 5 | 4 | 2 | 2 | 1 | 3 | 2 | 1 | |
| Visible water stains | | | | | | | | | | | | | |
| Visible growth | | | | | | | | | | | | | |
| Moisture readings | | | | | | | | | | | | | |
| Photos of damaged area | | | | | | | | | | | | | |
| Source of Moisture (identify) | | | | | | | | | | | | | |
| Occupant illness/complaints | | | | | | | | | | | | | |
| construction, (remodeling, additions) | | | | | | | | | | | | | |
| Maintenance schedule and when last (pm) performed | | | | | | | | | | | | | |
| Does the facility have a disaster plan? | | | | | | | | | | | | | |
| Combustion gas or fuel odors ever detected? | | | | | | | | | | | | | |
| soft, slippery or unstable ground both inside and out | | | | | | | | | | | | | |

| EVENT | HOW MUCH OF A ISSUE | | | | HOW MUCH OF RISK | | | | | PREPAREDNESS | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HIGH | MED | LOW | NONE | LIFE THREAT | HEALTH/ SAFETY | HIGH DISRUP-TION | MOD DISRUP-TION | LOW DISRUP-TION | POOR | FAIR | GOOD | |
| **SCORE** | **3** | **2** | **1** | **0** | **5** | **4** | **3** | **2** | **1** | **3** | **2** | **1** | |
| Sharp objects | | | | | | | | | | | | | |
| Site inspection | | | | | | | | | | | | | |
| obstacles to entry or exit points | | | | | | | | | | | | | |
| If the building was built before 1980, is paint inside or outside free from peeling or flaking? [lead paint hazard] | | | | | | | | | | | | | |
| Heat Stress | | | | | | | | | | | | | |
| chemical exposure | | | | | | | | | | | | | |
| Animals (snakes, birds) | | | | | | | | | | | | | |
| The right PPE | | | | | | | | | | | | | |
| The right APR | | | | | | | | | | | | | |
| Noise | | | | | | | | | | | | | |
| Electricity | | | | | | | | | | | | | |
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# Mold Assessment Checklist

Based on survey results, the items below indicate moisture and water incursion problems leading to mold growth. This survey is based on guidelines established by the US EPA, NYC Department of Health and Family Services of the Minnesota Department of Health.

| BUILDING NAME: | DATE OF SURVEY: |
|---|---|
| ADDRESS: | |

***SITE CHARACTERISTICS***

1. Soil type (e.g. clay, sand, gravel, loam)
   ____________________________________
2. Soil drainage characteristics
   ____________________________________
3. Depth to water table (feet)
   ____________________________________
4. Landscaping: (trees, shrubs, gardens against building)
   ____________________________________
5. Building distance to:
   - Swamps ____________________
   - Dry-cleaners/laundry ________
   - Compost ____________________
   - Others ____________________
6. Explain site drainage
   ____________________________________
   ____________________________________
   ____________________________________

***EXTERIOR***

1. Type of school
   - ☐ One story
   - ☐ Multi-story
   - ☐ Portable (modular)
2. Year of construction (approximately)
   ____________________________________
3. Size (sq. ft.) ______________________
4. Type of siding
   - ☐ Brick
   - ☐ Concrete
   - ☐ Vinyl
   - ☐ Stone
   - ☐ Wood
   - ☐ Stucco
   - ☐ Other
5. Type of windows/doors
   - ☐ Wood
   - ☐ Aluminum
   - ☐ Steel
   - ☐ Vinyl
   - ☐ Other

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*EXTERIOR (continued)*

6. Condition of windows/doors
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Leaks
   - ☐ Damaged
   - ☐ Corroded
   - ☐ Rot
   - ☐ Blistering paint
   - ☐ Visible mold/mildew
   - ☐ Warping

7. Roofing condition
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Leaks
   - ☐ Damaged
   - ☐ Corroded flashing
   - ☐ Rot
   - ☐ Visible mold/mildew
   - ☐ Pooling water

8. Gutters drains water > 5 feet from building
   - ☐ Yes
   - ☐ No

*INTERIOR*

1. Problem room:
   - ☐ Classroom number ________________
   - ☐ Office ____________________________
   - ☐ Cafeteria _________________________
   - ☐ Auditorium _______________________
   - ☐ Other ____________________________

2. Types of walls (check all that apply)
   - ☐ Concrete block/cinder block
   - ☐ Plaster with lathe
   - ☐ Sheetrock/gypsum
   - ☐ Paneling
   - ☐ Wall paper
   - ☐ Vinyl
   - ☐ Wood
   - ☐ Other ______________________________

*INTERIOR (continued)*

3. Condition of walls (check all that apply)
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Leaks
   - ☐ Condensation
   - ☐ Visible mold/mildew
   - ☐ Rot
   - ☐ Blistering paint
   - ☐ Damaging/corroded
   - ☐ Warping

4. Types of floors
   - ☐ Wood
   - ☐ Tile
   - ☐ Vinyl sheet goods
   - ☐ Carpet
   - ☐ Concrete
   - ☐ Other ___________________

5. Unit ventilator (if applicable)
   - ☐ No signs of moisture or mold growth
   - ☐ Deteriorating pipe insulation/possible condensation
   - ☐ Chilling pipe insulation
   - ☐ Hot water/steam pipe insulation
   - ☐ Condensate drain pain drainage problem
   - ☐ Dirty coils
   - ☐ Mold growth on coils
   - ☐ Dirty filter

6. Cleanliness of area
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Comments ________________

     ________________________________

*INTERIOR (continued)*

7. Storage areas
   - ☐ Clutter
   - ☐ Boxes/equipment
   - ☐ Other comments/observations

   ____________________________________

   ____________________________________

8. Signs of Pests:
   - ☐ Cockroaches
   - ☐ Mice/rats
   - ☐ Others (i.e. bird droppings etc.)

   ____________________________________

   ____________________________________

*BASEMENT*

1. Basement:
   - ☐ Yes
   - ☐ No

2. Crawl space:
   - ☐ Yes
   - ☐ No
3. Type of basement/crawl space floor
   - ☐ Poured concrete
   - ☐ Carpet
   - ☐ Dirt
   - ☐ Vinyl tile
   - ☐ Block
   - ☐ Stone
   - ☐ Other ________________________

   ____________________________________

4. Sump pump:
   - ☐ Yes
   - ☐ No

5. Damp:
   - ☐ Yes
   - ☐ No

6. Standing water:
   - ☐ Yes
   - ☐ No

*BASEMENT (continued)*

7. Cracks in walls:
   - ☐ Yes
   - ☐ No

8. Cracks in floor:
   - ☐ Yes
   - ☐ No
   - ☐
9. In floor drain/pump:
   - ☐ Yes
   - ☐ No

10. Dehumidifier:
    - ☐ Yes
    - ☐ No

11. Basement walls (check all that apply)
    - ☐ Plaster
    - ☐ Paneling
    - ☐ Sheetrock
    - ☐ Poured concrete
    - ☐ Stone
    - ☐ Concrete blocks

12. Condition of basement walls (check all that apply)
    - ☐ Good
    - ☐ Fair
    - ☐ Poor
    - ☐ Damaged
    - ☐ Visible mold/mildew
    - ☐ Rot
    - ☐ Leaks
    - ☐ Corroded
    - ☐ Blistering paint
    - ☐ Staining/efflorescence
    - ☐ Warping

*HVAC*

1. Central or Primary System
   - ☐ Gas
   - ☐ Oil
   - ☐ Electric

2. Distribution System
   - ☐ Forced air
   - ☐ Electric radiant
   - ☐ Gravity
   - ☐ Hydronic
   - ☐ Other ______________________
   
   ________________________________

3. Cooling system
   - ☐ Central air
   - ☐ Windows
   - ☐ Window air conditioner
   - ☐ None
   - ☐ Other ______________________
   
   ________________________________

4. Hot water heater
   - ☐ Electric
   - ☐ Part of boiler gas
   - ☐ Gravity vented
   - ☐ Powered vented

5. Asbestos:
   - ☐ Yes
   - ☐ No
   
   If yes, condition:
   - ☐ Good
   - ☐ Fair
   - ☐ Poor

6. Friable?
   - ☐ Yes
   - ☐ No

7. Humidifier:
   - ☐ Yes
   - ☐ No

*HVAC (continued)*

8. Water supply
   - ☐ Private well
   - ☐ Public water system

9. Sewage
   - ☐ City
   - ☐ Septic
   - ☐ Mound

10. Cooking appliances
    *Type:*
    - ☐ Gas
    - ☐ Electric
    
    *Ventilation:*
    - ☐ Recirculation
    - ☐ Outside exhaust

OTHER

1. Bathroom
   *Mechanical ventilation:*
   - ☐ Yes
   - ☐ No
   
   *Mechanical ventilation wired to:*
   - ☐ Humidistat
   - ☐ Individual switch
   
   *Condition/ function of bathroom ventilation:*
   - ☐ Good
   - ☐ Fair
   - ☐ Poor
   - ☐ Damaged
   - ☐ Visible mold/mildew/dst

*ADDITIONAL COMMENTS*

________________________________________

________________________________________

________________________________________

________________________________________

*ENVIRONMENTAL SAMPLING MEASUREMENTS*

| SAMPLING/ MEASUREMENTS | Basement | Cafeteria | Halls | Office | Auditorium | Classroom | Other |
|---|---|---|---|---|---|---|---|
| Relative Humidity | | | | | | | |
| Temperature | | | | | | | |
| Carbon Dioxide | | | | | | | |
| Carbon Monoxide | | | | | | | |
| Ventilation Effectiveness | | | | | | | |
| Moisture Meter Readings | | | | | | | |
| Other: | | | | | | | |

| Notes: |
|---|
| |

*INSPECTION FINDINGS*

| OBSERVATIONS | Basement | Cafeteria | Halls | Office | Auditorium | Classroom | Exterior | Other |
|---|---|---|---|---|---|---|---|---|
| Visible Mold | | | | | | | | |
| Musty Smell | | | | | | | | |
| Animal/Fecal Odor | | | | | | | | |
| Plumbing Leaks | | | | | | | | |
| Condensation on Plumbing, Windows, Etc. | | | | | | | | |
| Chemical Storage | | | | | | | | |
| Cleanliness | | | | | | | | |
| Water Stains | | | | | | | | |
| Stains (Other) | | | | | | | | |

*General housekeeping rating guidelines listed below.  This is subjective and based on inspector's interpretation.

Good:  well maintained, items in normal lived in appearance
Fair:  maintained, some disarray, the day's dishes in sink, clothes scatter in bedrooms, unswept floors
Poor:  several days dishes in sink, soiled laundry scattered over floor, presence of animal excrement

*NOTES/RECOMMNDATIONS:*

# Walkthrough Inspection Checklist

**This checklist is to aid during an IAQ Walkthrough of the school. The checklist includes considerations both inside and outside the school building:**

**Instructions:**

1. Read the *IAQ Backgrounder* and the information in this section.
2. For each area use the checklist hints to guide your observations. Note any obvious potential problems, including description and location. Use additional paper if necessary.
3. Return the checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

The Walkthrough Inspection is not intended to be an intensive, detailed, or costly inspection, but rather a quick overview of the conditions that affect the quality of air within your school. You may wish to have someone who is familiar with the operation of the building, such as a facility operator or custodian, assist you during the inspection. The Walkthrough Inspection is part of the IAQ Management Plan. While some schools wait until the initial parts of the Plan have been completed, some schools have had success "jump-starting" their program by beginning with a quick walkthrough and taking immediate action where the potential problems are obvious and easy to correct.

During your walkthrough inspection, you can learn a lot by using your sense of sight, smell, feeling, and hearing to gain information on factors which affect indoor air quality. You may even be able to make immediate corrections!

**Observe** the general level of cleanliness in classrooms and mechanical rooms. Look for pollutant sources such as mold, improperly stored chemicals, or excessively dirty air filters and ducts. Look for signs of water damage which may point to an underlying problem which increases the chance of biological contaminants. And look for blocked airflows such as those caused by books or papers on top of unit ventilators or plywood covering outdoor air intakes.

**Smell** for unique or objectionable odors—including mold, mildew, and "chemical" smells—as you move from room to room. Note any potential sources of these odors.

**Feel** for uncomfortable air temperatures, drafts, and high or low humidity, and feel for air flowing into and out of grilles and air vents.

**Listen** to the concerns of school occupants regarding IAQ. Do they provide clues to problems such as using their own pest spray to control pests, or turning off the unit ventilator because it is too noisy during class-time? Do you hear unusual equipment noises which may indicate potential problems, and do you hear air blowing out of supply vents?

Do a walkthrough inspection in all special-use areas, such as the cafeteria, art rooms, and industrial arts areas.

## EXTERIOR INSPECTION

Begin the walkthrough inspection outside. You are looking for anything which might impact the air indoors. Considerations include ventilation inlets, outdoor sources of pollution such as vehicle exhaust or pesticides, site drainage, holes in the building shell, and evidence of pests. Use the checklist to guide your inspection, and note any relevant observations on this sheet or on a plan of the school.

### GROUND LEVEL

**Location/Observation**

- Ventilation units on and air flowing into outdoor air intakes? (See Ventilation Checklist for more information.)
- Outdoor air intakes free from blockage or obstruction (boards, leaves, vegetation, snow, etc.)?
- No bird or animal nests or droppings near outdoor air intakes?
- No garbage dumpsters located near doors, windows, or outdoor air intakes?
- No painting, roofing, or maintenance of the exterior of the building in the vicinity of outdoor air intakes?
- No potential sources of air contaminants in the vicinity of the building (chimneys, stacks, industrial plants, exhaust from nearby buildings)?
- No vehicle engines (auto, truck, or bus) exhaust near outdoor air intakes? Vehicles left idling when parked at loading zones or docks?
- No exterior pesticide application?
- Roof downspouts and scuppers drain water away from the building?
- Good site drainage away from building?
- Sprinklers do not water excessively near building, or over-spray onto building or into outdoor air intakes, etc.?
- Clean walk-off mats at every exterior entrance?

## ROOF

**Location/Observation**

- !! **While on the roof, consider performing inspection of HVAC units (use *Ventilation Log*)**
- Roof in good repair?
- Evidence of ponding?
- Ventilation units on and air flowing into outdoor air intakes? (See Ventilation Checklist for more information.)
- Outdoor air intakes open, even at the minimum setting? (See Ventilation Checklist for more information.)
- Bird or animal nests or droppings near outdoor air intakes?
- Plumbing stacks 10 feet away from outdoor air intakes?
- Exhaust fans operating and air flowing out?
- Any exhaust air outlets within 10 feet of outdoor air intakes?

## ATTIC

**Location/Observation**

- Evidence of roof or plumbing leaks?
- Bird or animal nests?

## INTERIOR INSPECTION

Continue the walkthrough inspection inside. You are looking for noticeable temperature & humidity concerns, indications that the ventilation system is functioning, general cleanliness, evidence of pollutant sources including mold and mildew, anything which might impact the air indoors. Use the checklist to guide your inspection, and note any relevant observations on this sheet or on a floor plan of the school.

## GENERAL CONSIDERATIONS IN CLASSROOMS AND OTHER AREAS

Location/Observation

- Are temperature and humidity within acceptable ranges?
- Is air flowing into and out of the room as designed?
- Are supply and exhaust vents free from blockage or obstruction?
- Area free of objectionable odors?
- No signs of mold or mildew growth?
- No signs of unresolved or ongoing water damage?
- Is the area generally clean and dust under control?
- Area free of evidence of pests or obvious food sources or entryways?
- Do the room occupants report any concerns or problems?

## BATHROOMS AND GENERAL PLUMBING

Location/Observation

- Bathrooms and restrooms have operating exhaust fans?
- All drains have traps?
- Drain traps are filled with water (floor drains, sinks, toilets)?

## MAINTENANCE SUPPLIES

Location/Observation

- Odorous or hazardous chemicals used with adequate ventilation and only when building is unoccupied?
- Air exhausted from chemical (e.g., custodial closets) and trash storage areas?

## COMBUSTION APPLIANCES

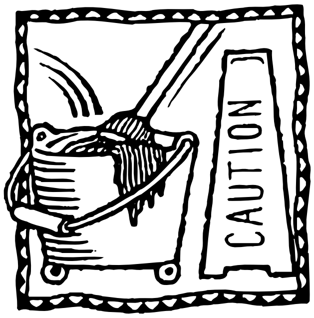
**Location/Observation**

- Combustion gas or fuel odors ever detected?
- Combustion appliances have flues (e.g., furnaces, boilers, water heaters) or exhaust hoods (e.g., kitchen ranges, kilns)?
- Flue components free from leaks, disconnections, deterioration, or soot?
- Soot on outside of flue components?

## OTHER

**Location/Observation**

- If the building was built before 1980, is paint inside or outside free from peeling or flaking? [lead paint hazard]
- Have radon measurements been performed in the school?




**This checklist discusses six major topics areas:**

Maintenance Supplies

Dust Control

Floor Cleaning

Drain Traps

Moisture, Leaks, and Spills

Combustion Appliances

Pest Control

**Instructions:**

1. Read the *IAQ Backgrounder*
2. Read each item on this Checklist.
3. Check the diamond(s) as appropriate or check the circle if you need additional help with an activity
4. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

# Building Maintenance Checklist

## MAINTENANCE SUPPLIES

Maintenance supplies may emit air contaminants during use and storage. Products low in emissions are preferable. However, a product that is low in emissions is not necessarily better if it is more hazardous, despite the lower emissions, if it has to be used more often or at a higher strength. Examples of maintenance supplies that may contribute to indoor air quality (IAQ) problems include:

- Caulks
- Solvents
- Paints
- Adhesives
- Sealants
- Cleaning Agents

**Learn about your maintenance supplies**

- Review and become familiar with your maintenance supplies
- Read labels and identify precautions regarding effects on indoor air or ventilation rate and requirements

◇ **Supplies reviewed and okay**

❍ **Need help determining impact of supplies**

**If you make purchase decisions, or recommend products for purchase, confirm that supplies are safe to use**

- Ask vendors and manufacturers to help select the safest products available that can accomplish the job effectively

◇ **Supplies are safe to use**

❍ **Need help determining if supplies are safe**

**Follow good safety, handling, disposal, and storage practices**

- Develop appropriate procedures and have supplies available for spill control
- Exhaust air from chemical and trash storage areas to the outdoors
- Store chemical products and supplies in sealable, clearly labeled containers
- Follow manufacturers' instructions for use of maintenance supplies
- Follow manufacturers' instructions for disposal of chemicals, chemical-containing wastes, and containers

◇ **Following good safety, handling, disposal, and storage practices**

◇ **Safety, handling, storage, and disposal practices are being revised**

❍ **Need help with good safety, handling, disposal, and storage practices**

**Establish maintenance practices that minimize occupant exposure to hazardous materials**

- Substitute less- or non-hazardous materials where possible
- Schedule work involving odorous or hazardous chemicals for periods when the school is unoccupied
- Ventilate during and after use of odorous or hazardous chemicals

◇ **Procedures established and followed to minimize occupant exposure**

❍ **Need help to develop and implement procedures to minimize occupant exposure**

## DUST CONTROL

By reducing the amount of dust and dirt that enters the school, and by reducing the amount of dust that leaves vacuum bags and dust cloths, it will be possible to maintain a clean school with less effort. A cleaner school can also have positive physical and psychological effects on the students and staff. Complaints of illness and discomfort have been associated with buildings having high dust levels. In addition to dust, other particles such as pollens which can cause allergic reactions will also be reduced.

**Purchase and maintain barrier floor mats for all school entrances**

- Barrier mats need to be long enough to allow five full steps for people entering the school (this allows dirt to be cleaned from the mats rather than from all over the school, saving cleaning costs)
- Vacuum each barrier mat daily using a beater brush or beater bar vacuum, vacuuming in two directions (in-line and side-to-side)

◇ **Barrier mats purchased and maintained**

❍ **Need help with barrier mats**

**Use higher efficiency vacuum bags**

- Standard paper or cloth bags allow lots of dust to pass completely through the vacuum and back into the air and onto surfaces. Use micro-filtration bags which retain dust and particles in the 3 micron size range, or smaller. Although the bags cost more, labor costs are reduced

◇ **High efficiency bags in use**

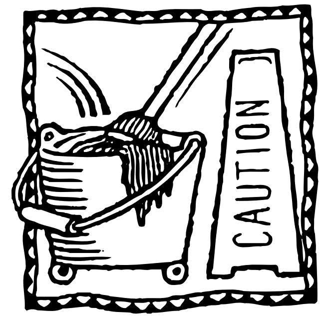
❍ **Need help with obtaining proper bags**

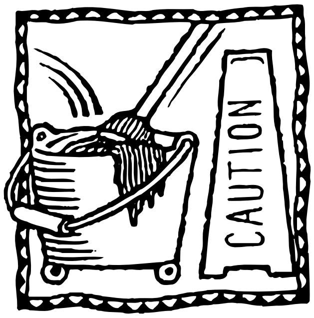
**Use proper dust wiping techniques**

- Ensure that dust that has been collected remains on the wipe by using a wiping motion with a folded wipe, rather than a flicking motion with a crumpled-up wipe
- Wrap hand-held feather-type dusters with a dust cloth. Use a wiping rather than a flicking or sweeping motion

◇ **Proper dusting techniques in use**

❍ **Need help with dust wiping**






**Vacuum dust from heating, cooling, and ventilation air return grilles and air supply vents periodically**

- In addition to vacuuming the grilles and vents using a soft bristle attachment, vacuum the ceiling and wall surfaces adjacent to the grilles and vents to remove visable dust

◇ **Dusting is performed periodically**

❍ **Need help with dusting grilles and vents**

## FLOOR CLEANING

All flooring, including vinyl, wood, terrazzo, tile, and carpet, requires daily attention to ensure cleanliness. In addition to the prevention technique of barrier mats as noted in previous activities, apply the following activities. Contact floor suppliers or manufacturers for recommended maintenance techniques. Follow specific guidelines of the Carpet and Rug Institute (CRI) for properly maintaining carpets (to obtain these guidelines, see information in **Appendix I**, *Resources,* in the Coordinator's Guide).

- Vacuum daily as needed for soil removal. Use a vacuum with brushes, beater bars, strong suction, and a high efficiency filter bag that will filter particles down to the 3 micron or smaller range

- Remove spots and stains immediately, using the flooring manufacturer's recommended techniques. Use care to prevent excess moisture or accumulation of cleaning residue, and ensure that cleaned areas will dry quickly

◇ **Floors are cleaned daily as needed and moisture has been removed**

❍ **Need help with daily floor maintenance**

**Perform restorative maintenance**

- Apply the manufacturer's recommended guidelines when cleaning to remove accumulated contaminants. For carpets, CRI recommends periodic extraction cleaning, wet or dry, and complete removal of the moisture and cleaning agents

◇ **Restorative maintenance is properly performed as needed**

❍ **Need help with restorative floor maintenance**

## DRAIN TRAPS

Drain traps can cause IAQ problems when water in the drain trap evaporates due to infrequent use. If the building interior is under negative pressure, soil gas or sewer gas can be drawn indoors through a dry drain trap.

**Confirm that all drains have drain traps**

- Install traps on any untrapped drains

◇ **All drains have drain traps**

❍ **Need help with traps**

**Confirm that all drain traps in areas to which only you have access are filled**

- Pour water down floor drains once per week (about one quart)

- Run water in sinks at least once per week (about one pint)

- Check water in seldom used toilets once each week. If low, flush

  ◇ **Traps are filled at least once per week**

  ❍ **Need help filling traps regularly**

## MOISTURE, LEAKS, AND SPILLS

Many people have allergic reactions to mold and mildew. Mold and mildew can grow almost anywhere that offers a food source and a small amount of moisture, whether from leaks and spills or condensation. Mold and mildew do not require standing water in order to grow. The higher the relative humidity, the higher the probability of fungal growth.

Assemble the following tools before starting the activities:

- a small floor plan for taking notes

- an instrument to measure relative humidity (e.g., sling psychrometer)

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

- Check for moldy odors

- Look for stains or discoloration on the ceiling, walls, or floor

- Check cold surfaces (e.g., locations under windows and in corners formed by exterior walls, uninsulated cold water piping)

- Check areas where moisture is generated (e.g., locker rooms, bathrooms)

- Look for signs of water damage in:

  - indoor areas in the vicinity of known roof or wall leaks

  - walls around leaky or broken windows

  - floors and ceilings under plumbing

  - duct interiors near humidifiers, cooling coils, and outdoor air intakes

- If you discover active leaks during your inspection, note their location(s) on your floor plan and repair them as quickly as possible

  ◇ **There are no signs of moisture, leaks, or spills**

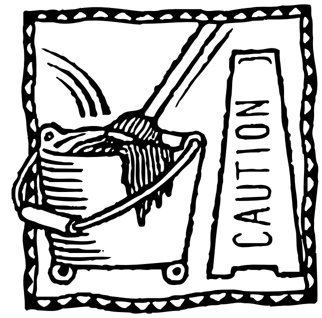
  ❍ **Found signs of moisture, leaks, or spills, or need help inspecting**

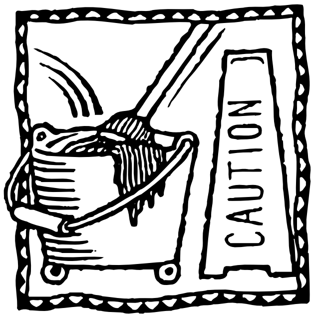
**Respond promptly when you see signs of moisture, or when leaks or spills occur**

- Clean and dry damp or wet building materials and furnishings

- Work with manufacturers of furnishings and building materials to learn recommended cleaning procedures and/or identify competent contractors who can clean damp materials

- Porous, absorbent building materials or furnishings, such as ceiling tiles, wall boards, floor coverings, etc., must be thoroughly dried and cleaned as soon as






possible. In some cases these materials might have to be disinfected. If these materials can't be dried and cleaned within 24 hours, they may have to be replaced after the cause of the moisture problem has been corrected

◇ **Moisture, leaks, or spills fixed**

❍ **Need help fixing damage from moisture, leaks, or spills**

### Prevent moisture condensation

There are several methods to prevent condensation:

- Reduce the potential for condensation on cold surfaces (piping, exterior walls, roof, or floor) by adding insulation. (Note: When installing insulation that has a vapor barrier, put the vapor barrier on the warm side of the insulation.)
- Raise the temperature of the air
- Improve air circulation in the problem location
- Decrease the amount of water vapor in the air
- In drier climates or winter, supply more outdoor ventilation air
- In humid climates or during humid times of the year, use a dehumidifier or desiccants to dry the air (for more information, obtain **Appendix H** from the IAQ Coordinator)
- Increase the capacity or operating schedule of existing exhaust fan(s); or add a local exhaust fan near the source of the water vapor

◇ **Moisture prevention activities completed**

◇ **Moisture prevention activities underway**

❍ **Need help with moisture prevention activities**

## COMBUSTION APPLIANCES

Combustion appliances are potential sources of carbon monoxide and other combustion gases. Carbon monoxide is odorless yet toxic, so it is important that appliances are properly vented to remove combustion gases. If inadequate combustion air is available to an appliance, air may be pulled, or backdrafted, down the flue, bringing combustion gases back into the indoors instead of exhausting them outside.

### Note odors when first entering a location containing combustion appliances

❑ One's nose quickly becomes accustomed to odors, but upon first entering a room the smell of combustion gas odors may indicate a leak or backdrafting problem

◇ **No combustion odors**

❍ **Need help resolving combustion gas problem**

### Visually inspect exhaust components

❑ Inspect flue components for leaks, disconnections, and deterioration

❑ Inspect flue components for corrosion and soot

◇ **No apparent problems**

❍ **Need help repairing exhaust components**

#### Check for backdrafting of combustion appliances

- When the combustion appliances are operating, and the building ventilation systems are in normal operating mode, use chemical smoke to determine whether air is flowing up the flue by puffing smoke near any vent openings or joints

◇ **No backdrafting**

❍ **Need help resolving backdrafting problem**

## PEST CONTROL

#### Use Integrated Pest Management (IPM) methods of pest control

❑ Do not rely on widespread, indiscriminate use of pesticides to control pests

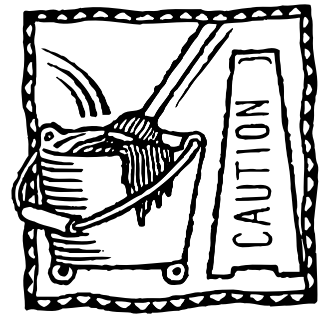
❑ If you are in charge of pest control, obtain information about IPM from the IAQ Coordinator (information available in the Coordinator's Guide)

❑ If pesticides are used outdoors, do not apply near outdoor air intakes for the ventilation system. If unavoidable, shut down the affected ventilation system(s) and remove occupants until application has been completed and ventilation has been restored. Similarly, avoid application near doors and open windows

◇ **No pest problems**

◇ **Already using Integrated Pest Management**

❍ **Need information or assistance with IPM**




❑ **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.

IAQ tools For Schools

# Teacher's Classroom Checklist

Instructions:

1. Read the *IAQ Backgrounder* and the information in this section.
2. Put a "check" in the "yes" or "no" box beside each item as appropriate.
3. Make comments as desired in the "Notes" section.
4. If any "no" boxes are checked, put a check in the circle beside the "need help" statement.
5. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:



## GENERAL CLEANLINESS

Regular and thorough classroom cleaning is important to ensure good indoor air quality. While custodians typically clean the classroom, as a teacher you also can play an important role in promoting and maintaining classroom cleanliness. The presence of dirt, moisture, and warmth also stimulates the growth of molds and other biological contaminants. Unsanitary conditions attract insects and vermin, leading to possible indoor air quality (IAQ) problems from animal or insect allergens. The overuse or improper use of pesticides for secondary control of insects, vermin, and head lice can cause IAQ problems.

**Reminder: Clean spills promptly**

- For spills on carpets, contact custodial staff immediately (carpets need to be cleaned properly, and dried within 24 hours to prevent mold growth)
- Request that unit ventilator be cleaned and filter replaced if spilled liquid goes into the unit
- Report previous spills on carpets or in unit ventilators because they can affect current indoor air quality

❑Y ❑N Classroom is clean

❑Y ❑N Classroom is dusted and vacuumed thoroughly and regularly

❑Y ❑N Trash is removed daily

❑Y ❑N Food is not kept in classroom overnight

❑Y ❑N Animal food, if any, is stored in tightly sealed containers

❑Y ❑N Room is free of pests

❑Y ❑N Room is free of the use of scented cleaners

❑Y ❑N Spills cleaned

❍ **Need help with cleaning or pest control**

**Notes** ______________________________

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## ANIMALS IN THE CLASSROOM

Certain individuals, in particular those with asthma, are sensitive to animal fur, dander, body fluids and feces, and may experience reactions to these allergens. Furthermore, individuals can become sensitized (made allergic) by repeated exposure to animal allergens.

❑Y ❑N Exposure to animal allergens minimized.

❑Y ❑N Animals kept in cages as much as possible; not allowed to roam

❑Y ❑N Cages cleaned regularly

❑Y ❑N Animals located away from ventilation system vents to avoid circulating allergens throughout the room or building

❑Y ❑N Alternatives to animals used when possible

❍ **Need help minimizing exposure to animal allergens**

**Take special care with asthmatic or other sensitive students**

❑Y ❑N School nurse consulted about student allergies or sensitivities (privacy laws may limit the information that health officials can disclose)

❑Y ❑N Parents asked about potential allergies in a note that students take home, or during parent teacher conferences

❑Y ❑N Check for allergies when new students enter the class

❑Y ❑N Sensitive students located away from animals and habitats

❍ **Need help determining if students have allergies**

**Notes** ______________________

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## DRAIN TRAPS IN THE CLASSROOM

Drain traps, if present, can become a problem when the water in the drain trap evaporates due to infrequent use, allowing sewer gases to enter the room.

❑Y ❑N Drain traps filled regularly

❑Y ❑N Water poured down floor drains once per week (approx. 1 quart of water)

❑Y ❑N Water run in sinks at least once per week (about 2 cups of water)

❑Y ❑N If not regularly used, toilets flushed once each week

❍ **Need help filling dry drain traps regularly**

**Notes** ______________________

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## EXCESS MOISTURE IN CLASSROOMS

Excess moisture contributes to mold growth. Mold can trigger allergic reactions and asthma in sensitive individuals. Mold can also cause odors and other IAQ problems. Excess moisture is the result of condensation on cold surfaces, leaking or spilled liquid, or excess humidity. Note here any signs of moisture that exist now or that recur.

**Condensate (condensed water, or "fog") on cold surfaces**

❑Y ❑N Windows, window sills, and window frames free of condensate

❑Y ❑N Cold water pipes free of condensate

❑Y ❑N Indoor surfaces of exterior walls free of condensate

❍ **Excess condensate found**

**Check for leaks or signs of moisture from plumbing or roofs**

❑Y ❑N Area around and under classroom sinks free of leaks

❑Y ❑N Classroom lavatories free of leaks

❑Y ❑N Ceiling tiles or walls leak-free (discoloration may indicate periodic leaks)

❍ **Found leaks or signs of moisture**

**Notes** ______________________________

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## THERMAL COMFORT

Temperature and relative humidity can affect comfort and IAQ. Changing thermostat settings or opening windows to try to control temporary fluctuations in temperature can worsen comfort problems and also have an adverse effect on other parts of the school.

**Check comfort factors**

❑Y ❑N Temperature (generally 72°F-76°F)

❑Y ❑N No signs of draftiness

❑Y ❑N No direct sunlight shining on students

❑Y ❑N Humidity is acceptable. (typically, too high if higher than 60% relative humidity [RH]–or too low if lower than 30% relative humidity)

❑Y ❑N Room usually comfortable

❍ **Need help, room frequently uncomfortable**

**Notes** ______________________________

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## VENTILATION

Ventilation is the process by which stale indoor air is exhausted to the outside, and outdoor air is drawn into the building. You may either have mechanical ventilation (supplied by fans) or natural ventilation (i.e., operable windows).

**Determine how your classroom is ventilated (see IAQ Backgrounder)**

❑Y ❑N Unit ventilator located

❑Y ❑N Air supply and return vents located

❑Y ❑N Windows are operable

❍ **Need help determining type of ventilation**

**If you have mechanical ventilation, confirm that air is flowing into the room from the air supply vent(s)**

Check for airflow by holding a piece of tissue paper near the air supply vent(s); if air is flowing, the tissue will flutter away from the supply vent. Make sure that the airflow is not diverted or obstructed by books, papers, furniture, or other obstacles. Never place anything on top of unit ventilators.

❑Y ❑N Air is flowing from air supply

❍ **Need help, supply air is not flowing**

**If you have mechanical ventilation, confirm that air is flowing from the room into the air return grille(s)**

Check for airflow at air return grille(s) in the same manner as with previous activity. If air is flowing, the plastic or tissue will be pulled toward the return. A piece of plastic that nearly covers the grille will stick to the face of the grille if air is flowing. Make sure airflow is not obstructed by books, papers, furniture, or other obstacles.

❑Y ❑N Air is flowing without obstruction

❍ **Need help, exhaust air is not flowing**

**Check for unexplained odors**

Improperly operated or poorly maintained ventilation systems may cause IAQ problems. Odors, or the need to use scented air fresheners, may indicate a ventilation problem. The ventilation system can carry air contaminants from another location in the school to your classroom.

❑Y ❑N No smell of vehicle exhaust

❑Y ❑N No smell of kitchen/food

❑Y ❑N No smell of "chemicals"

❑Y ❑N No smell of mold or mildew

❑Y ❑N Found source of odors and corrected problem

❍ **Need help, sometimes smell unexplained or unpleasant odors in classroom**

**Notes** ________________________

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***NOTE: Conduct the following activities as appropriate to your classroom.***

## LOCAL EXHAUST FANS

Local exhaust fans and fume hoods can be used to prevent air pollutants and moisture from accumulating in, or spreading beyond, the local area or classroom. Local exhaust fans may be used to exhaust entire rooms (e.g., bathrooms or locker rooms). Fume hoods are appropriate for activities that generate significant quantities of pollutants in a local area within a room (e.g., science experiments, spray painting, and welding).

- Determine if your classroom activities generate air pollutants and whether your classroom is equipped with local exhaust fans and/or fume hoods

- If there are no activities that generate air pollutants, you do not need a local exhaust fan or fume hood

❑Y ❑N No major pollutant generating activities

❑Y ❑N Have fume hood and/or exhaust fan

❍ **Need fume hood and/or local exhaust fan**

**Confirm that fume hoods and local exhaust fans function properly**

Check for air flow when fans are on (hold a piece of tissue paper near the fan - or within the space of the fume hood - to see whether it is pulled away from the room).

❑Y ❑N Fume hoods are in good repair; not cracked, broken, or pulling away from the ceiling or wall

❑Y ❑N Fan is operated. (Note if fans are not operated due to noise.)

❑Y ❑N Adjacent rooms or halls odor free.

❍ **Need help, hood or exhaust fan does not appear to function properly**

**Confirm that fume hoods and fans are used whenever activities that generate pollutants take place**

Train students and others who use the classroom or equipment on when and how to use the fume hoods and fans.

Conduct pollutant generating activities under the fume hood with exhaust fan turned on. Monitor use throughout the year.

**Confirm that fume hoods and fans are used whenever activities that generate pollutants take place**

❑Y ❑N Fans and fume hoods are used properly

**Notes** ______________________

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## ART SUPPLIES

Art supplies may emit contaminants during use and storage. In addition, certain activities (e.g., firing ceramic kilns) may generate air contaminants or heat up the classroom, causing thermal discomfort to occupants.

Although potentially toxic supplies have appropriate labeling since a 1990 federal law took effect, it is still up to teachers to see that safety precautions are followed. Examples of art supplies and activities that may contribute to IAQ problems include: solvents, inks, adhesives, and glues; wax varnishes and lacquers; powdered pigments, acids, clays, paints, and firing kilns.

**Learn about your supplies**

Check to see whether your supplies (noted above) are listed as toxic or nontoxic. Supplies that are nontoxic will be labeled AP Nontoxic, CP Nontoxic, or Health Label (without warning conditions) by the Art and

Craft Materials Institute or the Center for Safety in the Arts.

Read labels and identify precautions regarding fumes or ventilation. If you make purchase decisions, or recommend products for purchase, confirm that supplies are safe to use.

❑Y ❑N Supplies okay

**❍ Need help inventorying supplies, interpreting label warnings, or determining if supplies are safe**

### Follow good safety, handling, and storage practices

Have appropriate procedures and supplies available for spill control. Label all hazardous supplies with date of receipt/preparation and pertinent precautionary information. Tightly seal containers. Follow recommended procedures for disposal of used substances. Secure compressed gas cylinders. Supply storage areas should be separate from classroom and ventilated.

❑Y ❑N Following good handling and storage practices

**❍ Need help developing good safety, handling, or storage practices**

### Minimize exposure to hazardous materials

Substitute less- or non-hazardous materials where possible. Use local exhaust fans. Isolate contaminant producing activities or operations. Use moist-premixed products rather than powdered products. Use techniques that require the least amount of materials.

❑Y ❑N Exposure minimized

**❍ Need help minimizing exposure to art supplies**

**Notes** ____________________________

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## SCIENCE SUPPLIES

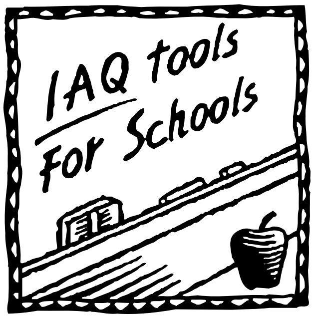
Some supplies used as teaching aids in science laboratories may contribute to IAQ problems. Science experiments should be conducted in well ventilated rooms using fume hoods and local exhaust systems wherever appropriate. Basic safety precautions can prevent spills or other mishaps that cause air contamination, and should be followed at all times. Examples of science supplies that may contribute to IAQ problems include: solvents, acids, flammables, caustics, biological products, and compressed gases.

Learn about your supplies. Read labels and identify precautions regarding fumes ventilation. Request information and Material Safety Data Sheets (MSDS) from suppliers and manufacturers.

❑Y ❑N Supplies reviewed

❑Y ❑N MSDS on hand

**❍ Need help determining impacts of supplies**




**Follow good safety, handling, and storage practices**

**Obtain guidance documents:**

- **School Science Laboratories:** *A Guide To Some Hazardous Substances*, 1984 Council of State Science Supervisors and U.S. CPSC, 800-638-2772 (800-492-8104 in MD) U.S. GPO #1984 421-506/3308 *Manual of Safety & Health Hazards In The School Science Laboratory*, 1980 NIOSH/ U.S. Department of Health & Human Services, National Technical Information Service, 703-487-4650, # PB-85-238-228

Have appropriate procedures developed and supplies available for spill control (i.e., absorbent materials to control the spread of spills).

❑Y ❑N Spill procedures in place.

❑Y ❑N All chemicals labeled accurately with date of receipt/ preparation and pertinent precautionary information

❑Y ❑N Supplies stored according to manufacturers' recommendations

❑Y ❑N Recommended procedures for disposal of used substances understood and followed.

❑Y ❑N Compressed gas cylinders secured.

❑Y ❑N Storage areas separate from main classroom area and ventilated separately

❍ **Need help with good safety, handling, or storage practices**

**Minimize exposure to hazardous materials**

❑Y ❑N Diluted substances rather than concentrates used wherever possible

❑Y ❑N Techniques that require the least quantity of hazardous materials used

❑Y ❑N Fume hoods capture respirable particles, gases, and vapors released within them

❑Y ❑N Exhaust fans operate

❍ **Need help minimizing exposure to supplies**

**Notes** ________________________

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## INDUSTRIAL AND VOCATIONAL EDUCATION SUPPLIES

Industrial and vocational education materials and operations can create IAQ problems. Examples of the kinds of activities and supplies that may contribute to IAQ problems include: machining, solvents, grinding, fuels, painting, soldering, welding, baking/ heating, and adhesives.

**Learn about your supplies**

Read labels and identify precautions regarding fumes or ventilation. Request information and Material

Safety Data Sheets (MSDS) from suppliers and manufacturers

❑Y ❑N Supplies reviewed

❑Y ❑N MSDS on hand

**❍ Need help determining impacts of industrial/vocational supplies**

**Follow good safety, handling, and storage practices**

Develop appropriate procedures and have supplies available for spill control (e.g., absorbent materials to control the spread of spills).

❑Y ❑N Spill procedures in place.

❑Y ❑N Supplies stored according to manufacturers' recommendations

❑Y ❑N Recommended procedures for disposal of used substances understood and followed.

❑Y ❑N Compressed gas cylinders secured.

❑Y ❑N Storage areas separate from main classroom area and ventilated separately

**❍ Need help with good safety, handling, or storage practices**

**Minimize exposure to hazardous materials**

❑Y ❑N Instructional techniques that require the least quantity of materials used

❑Y ❑N Fume hoods capture respirable particles, gases, and vapors released within them

❑Y ❑N Exhaust fans operate

**❍ Need help minimizing exposure to supplies**

## LOCKER ROOM

Locker room conditions that affect indoor air quality include: standing water, high humidity, warm temperatures, and damp or dirty clothing. In addition, some of the methods necessary to control germs and odors in the locker room (e.g., use of disinfectants) may themselves contribute to indoor air quality problems if used improperly (e.g., if sprayed into the air instead of directly onto surfaces).

**Verify that showers and other locker room areas are cleaned regularly and properly.**

Limit use of chemical cleaners and disinfectants to times when areas are unoccupied. Run exhaust fans to remove moisture and odors.

❑Y ❑N Locker room and showers cleaned regularly and properly

**❍ Need help to have showers and locker room cleaned regularly and properly.**

**Maintain cleanliness and reduce excess moisture in the locker room**

Remove wet towels regularly. Wash and dry soiled practice uniforms regularly. Encourage students to take soiled clothes home regularly. Operate exhaust fans to remove moisture.

❑Y ❑N Soiled clothes and towels are removed regularly

**❍ Need help to have soiled clothes or towels removed regularly**

IAQ tools For Schools

❑Y ❑N **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.

# Ventilation Checklist & Log

**This checklist discusses eight major topic areas:**

Outdoor Air Intakes

System Cleanliness

System Controls

Air Distribution

Exhaust Systems

Quantity of Outdoor Air

Adequacy of Outdoor Air Supply

How to Measure Air Flow

**Instructions:**

1. Read the *IAQ Backgrounder*.
2. **Important!** Read the Ventilation Activity explanations accompanying this checklist (pages 5-13).
3. Make one copy of the Ventilation Log (pages 3-4) for **each** ventilation unit in your school.
4. Complete each activity for **each** ventilation unit and note the status of each activity on the Ventilation Log.
5. Return the Ventilation Logs to the IAQ Coordinator and keep copies for future reference.

Schools use a variety of methods for ventilating the building with outdoor air: 1) mechanically-based systems such as unit ventilators, central HVAC systems, and central exhaust systems, and; 2) passive systems that rely on operable windows, air leaks, wind, and the stack effect (the tendency of warm air to rise).

The majority of the Ventilation Checklist/Log activities apply mainly to mechanical ventilation systems, and are designed to accomplish two functions:

- Ensure that the ventilation system is clean, and
- Ensure that an adequate amount of outdoor air is supplied to occupied areas

Many of these activities should be performed by individuals with appropriate training in mechanical systems and safety procedures. Most activities can be performed with basic maintenance tools, but Activity 22 will require airflow measurement equipment that you may not have. The section *How to Measure Airflow*, at the back of this Checklist, describes the type of equipment used to measure airflow. The IAQ Coordinator has information on how this equipment can be obtained (**Appendix C** of the Coordinator's Guide). Make an effort to obtain this equipment before conducting Activity 17. Supplying an adequate amount of outdoor air to an occupied area is necessary for good indoor air quality, and measuring airflow can only be done correctly with equipment that can reliably tell you if you're getting the proper amount of outdoor air (visual inspection or feeling for air movement is not sufficient).

Activities 17-21 can be applied to passive ventilation systems. For activities that do not apply, place a "NA" in the date column of the Ventilation Log.

Your school most likely has multiple units and systems, so be sure to perform the activities and complete the Ventilation Log for each unit. The activities are listed in a purposeful order to prevent having to repeat activities for a given unit as the inspection progresses. The following is a recommended process for saving time in performing the activities:

**Activities 1-3**

Perform these activities for all outdoor air intakes while outside the building, and mark the results on the Ventilation Log for each unit.

**Activities 4-12**

Perform these activities as a set on each ventilation unit while you're in the room and the unit is open.

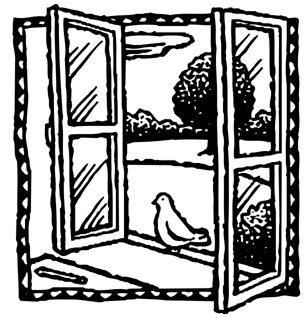
**Activities 13-16**

Perform these ventilation control system activities as required by your situation.

**Activities 17-21**

Perform these air distribution and exhaust system activities as required by your situation.

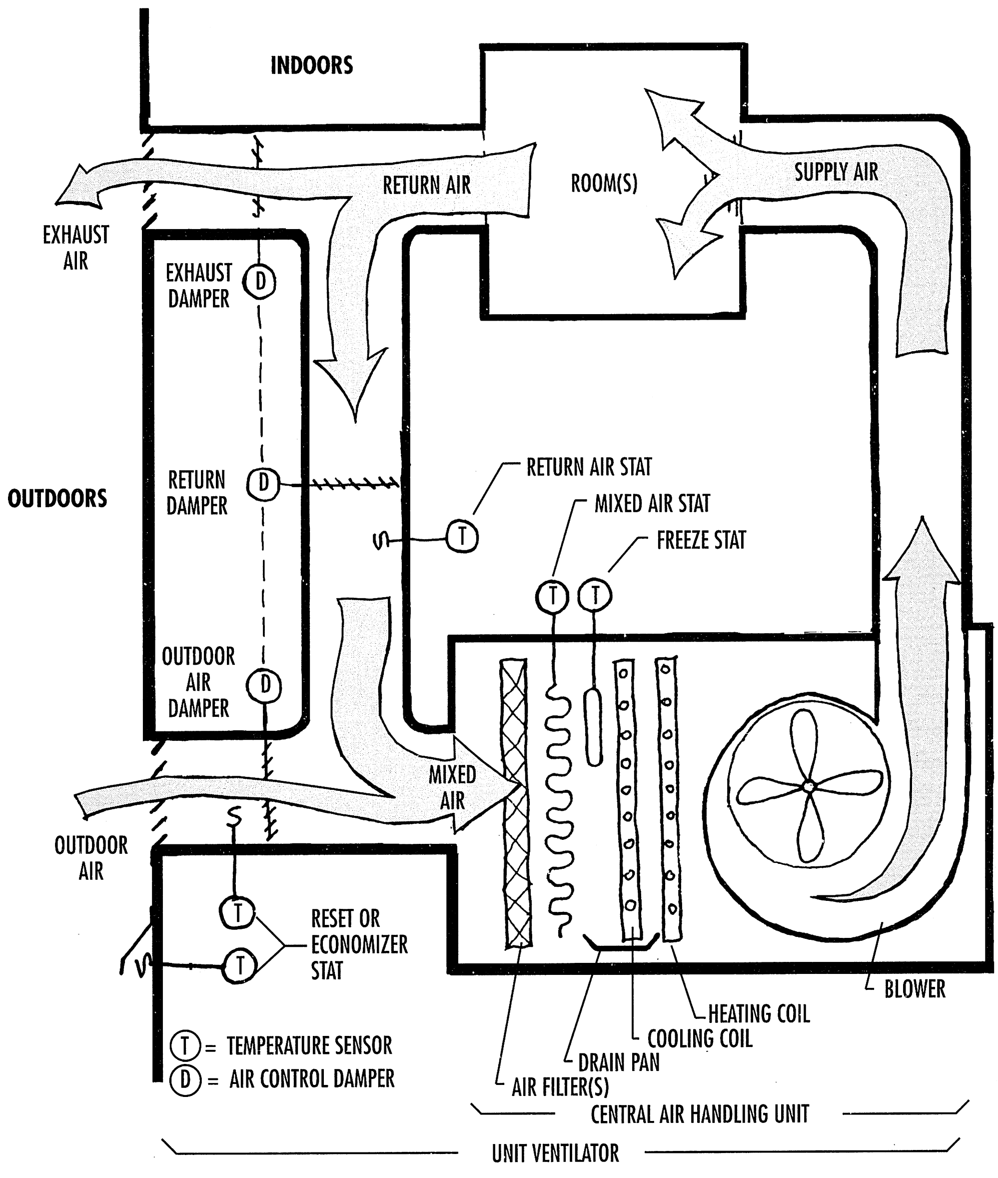
**Activities 22-23**



Perform these activities regarding the quantity of outdoor air on all units while you have the airflow measurement equipment available.

All of these activities are described in the information following the Log. For more detailed information see *Building Air Quality*: *A Guide for Building Owners and Facility Managers* (EPA-400-1-91-033) listed in Appendix I of the *IAQ Coordinator's Guide*.

Typical HVAC System



# Ventilation Log

Instructions:

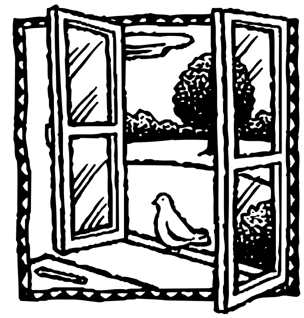
- ❑ Make one copy of this Checklist and Log for **each** ventilation unit in your school.
- ❑ Perform the activities on the Checklist and Log for **each** ventilation unit and record your results.
- ❑ One column is provided for each inspection. Put the date at the top of the column, and initial each response. For subsequent inspections on the same unit, move to the next column until the sheet is full.
- ❑ A "No" response requires further attention.

Name

School

Room or Area

| ACTIVITY | NEEDS ATTENTION IF "NO" | DATE: INITIALS | NEEDS ATTENTION IF "NO" | DATE: INITIALS | NEEDS ATTENTION IF "NO" | DATE: INITIALS |
|---|---|---|---|---|---|---|
| **Outdoor Air Intakes** (see page 5 for more information) | | | | | | |
| 1. Outdoor air intakes not obstructed | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 2. Outdoor air intake clear of nearby pollutant sources | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 3. Outdoor air moving into intake | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| **System Cleanliness** (see pages 5-6 for more information) | | | | | | |
| 4. Filters in good condition, properly installed, and no major air leaks | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 5. Drain pan clean and no standing water | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 6. Heating and cooling coil(s) clean | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 7. Interior of air handling unit and ductwork clean | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 8. Mechanical room free of trash and chemicals | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| **Controls for Outdoor Air Supply** (see pages 6-8 for more information) | | | | | | |
| 9. Controls information on hand | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 10. Clocks, timers, and switches properly set | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 11. Pneumatic controls okay | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 12 Outdoor air damper operating properly | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |



| ACTIVITY | NEEDS ATTENTION IF "NO" | DATE: INITIALS | NEEDS ATTENTION IF "NO" | DATE: INITIALS | NEEDS ATTENTION IF "NO" | DATE: INITIALS |
|---|---|---|---|---|---|---|
| **Controls for Outdoor Air Supply** (continued) | | | | | | |
| 13. Freeze-stat reset | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 14. Mixed air thermostat set properly | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 15. Economizer set per specifications | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 16. Fans supplying outdoor air operate continuously during occupied periods | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| **Air Distribution** (see pages 8-9 for more information) | | | | | | |
| 17. Air distribution function per design | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 18. Air flow direction (relative pressures) okay | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| **Exhaust Systems** (see page 9 for more information) | | | | | | |
| 19. Exhaust fans operating | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 20. Local exhaust fan(s) remove enough air to eliminate odors and chemical fumes | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| 21. Exhaust ductwork sealed and in good condition | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |
| **Quantity and Adequacy of Outdoor Air Supply** (see page 9-13 for more information) | | | | | | |
| 22. Measure quantity of outdoor air<br>a. outdoor air supply<br>b. number of occupants served by this unit<br>c. CFM/occupants (a ÷ b)<br>Meets original design specs? | ____<br>____<br>____ | | ____<br>____<br>____ | | ____<br>____<br>____ | |
| 23. Recommendation in Table 1 for this type of area: _______ | ❑ Yes ❑ No | | ❑ Yes ❑ No | | ❑ Yes ❑ No | |

# Explanatory Information for Ventilation Log Items

## OUTDOOR AIR INTAKES

If outdoor air intakes are deliberately blocked or become clogged with dirt or debris, areas they serve are likely to get insufficient outdoor air. Students or staff might experience stuffy or stagnant air, or develop health problems from exposure to accumulated pollutants.

- ❑ On a small floor plan (e.g., a fire escape floor plan), mark the locations of outdoor air intakes, based on mechanical plans (if available) and your observations while performing these activities.
- ❑ Obtain chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) before performing Activity 3. For more information on chemical smoke, see *How to Measure Airflow*, at the end of this Checklist.
- ❑ Ensure that the ventilation system is on and operating in "occupied" mode

**1. Ensure that outdoor air intakes are unobstructed**

- ❑ Check the intakes from outside the school building for obstructions, such as debris, clogged screens, or make-shift covers (e.g., boards or plastic)
- ❑ Remove any obstructions
- ❑ Install corrective devices if snowdrifts or leaves often block an intake

**2. Ensure that outdoor air intakes are clear of nearby pollutant sources**

- ❑ Check the intakes from outside the school building to confirm that pollutant sources are not located near outdoor air intakes
- At ground level, look for dumpsters, loading docks, and bus-idling areas
- At roof level, look for plumbing vents, exhaust outlets (such as kitchen, toilet, or laboratory exhaust fans), puddles on the roof, and mist from air-conditioning cooling towers
- ❑ Resolve problems due to pollutants near intakes:
- Remove sources, where possible (for example, move a dumpster to another location)
- Separate the source from the intake (for example, add another pipe section to raise a nearby exhaust outlet above the intake)
- Change operating procedures (for example, turn off vehicles instead of idling at loading docks and bus stands)

**3. Confirm that outdoor air is entering the system intake**

- ❑ Use chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) to show whether air is moving into the intake grille

## SYSTEM CLEANLINESS

Accumulated dirt can interfere with the proper operation of the ventilation system and lead to underventilation, uncomfortable temperatures, less efficient operation (higher utility bills), more maintenance, and decreased life expectancy of equipment. Air filters are intended primarily to prevent dirt and dust from accumulating in the HVAC system. If filters are not properly selected and maintained, built-up dirt in coils and ducts could provide a habitat for microbiological growth. Filters that are clogged with dirt restrict the flow of air through the HVAC system. If filters "blow out" and allow the passage of unfiltered air, dirt can accumulate on coils (producing a need for more frequent cleaning) and reduce the efficiency of the heating and/or cooling plant. It is much less expensive to trap dirt with properly maintained filters than to remove it from ductwork, coils, fan blades, and other HVAC system components.

***WARNING:*** *Do not clean dirty or biologically contaminated system components when the system is operating and the building is occupied.*

***WARNING:*** *If there is visible biological growth, such as mold, minimize your exposure to air in the interior of ducts or other HVAC equipment. Use proper respiratory protection; obtain expert advice about the kind of respiratory protection to use and how to use it.*

**4. Inspect air filters on ventilation equipment**

❑ Install new filters as needed. Shut off ventilation system fans when replacing associated filters so that dirt will not blow downstream. Vacuum the filter area before installing the new filter

❑ Confirm that filters fit properly in their tracks, with no major air leaks that would allow air to bypass (flow around) the air filter

❑ Confirm that filters are installed in the proper direction for airflow

**5. Ensure that condensate drain pans are clean and drain properly**

- Drain pans should slant toward the drain so they do not collect and hold water

**6. Ensure that heating and cooling coils are clean**

**7. Ensure that air handling unit(s) (air mixing chambers, coils, and fan blades) and duct interiors are clean**

**8. Ensure that the mechanical rooms are free of trash and chemicals**

❑ Check mechanical room for unsanitary conditions, leaks, or spills

❑ Confirm that mechanical rooms and air mixing chambers are not used to store trash or chemical products and supplies

## CONTROLS FOR OUTDOOR AIR SUPPLY

This group of activities is for ventilation systems that use fans or blowers to supply outdoor air to one or more rooms within a school. The primary objectives that you should keep in mind as you perform these activities are:

- Ensure that air dampers are always at least partially open (minimum position) during occupied hours, and
- Ensure that the minimum position provides an adequate amount of outdoor air for the occupants.

These activities are fairly generic, and apply to most ventilation systems. See the figures in the *IAQ Backgrounder* for more information.

Activities 9-11 generally serve multiple ventilation units, while activities 12-16 are related and performed at each individual ventilation unit. Based on your equipment and experience, perform as many of the activities and make as many indicated repairs as possible. Discuss the need for additional help for any uncompleted activities or repairs with your IAQ Coordinator.

**9. Gather controls information**

Your ventilation controls may be uniquely designed, and since there are many different types and brands of control components, it can be very helpful if you:

- Gather and read any controls specifications, as-built mechanical drawings, and controls operations manuals that you may have
- Contact the system installer or HVAC maintenance contractor to obtain controls information that is missing from your files

**10. Check Clocks, Timers, and Seasonal Switches**

❑ Confirm that summer-winter switches are in the right position

❑ Confirm that time clocks read the correct time

❑ Confirm that time clock settings fit the actual schedule of building use (night/weekend set-back and set-up)

**11. Check pneumatic control system components (if any)**

❑ Test the line pressure at both the occupied (day) setting and the unoccupied (night) setting to determine whether the overall system pressure is appropriate

❑ Confirm that the line dryer is preventing moisture buildup

❑ Check the control system filters. The filter at the compressor inlet should be changed periodically in keeping with the compressor manufacturer's recommendation (for example, when you blow down the tank)

❑ Ensure that the line pressure at each thermostat and damper actuator is at the proper level (no leakage or obstructions)

❑ Repair or replace defective components

**12. Check outdoor air damper operation**

Before continuing, the air temperature in the indoor area(s) served by this outdoor air damper must be within the normal operating range, and ensure that the outdoor air damper is visible for your inspection

- ❑ Turn off the air handler connected to the outdoor air damper and confirm that the damper fully closes within a few minutes

- ❑ Turn on the air handler and confirm that the outdoor air damper opens at least partially with little or no delay

- ❑ Set the room thermostat as follows, and observe the damper for movement (damper should go to its minimum position, but not completely closed):

    - If in heating mode, set the room thermostat to 85°F

    - If in cooling mode, set the room thermostat to 60°F, mark the current setting of the mixed air thermostat, and set it to a low setting (about 45°F)

If the outdoor air damper does not move:

- Confirm that the damper actuator is linked to the damper shaft and that any linkage set screws or bolts are tight

- Confirm that rust or corrosion are not preventing free movement

- Confirm that either electrical wires or pneumatic tubing is connected to the damper actuator

- Reset thermostat(s) to appropriate temperature(s)

Proceed to Activities 13-16 if the damper seems properly operating

***NOTE:*** *The minimum damper setting, adjusted with a nut or a knob, may have to be adjusted to allow a larger damper opening if the amount of outdoor air supply measured in Activity 22 is not adequate for the number of occupants being served.*

**Unit Ventilators** are sometimes specified to operate under one of the following ASHRAE sequences:

**Cycle I:** Except during warm-up stage (outdoor air damper closed), Cycle I supplies 100% outdoor air at all times.

**Cycle II:** During the heating stage, Cycle II supplies a set minimum quantity of outdoor air. Outdoor air is gradually increased, as required for cooling. During warm-up, the outdoor air damper is closed. (Typical sequence for northern climates.)

**Cycle III:** During the heating, ventilating and cooling stages, Cycle III supplies a variable amount of outdoor air as required to maintain a fixed temperature (typically 55°F) entering the heating coil. When heat is not required, this air is used for cooling. During warmup, the outdoor air damper is closed. (Typical sequence for southern climates, with adaptions for mechanical cooling.)

The following four items may be responsible for keeping outdoor air dampers closed during the normal occupied cycle.

**13. Confirm freeze-stat condition**

HVAC systems with water coils need protection from freezing. The freeze-stat may close the outdoor air damper and disconnect the supply air when tripped. The typical trip range is 35°F to 42°F.

- If the freeze-stat has a manual reset button (usually red), depress the button. If a click is heard, the freeze-stat was probably tripped. Consider replacing manual reset freeze-stats with automatic reset freeze-stats
- If the freeze-stat has an automatic reset, disconnect power to the controls and test for continuity across the terminals

**14. Check mixed air thermostat**

- The mixed air stat for heating mode should be set no higher than 65°F
- The mixed air stat for cooling mode should be set no lower than the room thermostat setting

**15. Check air economizer setting**

Economizers use varying amounts of cool outdoor air to assist with the cooling load of the room or rooms. There are two types of economizers, dry-bulb and enthalpy. Dry-bulb economizers vary the amount of outdoor air based on outdoor air temperature, and enthalpy economizers vary the amount of outdoor air based on outdoor air temperature and humidity level.

- [ ] Confirm proper settings based on design specifications or local practices (dry-bulb setting typically 65°F or lower)
- [ ] Check the sensor to make sure that it is shielded from direct sunlight

**16. Confirm that fans operate continuously during occupied periods**

- Any fan that helps move air from outdoors to indoors must operate continuously during occupied hours, even though the room thermostat is satisfied.
- If the fan shuts off when the thermostat is satisfied, change the control cycle to prevent underventilation.

## AIR DISTRIBUTION

Even if enough outdoor air is brought into a school building, IAQ problems can develop if the outdoor air is not properly distributed. In such cases, underventilation occurs in particular areas of the building rather than being widespread. Problems with air distribution are most likely to occur in areas where:

- Ventilation equipment is malfunctioning
- Room layouts have been altered without adjusting the HVAC system
- The population of a room or zone has grown without adjustment to the HVAC system
- Air pressure differences move air contaminants from outdoors to indoors and transport them within buildings.

In schools with mechanical ventilation equipment, fans are the dominant influence on pressure differences and air flows. In schools without mechanical ventilation equipment, natural forces (wind and stack effect) primarily influence airflows.

To prevent infiltration of outdoor air and soil gas (e.g., radon), mechanically-ventilated buildings are often designed to maintain a higher air pressure indoors than outdoors, which is known as positive pressurization (See “Exhaust Systems” and “How to Measure Airflow” for a description of building pressurization). At the same time, exhaust fans control indoor contaminants by keeping rooms such as smoking lounges, bathrooms, kitchens, and laboratories under negative pressure compared to surrounding rooms. “Negative pressure” and “positive pressure” describe pressure relationships. A room can operate under negative pressure as compared to neighboring rooms, but at the same time it may be positive compared to outdoors.

**17. Check air distribution**

Verify that air pathways in the original ventilation system design continue to function.

- ❑ Check to see whether operable windows have been replaced by windows that cannot be opened
- ❑ Check to see whether passive gravity relief ventilation systems and transfer grilles between rooms and corridors are functioning. If they are closed off or blocked to meet modern fire codes, consult with a professional engineer for remedies
- ❑ Verify that every occupied space has a supply of outdoor air (mechanical system or operable windows)
- ❑ Confirm that supplies and returns are open and unblocked. If outlets have been blocked intentionally to correct drafts or discomfort, investigate and correct the cause of the discomfort and reopen the vents
- ❑ If you discovered areas with no source of outside air, modify the HVAC system to correct the problem
- ❑ Check for barriers, such as room dividers, large free-standing blackboards or displays, or bookshelves, that could block movement of air in the room, especially if they block air vents

**18. Check air flow direction**

- ❑ Confirm that the system, including any exhaust fans, is operating on the occupied cycle when doing this activity.
- Where outdoor contaminant sources have been identified, use chemical smoke to determine whether the air flows out of the building through leaks in nearby windows, doors, or other cracks and holes in exterior walls
- Use chemical smoke to determine whether air flows out of the building through below-grade cracks and holes (e.g., floor joints, pipe openings)

## EXHAUST SYSTEMS

Exhaust systems are used to remove air that contains contaminants, including odors. Some HVAC designs also rely on the operation of exhaust fans to create negative pressure that draws outdoor air into the building through windows and gaps in the building envelope.

**19. Confirm that exhaust fans are operating**

- Use chemical smoke to confirm that air is flowing into the exhaust grille(s)

**20. Verify that local exhaust fans remove enough air to eliminate odors and chemical fumes**

If the fan is intended to exhaust the entire room, stand outside the room with the door slightly open and use chemical smoke to confirm that air is being drawn into the room from locations both high and low in the door opening (see *How to Measure Airflow* below).

If the fan is running, but air isn't flowing toward the exhaust intake (or too little air is moving to do the job), check for the following possibilities:

- The backdraft damper at the exhaust outlet does not open
- Obstructions in the ductwork
- Leaky or disconnected ductwork
- Broken fan belt
- Motor running backwards
- Design problems (e.g., undersized fan)

**21. If the exhaust fan is located close to the contaminant source, rather than on the roof, and exhaust air is ducted through the building under positive pressure**

- Confirm that the exhaust ductwork is sealed and in good condition.

## QUANTITY OF OUTDOOR AIR

**22. Measure quantity of outdoor air per person**

See *How to Measure Airflow* at the end of this Checklist for techniques on measuring outdoor air supply.

Measure the quantity of outdoor air supplied either to or from each ventilation unit. Use the Ventilation Log to calculate the quantity of outside air per person being provided to occupants (22a. on the Ventilation Log)

Count or calculate the number of occupants served by the ventilation unit under consideration (22b. on the Ventilation Log)

Divide the quantity of outdoor air supplied by the number of occupants served for the ventilation unit under consideration (22a divided by 22b on the Ventilation Log)

## ADEQUACY OF OUTDOOR AIR SUPPLY

**23. Compare the measured outdoor air per person to Table 1**

In the first column of Table 1, find the listing for the type of area that is served by the unit you are evaluating.

Check the second column to see if the occupancy for each 1,000 square feet that the ventilation unit serves is no greater than the occupancy assumed for the recommendations

Compare the recommended ventilation in the third column of Table 1 to the calculated outdoor air per person from Activity 22.

If the calculated airflow is below the recommendations in Table 1, it may be that the school was designed to meet a lower standard that was in effect at the time the school was built. If you have design specifications for the system or know code requirements in effect at the time of construction, compare the measured outdoor air to this specification. Repair the system to meet the design specification, if necessary.

If the school was designed to a lower standard and cannot meet the recommended levels in Table 1, discuss with the IAQ Coordinator means for increasing ventilation:

- Retrofitting the ventilation system for increased capacity
- Opening windows (Caution: Consider potential ventilation problems that this may cause in other parts of the building)
- Make any repairs permanent and take any other measures that appear to help ensure adequate outdoor air in the future. These improvements will probably require the services of a professional engineer.

**Table 1: Selected ASHRAE Ventilation Recommendations**

| Type of Area | Occupancy (people/1000 ft$^2$) | CFM/person |
|---|---|---|
| **Instructional Areas** | | |
| Classrooms | 50 | 15 |
| Laboratories | 30 | 20 |
| Music rooms | 50 | 15 |
| Training shops | 30 | 20 |
| **Staff Areas** | | |
| Conference rooms | 50 | 20 |
| Offices | 70 | 20 |
| Smoking lounges | 7 | 60 |
| Bus garage: 1.5 CFM per square foot of floor area. Distribution among people must consider worker location and concentration of running engines; stands where engines are run must incorporate systems for positive engine exhaust withdrawal. Contaminant sensors may be used to control ventilation. | | |
| **Assembly Rooms** | | |
| Auditoriums | 150 | 15 |
| Libraries | 20 | 20 |
| Gymnasiums | | |
| *Spectator areas* | 150 | 15 |
| *Playing floor* | 30 | 20 |
| **Food and Beverage Service** | | |
| Cafeteria | 100 | 20 |
| Kitchen | 20 | 15 |
| Additional airflow may be needed to provice make-up air for hood exhaust(s). The sum of the outdoor air and transfer air of acceptable quantity from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 CFM/square foot. | | |
| **Miscellaneous** | | |
| Nurse's offices (patient areas) | 10 | 25 |
| Corridors: 0.1 CFM/square foot | | |
| Locker rooms: 0.5 CFM/square foot | | |
| Restroom:50 CFM/urinal or water closet | | |

*SOURCE*: ASHRAE Standard 62-1989, Ventilation for Acceptable Air Quality

## HOW TO MEASURE AIRFLOW

This section provides basic guidance and options for determining air movement and measuring outdoor air supply. It is divided into three sections:

- Using chemical smoke to determine air flow direction
- Measuring airflow to determine outdoor air supply quantity
- Estimating outdoor air quantity using carbon dioxide measurements

### 1. Using Chemical Smoke to Determine Air Flow Direction

Chemical smoke can be helpful in evaluating HVAC systems, tracking air and pollutant movement, and identifying pressure differentials. Chemical smoke moves from areas of higher pressure to areas of lower pressure if there is an opening between them (e.g., door, utility penetration).

Because it is the same temperature as the surrounding air, chemical smoke is extremely sensitive to air currents. Investigators can learn about airflow patterns by observing the direction and speed of smoke movement. Smoke released near outdoor air intakes will indicate whether air is being drawn into the intake. Puffs of smoke released at the shell of the building (by doors, windows, or gaps) will indicate whether the HVAC systems are maintaining interior spaces under positive pressure relative to the outdoors.

Chemical smoke is available with various dispensing mechanisms, including smoke "bottles," "guns," "pencils," or "tubes." The dispensers allow smoke to be released in controlled quantities and directed at specific locations. It is often more informative to use a number of small puffs of smoke as you move along an air pathway rather than releasing a large amount in a single puff.

***Caution:*** *Chemical smoke devices use titanium tetrachloride to produce smoke. While the chemicals forming the smoke normally are not hazardous in the small quantities produced during testing, avoid inhaling smoke from smoke devices. Concentrated fumes from smoke devices are very corrosive.*

#### *Determining Air Movement From Diffusers And Grilles*

Puffs of smoke released near HVAC vents give a general idea of airflow. (Is it in or out? Vigorous? Sluggish? No flow?) This is helpful in evaluating the supply and return system and determining whether ventilation air actually reaches the breathing zone. (For a variable air volume system, be sure to take into account how the system is designed to modulate. It could be on during the test, but off for much of the rest of the day.) "Short-circuiting" occurs when air moves directly from supply diffusers to return grilles, instead of mixing with room air in the breathing zone. If a substantial amount of air short-circuits, occupants may not receive adequate supplies of outdoor air and source emissions may not be diluted sufficiently.

### 2. Measuring Outdoor Air Supply Quantity

This section describes methods for determining the amount of outdoor air being supplied by a single ventilation unit using either a flowhood or air velocity measurement device. These are general instructions for measuring airflow. Follow the instructions provided by the manufacturer of your measuring equipment.

#### Step 1. Determine Airflow Quantity

##### *Using a Flow Hood*

Flowhoods measure airflow in cubic feet per minute (CFM) at a diffuser or grille. Taking the measurement is simply a matter of holding the hood up to the diffuser and reading the airflow value. Follow the instructions supplied with the flowhood regarding use, care, and calibration.

### *Using Velocity Measurements*

For information on measuring air velocity using a Pitot tube or anemometer and calculating outdoor air supply, see the instructions supplied with the equipment.

Airflow in large ductwork can be estimated by measuring air velocity using a Pitot tube with a differential pressure gauge or an anemometer. (See the IAQ Coordinator for sources of these devices.)

- Measure the air velocity in the ductwork and calculate the outdoor airflow in cubic feet per minute (CFM) at the outdoor air intake of the air handling unit or other convenient location

- Enter the calculated outdoor air supply in the Ventilation Log

### *For Systems Without Mechanically-Supplied Outdoor Air*

If your system does not have mechanically supplied outdoor air, you can estimate the amount of outdoor air infiltrating the area. Estimate air infiltration by measuring the quantity of air exhausted by exhaust fans serving the area.

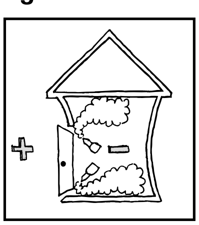
- Using a small floor plan, such as a fire escape map, mark the areas served by each exhaust fan

- Measure airflow at grilles or exhaust outlets using a flow hood. Determine the airflow in ductwork by using a Pitot tube with a differential pressure gauge or an anemometer

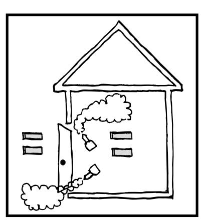
- Add the airflows (in CFM) from all exhaust fans serving the area you are measuring and enter the measurement in the Ventilation Log

> A room can be positively or negatively pressurized when compared to the spaces surrounding it. These spaces include another room, a corridor, or outdoors. To determine whether a room is positively or negatively pressurized, or neutral, release puffs of smoke near the top and bottom of a slightly opened door or window, and observe the direction of flow. Example: If the smoke flows inward at both the top and bottom of a slightly opened door, the room is negatively pressurized when compared to the space on the other side of the door.
>
> Negative pressurization may cause problems with natural draft combustion appliances, or cause outdoor pollutants such as pollens or vehicle exhaust in loading docks to be drawn into the building through openings.

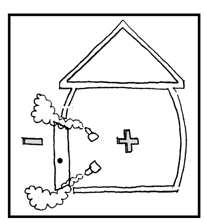
**Negative Pressure**



**Neutral Pressure**



**Positive Pressure**



### Step 2. Determine Occupancy

Count the number of students and staff located in areas served by the air handling unit (called the occupied zone). If you are estimating infiltration using exhaust fan airflows, count individuals in the area you have determined are affected by the fan(s) in Step 1.

- Using a small floor plan, mark the occupied zone served by the unit. In areas served by unit ventilators, an occupied zone is probably an individual classroom. In areas served by large air handling units, an occupied zone may include several rooms. A large gymnasium or other room may be served by several air handling units.

- Estimate the number of occupants in the occupied zone, including students, teachers, other staff members, volunteers and visitors.

**Step 3. Calculate Outdoor Air Per Person**

$$\frac{\text{Outdoor Air (CFM)}}{\text{Number of Occupants}} = \text{Outdoor Air (average CFM/person)}$$

- Use the equation below (the equation also appears on the Ventilation Log) to calculate average ventilation rates in CFM/person

### 3. Estimating Outdoor Air Using Carbon Dioxide Measurements

Carbon dioxide ($CO_2$) is a normal constituent of the atmosphere. Exhaled breath from building occupants and other sources increase indoor $CO_2$ levels above that of the outdoor air. $CO_2$ should be measured with a direct-reading meter. Use the meter according to manufacturer's instructions. Indoor $CO_2$ concentrations can, under some test conditions, be used to access outdoor air ventilation. Comparison of peak $CO_2$ readings between rooms and between air handler zones may help to identify and diagnose various building ventilation deficiencies.

**Step 1. Estimate quantity of outdoor air supply.**

$CO_2$ readings, with minimal delays between readings, can be taken at supply outlets or air handlers to estimate the percentage of outdoor air in the supply airstream.

The percentage or quantity of outdoor air is calculated using $CO_2$ measurements as shown below.

Outdoor air (%) = (CR-CS) ÷ (CR-CO) x 100

Where: CS = ppm of $CO_2$ in the supply air (if measured in a room), or in the mixed air (if measured at an air handler)

CR = ppm of $CO_2$ in the return air

CO = PPM of $CO_2$ in the outdoor air (Typical range is 300-450 ppm)

All these concentrations must be measured, not assumed.

To convert the outdoor air percentage to an amount of outdoor air in cubic feet per minute, use the following calculation:

Outdoor air (CFM) = Outdoor air (percent) ÷ 100 x total airflow (CFM)

The number used for total airflow may be the air quantity supplied to a room or zone, the capacity of an air handler, or the total airflow of the HVAC system. However, the actual amount of airflow in an air handler is often different from the quantity in design documents. Therefore only measured airflow is accurate.

**Step 2. Measure $CO_2$ levels in the area served by a given unit or exhaust fan(s) or in an area without any mechanical ventilation.**

The number of occupants, time of day, position of windows and doors, and weather should be noted for each period of $CO_2$ testing.

- Measurements taken to evaluate the adequacy of ventilation should be made when concentrations are expected to peak. It may be helpful to compare measurements taken at different times of day. Classroom $CO_2$ levels will typically rise during the morning, fall during the lunch period, then rise again, reaching a peak in mid-afternoon. Sample in the mid- to late-afternoon

- Take several $CO_2$ measurements in the area under consideration. $CO_2$ measurements for ventilation should be collected away from any source that could directly influence the reading (e.g., hold the sampling device away from exhaled breath)

- Take several measurements outdoors

- For systems with mechanically supplied outdoor air, take one or more readings at the following locations:

  - At the supply air vent

  - In the mixed air (if measured at an air handler)

  - In the return air

**Step 3. Note whether $CO_2$ levels are high.**

- Note locations with $CO_2$ concentrations of 1,000 ppm or higher. Elevated $CO_2$ indicates that there is not enough outdoor air for the number of people in the space (based on ASHRAE Standard 62, see **Appendix I** of the IAQ Coordinator's Guide)

- Note that there may still be underventilation problems in rooms with peak $CO_2$ concentrations below 1,000 PPM. $CO_2$ is produced by human respiration (breathing), and concentrations can change rapidly as people move in and out of a room. Four to six hours of continuous occupancy are often required for $CO_2$ to approach peak levels.

# ATC-20 Rapid Evaluation Safety Assessment Form

## Inspection

Inspector ID: ____________________

Inspection date and time: __________ ☐ AM ☐ PM

Affiliation: ____________________

Areas inspected: ☐ Exterior only ☐ Exterior and interior

## Building Description

Building name: ____________________

Address: ____________________

____________________

Building contact/phone: ____________________

Number of stories above ground: ____ below ground: ____

Approx. "Footprint area" (square feet): ____________

Number of residential units: ____________

Number of residential units not habitable: ____________

### Type of Construction

☐ Wood frame
☐ Steel frame
☐ Tilt-up concrete
☐ Concrete frame
☐ Concrete shear wall
☐ Unreinforced masonry
☐ Reinforced masonry
☐ Other: ____________

### Primary Occupancy

☐ Dwelling
☐ Other residential
☐ Public assembly
☐ Emergency services
☐ Commercial
☐ Offices
☐ Industrial
☐ Other: ____________
☐ Government
☐ Historic
☐ School

## Evaluation

Investigate the building for the conditions below and check the appropriate column.

| Observed Conditions: | Minor/None | Moderate | Severe |
|---|---|---|---|
| Collapse, partial collapse, or building off foundation | ☐ | ☐ | ☐ |
| Building or story leaning | ☐ | ☐ | ☐ |
| Racking damage to walls, other structural damage | ☐ | ☐ | ☐ |
| Chimney, parapet, or other falling hazard | ☐ | ☐ | ☐ |
| Ground slope movement or cracking | ☐ | ☐ | ☐ |
| Other (specify) ____________ | ☐ | ☐ | ☐ |

Estimated Building Damage (excluding contents)

☐ None
☐ 0 –1%
☐ 1 –10%
☐ 10 – 30%
☐ 30 – 60%
☐ 60 – 100%
☐ 100%

Comments: ____________________

____________________

## Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ____________________

____________________

____________________

## Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ____________________

____________________

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ____________

☐ Other recommendations: ____________________

Comments: ____________________

____________________

# ATC-20 Detailed Evaluation Safety Assessment Form

## Inspection

Inspector ID: ____________________

Affiliation: ____________________

Inspection date and time: ____________ ☐ AM ☐ PM

## Final Posting

from page 2

- ☐ Inspected
- ☐ Restricted Use
- ☐ Unsafe

## Building Description

Building name: ____________________

Address: ____________________

____________________

Building contact/phone: ____________________

Number of stories above ground: ____ below ground: ____

Approx. "Footprint area" (square feet): ____________

Number of residential units: ____________

Number of residential units not habitable: ____________

**Type of Construction**

- ☐ Wood frame
- ☐ Steel frame
- ☐ Tilt-up concrete
- ☐ Concrete frame
- ☐ Concrete shear wall
- ☐ Unreinforced masonry
- ☐ Reinforced masonry
- ☐ Other: ____________

**Primary Occupancy**

- ☐ Dwelling
- ☐ Other residential
- ☐ Public assembly
- ☐ Emergency services
- ☐ Commercial
- ☐ Offices
- ☐ Industrial
- ☐ Other: ____________
- ☐ Government
- ☐ Historic
- ☐ School

## Evaluation

Investigate the building for the conditions below and check the appropriate column. There is room on the second page for a sketch.

| | Minor/None | Moderate | Severe | Comments |
|---|---|---|---|---|
| **Overall hazards:** | | | | |
| Collapse or partial collapse | ☐ | ☐ | ☐ | ____ |
| Building or story leaning | ☐ | ☐ | ☐ | ____ |
| Other ____ | ☐ | ☐ | ☐ | ____ |
| **Structural hazards:** | | | | |
| Foundations | ☐ | ☐ | ☐ | ____ |
| Roofs, floors (vertical loads) | ☐ | ☐ | ☐ | ____ |
| Columns, pilasters, corbels | ☐ | ☐ | ☐ | ____ |
| Diaphragms, horizontal bracing | ☐ | ☐ | ☐ | ____ |
| Walls, vertical bracing | ☐ | ☐ | ☐ | ____ |
| Precast connections | ☐ | ☐ | ☐ | ____ |
| Other ____ | ☐ | ☐ | ☐ | ____ |
| **Nonstructural hazards:** | | | | |
| Parapets, ornamentation | ☐ | ☐ | ☐ | ____ |
| Cladding, glazing | ☐ | ☐ | ☐ | ____ |
| Ceilings, light fixtures | ☐ | ☐ | ☐ | ____ |
| Interior walls, partitions | ☐ | ☐ | ☐ | ____ |
| Elevators | ☐ | ☐ | ☐ | ____ |
| Stairs, exits | ☐ | ☐ | ☐ | ____ |
| Electric, gas | ☐ | ☐ | ☐ | ____ |
| Other ____ | ☐ | ☐ | ☐ | ____ |
| **Geotechnical hazards:** | | | | |
| Slope failure, debris | ☐ | ☐ | ☐ | ____ |
| Ground movement, fissures | ☐ | ☐ | ☐ | ____ |
| Other ____ | ☐ | ☐ | ☐ | ____ |

**General Comments:** ____________________

____________________

Continue on page 2

Building name: ______________________ Inspector ID: ______________________

## Sketch (optional)

Provide a sketch of the building or damaged portions. Indicate damage points.

## Estimated Building Damage

If requested by the jurisdiction, estimate building damage (repair cost ÷ replacement cost, excluding contents).

- ☐ None
- ☐ 0–1%
- ☐ 1–10%
- ☐ 10–30%
- ☐ 30–60%
- ☐ 60–100%
- ☐ 100%

## Posting

If there is an existing posting from a previous evaluation, check the appropriate box.

Previous posting: ☐ INSPECTED ☐ RESTRICTED USE ☐ UNSAFE Inspector ID: ____________ Date: _______

If necessary, revise the posting based on the new evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Local *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Indicate the current posting below and at the top of page one.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

______________________

______________________

## Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

______________________

☐ Engineering Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ____________

☐ Other recommendations: ______________________

______________________

______________________

Comments: ______________________

______________________

# INSPECTED

## LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

- ☐ **Inspected Exterior Only**
- ☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

______________________________________

______________________________________

______________________________________

______________________________________

Facility Name and Address:

______________________________________

______________________________________

______________________________________

Date ______________________________

Time ______________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

______________________________________
(Jurisdiction)

Inspector ID / Agency

______________________________________

______________________________________

______________________________________

**Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority**

# RESTRICTED USE

**Caution:** This structure has been inspected and found to be damaged as described below:

________________________________________
________________________________________
________________________________________
________________________________________

**Entry, occupancy, and lawful use are restricted as indicated below:**

- ☐ Do not enter the following areas: ____________
  ________________________________________
- ☐ Brief entry allowed for access to contents: _____
  ________________________________________
- ☐ Other restrictions: ________________________
  ________________________________________

Facility name and address:

________________________________________
________________________________________
________________________________________

Date ________________________________

Time ________________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

________________________________________
(Jurisdiction)

Inspector ID / Agency

________________________________________
________________________________________
________________________________________

**Do Not Remove, Alter, or Cover this Placard**
**until Authorized by Governing Authority**

# UNSAFE

## DO NOT ENTER OR OCCUPY
## (THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

______________________________________
______________________________________
______________________________________
______________________________________
______________________________________
______________________________________

**Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.**

Facility Name and Address:

______________________________________
______________________________________
______________________________________

Date ______________________________

Time ______________________________

This facility was inspected under emergency conditions for:

______________________________________
(Jurisdiction)

Inspector ID / Agency

______________________________________
______________________________________
______________________________________

**Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority**

**DISASTER SITE CLEANUP GUIDE**

**Intro:**
The general population may be exposed to many different hazards that could have significant consequences on life, property, and governmental functionality. The following disaster site cleanup guide identifies the following hazards that have the potential to adversely affect the residents and businesses in a given area:

- Floods
- Windstorms
- Tornado
- Winter Storm
- Wildfire
- Hazardous Material Spill
- Transportation Incident
- Civil Disorder
- Terrorism

***Natural disasters***
Use the following checklist to help determine the possible types of natural disasters that could occur in any given area.

***Floods***
Flooding typically falls into one of four categories:

1) Flash flooding
2) Riparian flooding
3) Lake flooding
4) Levee failures

Many areas around the country are vulnerable to one of the types of flooding. Normally localized to low-lying areas are most susceptible. Information on local flood hazards and flood maps can be obtained from the National Flood Insurance Program (NFIP). Flood damage can include total destruction or the need for building repairs required to bring the structure back into code compliance. Be sure to note ALL buildings and structures that are now grandfathered or very old as they may have been easily damaged, and require closer attention to safe entry.

## Windstorms

Thunderstorms accompanied by high winds are associated with relatively cold, dry air moving rapidly over a warm, moist surface air. The mid west states are extremely vulnerable to severe thunderstorms and high winds due to open flat land associated with them. This does not exclude other areas of the country. Normally these storms cover a wider area causing damage to towers, roofs, fences and damages caused from trees and other objects falling into structures. High winds normally do not cause a vast amount of total destruction, but will cause damages that must be repaired.

## Tornado

A tornado is a violent, rotating column of air forming a pendant, usually from a thunderstorm cloud, and touching the ground. A tornado's path averages four miles in length, but may extend over 200 miles. The path width averages 300 to 400 yards, but can exceed one mile. Tornadoes average 25 to 40 mph traveling speed, but may exceed 50 mph. Tornadoes will cause damages ranging from total destruction to repairs required to bring the structure back into code compliance.

## Winter Storm

Disturbances along the front between cold polar masses and warm tropical air masses tend to generate storms.

Fronts develop where air masses of different temperatures and densities mix and create instability. During cold winter months, such conditions can produce blizzards and/or ice storms. Typically, such storms have been wide spread, adversely affecting many people in several counties. When an area is hit by a winter storm, people may be injured or even killed. Livestock can die and crops may be lost.

## Wildfire

Wildfires are fires in the grasslands and rural areas of a state that primarily effect regions predominantly engaged in farming, ranching, and wildfire management. These fires can occur in any month of the year, but tend to occur most often in March through August and affect tens of thousands of areas annually.

***Man-made disasters***
Use the following checklist to identify and explain man-made disasters that could affect any given area during clean up.

**Hazardous Material Spill**
- Fixed facility
- Bulk storage
- Hospital and medical facilities
- Railroad
- University
- Transportation

**Gas Leak**
- Refinery
- Service station
- Bulk storage
- Electrical generating plant

**Chemical Release**
- Fixed facility
- Bulk storage
- Hospital and medical facilities
- Railroad
- University
- Transportation

**Nuclear Release**
- Fixed facility
- Hospital and medical facilities
- Universities

**Civil Disorder & Terrorism**
- Public buildings
- Transportation
- Communications
- Churches, synagogue, mosques

- Gas, chemical, nuclear and hazardous material explosions will cause damages radiating outward in all directions
- from the explosion site. The damages caused will range from total destruction to repairs required to bring the
- structure back into code compliance.

**Fixed Nuclear Facility Incident**

A nuclear facility incident is any occurrence at a fixed nuclear power facility resulting in a potential or actual release of radioactive material in sufficient quantity to constitute a threat to the health and safety of the off-site population.

**Transportation Incident**

Transportation accidents are defined as those roadway, railway, and/or airway incidents that cause significant numbers of deaths and/or severe injuries and/or property loss, excluding hazardous material and radiological transportation accident.

**Civil Disorder**

Civil disorder may occur during and following a disaster that disrupts normal community affairs and requires some type of law enforcement intervention to ensure public safety.

**Terrorism**

Event such as conventional attack or terrorist activities could threaten national or state security. Significant events of this type could cause widespread damage and threaten public safety.

**MAJOR BUILDINGS SURVEY FOR CLEANUP**

Use the following checklist to help determine the major buildings located in the disaster area. A checklist is a valuable tool for cleanup workers. It provides an inventory and identifier of locations of hazardous materials and the damage that may have already been assessed by structural inspectors in their evaluations of property, especially the descriptions of structural integrity.

For the purpose of this checklist all structures listed as singular may be plural due to the same structure at another location. Should additional comments be needed, relative to a particular facility, provide a more complete description and attach an additional sheet. (i.e. vehicles parked inside buildings, historic value, hazardous material storage and residential living areas, etc.)

## Government

| Building type | Name | Address | Location |
|---|---|---|---|
| Armories | | | |
| County buildings | | | |
| County court house | | | |
| Electric plant | | | |
| Federal buildings | | | |
| Fire station | | | |
| Municipal building | | | |
| Police station | | | |
| Sanitation | | | |
| Sewer plant | | | |
| State buildings | | | |
| Utility office | | | |
| Water plant | | | |
| Other buildings | | | |

## Schools

| Building type | Name | Address | Location |
|---|---|---|---|
| Grade Schools | | | |
| Middle Schools | | | |
| High Schools | | | |
| Private Schools | | | |
| Junior Colleges | | | |
| Trade Schools | | | |
| Universities | | | |
| Pre-school | | | |
| Day Care | | | |
| Other Schools | | | |

## Other Cleanup Areas

| **Building Type** | **Name** | **Address** | **Location** |
|---|---|---|---|
| Apartments | | | |
| Houses | | | |
| Churches | | | |
| Factories | | | |
| Malls | | | |
| Stadiums | | | |
| Hospitals | | | |
| Adult Care | | | |
| TV / Radio Stations | | | |

**DISASTER CLEANUP ASSESSMENT REPORT – RESIDENTIAL**

**LOCATION**
*Street*
*Address:*________________________________

**DAMAGE ASSESSMENT**
*Safe* _____ *Habitable* _____
*Limited Entry* _____ *Unsafe* _____
*Damage Percent* _______ *%*

**RECOMMENDATION**
*Follow up inspection required* _______

**INSPECTION NOTES**
*Exterior* _____ *Interior* _____

**DAMAGES NOTED**
*Foundation* _____ *Basement* _____
*Building off Foundation* _____

**EXTERIOR WALLS ROOF**
*Damaged* _____ *Leaning* _____
*Collapsed* _____ *Missing* _____

**INTERIOR WALLS FLOOR**
*Damaged* _____ *Leaning* _____
*Collapsed* _____ *Missing* _____

**STAIRWAYS**
*Damaged _____ Leaning _____*
*Collapsed _____ Missing _____*

**BUILDING OCCUPANCY**
*Single-Family _____ Two Family _____*
*Mobile Home _____ Multi-Family _____*
*Number of Apartments _____*

**BUILDING DESCRIPTION**
*Number of Stories _____*
*Basement: Yes _____ No _____ Unk _____*

**STRUCTURAL**
*Wood _____ Masonry _____*
*Steel _____ Concrete _____*
*Other _____*

**OCCUPANT INTERVIEW**
*Name ______________________________*
*Temporary Phone (_____) ______________*

*Structure ____ Contents ____ Flood____*
**OWNER INTERVIEW**
*Name _______________________________*
*Address _____________________________*
*City/State ___________________________*
*Zip Code____________________________*
*Telephone (_____) ____________________*
*Structure ____ Contents ____ Flood____*

**INSPECTOR NAME: ________________**
**ID No.__________.**
*Mo/Day/Yr ______________________________*
*Time ____________ AM__ PM__*

**DAMAGE CLEANUP ASSESSMENT REPORT – COMMERCIAL LOCATION:**

Address ________________________________
Lot/s _____________ Block ______________
Subdivision _____________________________

**DAMAGE ASSESSMENT:**
Safe _____ Habitable _____
Limited Entry _____ Unsafe _____
Damage Percent ________________%

**RECOMMENDATION:**
No Further Action Required _____
Detailed Inspection Required _____
Architect Evaluation Required _____
Engineer Evaluation Required _____
Barricades Required _____
Immediate Demolishing _____

**INSPECTION NOTES:**
Exterior _____ Interior _____ Both _____

**Damages Noted:**
Foundation _____ Basement _____
Building off Foundation _____

**Exterior Walls:**
Damaged _____ Collapsed_____
Leaning _____ Leaning _____

**Roof:**
Collapsed _____ Damaged _____
Missing _____

**Interior Walls Floors:**
Damaged _____ Leaning _____
Collapsed _____ Missing _____

**Stairways:**
Damaged _____ Leaning _____
Missing _____

**BUILDING OCCUPANCY:**
Commercial _____ School _____
Industrial _____ Church _____
Government _____ Museum _____
Name __________________________

**BUILDING DESCRIPTION:**
Number of Stories _____
Basement: Yes _____ No _____ Unk _____
Professional Frame:
Wood _____ Masonry _____
Steel _____ Concrete _____
Other _____

**REVIEWED BY (Cleanup Personnel):**
Name _________________________________
Affiliation _____________________________
Notes: _________________________________
___________________________________________
___________________________________________
___________________________________________
Time ____________ Am__ PM__

**Comments on the Back: Y _____ N ____**

# DAMAGE ASSESSMENT PLACARD
# Do Not Remove this Placard until Authorized by Governing Authority

# SAFE

**SAFE FOR OCCUPANCY**

**WARNING:**

**This structure has been inspected under emergency conditions and minimal damage has been found. Report any damage or unsafe conditions to the local authority.**

**ADDRESS____________________________ Date_________**

**Time______**

**INSPECTOR _________________ ID No. ________**
**Type Inspection: Exterior Interior**
**Contact the Inspection Department and/or Jurisdiction Authorities for a copy of the damage report for cleanup purposes. All damage repairs must comply with local building codes and regulations.**

**DAMAGE ASSESSMENT PLACARD**
**Do Not Remove this Placard until**
**Authorized by Governing Authority**

# HABITABLE

REPAIRS ARE REQUIRED

**WARNING:**

This structure has been inspected under emergency conditions and repairs are required. Report any damage or unsafe conditions to the local authority.

ADDRESS ________________________ Date ________

Time ______

Inspector __________________ ID No. ________

Type Inspection: Exterior Interior

Contact the Inspection Department and/or Jurisdiction Authorities for a copy of the damage report for insurance purposes. All damage repairs must comply with local building codes and regulations.

**DAMAGE ASSESSMENT PLACARD**
**Do Not Remove this Placard until**
**Authorized by Governing Authority**

# UNSAFE

Enter at Your own Risk! Do Not Occupy!

WARNING:

This structure has been inspected under emergency conditions and is not be safe to enter due to serious structural damage.

Entering this structure may result in death or injury.

ADDRESS ________________________Date_______

Time ________

Inspector ________________ ID No. ________

Type Inspection: Exterior Interior

Contact the Inspection Department and/or Jurisdiction Authorities for a copy of the damage report for insurance purposes. All damage repairs must comply with local building codes and regulations.

# Summary

This document provides examples of various types of disasters and their definitions. These could occur in any area throughout the country, and a system should be in place to address each issue associated with a disaster, including cleanup. It also provides examples of site cleanup checklists that may be used for residential and business structures. Warning signs or placards that may be attached to any building following a disaster are important tools for disaster cleanup workers and should be recognizable. Some examples of warning signs and placards are included in this document; even though they may be in a different format the information should be the same.

# Mold Testing

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## Introduction - The Questions

Homeowners want to know if they have a mold problem. Investigators want to find out where the mold is. Insurance companies want to know if the mold has been cleaned up. Doctors want to know if there has been exposure to mold. So why not do mold testing? This sounds very scientific. If only it were that simple. The problems with testing are:

• Airborne fungal spore concentrations vary greatly over the course of hours, days, weeks and seasons. A sample taken at one instant in time, at one location, may not be representative of typical conditions.

• There are no numerical standards to which tests can be compared making interpretation difficult.

• Even extensive, well made tests cannot determine how much exposure people had in the past.

• Fungal air tests are expensive to make. Any money spent on mold testing will not be available for cleaning up the mold and fixing the water problem that led to the mold.

• It may be days, often weeks before the results of testing are known.

Testing for mold should be done to answer specific questions that can't be answered by easier, more accurate or more direct approaches with fewer uncertainties. Neither the New York City (NYC) Department of Health nor the Environmental Protection Agency (EPA) recommend measuring airborne fungal levels.

The likelihood that airborne samples will provide information that careful inspection does not is very small. Airborne sampling should be limited to instances where people are experiencing symptoms that seem to be mold related, but no mold is found by inspection.

## How Do You Answer the Questions?

If you see mold or you smell mold you have mold. You do not need to test for mold if you see it or smell it. Knowing the type of mold does not change the way you respond. All mold should be treated the same way. It should be removed without exposing people to lots of mold spores or fragments and the underlying moisture problem causing the mold should be fixed. Knowing the species (type) of mold does not affect what must be done to correct the moisture problem or to safely clean up the mold.

What you do need to know is the size of the areas that are contaminated and where the areas are located so you can plan the clean-up and protect people from exposure during the clean-up. The greater the area that has mold, the more careful you have to be in how it is cleaned up. Both the NYC Department of Health and the EPA mold remediation guidance are based on the extent of the visible mold growth.

Determining the amount of surface area of moldy surfaces is done by looking. Since mold problems are caused by water problems, looking carefully where water is likely to be or where water likely had been is the best approach to looking for mold. It is easier to "find" the water problem by looking for water than it is to find the water problem by testing for mold.

How to inspect for mold? Look in the places where you might find water. Remember that mold may grow in hidden spaces such as within walls or beneath furniture and cabinets. Air testing will not tell you where the mold is coming from – it will only tell you that it is in the air at the instant in time the air sample was taken. The air testing may provide an inference as to a source, but not the specific location. The source for the mold still has to be found. Sampling is no substitute for inspection. However, inspection can often be a substitute for testing.

## What Testing Cannot Answer

Mold testing procedures were not developed to determine whether a home is "safe" or "healthy" or "clean". Presently no standards exist to determine "safe", "healthy" or "clean". Indoor mold testing procedures were developed to identify the locations where mold is growing or where it has grown – the mold "reservoir" locations or mold "amplification" sites.

Part of the problem is that no one knows what typical conditions are for homes, offices and schools – there is no "baseline" for comparison. Research is going on to answer this question. One day we will know, but we don't know now and it will be many years before we know the answer to this question.

The other part of the problem is that there is no "dose-response" curve for mold and humans. We just don't know how much exposure to which molds and for how long leads to problems. It's even more difficult when you realize that no two people are alike. Research is also going on to answer this question and one day we will also have the answer to this question. This question is far more difficult than the previous question and it will likely take much longer to answer. Common sense tells us that "too much" mold for "too long" is a problem for most people. Prudent avoidance is the best course of action at present.

Mold testing is not necessary to quantify "too much". Too much mold in a home is obvious. If you see mold and you smell mold – you have mold – and if you see it and you smell it you probably have too much of it.

Remember, mold needs water. No water, no mold. In fact it is more basic than that. No water problem, no mold problem. Find the water problem and you will find the mold.

If a home has mold and the water problem that led to mold is obvious it is pointless to test for mold. The mold testing will not tell you anything that you don't already know you have to do which is to clean up the mold and fix the water problem that led to the mold.

Mold testing is expensive. Any money spent on mold testing will not be available for cleaning up the mold and fixing the water problem that led to the mold. Also, the samples can take days or weeks to be analyzed – time that is lost that could better be spent cleaning up the mold and fixing the water problem. No recognized authoritative public agency recommends mold testing to guide the clean-up or to direct correction of the water problem.

Mold testing – especially air testing - is often inaccurate. Air samples at best give a “snapshot” of the air in one location at one time – air samples are not representative of air conditions over time unless many air samples are taken over a long period of time. Air sampling typically overestimates or underestimates the amount of mold in the air on average throughout the day.

## How Do I Look for Moisture and Mold?

Look in the places where you might find water that has leaked in from the outside, leaked from interior water sources or has condensed on cold surfaces

• The high spots - roofs and attics, especially near dormers and valleys, roof penetrations for plumbing vents or skylights and walls that intersect roof planes

• The low spots - basements and crawlspaces

• The holes - doors, windows (especially under windows since water usually migrates down from the area of the leak)

• Plumbing pipes and fixtures - water tanks, toilets, sinks, dishwashers, showers, clothes washers and the ceilings underneath these if they are located on an upper floor

• The cold spots - areas in contact with the outside (especially corners of closets), surfaces that are cooled by air conditioning (especially ducts that are near exterior walls or in soffits that connect to exterior walls)

Look carefully in wet places that also have materials that are good mold food:

• processed wood products - paper, paper covered gypsum board, cardboard, particle board, OSB, fiberboard

• wood products - lumber, plywood

### Going Deeper - finding hidden mold:

Mold may grow in hidden spaces. The most likely hidden spaces for mold growth are in exterior walls or ceilings or spaces that contain water pipes or air conditioning ducts that are open to crawl spaces or foundations materials. Hidden spaces that frequently hide mold are:

• behind or beneath cabinets, furniture, shelving, appliances fixtures, storage containers; under sinks, cabinets, cardboard boxes, toilets; on walls behind headboards, bookcases, sofas, dressers, file cabinets or toilets.

• behind wall, ceiling or floor surfaces - under vinyl wallpaper, mopboards (the space under kitchen and bathroom cabinets), under carpet or vinyl flooring

There are a number of ways to try to figure our whether mold is growing in any of these locations. Inspection is the most direct method and has the most useful return on effort. Move the furniture; look under boxes, behind toilets and inside closets. Examine vinyl wallpaper for lumps and bumps and pink or purple bleed-through spots. Moisture meters can help determine whether a material is wet, even when it appears dry and can therefore help locate a moisture source or reservoir; the moisture meter provides immediate results. Several fiberoptic instruments (boroscopes and endoscopes) permit looking inside cavities through a small hole. However, this method is not as reliable as opening up the cavity and looking directly. If you are going to cut open a wall, be careful. In the process you could release a large amount of mold into the air. At a minimum have a good vacuum to collect the dust and protect yourself from exposure with a dust mask (N95 mask available at most home improvement stores).

## How Do I Know How to Clean Up If I Don’t Test?

How to clean up the mold should be based on how much mold is present. The more mold present, the more careful you have to be in how it is cleaned up.

The amount of mold present is best determined by how much surface area is covered with mold. Mold remediation guidelines developed by the EPA and others are based on this principle. The number of square feet of mold present on moldy surfaces determines the approach to the clean up.

Determining the amount of surface area of moldy surfaces is not done by mold testing. It is done by looking. It is done by looking everywhere. In order to do this it is often necessary to cut holes in walls, ceilings and floors to see. Since mold problems are caused by water problems looking carefully where water is likely to be or where water likely has been is the best approach to look for mold.

## Where Testing is Useful

Biological measurements sometimes provide useful information in finding hidden mold when thorough inspection has not found moisture or mold.

Comparing air samples in many rooms and outdoors sometimes provides evidence that there is fungal growth or at least a reservoir of spores inside a building. However, there are problems with using this method as an assessment tool:

• Large variations over hours, days, seasons require numerous samples, systematically made to be certain that the sample are representative. (Variations are the result of intermittent spore release and the dynamics of air transport).

• There is a difference between total spore counts and viable spore counts. Total spore counts are more representative of allergen load than viable spore counts. Viable spore counts represent a fractional subset of the total spore count and may grossly underestimate the total amount of mold in the air.

• Viable spore counts can provide some information that total spore counts cannot. Only viable spore counts permit speciation, the identification of fungi to the species level. This may be useful in trying to distinguish whether air borne spore counts reflect an outdoor or indoor source.

• Samples that show no evidence of indoor growth can be false negatives. “No growth” cannot be used to conclude that there is not an indoor source of mold.

Because of these uncertainties many samples should be taken to increase the probability of obtaining useful information.

The likelihood that airborne samples will provide evidence that inspection does not is very small. Reserve air sampling for mystery cases, where things smell moldy or people complain of symptoms that are consistent with mold exposure, but no mold is found upon inspection.

## What if the Insurance Company or a Lawyer really wants Mold Testing?

If an insurance company or a third party requires "testing to verify the presence of mold," simply send a piece of moldy material to a qualified lab for verification of the presence of mold (follow the lab's procedures for handling and shipping the sample.)

If it is important for someone to make an estimate (educated guess) of the fungal exposures people have received, then you need to contact someone who has extensive experience in mold investigations. The "educated guess" may or may not involve airborne testing since airborne testing was not developed to assess exposure. And remember, it is only an educated guess.

## How Do I Know If The Mold is Cleaned Up If I Don't Test?

The mantra for clean-up is **"clean and dry."** If you don't see it or smell it on a surface you probably don't have it. And if you do have some, even though you don't see it or smell it – you certainly don't have much of it. A little bit of residual mold is not a problem unless moisture is available. Remember, mold is everywhere. Even if the clean-up removes 100 per cent of the mold, spores that are in the air will reintroduce mold back into the cleaned area. The "white glove test" and common sense are currently the best approach. No dust and dirt – no mold. Clean everything for dust and dirt and everything will be clean of mold.

All surfaces must be free of debris, dust and dirt. There may be residual mold left in the building that is unseen, but this is acceptable. The object is not to sanitize or sterilize the building. The object is to avoid exposing people to large amounts of mold. Bear in mind that many of the molds that colonize buildings are common in the outdoor air where spore levels may be very high (often having counts of hundreds of cfu/cubic meter, periodically thousands and occasionally tens of thousands). Even if the clean-up does remove 100 per cent of the mold, outdoor air will quickly reintroduce mold spores into the cleaned area. This is why the underlying moisture problem must be corrected to prevent the recurrence of mold.

This brings us to the second part of the clean-up mantra- **dry, dry, dry**. A little bit of mold is not a problem. A little bit of residual moisture may be a problem. Materials that have been salvaged must be dry before reconstruction begins. Wooden materials should be less than 15 per cent moisture content by weight and concrete should be less than 4 per cent moisture by weight.

# Sampling Overview and Interpretations

## Sample Overview

| Sample | Target | Type | Quantification | Equipment |
|---|---|---|---|---|
| Air-o-cell | air | non-cultured | spores/$m^3$ | sampling pump + Air-o-cell cassettes |
| Allergenco | air | non-cultured | spores/$m^3$ | Allergenco sampler + greased slides |
| Andersen | air | cultured | CFU/$m^3$ | Andersen sampler + petri dishes |
| Bulk[a] | bulk\dust | cultured[a] | CFU/g [b] | none |
| Swab[a] | bulk\dust | cultured[a] | CFU/$m^2$ [c] | sterile swab (Q-tip or cotton ball will work) |
| Tape-lift | bulk\dust | non-cultured | semi-[d] | clear sticky tape (scotch, etc...) |

[a] Bulk and Swab samples can be tape-lifted for direct examination

[b] Quantification of cultured Bulk sample requires that more than 1 gram of sample be provided

[c] Quantification of cultured Swab sample requires that the area sampled (9 $cm^2$, 1 square inch, etc...) be measured and provided

[d] Not for true quantification, but a semi-quantitative rating is provided (trace, minor, major, abundant)

Notes:

Non-cultured - viable and non-viable spores (and other particulate) directly examined under a microscope

Cultured - viable spores are grown in a petri dish for several days before identification

CFU - colony forming unit

General:

Non-cultured samples involve direct exam and identification of individual spores. Some mold types such as Aspergillus and Penicillium are not distinguishable by their spores alone, so for non-cultured samples some molds have to be grouped together like Aspergillus\Penicillium. Direct exams do not require any growing time, so rush or same day results are available at additional cost.

Cultured samples are grown in a petri dish for several days before analysis, and the entire colony, not just the spore, is utilized for the identification. This enables better or more exacting identification of certain mold types, but certain molds don't grow at all in standard culture media or will grow very slowly. Additionally, dead spores will not grow at all even though these spores can have the same health effects as viable spores. Rush results are not available because cultures require a certain amount of time to grow (7-10 days, which can vary from sample to sample.)

*Stachybotrys* in particular does not grow well in standard culture media, and direct examination is the preferred method of identification (airocell/allergenco or tape). If you are specifically testing for *Stachybotrys* using a cultured method, then other media types such as Rose Bengal might be preferred or requested instead of Malt Extract Agar.

Gravity plates (commonly found in "home test kits") are not generally used by professionals

## AIR-O-CELL SAMPLES
## ALLERGENCO SAMPLES

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Air-o-cell and Allergenco samples require specialized equipment. This type of sample is a non-cultured air sample. Results are reported in concentrations of spores per cubic meter (spores/$m^3$). This test is referred to as a "snapshot" of the air at the exact time of sampling. Results account for both alive and dead spores as well as pollen, skin, insect parts etc. (if a *full profile* analysis is requested). It is important to note that allergic reactions can come from dead spores and alive spores alike. In addition, the toxins that some fungal spores produce remain toxic after the spore itself has died. Air-o-cells can also be used to test inside a wall cavity (by removing a light switch panel or other opening. Usually only 15 to 30 liters is the most one can sample before completely overloading the sample with drywall dust.) Normal laboratory turnaround time is usually several days, but rush or same day results are available for additional cost.

*Interpretation of Results*

The general guideline to follow is that the concentration and types of spores in the inside sample should be similar to or lower than the concentration and types of spores found in the out of doors sample. Do to the high variability in results, this test is mainly useful as a "check" to alert one to potential problems that might have been missed by visual inspection. Accurate measurements of true airborne concentrations requires multiple samples taken during different times, and it can involve complex statistical analysis. The category Aspergillus / Penicillium are small (1-3 microns), round, colorless spores that may include: Gliocladium, Trichoderma, other morphologically consistent with Aspergillus / Penicillium types. A culture sample would be necessary to differentiate between them. Currently there are no dose response relationship statistics for allowable or safe levels of aeroallergens. However if spores of Aspergillus / Penicillium are found at higher levels than outside, or Stachybotrys are found inside at even low concentrations, further investigation of the source should be conducted and evaluated by a professional. For information about types of molds found on the lab report, please see glossary page.

**How to sample**

- What you need: Air-o-cell = a high volume pump (15Lpm) and Air-o-cell cassettes
- Allergenco = Allergenco sampling unit, greased slides and slide protector box

**Air-o-cell Sampling Procedure:**

1. Calibrate pump to 15 LPM
2. Open round end of cassette and attach to pump
3. Open square end of cassette
4. Sample for 5 to 10 minutes at 15 LPM; sample inside complaint area, non-complaint area, and out of doors.
5. Wall cavity samples should be run for only 1 to 2 minutes.
6. Replace stickers on both ends of cassettes and label the samples with a sample number and location and volume.

**Allergenco Sampling Procedure:** please refer to owner’s manual supplied by the manufacturer

## ANDERSEN SAMPLES

Andersen samples require specialized equipment. This type of sample is a cultured air sample grown in the laboratory on Malt Extract Agar or other media. Results are reported in concentrations of CFU's per cubic meter (CFU/$m^3$). Results indicate the number of viable (alive) spores in the air at the time of sampling. Cultured samples such as this allow better differentiation of certain mold types such as Aspergillus and Penicillium because once growth occurs, you are identifying colonies rather than just individual spores. On the other hand, certain molds do not grow or compete well on standard culture media. Analysis does not and cannot include counts for dead spores, pollen, skin, insect parts, etc. It is important to note that allergic reactions can come from dead spores as well as live spores. In addition, the toxins that some fungal spores produce remain toxic after the spore itself has died. Normal laboratory turnaround time is 7 to 10 days (cultures require time to grow and it is impossible to provide rush service.)

*Interpretation of Results*

The general guideline to follow is that the concentration and types of colonies found in the inside sample should be similar to or lower than the concentration and types of colonies found in the out of doors sample. Do to the high variability in results, this test is mainly useful as a "check" to alert one to potential problems that might have been missed by visual inspection. Accurate measurements of true airborne concentrations requires multiple samples taken during different times, and it can involve complex statistical analysis. Currently there are no dose response relationship statistics for allowable or safe levels of aeroallergens. Please note that Stachybotrys does not grow well on most laboratory media and an absence of Stachybotrys on a culturable sample report should not rule out this type of mold. For information about types of molds found on lab report, please see glossary page.

**How to sample**

- What you need: An Andersen sampling unit and Malt Extract Agar or other media plates (provided by the lab)

**Andersen Sampling Procedure:** please refer to owner's manual supplied by the manufacturer

## BULK SAMPLES

Bulk samples are a little trickier to take than swabs or tape-lifts, and these are more appropriate for certain kinds of materials where the spores might be present beneath the surface (such as thermal insulation.) These are usually analyzed by culturing, though the surface can also be tape-lifted (see below) for direct exam. The cultured sample is grown in the laboratory on Malt Extract Agar or other media. Results are reported in concentrations of colony forming units per gram of sample (CFU/g). The results of a bulk sample culture can be problematic because of the inconsistency of contamination of the material sampled. Additionally, Stachybotrys does not grow well on standard culture media, and an absence of Stachybotrys on a culturable sample report should not rule out this type of mold. Normal laboratory turnaround time is 7-10 days for culture and/or several days for direct exam. Rush or same day results at additional charge are available for direct exams, but cultures require time to grow and it is impossible to provide rush service for these.

*Interpretation of Results*

less than 10,000 is low
10,000 to 100,000 is medium
100,000 to 1,000,000 is medium to heavy
greater than 1,000,000 is heavy

For information about types of molds found on lab report, please see glossary page.

**How to Sample**

- What you need: a cutting tool (scissors, knife, etc.), baggies

**Bulk Sample Procedure:**

1. Remove approx. 1 square inch of material (about the size of a quarter). Try not to touch the sample with bare hands (use the baggie like a glove).
2. Place sample in baggie
3. Note the location the sample was taken from. If you take more than one sample, write a unique number (01, 02, 03, etc…) and a brief description distinguishing it from the other samples (AHU supply vent, AHU return vent etc…) (Some individuals also photograph the area sampled and keep this for their records.)

## SWAB SAMPLES

Swab samples are easier to take, however, you must have a sterile swab for testing (these are available from Moldlab for a nominal fee). This type of sample can be cultured and\or analyzed directly. For the cultured swab, results are reported in colony forming units per square inch of material. For direct exam swab samples, results are reported semi-quantitatively like tape-lifts (trace, minor, major, abundant). Swab samples are a good choice if the suspect area is hard to access, or if you wish to do a direct exam and a culture from the same spot. Be aware that large surfaces can have multiple mold types spanning across it, and a single one square inch swab might not be inclusive or representative of all the molds. Normal laboratory turnaround time is 7-10 days for cultures and/or several days for direct exam. Rush or same day results at additional charge are available for direct exams, but cultures require time to grow and it is impossible to provide rush service for these.

*Interpretation of Results*

Cultured swab samples are used if both concentration and type of mold data is needed. For information about types of molds found on lab report, please see the glossary page.

**How to Sample**

- What you need: sterile swabs (available from Moldlab for nominal fee)

**Swab Procedure:**

1. Simply swab about a square inch or so of area at the sample site. If you want quantification, measure out the area sampled and record this. Areas you might want to sample include areas of visible mold growth that are hard to access. For example, the air duct supply and return vents are good locations to sample.
2. Place each swab back into the original swab protection tube
3. Note the location the sample was taken from. If you take more than one sample, write a unique number (01, 02, 03, etc…) and a brief description distinguishing it from the other samples (AHU supply vent, AHU return vent etc…) (Some individuals also photograph the area sampled and keep this for their records.)

## TAPE LIFT SAMPLES

Tape samples are the quickest and easiest method of testing. No special equipment is needed for this non-cultured sample. Results are reported semi-quantitatively as a rating (trace, minor, major, abundant) so that one can have an idea of relative amounts if more than one mold is present, though this test is primarily used qualitatively to identify visible mold or to check surfaces for trace amounts of Stachybotrys. If results are negative, a bulk or swab culture of the material might be recommended to verify results because spores can be down inside the material and can be missed by direct exam. Also, be aware that large surfaces can have multiple mold types spanning across it, and a single square half-inch tape-lift might not be inclusive or representative of all the molds. Most people use this test in combination with an quantitative analysis such as Andersen or Air-o-cell / Allergenco. Normal laboratory turnaround time is several days, though rush and same day results are available for additional cost.

*Interpretation of Results*

To be used to identify the type of mold to a Genus level in most cases. Not generally used for quantitative analysis, though each mold type present is rated in terms of trace, minor, major, or abundant amounts. For information about types of molds found on lab report, please see glossary page.

**How to Sample**

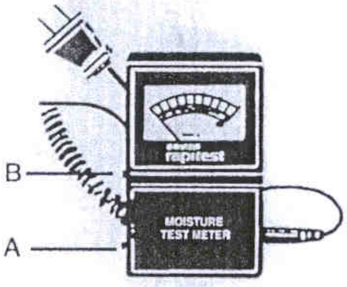
- What you need: clear tape, ziploc type baggies or slide box.

**Tape Lift Procedure:**

1. Simply depress a piece of <u>clear or invisible</u> tape to the visible mold or suspected area and lift off about a nickel size portion. Make sure there are no folds or wrinkles in the tape at the area of interest. Areas you might want to sample include spots of visible mold growth or color, damp materials like wallboard, and\or maybe places that collect dust to see what has fallen out of the air.
2. Only about a half inch square portion of the tape will be analyzed. Certain materials like wallboard might require multiples samples to be taken because multiple colonies of Stachybotrys, Aspergillus niger, Chaetomium, and others can exist side by side but be indistinguishable by the naked eye.
3. Place each sample you wish to be tested into separate Ziploc or airtight baggies and stick it against the inside of the bag. Do <u>not</u> stick the tape back on itself. Another option is to place the tape sample sticky side down on a glass slide, then place the slide in slide container or an airtight baggie.
4. Note the location taken. If you take more than one sample, write a unique number (01, 02, 03, etc...) and brief description distinguishing it from the other samples (Bathroom tile, Bathroom wallpaper, etc...) (Some individuals also photograph the area sampled and keep this for their records.)

# THE SONIN RAPITEST MOISTURE TEST METER

The SONIN RAPITEST MOISTURE TEST METER is designed to alert users to possible moisture problems. The metal contact at the end of a 3 foot coiled cable detect moisture present in difficult to reach locations. The 10 point scale corresponds to moisture levels from 10-28%.Scale and reference chart correlate relative and moisture % readings. Use it to check surfaces before painting, wallpapering or laying floors or tile.




READ COMPLETELY AND BE SURE YOU UNDERSTAND ALL INSTRUCTIONS BEFORE USING THIS TOOL.

## BEFORE USE:

Install a 9V battery (not included) in the battery compartment, pressing tabs firmly in place. Move the ON/OFF switch to the ON position. Move the MOISTURE TEST switch (B) to BATTERY TEST . If the meter moves to the "V"section of the meter, the unit is ready to start testing. If the needle on the meter does not move to reach the "V"section, replace the battery.

## INSTRUCTIONS FOR USE:

Move the ON/OFF switch (A) to ON. Move the MOISTURE TEST switch (B) to MOISTURE TEST. Firmly insert the end of the coiled cable into the connector on the side of the meter. Press the probes about 1/8" (4mm) into wood, wallboard or soft material to be tested. For concrete, brick or "hard" materials and painted surfaces, hold the probes against the surface to be tested. The needle on the meter will move to show the extent of moisture present.

| METER READING | MOISTURE CONTENT | METER LABEL |
|---|---|---|
| no movement | 0 - 10% | SAFE |
| 0 - 1 | 10 - 14% | SAFE |
| 1 - 2 | 14 - 15% | SAFE |
| 2 - 3 | 15 - 16% | ATTENTION |
| 3 - 4 | 16 - 16.5% | ATTENTION |
| 4 - 5 | 16.5 - 17% | ATTENTION |
| 5 - 6 | 17 - 18% | ATTENTION |
| 6 - 7 | 18 - 19% | ATTENTION |
| 7 - 8 | 19 - 20% | ATTENTION |
| 8 - 9 | 20 - 22% | ACTION |
| 9 -10 | 22 - 28% | ACTION |

IMPORTANT: Abnormally high readings may be caused by the surface salts on newly plastered walls or by contact with metal or steel reinforcing bars, etc- behind a particular surface. Readings on concrete should be interpreted with caution and should be assessed in conjunction with a physical investigation. The test meter may indicate damp conditions at very low levels of moisture.

## FOR MORE INFORMATION:

For additional information, or help using any SONIN products, call SONIN Customer Service at
(800) 223-7511
Website: www. sonin.com
e-mail: info@sonin. com

## THE SONIN RAPITEST MOISTURE TEST TOOL

The SONIN RAPITEST MOISTURE TEST TOOL is designed to alert users to possible moisture problems. The metal contact and 4 lamp system tell how much moisture is present. Check surfaces before painting, wallpapering or laying floors or tile.


**READ COMPLETELY AND BE SURE YOU UNDERSTAND ALL INSTRUCTIONS BEFORE USING THIS TOOL.**

**BEFORE USE:**

Install a 9V battery (not included) in the battery compartment, pressing tabs firmly in place. Keep probes from touching anything, including your fingers to complete this test. Press the TEST button, Green lamp will light of battery is good and tool is ready to start testing. If green lamp is faint or fails to light, replace the battery.

**INSTRUCTIONS FOR USE:**

Remove cap (A) from top of the MOISTURE TEST TOOL. Press the probes about 1/8"(4mm) into wood wallboard, or "soft" material to be tested, For concrete, brick or "hard" materials and painted surfaces, hold the probes against the surface to be tested. Press and hold the red test button. The lamps will light to show the extend of moisture present.

| LAMP | % | LABEL |
|---|---|---|
| GREEN | 0-14 | DRY |
| GREEN +1 RED | 14.5-15.5 | NORMAL |
| GREEN +2 RED | 15.2-20 | ATTN* |
| GREEN +3 RED | 20.0-100 | ACTION** |

* Requires further investigation
** Requires immediate action

**IMPORTANT:** Abnormally high readings may be caused by the surface salts on newly plastered walls or by contact with metal or steel reinforces bars, etc., behind a particular surface. Readings on concrete should be interpreted with caution and must be assessed in conjunction with a physical investigation. The test tool may indicate damp conditions at very low levels of moisture.

**FOR MORE INFORMATION:**

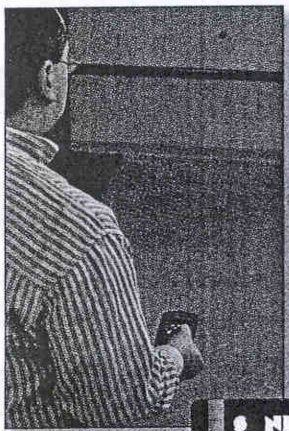
For additional information, or help using any SONIN products, call SONIN Customer Service at (800)223-7511 Email:info@sonin.com between 9:00 a.m. and 5:00 p.m. Eastern Time.

# Eliminate Guesswork.
# Target Your Measurements With A Laser.

Just when you thought measuring couldn't get any easier or more convenient, SONIN comes up with a bright new idea: the Laser Targeting Range Finder.

Just point, press, and a high-visibility laser* shows you where you are aiming, while the ultrasonic beam takes an instant, accurate measurement. Narrow beams of sound waves "bounce" off solid objects back to the hand-held receiver. Custom electronics and a micro-processor convert elapsed time into a distance measurement and display it on the LCD. No more guesswork — just easy, accurate, repeatable results, from up to 60 feet away. It's as easy to use as pointing and pushing a button.

The Range Finder provides measurements in feet/inches/fractions, decimal feet, yards or meters.




*Laser pointer is for reference use only. See package for full details.

***FEATURES***

This compact unit has a host of powerful, convenient features.

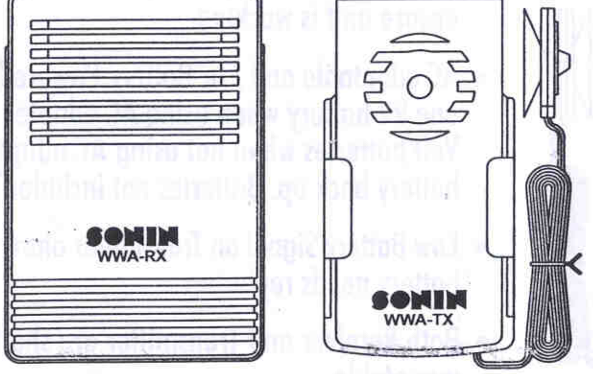
| | **Laser Targeting Range Finder** |
|---|---|
| *Class II Visible Laser* | ✔ |
| *Minimum Measurement Off Wall* | *1'10"/56 cm* |
| *Maximum Measurement Off Wall* | *60'/18 m* |
| *Smart Beam Cone* | ✔ |
| *Adds Linear Measurements, Areas or Volumes* | ✔ |
| *Subtracts Linear Measurements* | ✔ |
| *Computes Areas & Volumes* | ✔ |
| *Units of Measure* | *ft:in:frac, dec ft, yds, m* |
| *Tracking & Validate Measurement Modes* | ✔ |
| *Measures From Bottom of Unit* | ✔ |
| *Measures From Top of Unit* | ✔ |
| *One-Push Measurement* | ✔ |
| *Memories* | seven |
| *Temperature Compensation & Read Out* | ✔ |
| *On/Off Switch* | ✔ |
| *Protective Pouch Included* | ✔ |
| *One-Year Warranty* | ✔ |
| *# Of 9 Volt Batteries Required (not included)* | one |
| *Low Battery Warning* | ✔ |
| *Auto Off* | ✔ |

*Range may be longer or shorter depending on environmental factors. Accuracy is 99.5% ± 1/4".*

# Wireless Water Alarm

## The SONIN Wireless Water Alarm helps prevent costly water damage that may otherwise go undetected.

### Now you can be alerted of water leaks or overflows up to 50 feet away.

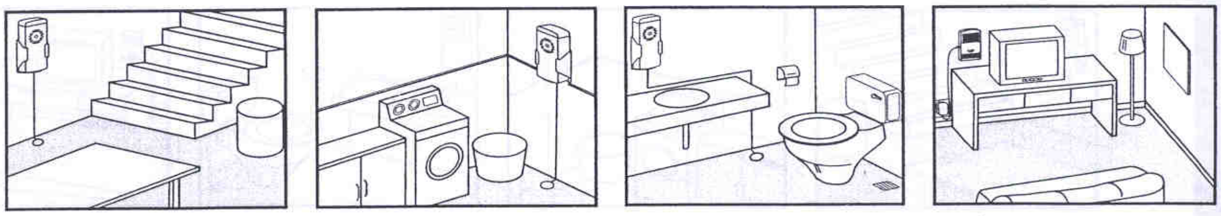



Model: #03300

- Typical Transmitter range up to 50 feet - You place Receiver where you know you will hear it!
- Test button allows you to periodically activate to ensure unit is working.
- AC adaptable and / or Battery Powered (requires one 9V battery when using AC adapter or two 9 Volt batteries when not using AC adapter or as a battery back up. Batteries not included).
- Low Battery Signal on Transmitter alerts you when battery needs replacing.
- Both Receiver and Transmitter are shelf or wall mountable.
- Security Code setting to avoid false triggering.
- AC Adapter for Receiver included.

*Three easy steps:*
1. *Place remote sensor where water might collect and hang transmitter up to 6 feet away.*
2. *Then place Receiver within your range of hearing up to 50 feet away from transmitter - even on another floor.*
3. *Test Unit to make certain it is within range.*

*You are set! In the event of a leak or overflow the alarm will sound for up to three days!*



*Ideal near hot water heater, washing machine, dishwasher, or as a sump pump back up. Even use to fill a tub or swimming pool by placing the suction cup at the point where you want to be alerted!*

SONIN Inc., Phone : 800-223-7511 • Website : www.sonin.com


SONIN®
The Measure of Excellence®

GROUP ACTIVITY

Monitoring and Assessment - MOLD

Date:________________

Area:______________________________________________________

Notes: _____________________________________________________

___________________________________________________________

Area:______________________________________________________

Notes: _____________________________________________________

___________________________________________________________

Area:______________________________________________________

Notes: _____________________________________________________

___________________________________________________________

Area:______________________________________________________

Notes: _____________________________________________________

___________________________________________________________

# Monitoring and Assessment

# SOME MOLDY FACTS

In many cases, ***you won't even see mold!***
It often grows between walls and in hidden places.

Seeing a ***small*** patch on a wall may indicate a ***large*** mold infestation behind the wall.

If you can see or smell mold, you have mold and you do not need to test for it!

Knowing the type of mold does not change the way you respond. All mold is treated the same way.

# MOLD = WATER

Since mold problems are caused by water problems, looking carefully for where water is or where water has been is likely the best approach to looking for mold.

*"It is easier to find the water problem by looking for water than it is to find the water problem by testing for mold".*

# OH WHERE OH WHERE CAN IT BE?

- The high spots: roofs, gutters, dormers, attics, vents, sky lights.
- The low spots: basements & crawlspaces
- The cold spots: areas in contact with outside and areas and surfaces cooled by air conditioning
- The holes: doors & windows
- Pipes & fixtures: water tanks, toilets, showers, sinks, dishwashers, refrigerators
- Wood products: paper, gypsum or particle board, cardboard, lumber, plywood

*One of mold's favorite foods is wood!*

# WHAT AM I LOOKING FOR

- Visible Growth
- Musty or Earthy Odor
- Water Stains, trails of water
- Lumps, Bumps, Warping
- Discoloration or “bleed through” spots

Visible black biogrowth under floor tile in the utility closet

# WHAT INFO MIGHT BE HELPFUL?

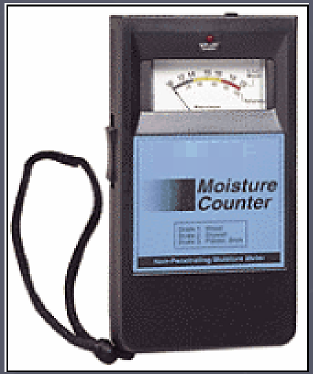
- Occupant Illness
- Building History: Age, Recent Construction, Remodeling
- Previous Water Damage: When, Where
- Previous Remediation & Sampling

# WHAT WILL I NEED TO MONITOR & ASSESS?

- Floor plan or Map
- Inspection Log
- Markers to identify areas
- Camera to photograph areas
- Instrument(s) to measure moisture

# Measuring Moisture In or On a Surface

**Non-Penetrating Moisture Meter:**
*Pro*: Different settings
*Con*: False readings from nails, metal ducts, etc.




**Penetrating Moisture Meter:**
*Pro*: Moisture content of all building materials
*Con*: Destructive

# Group Activity

# SAMPLING

WHY?

Pre-remediation samples are proof that mold spores exist and post-remediation samples are proof that mold spores have been removed. Air sampling is a good way to monitor for cross contamination.

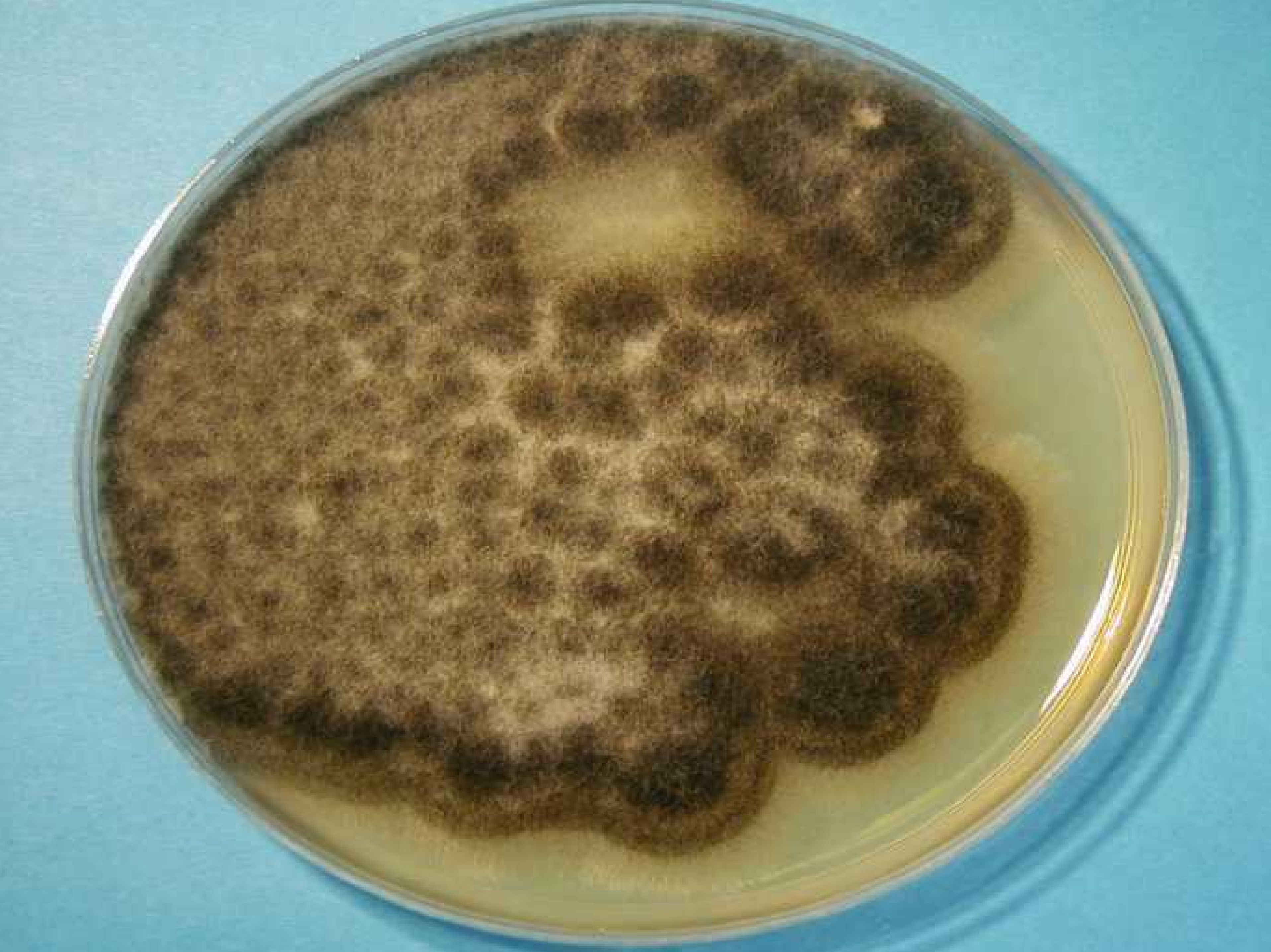
# MOLD SAMPLING

- Can confirm the presence of mold when inspection cannot
- **Types of mold** can be determined under microscope
- **Species & count** can be determined by culture (mold growth)
- Culture results are reported in concentrations of colony forming units per gram or inch of sample (CFU/g or CFU/in)
- Not all molds are receptive to all sampling methods
- Mold growth varies according to temperature, moisture content, season, etc. making it difficult to obtain representative samples
- Normal laboratory turnaround time is several days for microscope analysis and 7-10 days for culture analysis
- Currently, there are no numerical standards to which tests can be compared making interpretation difficult.

# Air Samples

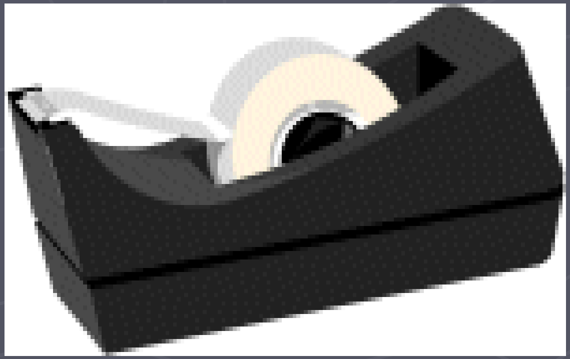
- Air is pumped through a filter
- Particles are trapped on filter
- Filter sent for analysis at lab
- Microscope & Culture Analysis


Tyvek



# Tape Samples (Surface)

- Utilizes clear adhesive tape
- Strip mold from surface
- Microscope analysis



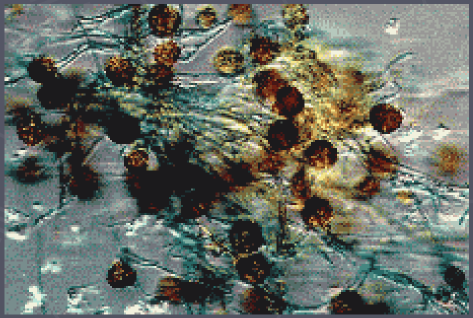
# Swab Samples (Surface)

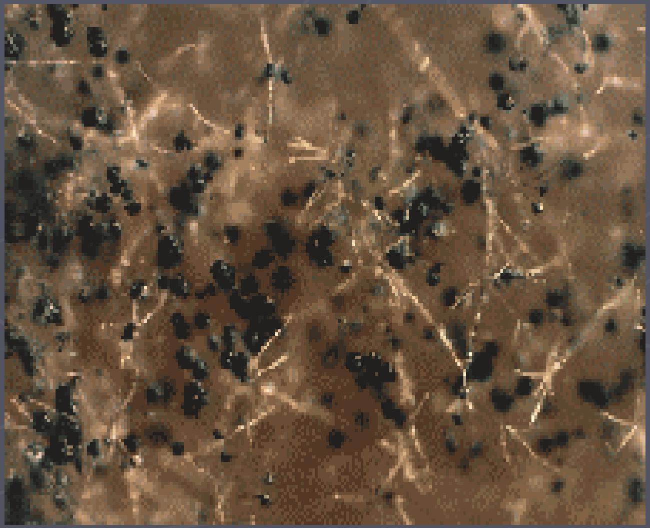
- Sterile swab used to collect mold
- Often used in hard to access areas
- Color metric, microscope or culture analysis

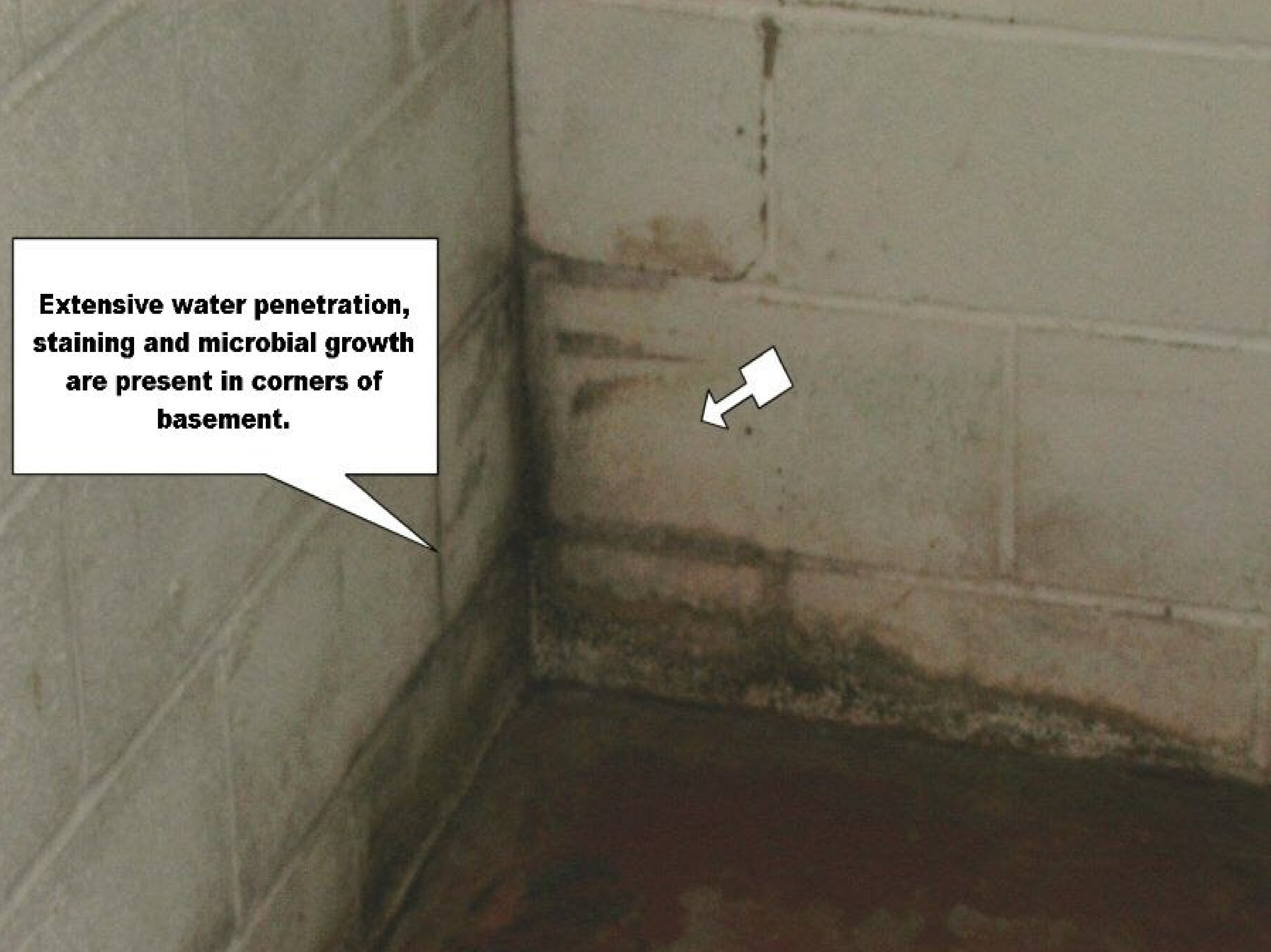
# Bulk Samples

- Collection of actual material
- Good for analysis where mold is suspected “beneath the surface”
- Microscope and culture analysis
- Sampling is often destructive

Especially useful for particle board, wallboard, insulation, carpeting, filters and carpet dust.



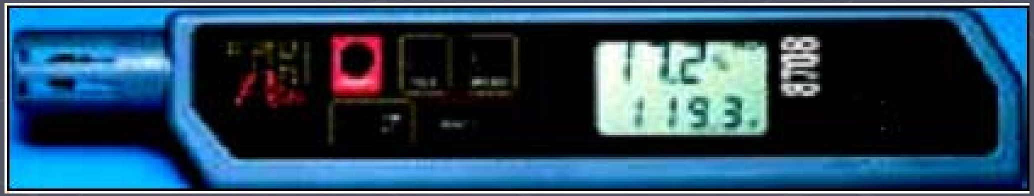


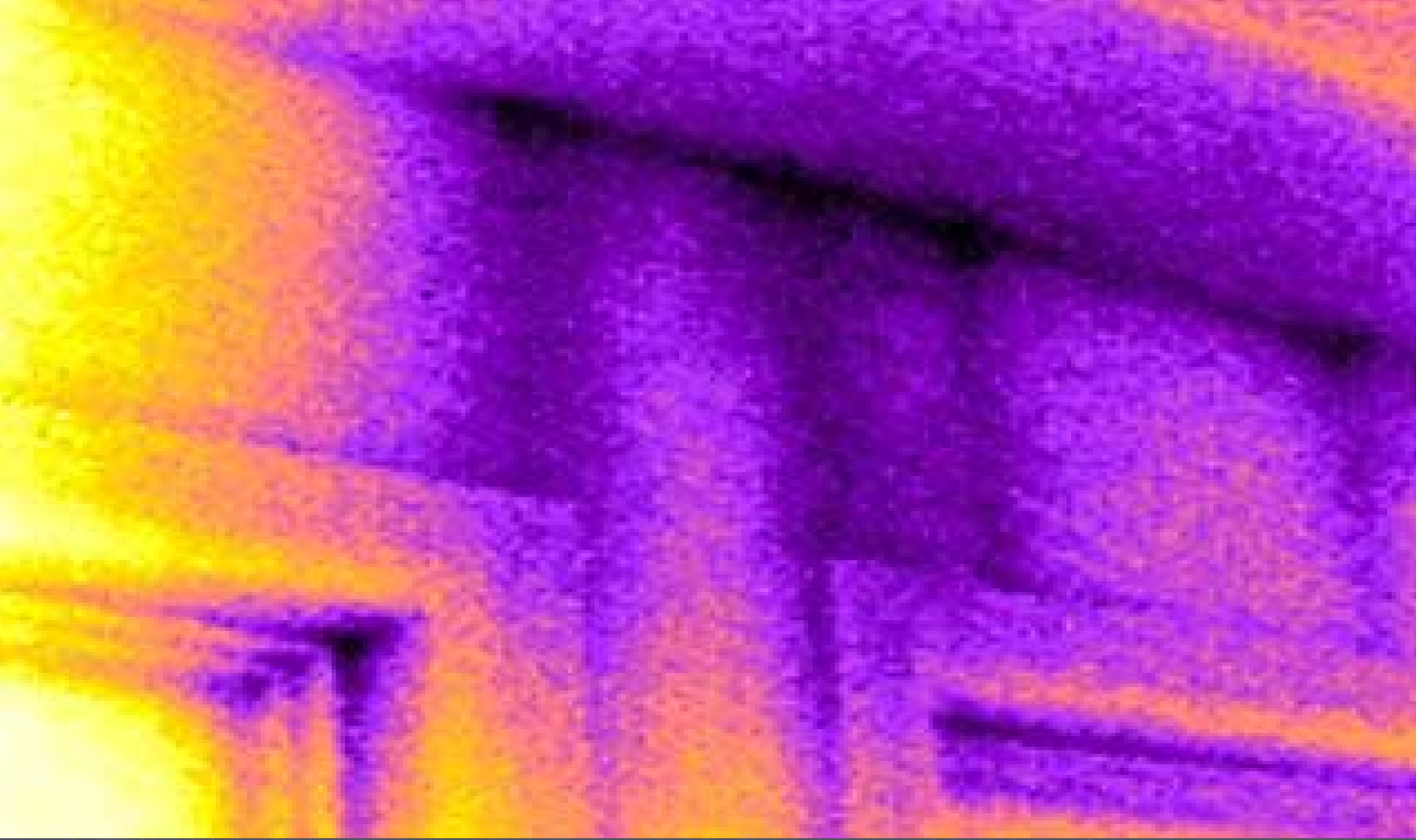

Extensive water penetration, staining and microbial growth are present in corners of basement.

# Measuring Moisture in Air

**Thermo-hygrometer** = An instrument which measures both temperature and water vapor in air as a percentage (relative humidity).

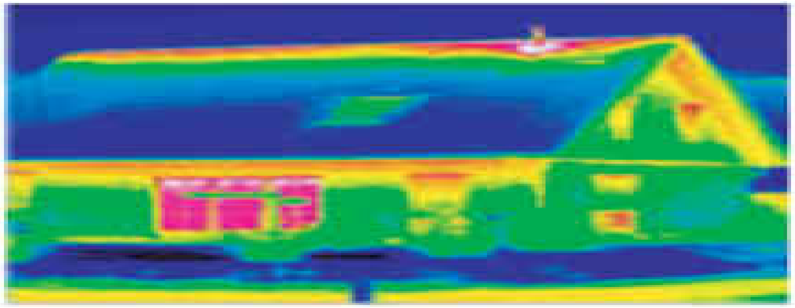






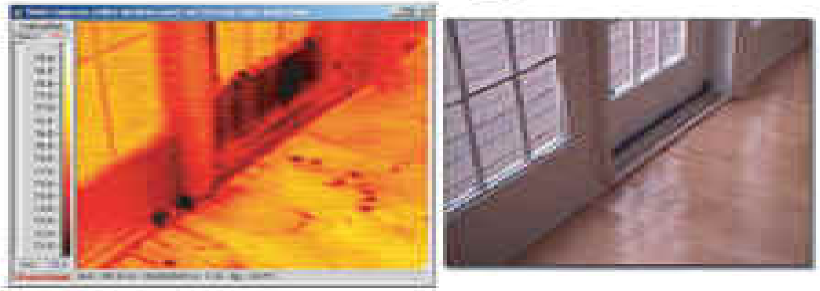
Moisture present in roofs and walls can be detected with our sensitive infrared camera. The temperature difference created by the presence of moisture on the inside surface of a wall will appear differently than the surrounding area.

# Thermal Infrared Camera Images



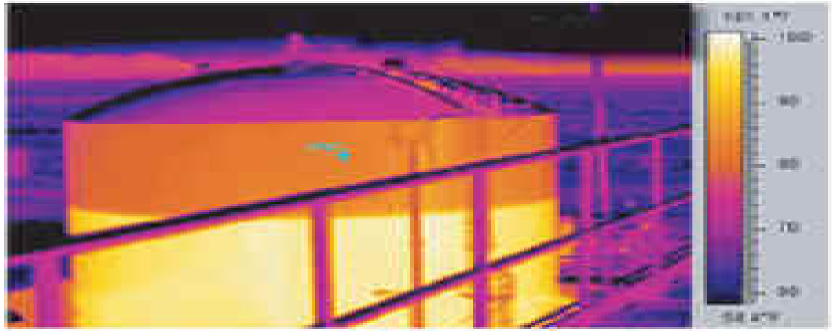
House showing heat/cold


Faucet showing heat/cold

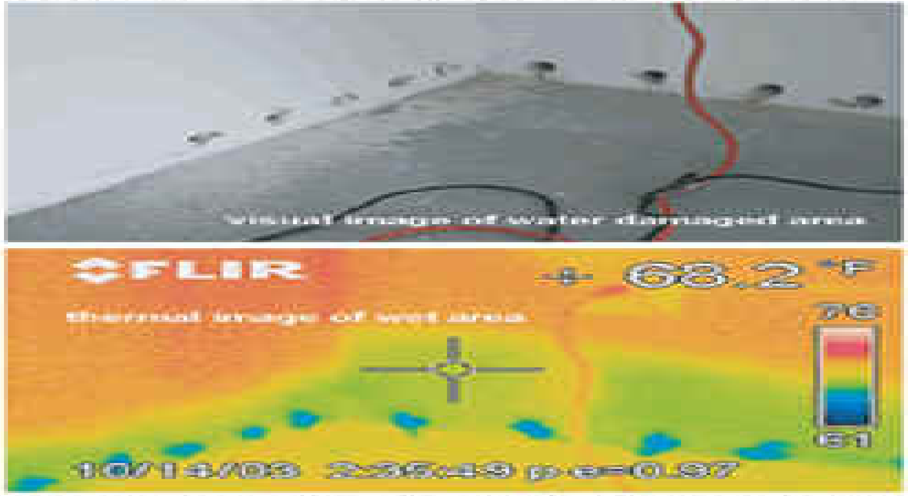


Doorway showing water damage


Ceiling showing water penetration




Tank showing liquid heat/cold




Corner showing heat/cold/moisture

**How can we be sure that it is wet?**

# - RECAP -

## What 5 things are needed for mold to grow

**Food Source**

**Air**

**Surface for growth**

**Desirable Temperature**

**“MOISTURE”**

If you eliminate one of these requirements then mold stops. Which one do you eliminate?

# Any questions?

# Tab 5

# PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal Protective Equipment (PPE) is "*equipment for the eyes, face, head, and extremities, protective clothing, respiratory devices, protective shields and barriers*". [1]

For information on Respirators or Protective Clothing refer to those specific chapters in this Resource Manual. This chapter shall be an overview of the OSHA Standard covering PPE (Subpart I) but the focus will be on combinations of PPE needed to be properly protected when working with chemicals or responding to accidental spills involving chemicals. These combinations of PPE are often referred to as "levels of protection".

## Who pays for PPE? Employer or Employee?

Ever since the PPE standard has been in force, there has been an on going debate as to who is responsible for paying for PPE used in the work place. It was not clear if, **"shall be provided"** from Subpart I-Personal Protective Equipment 1910.132(a) [General Requirements] was intended to say that the employer must pay for the PPE or that the employer must just make it available.

OSHA has decided to address this issue through administrative action, including rulemaking. OSHA Administrator Charles N. Jeffress said that the agency will also, "*revise its policy directive to make clear that we expect employers to pay for protective equipment that is not uniquely personal in nature and that employees must use to perform their jobs safely*"[2]

As with other health and safety issues, strong and clear contract language is always recommended for your best protection.

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1 OSHA Subpart I; Personal Protective Equipment 29 CFR 1910.132 (a)

2 *Occupational Safety and Health Reporter*, Vol. 27, No. 29, Page 1048, December 17, 1997.

# OSHA SUBPART I: PERSONAL PROTECTIVE EQUIPMENT

Subpart I consists of several sections [3]. They are:

| | |
|---|---|
| 1910.132 | General Requirements |
| 1910.133 | Eye and face protection |
| 1910.134 | Respiratory protection |
| 1910.135 | Head protection |
| 1910.136 | Foot protection |
| 1910.137 | Electrical protective equipment |
| 1910.138 | Hand protection |

# SUMMARY BY SECTION

## 1910.132 General requirements

**(a) Application:** Personal Protective Equipment must be provided when needed to protect any part of the body from injury or impairment.

**(b) Employee owned equipment:** If a worker provides his/her own PPE the employer is responsible to insure it is the proper type and is properly maintained.

**(c) Design:** All PPE must be safely designed for the work to be performed.

[3] This summary will not include the sections on Respiratory Protection or Electrical Protective Equipment. These sections are separated out by OSHA in 1910.132 (g) which states ...**"Paragraphs (d) and (f) of this section do not apply to 1910.134 and 1910.137."**

**(d)** **Hazard assessment and equipment selection:** The employer must assess the workplace to determine if hazards are present, or are likely to be present, which would require the use of personal protective equipment. (Appendix B of the standard explains how to perform a hazard assessment.) If such hazards are present, the employer must:

(i) Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.

(ii) Communicate selection decisions to each affected employee, and

(iii) Select PPE that properly fits each affected employee

**(e) Defective and damaged equipment:** Defective and damaged equipment shall not be used.

**(f) Training:** Each worker required to use PPE must be trained to know at least the following:

(i) When PPE is needed

(ii) What PPE is needed

(iii) How to properly don, doff, adjust, and wear PPE

(iv) The limitations of PPE

(v) The proper care, maintenance, useful life and disposal of the PPE

**Each affected employee must be able to demonstrate an understanding of the training in this section.**

<u>Circumstances that require re-training include but are not limited to:</u>

(i) changes in the work-place render previous training obsolete.

(ii) changes in the types of PPE to be used render previous training obsolete.

(iii) the affected employee has not retained the requisite understanding or skill.

**The employer must have written certification that training has been received and understood by each affected employee.**

## 1910.133 Eye and face protection

**(a) General requirements:** Workers must wear appropriate eye and face protection when exposed to flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. Sideshields are required when there are flying objects. When a worker wears prescription lenses they must either wear safety glasses that incorporate the correction or wear protective goggles over their glasses.

**(b) Criteria for protective eye and face devices:** Protective eye and face devices must comply with ANSI Z87.1-1968 criteria.

## 1910.134 Respiratory protection

**There is an entire Resource Manual chapter dedicated to respirators. Refer to this for more information.**


## 1910.135 Head protection

**(a) General requirements:** Workers must wear protective helmets when there is potential for injury to the head from falling objects.

**(b) Criteria for protective helmets:** Helmets must comply with the provisions of ANSI Z89.1-1969.


## 1910.136 Foot protection

**(a) General requirements:** Workers must wear protective footwear when there is potential for injury to the foot from falling and rolling objects, objects piercing the sole, and exposure to electrical hazards.

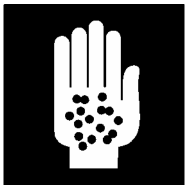
**(b) Criteria for protective footwear:** Footwear must comply with the provisions of ANSI Z41.1-1967.

## 1910.138 Hand protection

(a) **General requirements:** The employer must select and insure that employees use the proper glove when hands are exposed to hazards such as:

- skin absorption of harmful chemicals
- cuts or lacerations
- abrasions
- punctures
- chemical burns
- thermal burns
- harmful temperature extremes

## (b) Selection:



The employer must select the glove best suited to the specific job. The hazards and potential hazards must be identified (***hazard assessment)*** and the glove selected based on this information. According to the guidelines in Appendix B [3(a)(c)(d)] this assessment should contain the following three steps:

**Workplace Survey:** This walk-through should identify sources of hazards to workers. The categories of hazards to look for are:

T impact
T penetration
T compression (rollover)
T chemical
T harmful dust
T light (optical) radiation
T rolling or pinching objects
T electrical hazards

**Organize data:** Bring all the information together for use in making the proper glove selection.

**Analyze data:** Decide, based on all the information gathered what level of risk for potential injury exists.

# Levels of Protection

The term "levels of protection" refers to the different combinations of PPE that can be worn together for emergency response. There are specific things that need to be considered when selecting the "level of protection". Some of these considerations are:

- ## Identification of the hazards:

  We must first know what the hazardous substance is before we can select the proper "level of protection". For responses to emergency releases, we will rarely have time to measure concentrations and should assume that "IDLH" levels exist. ***"As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand".*** [4]

- ## Routes of entry:

  We need to know how hazardous chemicals get into our system and harm us. The four basic routes of entry are **inhalation, ingestion, absorption, and contact**.

***Inhalation:*** This is exposure as a result of breathing the hazardous substance into the lungs.

***Ingestion:*** This is exposure as a result of somehow getting the hazardous substance into the stomach. This can be done easily by eating with contaminated hands, biting your finger nails, etc.

***Absorption:*** This is exposure as a result of the hazardous substance permeating through intact skin. This does not require that the worker come in contact with or be directly splashed by the hazardous substance. Gases and vapors from the hazardous substance can permeate the skin and enter the system without the worker ever knowing that it has occurred.

***Contact:*** This is exposure as a result of the hazardous substance contacting the skin and doing damage to it which destroys the skins ability to offer protection as a barrier. We must also consider eye contact.

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[4] 29 CFR 1910.120 Appendix B

! **Task:**

The work to be done while wearing the PPE is a factor in the selection of "levels of protection". Although a substance such as Benzene is a skin absorber, you would probably select a different combination of PPE for cleaning up 2 ounces that had been spilled in the lab than you would for responding to a spill of several hundred gallons. Consideration must be given to the flammability of the hazardous substance when a flash suit may be needed.

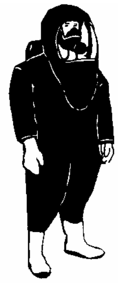
! **Performance of PPE:**

We must consider how well selected PPE will perform as a barrier to the anticipated hazards. ***"The amount of protection provided by PPE is material/hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work duration."***[5]

## Levels of Protection for Emergency Response

The following are guidelines from Appendix B of the OSHA standard entitled "Hazardous Waste Operations and Emergency Response" (29 CFR 1910.120). You will most likely use a combination of Personal Protective Equipment (PPE) selected from the different protection levels (i.e. A, B, C, or D). Proper selection will depend on the hazards of the task to be performed. These guidelines however, do not address the materials of the PPE in relation to the task. The description of the levels found in Appendix B are as follows:

[5] 29 CFR 1910.120 Appendix B



# Level A

1. Positive pressure, full face-piece Self Contained Breathing Apparatus (SCBA) or Positive pressure, Supplied Air Respirator (SAR) with escape SCBA

2. Totally - encapsulating chemical protective suit (note: At the time the standard was written, the National Fire Protection Association was in the process of developing standards on chemical protective clothing. These standards are referenced by OSHA in appendix B. The NFPA standard that applies to Level A is NFPA 1991 and requires that the suit be **GAS TIGHT**.)

3. Coveralls (Optional)

4. Long underwear (Optional)

5. Gloves, outer, chemical-resistant

6. Gloves, inner, chemical-resistant

7. Boots, chemical-resistant, steel toe and shank

8. Hard hat (under suit) (Optional)

9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit)

**Level A should be used when:**

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system ..... harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.[6]

[6] 29 CFR 1910.120 Appendix B (Part B)

# Level B

*Used when the highest level of respiratory protection is necessary but a lesser level of skin protection is needed.*

1. Positive pressure, full face-piece Self Contained Breathing Apparatus (SCBA) or Positive pressure Supplied Air Respirator (SAR) with escape SCBA

2. Hooded chemical-resistant clothing (this can be either non-encapsulating or encapsulating that is <u>not</u> gas-tight)

3. Coveralls (Optional)

4. Gloves, outer, chemical-resistant

5. Gloves, inner, chemical-resistant

6. Boots, outer, chemical-resistant steel toe and shank

7. Boot covers, outer, chemical-resistant, disposable (Optional)

8. Hard hat (Optional)

9. Face shield (Optional)

Level B should be used when the hazardous substance has been identified and measured and requires a high level of respiratory protection, but less skin protection.

# Level C

*This level is used when the concentration and type of airborne substance is known and the criteria for using air purifying respirators are met.*

1. Full-face or half-mask, air purifying respirators
2. Hooded chemical-resistant clothing
3. Coveralls (Optional)
4. Gloves, outer, chemical-resistant
5. Gloves, inner, chemical-resistant
6. Boots (outer), chemical-resistant steel toe and shank (Optional)
7. Boot-covers, outer, chemical-resistant (disposable) (Optional)
8. Hard hat (Optional)
9. Escape mask (Optional)
10. Face shield (Optional)

Level C should be used when:

1. The hazardous substance will not adversely affect or be absorbed through any exposed skin;
2. All criteria for the use of air purifying respirators have been met.[7]

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[7] 29 CFR 1910.120 Appendix B (Part B)

# Level D

*A work uniform affording minimal protection, used for nuisance contamination only.*

1. Coveralls
2. Gloves (Optional)
3. Boots/shoes, chemical-resistant steel toe and shank
4. Boots, outer, chemical-resistant, disposable (Optional)
5. Safety glasses or chemical splash goggles
6. Hard hat (Optional)
7. Escape mask (Optional)
8. Face shield (Optional)

**Level D should be used when:**

1. The atmosphere contains no known hazards;
2. Work function creates no potential for contact with hazardous substances.[8]

[8] 29 CFR 1910.120 Appendix B (Part B)

# *Respirators*

*There are two main categories of respirators:*

## *Air Purifying Respirators*

***and***

## *Supplied Air Respirators*

***Air Purifying Respirators (APRs)***: *These provide protection by passing the contaminated air through a "purifying" element before it reaches the wearer.*

***Supplied Air Respirators (SAR):*** *These provide protection by supplying an alternate source of uncontaminated air.*

*The first part of this Respirator Section concentrates on the uses and limitations of Air Purifying Respirators.*

*The second part focuses on Self-Contained Breathing Apparatus (SCBA), and includes a brief summary of the OSHA Respiratory Protection Standard.*

# The Respiratory Protection Standard [29 CFR 1910.134(a)(1)] states:

> *"In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section."*

So before respirators are ever issued, the employer must try to control the hazard through engineering controls. All personal protective equipment is used as a **last resort** or as back-up protection because if the equipment fails, the worker is exposed. Also, no personal protective equipment is fail-proof. Just like there is no clothing that will protect against all chemicals, respirators leak because of their design and their inability to conform to every individual facial feature. As a result, selecting the proper respirator is very important to your safety and will be thoroughly explained in this chapter. But even the most protective respirator has its limitations so engineering controls should always be done first, if at all feasibly possible.

Also, workers must have medical clearance to determine if they are physically able to perform the work and use the equipment.[1] If they are not, they cannot wear a respirator. This is just part of the respirator program that must be in place before respirators can be issued. More specific requirements of the OSHA Respiratory Protection Standard can be found on pages 23 - 25. This revised Respirator Standard went into effect October 5, 1998.

[1] 29 CFR 1910.134(c)(1)(ii)

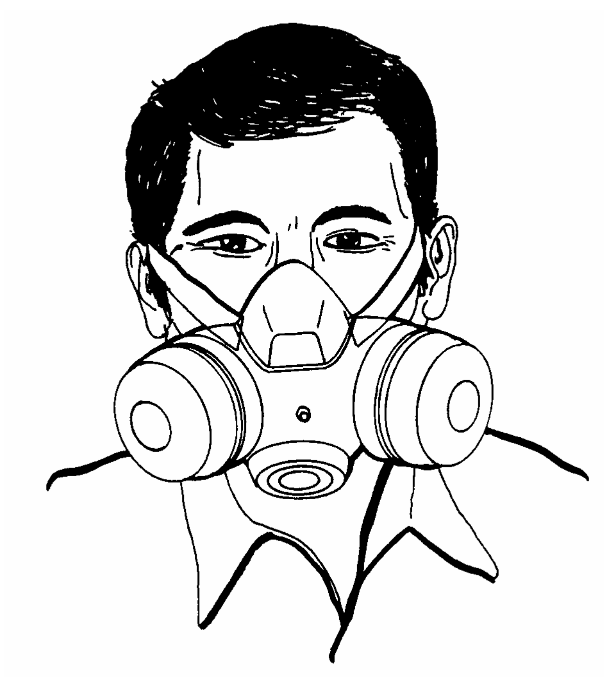
# Air Purifying Respirators

**Air Purifying Respirators (APRs)** are the most commonly used type of respiratory protection. APRs use cartridges or canisters to "purify" the air.

## There are two kinds of APR canisters:

- ones which mechanically filter out dusts and particulates
- ones which use activated carbon or other adsorbent material to "capture" hazardous vapors and gases

**There is no one canister or cartridge which can be used to protect against all vapors or gases.**



# Selection of Air Purifying Respirators

The following steps must be considered when deciding whether conditions allow the use of **Air Purifying Respirators**.

## STEP ONE: Is there at least 19.5% oxygen in the air?

1

**Check oxygen content first**. If it is less than 19.5% you cannot use an APR. According to the Respiratory Protection Standard, all oxygen-deficient atmospheres are considered IDLH atmospheres (Immediately Dangerous to Life and Health) [1910.134(d)(2)(iii)] and so supplied air respirators are required [1910.134(d)(2)(i)].

**If there is at least 19.5% oxygen in the atmosphere, then before selecting an APR you must identify the chemical and its concentration.**

**Remember** - APRs only clean the air, they don't supply oxygen. If there is less than 19.5%, oxygen you must use an air-supplied respirator, such as a Self Contained Breathing Apparatus (SCBA).

## STEP TWO: Can you identify the chemical contaminant?

You need to know the chemical in order to select the correct canister.

2

**If you cannot identify the chemical, you cannot use an APR**. The Respirator Protection standard says if "the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH" [1910.134(d)(1)(iii)]. As stated above, supplied air respirators are required for IDLH atmospheres.

Even if the contaminant can be identified, **NIOSH** recommends that **APRs not be used for protection against carcinogens** since there is no known safe level of exposure to cancer-causing chemicals.

**STEP THREE**: **What is the concentration of the known contaminant?**

**3**

After measuring the oxygen content and identifying the chemical you need to find out how much of the chemical is present.

**Monitoring is the best method to find out the concentration of the chemical.** CAUTION: under 1910.134(d)(1)(iii) the employer is allowed to make a "reasonable" estimate of employee exposure. If the employer cannot identify or reasonably estimate the worker exposure, the atmosphere is considered IDLH.

**Note: If an estimate of the concentration is used, you may question the findings.**

**APRs cannot be used when the concentration of a contaminant is immediately dangerous to life or health (IDLH).** [1910.134(d)(2)]

**Immediately Dangerous to Life and Health (IDLH)**:

Conditions that have the potential to pose an immediate threat to life or could cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. For many chemicals, there are specific concentrations at which they become IDLH.

**For example**, the IDLH for hydrogen sulfide is 100 ppm[2].

**You must know the IDLH of the chemical you are potentially**

2 NIOSH Pocket Guide to Chemical Hazards (81994)

**exposed to**. Although APRs are approved for use in concentrations up to the IDLH, there are many other factors which must be considered before you decide that an APR will provide adequate protection.

**So, in summary, IDLH conditions include the following:**

- Unknown concentrations of chemicals in the atmosphere
- Oxygen-deficient atmospheres
- Atmospheres in excess of published IDLH limits

In addition, the new 1910.134 standard [1910.134(g)(3)] has specific procedures that must now be followed for IDLH atmospheres. For example, at least one employee has to be located outside of the IDLH atmosphere and there must be some type of communication between the employee inside the IDLH atmosphere and the one outside. The employee outside of the IDLH atmosphere must also be equipped with a supply air respirator and have a way of retrieving the employee inside the IDLH atmosphere.

## <u>STEP FOUR:</u> Does the respirator have an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant or does the employer have a change schedule for canisters and cartridges based on objective data?

**4**

The respirator must either be equipped with an **end-of-service-life indicator** (ESLI) certified by NIOSH for the contaminant **or the employer must have a change schedule** for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. [1910.134(d)(3)(iii)(B)] **Service Life** is the length of time a canister/cartridge will effectively remove contaminants. Canisters/cartridges have only limited capacity to remove contaminants from the air. When that limit is reached, the canisters/cartridges can no longer remove the contaminant. Previously a contaminant had to have adequate warning properties or an ESLI. The problem with adequate warning properties is that not everybody may be able to detect it.

**There are many factors which can shorten the service life of a canister or cartridge. These include:**

- **Improper storage** or storage in either a very dry or very humid environment
- **Breathing rate of the wearer**. If the wearer has a rapid breathing rate, the canister/cartridge will become saturated sooner.
- **Concentration of the Contaminant**. The higher the concentration of the chemical, the faster it will saturate the canister/cartridge.
- **The type of adsorbent material used in the canister/cartridge**. Materials used to absorb a specific organic vapor do not work equally well against all organic vapors.
- **Shelf life**. A canister/cartridge which has been sitting around on the shelf for an unknown amount of time should not be used.
- **No protective packaging**. Never use a cartridge/canister which is not wrapped in protective packaging.

## STEP FIVE: What is the assigned protection factor of the mask?

5

Assigned Protection Factor (APF) is a measure of the protection your mask gives you. It tells you if the respirator you're using is good enough or adequate for the concentration of the substance you are dealing with.

A respirator with an APF of 10 can be used when the concentration of a substance is up to, but not more than, 10 times the substance's **OSHA Permissible Exposure Limit (PEL).**

A respirator, such as a full-face APR, with an APF of 50 can be used when the concentration of the chemical is up to, but not exceeding, 50 times the chemical's OSHA PEL.

**If the concentration of the substance is more than the Assigned Protection Factor multiplied by the OSHA PEL, then you need a respirator with a higher Assigned Protection Factor.**

**But, remember air purifying respirators can only be used if the concentration of the contaminant does not exceed the IDLH level!**

Assigned Protection Factors are usually determined under **ideal** conditions that rarely exist in the workplace. So it's likely that all Assigned Protection Factors are over-rated. **If there is any doubt about whether the protection factor of your respirator is adequate, go for a better respirator!**

# How To Use The Assigned Protection Factor (APF) When Selecting A Respirator

Here are the published, generic **Assigned Protection Factors (APFs)** for three different types of respirators:

- **half-face mask APR** has an **APF of 10**
- a **full face mask APR** has an **APF of 50**[3]
- a self-contained breathing apparatus (**SCBA**) operating in a positive pressure mode, has an **APF of 10,000**

**NOTE**: *There are many additional types of respirators that are approved for use. Refer to the "NIOSH Decision Logic" for the APF of the type you use if it is not listed above.*

[3] This is the APF assigned if the mask is quantitatively fit tested. Otherwise it is given an APF of 10. Quantitative and qualitative fit testing will be discussed later in this chapter. Also ANSI has its own published APFs. ANSI assigns a protection factor of 100 for a full face APR which is not as protective. Though OSHA says they are going by the NIOSH APFs, there is currently nothing in the respirator standard. That section of the revised regulations [1910.134(d)(3)(i)(A)] has been reserved.

# To find out if your respirator will provide adequate protection against a known concentration of a chemical:

1. Multiply the APF for your respirator by the OSHA PEL or TLV[4] of the substance you are dealing with.

2. The number you get, called the Maximum Use Concentration (MUC), will be the highest concentration of the substance for which your respirator is OK.

3. If the concentration you are dealing with is **above** the **Maximum Use Limit** you calculated or **above the IDLH, you need a better respirator!!**

**Here are a couple of examples:**

Suppose you're being exposed to **750 ppm** of ethyl butyl ketone and you want to know if your full facepiece APR is giving you enough protection.

50 (APF) X 50 ppm (OSHA PEL) = **2500 ppm**

In this case, the Maximum Use Limit is above the concentration you are dealing with so your respirator would be considered **adequate**.

Suppose, however, that you were working with Dimethylaniline at a concentration of **200** ppm.

50 (APF) X 5 ppm (OSHA PEL) = **250 ppm**

[4] "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices", American Conference of Governmental Industrial Hygienists

**This looks okay, but the IDLH level for Dimethylaniline is 100 ppm. You could not use an air purifying respirator at all** - you need an SCBA

**Remember, Assigned Protection Factors are based solely on laboratory fit testing and must be used with caution when applied to Respirator Selection[5].**

## STEP SIX: Have you been fit-tested for this particular respirator?

**6**

Once the type of respirator has been selected, the respirator must be fit-tested to make sure it fits properly. With the variety of respirators that are available, everybody should be able to get a good fit. However the Respiratory Protection Standard [CFR 1910.134(f)] says the following about respirator fit:

"*Before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used.*"

[5] *NIOSH Respirator Decision Logic*, Page 2, U.S. Department of Health and Human Services, 1987. DHHS (NIOSH) Publication No. 87-108

**There are two ways to Fit Test [6]. They are:**

# Qualitative (QLFT) & Quantitative (QNFT)

# Qualitative

**(called QLFT in the standard)**

In this type of fit testing the wearer must find a mask which fits snugly but comfortably. Some people may have to try on several different makes of mask before they find one which feels right. The test involves the use of a substance that the wearer will be required to somehow identify by smell or taste. There must be a threshold test of some sort to insure that the wearer is able to detect the level that will be used during the actual test.

The wearer must enter an enclosure in which a pre-determined level of the test agent can be introduced. If the test agent is irritant smoke (stannic oxychloride) and the facepiece does not fit properly, the wearer will most likely be irritated and cough. If the test agent is "banana oil" (isoamyl acetate), then we must rely upon the wearer to tell us that he/she can smell the "banana oil" which would indicate a poor fit. Other test agents include BitrexJ (denatonium benzoate) and saccharin.

[6] In order to properly fit-tested, the fit test must use an OSHA-accepted protocol [1910.134(f)(5)]. These protocols and procedures are in Appendix A which is a mandatory appendix to the Respirator Standard.

**Limitations of qualitative methods**

The following are limitations to qualitative fit testing:

- The worker may become desensitized to test agent and not be able to detect it during the actual fit testing.
- The test is subjective
- Some of the test agents can be toxic. For example, saccharin is a suspected carcinogen and NIOSH says there is no safe level of exposure to suspected carcinogens. Also, banana oil (isoamyl acetate) has a PEL.

# Quantitative

**(called QNFT in the standard) –**

Your respirator is probed and connected to a device that measures leakage. This method does not rely upon the wearer to detect the test agent.

There are three ways of doing this. One uses a non-hazardous test aerosol. Another is the Portacount (condensation nuclei counter - this device measures dust in the ambient air and detects how much of that dust leaks into the facepiece during the fit test). The third is the Dynotech Fit Tester 3000 (controlled negative pressure). Here is how the test aerosol and Portacount work:

$$\frac{\text{Co (Conc. outside facepiece)}}{\text{Ci (Conc. inside facepiece)}} = \text{FF (Fit Factor)}$$

$$\frac{50{,}000}{500} = 100 \qquad \frac{50{,}000}{5} = 10{,}000$$

**Worst fit** → **Better fit**

**The higher the Fit Factor, the better the fit!**

This FF is pre-set in the device. The person being fitted only knows if they passed or failed.

Pass/fail numbers may vary according to specific chemicals which have their own standards or company policy which may set higher limits.

**Remember, only full-face masks tested in this manner will receive an APF of 50. If they are only qualitatively fit-tested, full-face masks are given an APF of 10.**

**NOTE:** **Both qualitative and quantitative test are only measuring how good the seal is - not what it will protect the wearer from**. For example, though a quantitative test may use dust to measure leakage, that **does NOT mean** that that particular APR can only be used to protect against dust. It is only measuring the quality of the face seal.

**The employer is required to maintain records of fit testing including the name of the workers fit tested; the type of fit testing performed; the specific make, model, style, and size of respirator tested; the date of the test; and the results of the fit test such as strip chart recordings. These records must be retained until the next fit test is done.** [1910.134(m)(2)(i)]

# Things which can prevent a good seal on a respirator:

Many things can interfere with a good face-to-respirator seal. You can't wear a respirator if you don't have a good seal. Things that can cause a bad seal include [1910.134(f)(3)]:

- facial hair - beards, sideburns etc.
- a large or small nose
- an obvious change in body weight
- high cheekbones
- thin faces
- scars
- skull cap
- makeup
- glasses
- dentures

## STEP SEVEN: 7 Has the respirator been approved?

Respirators must be certified by **NIOSH** (the National Institute for Occupational Safety and Health). [1910.134(d)(1)(ii)].

**NIOSH approval indicates:**

- That the respirator provides adequate protection against the substance for which it was tested.
- That the assembly - the mask together with those particular purifying elements (cartridge or canister) - is adequate for the materials tested.

# 42 CFR 84 for Particulate Filters

The National Institute for Occupational Safety and Health (NIOSH) has recently developed a new set of regulations in 42 CFR 84 (also referred to as "Part 84") for testing and certifying particulate filter Air Purifying Respirators (APRs). The two things that have changed are:

- The size of the particle used to challenge the filter media is now smaller so the filter has to be better in order to pass.
- The way the filters are labeled is different.

**The new labeling is easiest to remember if you use the following guide:**

**N** for **NOT** resistant to oil

**R** for **RESISTANT** to oil

**P** for oil **PROOF**

**Note!** What this means is that if **oil is suspected** in the atmosphere where the respirator is to be used, you **CANNOT use an "N" type filter**. If a **type "R"** filter is used when oil is present, then it should only be used for a single shift (or for 8 hours of continuous or intermittent use). In order to use either N-series filters in dirty non-oil workplaces with high filter loading or R-series filters in areas where oil is present for longer than 8 hours, then testing of the filters should be done to make sure they are still efficient. For more details about this, consult the NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84. [DHHS (NIOSH) Publication No. 96-101]

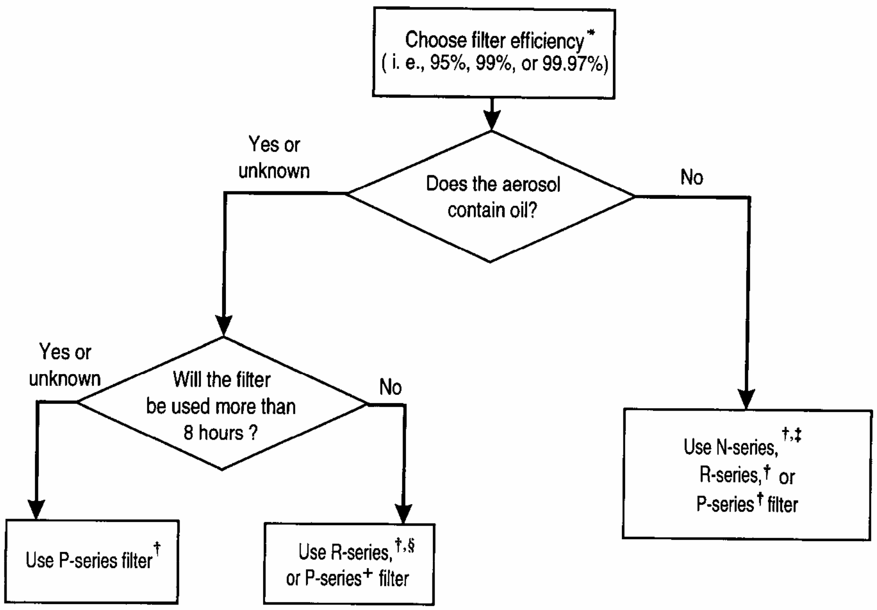
You will see these letters followed by one of three numbers. The numbers are **100** (99.97% efficient), **99** (99% efficient), & **95** (95% efficient). **The higher the number, the more efficient the filter.**

For example:

| | |
|---|---|
| **N100** | NOT resistant to oil & 99.97% efficient |
| **N 99** | NOT resistant to oil & 99% efficient |
| **N 95** | NOT resistant to oil & 95% efficient |
| **R100** | RESISTANT to oil & 99.97% efficient |
| **R 99** | RESISTANT to oil & 99% efficient |
| **R 95** | RESISTANT to oil & 95% efficient |
| **P100** | oil PROOF & 99.97% efficient |
| **P 99** | oil PROOF & 99% efficient |
| **P 95** | oil PROOF & 95% efficient |

This information is nice to know when selecting particulate cartridges for elastomeric facepieces. However, don't forget the importance of "fit testing". The paper disposable respirators will use the same labeling system but they must also be fit tested which may prove to be more difficult than tight-fitting facepieces.

## FLOW CHART FOR SELECTING PART 84 PARTICULATE FILTERS




*The higher the filter efficiency, the lower the filter leakage.

†Limited by considerations of hygiene, damage, and breathing resistance.

‡High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that demonstrates (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

§No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by demonstrating (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

# Recommendations For Changing Canisters/Cartridges

On the next page there is a list of some of the most commonly used gas and vapor canisters/cartridges and the colors assigned to them. First, it is important to know how often canisters and cartridges need to be changed. If there is no ESLI, the employer must have a schedule in place for the change out of canisters/cartridges. The employer must also have justification for how they came up with that schedule.

Canisters and cartridges generally have very limited useful service time. Clearly, saturated canisters/cartridges need to be replaced immediately. However, **unsaturated canisters/cartridges also need to be replaced frequently to ensure maximum effectiveness.**

- Unless replaced more frequently, NIOSH recommends replacing canisters daily or after each use. Used canisters should be discarded at the end of the day.

- If your workplace has a change-out schedule for canisters/cartridges based upon manufacturer's service data, make sure they are changed on schedule regardless of whether they are saturated. Do not wait until canisters/cartridges become saturated in order to change them.

- Some canisters/cartridges are harmed by humid conditions, others are harmed by dry conditions. Keep in mind that these conditions shorten the service life.

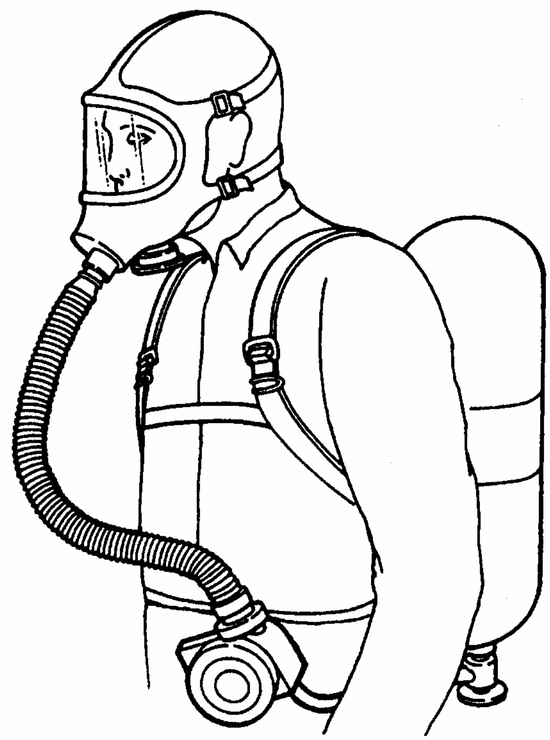
- Never use canisters/cartridges which have had their outer wrappings removed.

- Never use a canister/cartridge that someone else has already used.

# Air Purifying Canisters

| Atmospheric Contaminant to be Protected Against | Color Assigned to Cartridge/Canister |
|---|---|
| acid gases | white |
| hydrocyanic acid gas | white with 1/2 inch green stripe around canister near bottom |
| chlorine gas | white with 1/2 inch yellow stripe around canister near bottom |
| organic vapors | black |
| ammonia gas | green |
| acid gases & ammonia gas | green with 1/2 inch white stripe around canister near bottom |
| carbon monoxide | The only NIOSH approved canister for use with carbon monoxide is a red acid/carbon monoxide canister with a blue color change service life indicator |
| acid gases & organic vapors | yellow |
| hydrocyanic acid gas & chloropicrin vapor | yellow with 1/2 inch blue stripe around canister near bottom |
| acid gases, organic vapors & ammonia gases | brown |
| radioactive particulates | purple (magenta) |
| particulates in combination with any of the above gases or vapors | canister color for gas/vapor with 1/2 inch gray stripe around canister near top |

# Atmosphere or Air Supplying Devices



When Air Purifying Respirators are not permitted or are inadequate, **Air (or Atmosphere) Supplying Respirators** must be used.

There are a variety of types of Atmosphere Supplying Respirators. We will cover the two groups most commonly used in industry. They are **supplied air respirators (SAR) and self contained breathing apparatus (SCBA).**

Atmosphere supplying respirators supply clean (grade D) breathing air to the wearer.

# SUPPLIED AIR RESPIRATORS

**Supplied air respirators** deliver breathing air through a hose connected to the facepiece. The air delivered must be free of contaminants. The air can be supplied from a large cylinder or from a compressor. When using a compressor it is important that the compressor be located in clean air. The OSHA requirements for compressed air used for breathing, including monitoring for carbon monoxide, are listed in 1910.134(i). **Air-line respirators** are **NOT APPROVED** for use in IDLH atmospheres unless equipped with an escape bottle. An escape bottle is a small SCBA cylinders designed only for escape.

## Types of Supplied Air Respirators

There are three types of supplied air respirators. They are referred to as Types A, B, & C. Types A & B are nothing more than hose masks. Type C supplied air respirators are commonly referred to as **air-line respirators.** Air-line respirators must be supplied with grade D air. Specifications for grade D air can be found in ANSI/Compressed Gas Association's Specification for Air CGA G-7.1989.

### There are three basic classes of air-line respirators. They are:

- Continuous Flow
- Demand Flow
- Pressure Demand Flow

# Continuous Flow

This unit has a continuous flow of air supplied to the facepiece and is normally used when there is an ample supply of air such as a compressor. Although most continuous flow respirators do not have positive pressure in the facepiece, some models do. Check with the manufacturer to see if your continuous flow respirator meets the qualifications to be considered a positive pressure respirator.

# Demand Flow

This unit delivers air only when the user inhales. These respirators are normally used with compressed air cylinders. It is important that the regulator be set to deliver within the pressure range recommended by the manufacturer of the respirator to ensure proper air supply. Pressure inside the mask is positive during exhalation and negative during inhalation.

# Pressure Demand Flow

This unit provides a positive pressure inside the facepiece during both inhalation and exhalation. This type provides the highest level of protection. Should there be a break in the facepiece to face seal, air will escape and lessen the chance of contaminant entering the breathing zone.

# SELF CONTAINED BREATHING APPARATUS (SCBA)

The SCBA supplies clean (Grade D) breathing air to the wearer. It is largely dependent on the wearer as to how long a cylinder will last since we all consume air at a different rate. However, you will often hear the different size cylinders referred to as 30 minute or 60 minute units. There are a variety of cylinders on the market but the two most common are the 2216 PSI (30 minute) and the 4500 PSI (60 minute). **Because SCBAs supply clean air, they are the only type respirator approved for use in IDLH atmospheres (unless the supplied air respirator has an escape bottle) and/or when the oxygen content of air is 19.5% or less.**

**With pressure-demand there is positive pressure inside the facepiece at all times.** That means that the pressure in the facepiece is greater than the outside pressure. Any leaks that occur "leak outward", rather than into the facepiece. This should prevent contaminants from entering the mask.

## Fit Testing

Pressure Demand Respirators require the same fit testing protocol discussed earlier in the section on air purifying respirators. The manufacturer must supply a facepiece that can be tested in the negative pressure mode. Fit testing for supplied air respirators is required in the new Respiratory Protection Standard [1910.134(f)].

# SCBAs
## Must Be Used When:

* **There is less than 19.5% oxygen in the air**

* **The concentration of a substance is at the IDLH level**

* **You don't know the substance you are dealing with OR what its concentration is.**

# THE OSHA RESPIRATORY PROTECTION STANDARD (29 CFR 1910.134)

Respirator use must be in compliance with the OSHA Respiratory Protection Standard. There are many requirements of this standard. The employer has to determine if respirator use is required by September 8, 1998 and all parts of the standard must be complied with by October 5, 1998. It is important for workers to know what the OSHA standard includes.

Listed below are the major requirements of the respiratory protection program employers must establish under Section c of the Standard.

- Written **standard operating procedures** for selection and use of respirators [1910.134(c)(1)(i)]

- Those who wear respirators must have an initial **medical evaluation** [1910.134(c)(1)(ii)]

  Before you are required to wear a respirator you <u>must</u> be medically evaluated! This must be done by a physician or other licensed health care professional (PLHCP) who perform the medical evaluation using a medical questionnaire or an exam. If a questionnaire is used, this information is considered confidential [1910.134(e)(4)(i)].

  If a worker answers "Yes" to any of the questions #1 - #8 in Section 2, Part A of Appendix C, then a medical exam is required [1910.134(e)(3)(i)]. For example, the first question asks, "Do you smoke?" so all smokers are required to have medical exams before being allowed to wear a respirator. The mandatory questionnaire is found in Sections 1 and 2, Part A of Appendix C of 1910.134. If the exam is used in place of the questionnaire, it must get the same information as is on the questionnaire [1910.134(e)(2)(ii)]. Consult 1910.134(e) for other requirements regarding medical evaluation.

- Workers must be **fit tested** for tight-fitting respirators [1910.134(c)(1)(iii)]

- There must be procedures for **proper use of respirators in routine and "reasonably" foreseeable emergency situations** [1910.134(c)(1)(iv)]

- There must be procedures and schedules for **cleaning, disinfecting, storing, inspecting, repairing, discarding, and maintaining** respirators. [1910.134(c)(1)(v)]

- Procedures to **ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators** (this means the air for Self Contained Breathing Apparatuses - SCBAs - and airline respirators) [1910.134(c)(1)(vi)]

- Workers must be **trained in the respiratory hazards to which they are potentially exposed during routine and emergency situations**. So it is not enough to know just how to properly wear a respirator, you have to know **why** you possibly have to wear one; what is the hazard? [1910.134(c)(1)(vii)]

- Workers must be **trained in proper use** and limitations of respirators. This includes putting them on, removing them, and any maintenance they must do. [1910.134(c)(1)(viii)]

**You must be trained before you can wear a respirator. This training must include:**

- Whey the respirator is necessary and how improper fit, usage, or maintenance can affect the protective fit of the respirator.
- What the limitations and capabilities of the respirator are
- How to use the respirator in emergency situations including what to do if the respirator malfunctions
- How to inspect, put on, and remove the respirator as well as how to check the seals of the respirator.
- What the procedures are for maintaining and storing the respirator.
- How to recognize medical signs and symptoms that may prevent effective use of the respirator.
- The general requirements of the respirator standard

**This training must be given <u>before</u> the worker has to use a respirator in the workplace. There must also be annual retraining however this may occur sooner if there are changes in the workplace that makes previous training obsolete.**

Respirator **program must be regularly evaluated** for effectiveness
[1910.134(c)(1)(ix)]
The employer must make regular evaluation of how respirators are being used in the workplace. This includes consulting with the workers who have to actually wear the respirators to ask their views on program effectiveness and to identify any problems they see. The employer is not only required to consult with these workers, but they are also required to correct any problems that are identified during this assessment. Such factors include, but are not limited to, respirator fit, appropriate respirator for the hazard, and proper maintenance. [1910.134(l)]

**Respirators must be certified by NIOSH** for use against the particular hazards for which it is designed. [1910.134(d)(1)(ii)]

**Voluntary Use of Respirators:**

Sometimes workers want to wear respirators where they would not be required (i.e. in areas that are below the PEL). In cases like this, the employer must make sure the worker is medically able to use the respirator and that the respirator is properly cleaned, stored, and maintained. The employer must also give the worker the advisory information found in Appendix D of the standard. Besides these elements, the employer is not required to comply with any other elements of a respirator program (such as training) since the use is voluntary. Also, none of these elements are required if the worker wants to voluntarily wear a dust mask.

## Standards affected by the revised 1910.134:

The following standards have respiratory protection elements which may be affected by the revised Respiratory Protection Standard:

1910.156 Fire brigades

1910 Subpart L Appendix A

1910.1001, Asbestos

1910.1017, Vinyl chloride

1910.1018, Inorganic arsenic

1910.1025, Lead

1910.1027, Cadmium

1910.1028, Benzene

1910.1029, Coke oven emissions

1910.1044, 1,2-dibromo-3-chloropropane

1910.1045, Acrylonitrile

1910.1047, Ethylene oxide

1910.1048, Formaldehyde

1910.1050, Methylenedianiline

1910.1051, 1,3-Butadiene

1910.1052, Methylene chloride

## THINGS TO REMEMBER
## ABOUT RESPIRATORS

- Respirators are the least effective way of controlling exposure to hazardous substances. **Respirators are supposed to be used only when engineering controls are not feasible, when engineering controls are being installed or repaired or during emergencies.**

- **Respirators don't protect you against chemicals which are harmful to or absorbed through the skin.**

- **NIOSH does not recommend using Air Purifying Respirators to protect against exposure to carcinogens** (substances which cause cancer) **since there is no known safe level to carcinogens**.

- **Respirators put a strain on the heart and lungs**. OSHA requires that workers who wear respirators have medical evaluations to determine if they are physically fit to perform necessary work while wearing a respirator. [1910.134(e)(1)]

- **The highest anticipated concentration of a contaminant should be used to calculate needed protection factor for each wearer.**

# The following is a list of problems we may

**encounter when implementing a respirator program. We must always look first to engineering controls.**

- **respirators do not correct the problem**
- **respirators interfere with workers' rights** to have beards, sideburns etc.
- **respirators are uncomfortable**, hot, isolating and stressful.
- respirator use may **increase the risk of accidents.**
- respirator use means **management may be able to get rid of workers** found to be medically "unfit" to wear respirators
- **Employers who require that their workers wear respirators must comply with all provisions of the OSHA Standard**.

**Unions continually confront these problems on a case by case basis**

# Tab 6

**In all situations, the underlying cause of water accumulation must be rectified or fungal growth will recur. Any initial water infiltration should be stopped and cleaned immediately. An immediate response (within 24 to 48 hours) and thorough clean up, drying, and/or removal of water damaged materials will prevent or limit mold growth. If the source of water is elevated humidity, relative humidity should be maintained at levels below 60% to inhibit mold growth.[31] Emphasis should be on ensuring proper repairs of the building infrastructure, so that water damage and moisture buildup does not recur.**

**Five different levels of abatement are described below. The size of the area impacted by fungal contamination primarily determines the type of remediation. The sizing levels below are based on professional judgement and practicality; currently there is not adequate data to relate the extent of contamination to frequency or severity of health effects. The goal of remediation is to remove or clean contaminated materials in a way that prevents the emission of fungi and dust contaminated with fungi from leaving a work area and entering an occupied or non-abatement area, while protecting the health of workers performing the abatement. The listed remediation methods were designed to achieve this goal, however, due to the general nature of these methods it is the responsibility of the people conducting remediation to ensure the methods enacted are adequate. The listed remediation methods are not meant to exclude other similarly effective methods. Any changes to the remediation methods listed in these guidelines, however, should be carefully considered prior to implementation.**

**Non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood, and concrete) materials that are structurally sound and are visibly moldy can be cleaned and reused. Cleaning should be done using a detergent solution. Porous materials such as ceiling tiles and insulation, and wallboards with more than a small area of contamination should be removed and discarded. Porous materials (e.g., wallboard, and fabrics) that can be cleaned, can be reused, but should be discarded if possible. A professional restoration consultant should be contacted when restoring porous materials with more than a small area of fungal contamination. All materials to be reused should be dry and visibly free from mold. Routine inspections should be conducted to confirm the effectiveness of remediation work.**

**The use of gaseous ozone or chlorine dioxide for remedial purposes is not recommended. Both compounds are highly toxic and contamination of occupied space may pose a health threat. Furthermore, the effectiveness of these treatments is unproven. For additional information on the use of biocides for remedial purposes, refer to the American Conference of Governmental Industrial Hygienists' document, "Bioaerosols: Assessment and Control."**

**3.1 *Level I*: Small Isolated Areas (10 sq. ft or less) - e.g., ceiling tiles, small areas on walls**

a. **Remediation can be conducted by regular building maintenance staff. Such persons should receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).**

b. **Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.**

c. **The work area should be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons recovering from recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).**

d. **Containment of the work area is not necessary. Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.**

e. **Contaminated materials that cannot be cleaned should be removed from the building in a sealed plastic bag. There are no special requirements for the disposal of moldy materials.**

f. **The work area and areas used by remedial workers for egress should be cleaned with a damp cloth and/or mop and a detergent solution.**

g. **All areas should be left dry and visibly free from contamination and debris.**

**3.2 *Level II*: Mid-Sized Isolated Areas (10 - 30 sq. ft.) - e.g., individual wallboard panels.**

h. **Remediation can be conducted by regular building maintenance staff. Such persons should receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).**

i. **Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.**

j. **The work area should be unoccupied. Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).**

k. **The work area should be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.**

l. **Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.**

m. **Contaminated materials that cannot be cleaned should be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials.**

n. **The work area and areas used by remedial workers for egress should be HEPA vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) and cleaned with a damp cloth and/or mop and a detergent solution.**

o. **All areas should be left dry and visibly free from contamination and debris.**

**3.3 *Level III*: Large Isolated Areas (30 - 100 square feet) - e.g., several wallboard panels.**

**A health and safety professional with experience performing microbial investigations should be consulted prior to remediation activities to provide oversight for the project.**

**The following procedures *at a minimum* are recommended:**

p. **Personnel trained in the handling of hazardous materials and equipped with respiratory protection, (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.**

q. **The work area and areas directly adjacent should be covered with a plastic sheet(s) and taped before remediation, to contain dust/debris.**

r. **Seal ventilation ducts/grills in the work area and areas directly adjacent with plastic sheeting.**

s. **The work area and areas directly adjacent should be unoccupied. Further vacating of people from spaces near the work area is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).**

t. **Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.**

u. **Contaminated materials that cannot be cleaned should be removed from the building in sealed plastic bags. There are no special requirements for the disposal of moldy materials.**

v. **The work area and surrounding areas should be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.**

w. **All areas should be left dry and visibly free from contamination and debris.**

**If abatement procedures are expected to generate a lot of dust (e.g., abrasive cleaning of contaminated surfaces, demolition of plaster walls) or the visible concentration of the fungi is heavy (blanket coverage as opposed to patchy), then it is recommended that the remediation procedures for Level IV are followed.**

**3.4 *Level IV*: Extensive Contamination (greater than 100 contiguous square feet in an area)**

**A health and safety professional with experience performing microbial investigations should be consulted prior to remediation activities to provide oversight for the project. The following procedures are recommended:**

x. **Personnel trained in the handling of hazardous materials equipped with:**

   i. **Full-face respirators with high efficiency particulate air (HEPA) cartridges**
   ii. **Disposable protective clothing covering both head and shoes**
   iii. **Gloves**

y. **Containment of the affected area:**

   i. **Complete isolation of work area from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts/grills, fixtures, and any other openings)**
   ii. **The use of an exhaust fan with a HEPA filter to generate negative pressurization**
   iii. **Airlocks and decontamination room**

z. **Vacating people from spaces adjacent to the work area is not necessary but is recommended in the presence of infants (less than 12 months old), persons having undergone recent surgery, immune suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies).**

aa. **Contaminated materials that cannot be cleaned should be removed from the building in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a detergent solution or HEPA vacuumed in the decontamination chamber prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.**

bb. **The contained area and decontamination room should be HEPA vacuumed and cleaned with a damp cloth and/or mop with a detergent solution and be visibly clean prior to the removal of isolation barriers.**

cc. **Air monitoring should be conducted prior to occupancy to determine if the area is fit to reoccupy.**

### 3.5 *Level V*: Remediation of HVAC Systems

#### 3.5.1 A Small Isolated Area of Contamination (<10 square feet) in the HVAC System

dd. **Remediation can be conducted by regular building maintenance staff. Such persons should receive training on proper clean up methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).**

ee. **Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.**

ff. **The HVAC system should be shut down prior to any remedial activities.**

gg. **The work area should be covered with a plastic sheet(s) and sealed with tape before remediation, to contain dust/debris.**

hh. **Dust suppression methods, such as misting (not soaking) surfaces prior to remediation, are recommended.**

ii. **Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, should be removed. Other contaminated materials that cannot be cleaned should be removed in sealed plastic bags. There are no special requirements for the disposal of moldy materials.**

jj. **The work area and areas immediately surrounding the work area should be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution.**

kk. **All areas should be left dry and visibly free from contamination and debris.**

ll. **A variety of biocides are recommended by HVAC manufacturers for use with HVAC components, such as, cooling coils and condensation pans. HVAC manufacturers should be consulted for the products they recommend for use in their systems.**

### 3.5.2 Areas of Contamination (>10 square feet) in the HVAC System

**A health and safety professional with experience performing microbial investigations should be consulted prior to remediation activities to provide oversight for remediation projects involving more than a small isolated area in an HVAC system. The following procedures are recommended:**

mm. **Personnel trained in the handling of hazardous materials equipped with:**

  i. **Respiratory protection (e.g., N95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended.**
  ii. **Gloves and eye protection**
  iii. **Full-face respirators with HEPA cartridges and disposable protective clothing covering both head and shoes should be worn if contamination is greater than 30 square feet.**

nn. **The HVAC system should be shut down prior to any remedial activities.**

oo. **Containment of the affected area:**

  i. **Complete isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape.**
  ii. **The use of an exhaust fan with a HEPA filter to generate negative pressurization.**
  iii. **Airlocks and decontamination room if contamination is greater than 30 square feet.**

pp. **Growth supporting materials that are contaminated, such as the paper on the insulation of interior lined ducts and filters, should be removed. Other contaminated materials that cannot be cleaned should be removed in sealed plastic bags. When a decontamination chamber is present, the outside of the bags should be cleaned with a damp cloth and a detergent solution or HEPA vacuumed prior to their transport to uncontaminated areas of the building. There are no special requirements for the disposal of moldy materials.**

qq. **The contained area and decontamination room should be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution prior to the removal of isolation barriers.**

rr. **All areas should be left dry and visibly free from contamination and debris.**

ss. **Air monitoring should be conducted prior to re-occupancy with the HVAC system in operation to determine if the area(s) served by the system are fit to reoccupy.**

tt. **A variety of biocides are recommended by HVAC manufacturers for use with HVAC components, such as, cooling coils and condensation pans. HVAC manufacturers should be consulted for the products they recommend for use in their systems.**

| Table 2: Guidelines for Remediating Building Materials with Mold Growth Caused by Clean Water* | | | |
|---|---|---|---|
| Material or Furnishing Affected | Cleanup Methods† | Personal Protective Equipment | Containment |
| **SMALL - Total Surface Area Affected Less Than 10 square feet ($ft^2$)** | | | |
| Books and papers | 3 | Minimum<br><br>N-95 respirator, gloves, and goggles | None required |
| 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 | | |
| **MEDIUM - Total Surface Area Affected Between 10 and 100 ($ft^2$)** | | | |
| Books and papers | 3 | Limited or Full<br><br>Use professional judgment, consider potential for remediator exposure and size of contaminated area | Limited<br><br>Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area |
| Carpet and backing | 1,3,4 | | |
| 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 | 1,3,4 | | |
| Wallboard (drywall and gypsum board) | 3,4 | | |
| Wood surfaces | 1,2,3 | | |
| **LARGE - Total Surface Area Affected Greater Than 100 ($ft^2$) or Potential for Increased Occupant or Remediator Exposure During Remediation Estimated to be Significant** | | | |
| Books and papers | 3 | Full<br><br>Use professional judgment, consider potential for remediator/occupant exposure and size of contaminated area | Full<br><br>Use professional judgment, consider potential for remediator exposure and size of contaminated area |
| Carpet and backing | 1,3,4 | | |
| Concrete or cinder block | 1,3 | | |
| Hard surface, porous flooring (linoleum, ceramic tile, vinyl) | 1,2,3,4 | | |
| Non-porous, hard surfaces (plastics, metals) | 1,2,3 | | |
| Upholstered furniture & drapes | 1,2,4 | | |
| Wallboard (drywall and gypsum board) | 3,4 | | |
| Wood surfaces | 1,2,3,4 | | |

**Table 2 continued**

*Use professional judgment to determine prudent levels of Personal Protective Equipment and containment for each situation, particularly as the remediation site size increases and the potential for exposure and health effects rises. Assess the need for increased Personal Protective Equipment, if, during the remediation, more extensive contamination is encountered than was expected. Consult Table 1 if materials have been wet for less than 48 hours, and mold growth is not apparent. 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 the Occupational Safety and Health Administration (OSHA) requires PPE and containment. An experienced professional should be consulted if you and/or your remediators do not have expertise in remediating contaminated water situations.

†Select method most appropriate to situation. Since molds gradually destroy the things they grow on, if mold growth is not addressed promptly, some items may be damaged such that cleaning will not restore their original appearance. If mold growth is heavy and items are valuable or important, you may wish to consult a restoration/water damage/remediation expert. Please note that these are guidelines; other cleaning methods may be preferred by some professionals.

**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 (except wood —use wood floor cleaner); scrub as needed.
- Method 3: High-efficiency particulate air (HEPA) vacuum after the material has been thoroughly dried. Dispose of the contents of the HEPA vacuum in well-sealed plastic bags.
- Method 4: Discard _ remove water-damaged materials and seal in plastic bags while inside of containment, if present. Dispose of as normal waste. HEPA vacuum area after it is dried.

**Personal Protective Equipment (PPE)**

- Minimum: Gloves, N-95 respirator, goggles/eye protection
- Limited: Gloves, N-95 respirator or half-face respirator with HEPA filter, disposable overalls, goggles/eye protection
- Full: Gloves, disposable full body clothing, head gear, foot coverings, full-face respirator with HEPA filter

**Containment**

- Limited: Use polyethylene sheeting ceiling to floor around affected area with a slit entry and covering flap; maintain area under negative pressure with HEPA filtered fan unit. Block supply and return air vents within containment area.
- Full: Use two layers of fire-retardant polyethylene sheeting with one airlock chamber. Maintain area under negative pressure with HEPA filtered fan exhausted outside of building. Block supply and return air vents within containment area.

*Table developed from literature and remediation documents including Bioaerosols: Assessment and Control (American Conference of Governmental Industrial Hygienists, 1999) and IICRC S500, Standard and Reference Guide for Professional Water Damage Restoration, (Institute of Inspection, Cleaning and Restoration, 1999); see Resources List for more information*

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[7] Please note that Tables 1 and 2 contain general guidelines. Their purpose is to provide basic information for remediation managers to first assess the extent of the damage and then to determine whether the remediation should be managed by in-house personnel or outside professionals. The remediation manager can then use the guidelines to help design a remediation plan or to assess a plan submitted by outside professionals.

[8] Although this document has a residential focus, it is applicable to other building types

*Fact Sheet*

FEMA

# Mold . . . A Growing Threat

## FLOODED HOMES MAY HARBOR MOLD PROBLEM

Mold growth is likely to occur in homes after flooding. It's very important to clean and thoroughly dry any areas of the home that have gotten wet from floodwaters. Failure to remove contaminated materials and to reduce moisture and humidity can present serious long-term health risks, according to the Office of Indoor Air Quality at the Environmental Protection Agency.

**Mold - What Is It?**

Molds are simple microscopic organisms found virtually everywhere, indoors and outdoors. When molds are present in large quantities they can cause allergic symptoms similar to those caused by plant pollen.

**Should I Be Concerned About Mold In My Home?**

Yes, if the contamination is extensive. When airborne mold spores are present in large numbers they can cause allergic reactions, asthma episodes, infections, and other respiratory problems.

**Who Is At Greatest Risk When Exposed To Mold?**

The following individuals are at higher risk for adverse health affects from molds:

- Infants, children and the elderly
- Immune compromised individuals (people with HIV infection, liver disease, in chemotherapy, etc)
- Pregnant women
- Individuals with existing respiratory conditions such as allergies, multiple chemical sensitivity, and asthma

*People with these conditions should consult a physician if they are experiencing health problems.*

Typical symptoms reported from mold exposure include respiratory problems (like wheezing and asthma attacks), burning or watery eyes, nose or throat irritations, skin irritations like rashes or hives, and nervous system disorders like headaches, memory loss and mood changes.

## What Can I Save? What Should I Toss?

Porous materials can trap molds. Items such as paper, rags, wallboard, and rotten wood should be thrown out. Harder materials such as glass, plastic and metal can be kept after they are cleaned and disinfected.

## Removing Moldy Materials

- Wear a filter mask and gloves to avoid contact with the mold.
- Remove porous materials (ex: ceiling tiles, drywall, carpeting, wood products.)
- Carpeting can be a difficult problem - drying does not remove the dead spores. If there is heavy mold, disposal of the carpet should be considered.
- Allow areas to dry 2 to 3 days before replacing damaged materials
- If dry wall, or wallboard, is flooded, remove all drywall to at least 12 inches above the high water mark.

## General Mold Clean-Up Procedures

- Identify and correct the moisture source. Remove all water and fix any leaks before cleaning.
- Clean, disinfect, and dry the moldy area.
- Bag and dispose of any material that has moldy residue, such as rags, paper, leaves or debris.

## Soap Cleanup

- Wear protective gloves and a filter mask.
- Use non-ammonia soap or detergent, or a commercial cleaner in hot water. Scrub the entire area affected by the mold.
- Use a stiff brush or cleaning pad.
- Rinse with clean water.

## Disinfect Surfaces

- Wear a filter mask and protective gloves when using disinfectants.
- After thorough cleaning and rinsing, disinfect the area with household bleach (1/4 cup bleach per gallon of water).
- Never mix bleach with ammonia - the fumes are toxic!
- Let disinfected areas dry naturally overnight to kill all the mold.

Be aware that exposure to mold can occur during cleanup. To minimize exposure, consider using a breathing mask or respirator, wear rubber gloves and take breaks in a well-ventilated area.

# Mold & Mildew

Cleaning Up Your
Flood-Damaged Home

FEMA

## The Problem With Mold

Mildew and molds are fungi - simple microscopic organisms that thrive anywhere there is a moist environment. Molds are a necessary part of the environment; without them, leaves would not decay and aspects of soil enrichment could not take place. It is their ability to destroy organic materials that makes mold a problem for people.

Mildew (mold in its early stages) and molds grow on wood products, ceiling tiles, cardboard, wallpaper, carpets, drywall, fabric, plants, foods, insulation, decaying leaves and other organic materials. Mold colonies can start to grow on a damp surface within 24 to 48 hours. They reproduce via spores - tiny, lightweight "seeds"- that travel through the air. Molds digest organic material, eventually destroying the material they grow on, and then spread to destroy adjacent organic material. In addition to the damage molds can cause in your home, they can also cause mild to severe health problems. See the **Health Problems From Mold** section to check for possible mold related health problems.

The Environmental Protection Agency has this to say about mold: During a flood cleanup, the indoor air quality in your home or office may appear to be the least of your problems. However, failure to remove contaminated materials and to reduce moisture and humidity can present serious long-term health risks. Standing water and wet materials are a breeding ground for microorganisms, such as viruses, bacteria, and mold. They can cause disease, trigger allergic reactions and continue to damage materials long after the flood.

**Bridgeville, PA, September 29, 2004**
David Lupi continues to clean up after a flash flood caused by two hurricanes struck the area within a two week period, causing normally small creeks to jump their banks. All the baseboards and insulation have to be removed to prevent an outbreak of mold and mildew.

FEMA News Photo/Bob McMillian

**Visible Mold?**
Are the walls and ceilings discolored?

No

**Smell of Mold?**
From "musty earth" to foul stench.

Yes

**Identify & Eliminate Source of Moisture**

Yes

No

**See Mold Prevention**

**How Much Mold is Present?**

Visible sq. ft. ______

*Hidden sq. ft. ______

+

**Total** sq. ft. ______

**If less than 25 sq. ft.,**
Follow instructions in this booklet.

**If more than 25 sq. ft.,**
Consult a professional contractor

## Mold In Your Home?

You may have mold and/or mildew growing in your home if your home has water damage due to:

- Flooding,
- Sewage back-up from flooding in the area,
- Plumbing or roof leaks,
- A damp basement or crawl space,
- Overflows from sinks or bathtub
- High humidity (steam cooking, dryer vents, humidifiers)

Mold and mildew will develop within 24-48 hours of water exposure. Even worse, it will continue to grow until steps are taken to eliminate the source of moisture, and effectively deal with the mold problem. Use the diagram above to assess the extent of mold in your home. Then refer to the **Solution** section for steps you need to take to remedy the problem. Also refer to the **Prevention** section for tips on keeping mold out of your home in the future.

# Solutions to Mold Problems

## Dry Out a Mold or Water Damaged House

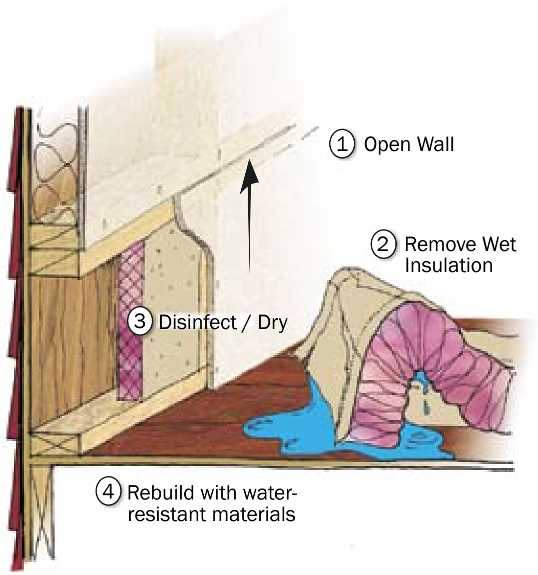
**General** Turn off main power if wiring is wet or moldy. Have an electrician check the house's electrical system before turning power on again. Open the house to fresh air when the humidity is lower outside than inside. Use fans and dehumidifiers to remove moisture unless mold has already started to grow (fans may spread existing mold). Use the furnace only if the ducts have not been inundated (any forced air central heating ducts that have come in contact with water or mold should be professionally checked). Remove all wet items such as furniture, rugs, bedding and toys. Discard soaked or moldy carpeting. Clean and disinfect other items. Discard all food products that were not stored in a water tight container.

**Interior walls and Ceilings** Remove all wet or contaminated porous materials such as ceiling tiles, sheetrock and wood by-products. If wallboard is soaked, remove to a foot above the watermark and discard. Drain walls by removing the baseboards and drilling holes near the floor. Dry panel-type walls by pulling the bottom edge out from the studs. Check the interior of the wall for hidden mold.

**Floors and Exterior Walls**
Remove all wet insulation. Discard all but rigid insulation. Rigid insulation can be reinstalled after disinfecting and drying.

### Materials You'll Need

- Buckets and trash bags
- Scrub brush, sponges, and rags
- Gloves (latex, rubber) and mask (painter's or respirator)
- Broom, mop, and wet-dry shop vacuum
- Non-ammonia soap or commercial cleaner (phenolic or pine-oil based)
- Disinfectant chlorine bleach (a 10% solution) 1 cup of bleach to 1 gallon of water




### Some General Cautions:

- Exercise caution in cleaning and disinfecting molds because they release mold spores when disturbed. Wear gloves and a mask.
- Never mix bleach with ammonia; doing so will create toxic fumes.
- When discarding items contaminated with mold, use extreme caution or hire a professional

## Cleaning and Disinfecting

### Before you begin:

- Wear gloves and a mask; protect your eyes.
- Make sure the working area is well ventilated
- If mold is present, clean a small test patch. If you feel your health is adversely affected, consider hiring a professional to do the work.
- Only apply disinfectants to already cleaned materials.

**Hard Surfaces** Wash items such as metal, glass, solid wood, plastic and other nonporous materials with a non-ammonia detergent and hot water. Use a stiff brush on rough surface materials such as concrete. Use a Wet-Dry shop vacuum to remove water and to clean items such as studs or exposed wood framing. Disinfect all cleaned surfaces with a bleach solution (1 cup of bleach in 1 gallon of water). Let the solution stay on the surface for at 10 minutes before rinsing with clear water and allowing to dry.

**Porous Materials** This includes upholstered furniture made of pressed particle materials. Deciding whether or not to keep a contaminated item? Remember, when in doubt, throw it out. If an item has been wet for less than 48 hours, it may be able to be cleaned and disinfected with phenolic or pine-oil cleaner. It should then be completely dried and monitored for several days for any fungal growth and odors – if any mold develops, discard the item. **Allow the wet area to dry completely (usually two to three days) before beginning to rebuild or replace the damaged items.**

## Health Problems From Mold

We are exposed to many kinds of mold both inside and outside the house. The exposure is greater in damp or wet conditions, especially when timely drying out does not have a chance to occur.

Of the thousands of molds that exist, some are known allergens (aggravating or causing skin, eye and respiratory problems) and a few molds produce harmful mycotoxins that can cause serious problems. But all molds, in the right conditions and high enough concentrations, are capable of adversely affecting human health.

The potential for health problems occurs when people inhale large quantities of the airborne mold spores. For some people, however, a relatively small number of mold spores can cause health problems. Infants, children, immune-compromised patients, pregnant women, individuals with existing respiratory conditions and the elderly are at higher risks for adverse health effects from mold.

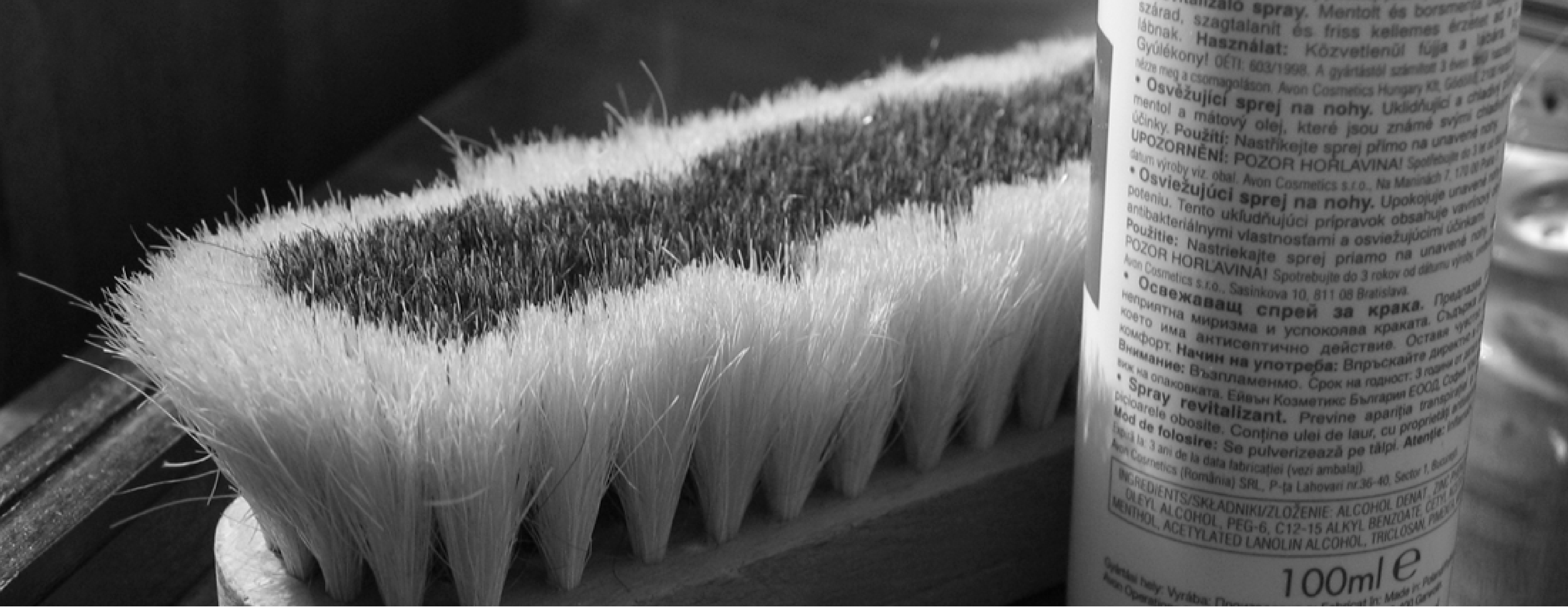
### Serious Health Problems from Mold Exposure

Typical symptoms reported from mold exposure include:

- Respiratory problems – sneezing, asthma attacks, etc.
- Nasal and sinus congesting or dry, hacking cough
- Eye irritation – burning, watery, redness
- Nose or throat irritation – sneezing fits, bloody noses
- Skin irritations – rashes or hives
- Nervous system – headaches, memory loss, mood changes
- Aches and pains

The more serious health problems have been associated with Stachybotrys atra, a highly toxic mold. The mold is a greenish-black and slimy, resembling tar or black paint. Stachybotrys typically grows only on repeatedly wetted materials that contain cellulose like paper and ceiling tiles, and any kind of wood. In most cases, this mold can be removed by a thorough cleaning with a bleach solution. Severe mold infestations may require the assistance of a professional with experience in dealing with Stachybotrys.

If mold exposure is unavoidable, sensitive people should wear tight-fitting masks or respirators.




## Mold Prevention

There is no practical way for you to eliminate all of the molds and mold spores in the indoor environment. But there are many ways to help control moisture and mold growth in your home.

### Stop the Water

- Fix leaks in pipes and any damp areas around tubs and sinks so that biological pollutants don't have a growing environment.
- Rebuild or retrofit using water-resistant materials such as tile, stone, deep-sealed concrete, galvanized or stainless steel hardware, indoor/outdoor carpet, waterproof wallboard, water-resistant glues and so on.
- Prevent seepage of water from outdoors into your house. Rain water from gutters needs to drain away from the house. Ground around the house needs to slope away to keep the basement and crawl space dry.
- Cover dirt in crawl spaces with plastic to prevent moisture coming from the ground. Ventilate the area as much as possible.

### Keep it Clean

- Clean fabrics often and store them in a well-ventilated area to keep them dry. Soiled fabric promotes mold growth.
- Consider having your air ducts cleaned if you suspect mold exists on the inside surfaces or if the duct insulation has been wet.
- Routinely check potential problem spots like the bathroom and laundry for moldy odors and disinfect as necessary with bleach (1 cup of bleach to 1 gallon of water).

### Keep it Dry

- Reduce the moisture in the air with dehumidifiers, fans and open windows or air conditioners, especially in hot weather. Do NOT use fans if mold may already exist; a fan will spread the mold spores.
- Try to keep the humidity in your home below 40%.
- In moisture-prone areas, choose carpets made from man-made fibers.
- Reduce potential for condensation on cold surfaces by insulating.

# For More Information

An excellent publication from the American Red Cross and the Federal Emergency Management Agency (FEMA) is **Repairing Your Flooded Home**. This source of comprehensive information is available for free from the FEMA Distribution Center:

**FEMA Publications**
P.O. Box 70272
Washington, DC 20024
(800)480-2520

Local information and/or assistance is available through your county or city. Contact any of these agencies or departments:

- Health
- Social Services
- Environmental Health
- Housing.

More information on cleanup after a flood and ways to reduce damages from future disasters can be found at: **www.fema.gov/fima**

The Environmental Protection Agency (EPA) has an extensive listing of resources on mold and indoor air quality in general: **www.epa.gov/iaq.**

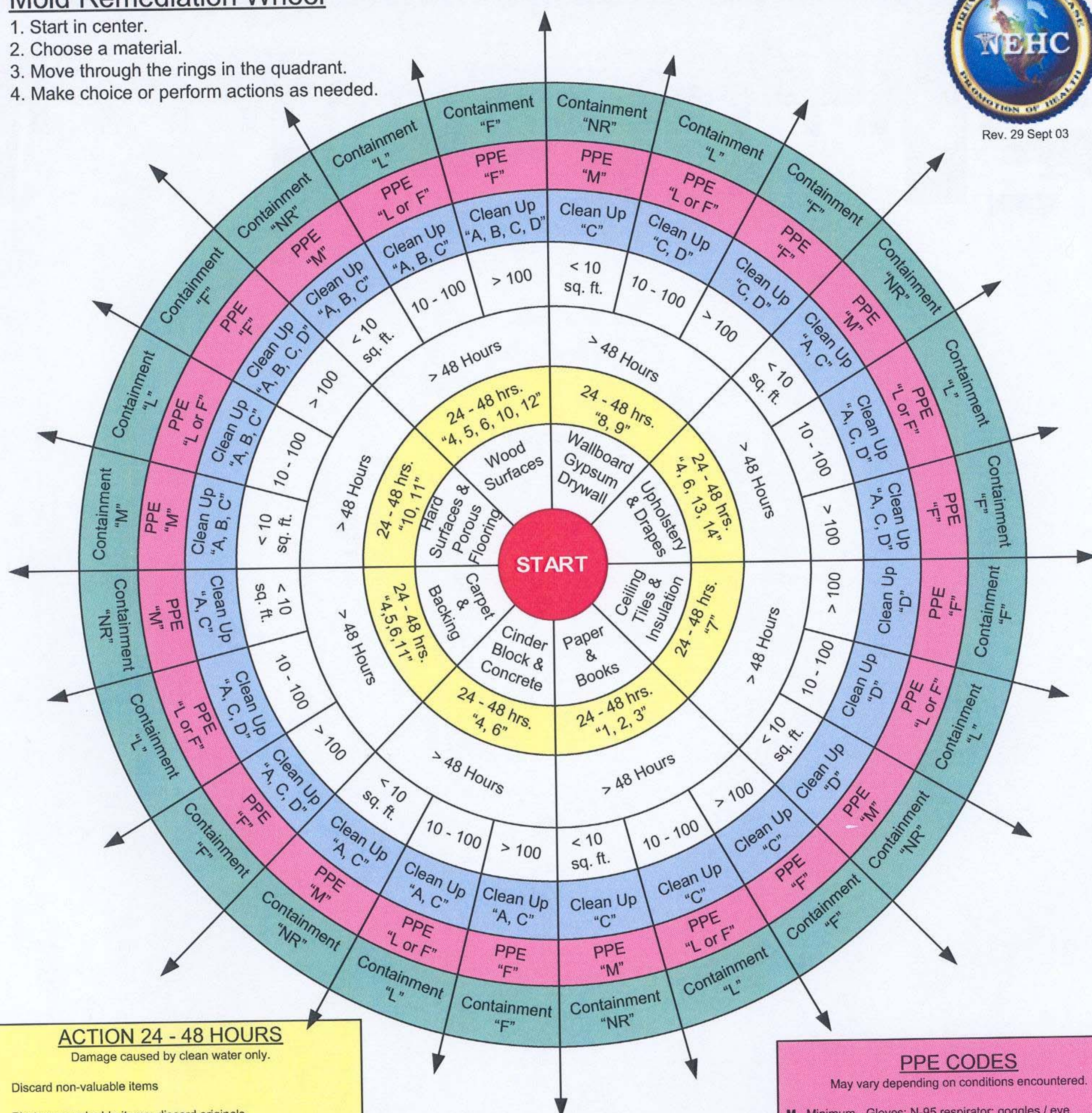
FEMA

This publication produced by FEMA Region 10 / Bothell, WA

# Mold Remediation Wheel

1. Start in center.
2. Choose a material.
3. Move through the rings in the quadrant.
4. Make choice or perform actions as needed.

Rev. 29 Sept 03




## ACTION 24 - 48 HOURS

Damage caused by clean water only.

1. Discard non-valuable items
2. Photocopy valuable items; discard originals.
3. Freeze (frost-free) or freeze dry.
4. Remove water with water extraction vacuum.
5. Use dehumidifiers to reduce humidity.
6. Accelerate drying with heaters and or fans. DO NOT use heat on carpet. USE CAUTION with heat on wood floors.
7. Discard and replace.
8. Dry in place if there is no swelling and seams are intact. Otherwise, discard and replace.
9. Ventilate wall cavity.
10. Vacuum or damp wipe with water / mild detergent. Allow to dry. Scrub if necessary.
11. For flooring, ensure sub flooring is clean and dry.
12. Pry wet paneling away from wall for drying.
13. May be difficult to dry. If items are valuable, consult restoration professional.
14. Launder or professionally clean fabrics.

## CLEAN-UP / MOLD REMEDIATION METHODS

Damage caused by clean water and not addressed in 48 hours.

**A.** Wet Vacuum - If material is porous, some mold fragments or spores may remain, but they will not grow if the material completely dried.

**B.** Damp wipe surfaces with water / mild detergent solution. On wood floors, use a wood floor cleaner.

**C.** Use HEPA (High Efficiency Particulate Air) vacuum after material is dry. Dispose of HEPA vacuum bag as contaminated waste (double bag & seal).

**D.** Remove & discard water damaged materials and seal in plastic bags inside the containment area. HEPA vacuum area after it is dry.

## PPE CODES

May vary depending on conditions encountered.

**M.** Minimum - Gloves; N-95 respirator; goggles / eye protection.

**L.** Limited - Gloves; N-95 respirator or half face with HEPA filters; disposable coveralls; goggles / eye protection.

**F.** Full - Gloves; disposable full body coveralls; head and foot coverings; full face respirator with HEPA filters.

## CONTAINMENT CODES

May vary depending on conditions encountered.

**NR.** None Required

**L.** Limited - Contain remediation area with 1 layer polyethylene sheeting. Block off supply & return air vents. Keep under negative pressure with HEPA filtered fan unit.

**F.** Full - Contain remediation area with double poly sheeting. Use airlock entrance. Secure ventilation to/from the affected area. Maintain negative pressure with HEPA filtered exhausted outside of the building.

# Standard Operating Procedure
for
# Reporting & Cleaning Mold Contaminated Materials

- Report mold contaminated building materials via e-mail to:
    - Physical Plant [ fix-it@southwestern.edu ]

- Once notified, our custodial staff will help to document the rooms/items that show evidence of mold growth. Keeping a running log of events related to the dates of mold growth, cleaning process and any re-growth will help us identify the extent of the problem.

- Physical Plant housekeeping staff will follow the standard operating procedure to clean/disinfect the mold contaminated items.

- Health concerns related to mold in the working environment should be forwarded to the Safety Officer at 863-1677 or delancem@southwestern.edu

**Housekeeping Log:**

| Building | Room | Item | Mold | Cleaned | Re-growth | Cleaned |
|---|---|---|---|---|---|---|
| | | | | | | |
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**Mold Contaminated Material Guide**

- **Non-porous surfaces: desks, furniture, doors/frames, window sills/frames, air vents, etc**
  - *These items can usually be effectively cleaned/disinfected*

- **Semi-porous or porous items: carpets, fabric covered furniture, books, etc**
  - *These items might be able to be cleaned/disinfected satisfactorily*

- **Building materials: sheetrock walls/ceilings, ceiling tiles, fiberglass insulation**
  - *These items cannot be properly cleaned/disinfected – they should be removed and disposed of and replaced with new material*

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# • Disinfecting Process

- **Wear safety glasses or goggles.**
- **Recommend wearing latex/vinyl/nitrile gloves, and a charcoal lined dust/mist mask** *: 3M 8247 respirator*
- **Use sparquat cleaner according to instructions**

  or
- **1 part bleach to 4 parts water mixture.**
  - **24 oz of water and then add 6 oz bleach**

- **Use a spray bottle to apply a light mist of cleaning solution to all exposed surfaces**
- **Allow cleaning solution to sit for a minimum of 10 minutes !**
- **After 10 minutes, wipe surfaces in one direction and turn rag each wipe**
- **Change rags very frequently - [ 3 – 5 rags per average sized room ]**
- **Place all dirty rags in a container with the cleaner for 10 – 15 minutes, then thoroughly rinse out and send to launder as usual**
- **Or – use disposable towels and place in trash – seal bag and dispose of in garbage**
- **Dry surfaces that were cleaned with a clean dry rag or towel**

Note:

The cleaning/disinfecting process can be used as an effective deterrent against mold growth in areas where it was caused by a water leak.

In areas where mold is a chronic problem due to humidity content and inadequate ventilation, this process should be considered an interim or short-term solution to the problem.

Another option to consider in problematic areas is to install a properly sized de-humidifier. This unit will need to be maintained by Department staff – emptied daily and cleaned/disinfected every other week.

Improvements to the ventilation system are usually considered to be the only effective long-term solution**.**

## REMEDIATION METHODS

In the remediation guidelines reviewed for this document, recommended remediation criteria (such as clean-up methods, personal protective equipment, and containment required) are based upon the amount of mold present. Typically, this is expressed in terms of contaminated surface area. NYC DOH classifies mold contamination on building materials into four levels:

| Designation | Description | Area (sq ft) | Examples |
|---|---|---|---|
| Level I | Small Isolated Areas | < 10 | Ceiling tiles, small areas on walls |
| Level II | Mid-Sized Isolated Areas | 10 – 30 | Individual wallboard panels |
| Level III | Large Isolated Areas | 30 – 100 | Several wallboard panels |
| Level IV | Extensive Contamination | > 100 contiguous square feet in an area | |

NYC DOH also includes a fifth designation (Level V) for contamination in HVAC systems. Level V contains two sub-categories: small isolated areas of contamination less than 10 sq ft ("V-a") and areas of contamination greater than 10 sq ft ("V-b").

USEPA and ACGIH propose three-group schemes in their remediation guidelines. USEPA classifies mold growth as Small (total surface area affected less than 10 sq ft), Medium (10 – 100 sq ft), or Large (greater than 100 sq ft OR potential for increased occupant or remediator exposure during remediation estimated to be significant). The ACGIH guidelines simply describe the contamination as Minimal, Moderate, or Extensive without giving specific areas associated with those terms. Health Canada mentions small-, medium-, and large-scale operations as being associated with areas of contamination of 0.3 sq m, 3 sq m, and 10 sq m respectively, but does not provide much detail about the associated remediation practices. HVAC (heating, ventilating, air conditioning) systems are addressed much less extensively by the other publications than by NYC DOH.

Current guidance documents agree that remediation of a mold problem includes at least two aspects, (1) identification and correction of the moisture problem(s) that caused mold growth and (2) elimination of the mold by removal of mold-contaminated materials or, under certain conditions, by cleaning the materials. Most also add that removal of dusts (including dusts generated during other remediation activities) that can contain mold fragments, spores, and toxins is an essential part of remediation. Whether mold-contaminated materials should be cleaned or discarded depends upon the nature of the materials and the extent of contamination.

Building materials can be classified as non-porous (e.g., metal, plastic, glass), semi-porous (e.g., wood, concrete), or porous (e.g., wallboard, ceiling tiles), according to their ability to absorb water. Generally, non-porous materials can be cleaned using a detergent solution and re-used.  If the structural integrity of a non-porous material has been compromised, however, then NYC DOH and AIHA recommend that the material be replaced.

Re-use of a semi-porous material depends upon the extent to which fungal contamination has penetrated it.  For example, surface contamination of wood can be removed by refinishing or sanding (ACGIH, AIHA), whereas semi-porous materials that are not structurally sound or that have more than surface contamination should be discarded rather than cleaned (AIHA, NYC DOH, ACGIH).  All materials of any porosity that are re-used should be dry and free of surface contamination; routine inspections of re-used materials should be conducted to assure that they remain mold-free.

As a rule, porous materials should be discarded rather than cleaned and re-used.  Although NYC DOH makes allowances for re-use of contaminated porous materials, they note, "Porous materials…should be discarded if possible."  Health Canada recommends that contaminated porous materials be removed because there is no way to determine whether the cleaning has eliminated the fungal growth.  ACGIH notes that porous materials not supporting active fungal growth can still be contaminated with fungal spores or particles released from other sites.  USEPA does not make general remediation recommendations for the various porosities of materials.  USEPA does, however, discuss four clean-up methods (wet vacuuming, damp wiping, HEPA vacuuming, and discarding contaminated materials) and makes recommendations for their use on various building and content materials under various contamination scenarios (small, medium, or large areas of contamination; see Tables 1 and 2 in the Appendix).

.S. Environmental Protection Agency (EPA)
http://www.epa.gov/iaq/molds/

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention (CDC)
http://www.cdc.gov/nceh/airpollution/mold/

California Department of Health Services
http://www.cal-iaq.org/mold0107.htm or
http://www.cal-iaq.org/mold0107.pdf

Florida Cooperative Extension, University of Florida
http://edis.ifas.ufl.edu/TOPIC_Moisture_Mold_and_Mildew

Florida Solar Energy Center, University of Central Florida
http://www.fsec.ucf.edu/bldg/science/mold/index.htm

Minnesota Department of Health
http://www.health.state.mn.us/divs/eh/indoorair/mold/index.html

New York City Department of Health
http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html

North Carolina Department of Health and Human Services
http://www.epi.state.nc.us/epi/oii/mold/

Texas Department of Health
http://www.tdh.state.tx.us/beh/IAQ/protecting_your_home_from_mold.html
http://www.tdh.state.tx.us/beh/IAQ/Mold_Rem3.htm

Washington State Department of Health
http://www.doh.wa.gov/ehp/ts/IAQ/Got_Mold.html

American College of Occupational and Occupational Medicine (ACOEM)
http://www.acoem.org/guidelines/article.asp?ID=52

American Industrial Hygiene Association (AIHA)
http://www.aiha.org/GovernmentAffairs-PR/html/prmoldsources.htm

Building Science Corporation
http://www.buildingscience.com/resources/mold/default.htm

**Mold Resources List**

An Office Building Occupant's Guide to IAQ
http://www.epa.gov/iaq/pubs/occupgd.html

Biological Contaminants
http://www.epa.gov/iaq/biologic.html

Building Air Quality Action Plan (For Commercial Buildings)
http://www.epa.gov/iaq/largebldgs/actionpl.html

Floods / Flooding
http://www.epa.gov/iaq/pubs/flood.html

Indoor Air Quality (IAQ) Home Page
http://www.epa.gov/iaq

IAQ in Large Buildings/Commercial Buildings
http://www.epa.gov/iaq/largebldgs/

IAQ in Schools
http://www.epa.gov/iaq/schools

Mold Resources
http://www.epa.gov/iaq/molds/moldresources.html

Mold Remediation in Schools and Commercial Buildings
http://www.epa.gov/iaq/molds/mold_remediation.html

U.S. EPA IAQ Information Clearinghouse (IAQINFO)
Phone: (800)438-4318 or (703)356-4020
Fax: (703)356-5386
Email: iaqinfo@aol.com

Air Conditioning Contractors of America (ACCA)
(703)575-4477
http://www.acca.org/index.html
Information on indoor comfort products and services.

American College of Occupational and Environmental Medicine (ACOEM)
(847)818-1800
http://www.acoemprivatepractice.com/
Referrals to physicians who have experience with environmental exposures.

American Conference of Governmental Industrial Hygienists, Inc. (ACGIH)
(513)742-2020
http://www.acgih.org
Occupational and environmental health and safety information.

American Industrial Hygiene Association (AIHA)
(703)849-8888
http://www.aiha.org
Information on industrial hygiene and indoor air quality issues including mold hazards and legal issues.

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
(800)527-4723
http://www.ashrae.org
Information on engineering issues and indoor air quality.

Association of Occupational and Environmental Clinics (AOEC)
(202)347-4976
http://www.aoec.org

Association of Specialists in Cleaning and Restoration (ASCR)
(800)272-7012 or (410)729-3603
http://www.ascr.org/institutes

American Academy of Allergy, Asthma & Immunology (AAAAI)
(800)822-2762
http://www.aaaai.org/
Physician referral directory, information on allergies and asthma.

Asthma and Allergy Foundation of American (AAFA)
(800) 7ASTHMA (800)727-8462)
http://www.aafa.org
Information on allergies and asthma.

American Lung Association (ALA)
(800) LUNGUSA (800)586-4872)
http:// www.lungusa.org
Information on allergies and asthma.

Allergy and Asthma Network Mothers of Asthmatics (AANMA)
(800)878-4403 or (703)641-9595)
http://www.aanma.org
Information on allergies and asthma.

National Institute of Allergy and Infectious Diseases (NIAID)
(301)496-5717
http://www.niaid.nih.gov
Information on allergies and asthma.

National Jewish Medical and Research Center
(800) 222LUNG (800)222-5864)
http://www.njc.org
Information on allergies and asthma.

Carpet and Rug Institute (CRI)
(800) 882-8846
http://www.carpet-rug.com
Carpet maintenance, restoration guidelines for water-damaged carpet, other carpet-related issues.

Centers for Disease Control and Prevention (CDC)
(800)311-3435
http://www.cdc.gov

Floods/Flooding
Federal Emergency Management Agency (FEMA)
(800)480-2520
http://www.fema.gov/mit
Publications on floods, flood proofing, etc.

University of Minnesota, Department of Environmental Health and Safety
(612)626-5804
http://www.dehs.umn.edu/iaq/flood.html
Managing water infiltration into buildings.

Indoor Environmental Remediation Board (IERB)
(215)387-4097
http://www.ierb.org
Information on best practices in building remediation.

Institute of Inspection, Cleaning and Restoration Certification (IICRC)
(360)693-5675
http://www.iicrc.org
Information on and standards for the inspection, cleaning, and restoration industry.

International Sanitary Supply Association (ISSA)
(800)225-4772
http://www.issa.com
Education and training on cleaning and maintenance.

MidAtlantic Environmental Hygiene Resource Center (MEHRC)
(215)387-4096
http://www.mehrc.org

National Air Duct Cleaners Association (NADCA)
(202)737-2926
http://www.nadca.com
Duct cleaning information.

National Institute of Building Sciences (NIBS)
(202)289-7800
http://www.nibs.org
Information on building regulations, science, and technology.

National Institute for Occupational Safety and Health (NIOSH)
(800) 35NIOSH (800)356-4674)
http://www.cdc.gov/niosh
Health and safety information with a workplace orientation.

National Pesticide Information Center (NPIC)
(800)858-7378
http://npic.orst.edu/
Information on pesticides/antimicrobial chemicals, including safety and disposal information.

New York Department of Health, Bureau of Environmental and Occupational Disease Epidemiology
(212)788-4290
http://www.ci.nyc.ny.us/html/doh/html/epi/moldrpt1.html

Occupational Safety and Health Administration (OSHA)

(800)321-OSHA (800)321-6742)
http://www.osha.gov

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
(703)803-2980
http://www.smacna.org
Technical information on topics such as air conditioning and air ducts.

# Mold Remediation

# NYC Guidelines

There are five levels of remediation

# Level 1: Small Isolated Areas

- 10 ft2 or less
- Regular Building Maintenance
- Training on Clean-up Methods
- Work Area Unoccupied
- Dust Suppression Methods

# Level II: Mid-Size

- 10-30 ft2
- Regular Building Maintenance
- Work Area Covered with Poly
- HEPA Filtered Vacuum
- Plus Level I Recommendations

It may be necessary to remove electrical and plumbing to sand down an area properly. Do what it takes to do the job RIGHT! No Short-cuts.

# Level III: Large Isolated Area

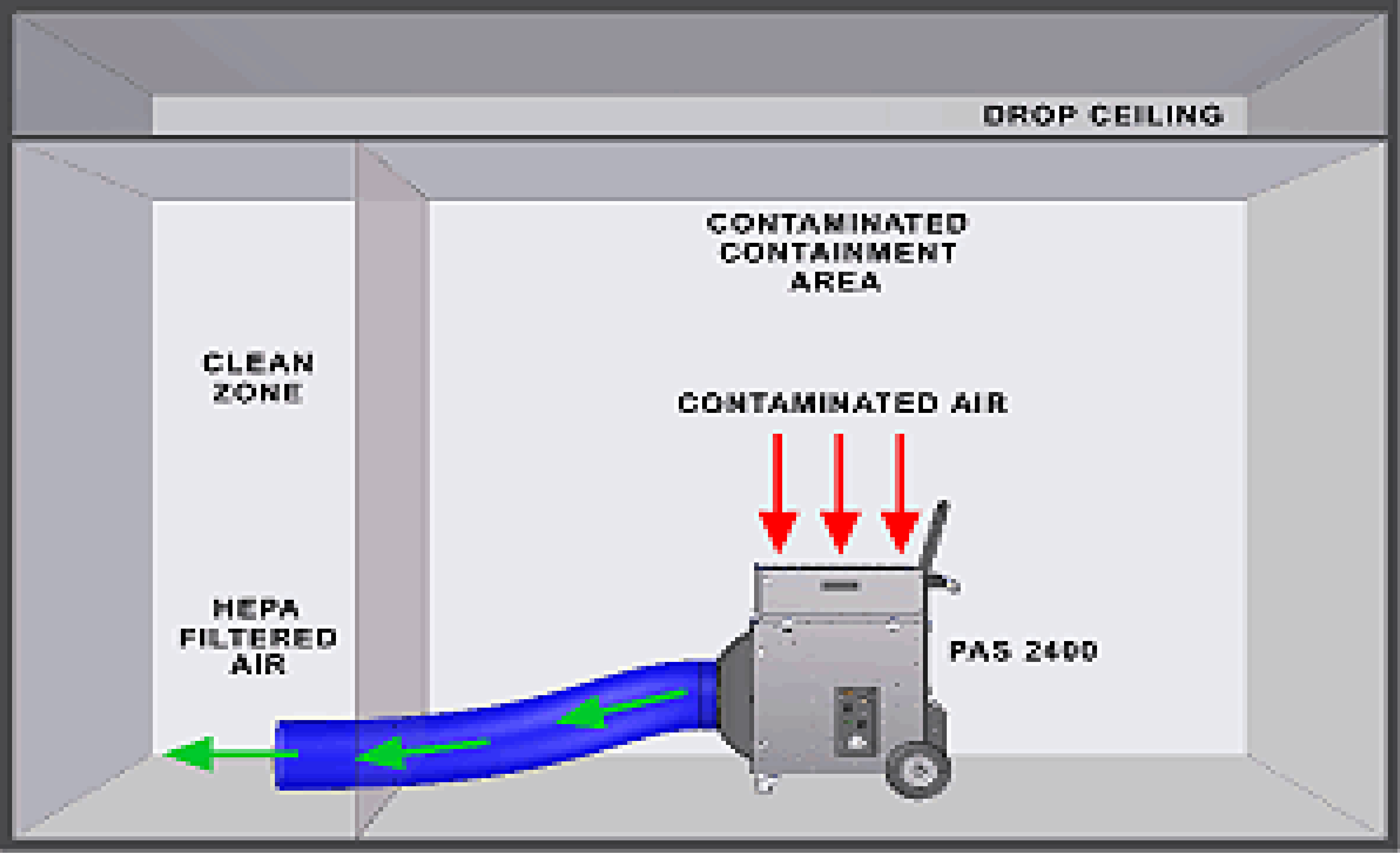
- 30-100 ft2
- Health & Safety Professional Provide Oversight
- Trained Abatement Workers
- Seal off Work Area: Adjacent Areas Unoccupied
- Generate “a lot of dust”, use level IV Recommendations

# Level IV: Extensive Contamination

- >100 Contiguous ft2
- Exhaust Fan with HEPA Filter
- Decon with Airlocks
- Air Monitoring (final clearance) Prior to Occupancy

# Level V: HVAC Systems

- <10ft2, Regular Maintenance Staff
- >10ft2
  - Health & Safety professional
  - Trained Abatement Workers
  - Containment
  - Air Monitoring (Final Clearance)




▪**Negative pressure mode with the PAS located inside of the containment zone:** The PAS pulls in contaminated air, filters out contaminants and propels the filtered air outside the containment zone through flexible ducting to negatively pressurize the work area.


JUN 2 2004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Any Questions?