CHANGE THE AIR
FOUNDATION

A GUIDE TO

TESTING YOUR HOME FOR MOLD & WATER DAMAGE

ChangeTheAirFoundation.org

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Dear Reader,

Congratulations! If you are reading this, you are taking an important step towards understanding the connection between your *health* and *home*.

When it comes to testing, it can be hard to know where to put your time, trust, and money. I wrote this Guide to answer all those questions and misconceptions I had about testing my home when I first started this journey. I hope it brings you one step closer to safer indoor air.

I, along with everyone at Change the Air Foundation, truly believe that each person is their own best advocate when armed with reliable information and resources.

Best,

Kendra Seymour
Vice Chair & Co-Founder
Change the Air Foundation

"The people who manage your building have a greater impact on your health than your doctor."

-Dr. Joseph Allen,

Healthy Buildings Program at

Harvard University's T.H. Chan School of Public Health

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How to Use This Guide

This guide is meant to help you understand commonly available testing options for your home. As much as possible, it is written in layman's terms and filled with helpful analogies and examples so that you can feel empowered and confident when talking with professionals and making decisions for your home.

You may choose to read it cover to cover or simply skip to the sections that are most relevant to you. There is no wrong way.

This guide will be helpful to anyone who wants to:

- ✓ Understand the pros and cons of different testing methods;
- ✓ See sample reports of different testing methods;
- ✓ Learn more about how and why to strategically test the home;
- ✓ Learn about different molds and bacteria that occur in water-damaged buildings; and
- ✓ Understand how to read test results themselves!

This guide does *not* go into detail about *all* the aspects of a quality home inspection. However, the "Getting Started" section near the end provides resources to help you find a good Indoor Environmental Professional (I.E.P.) and remediation company. **Testing is merely one piece of the puzzle.**

Finally, the inclusion of any testing method in this guide is *not* an endorsement for any specific test. Rather, we are including testing methods that are commonly available to the public.

A Note About Testing Your Home

These days, there are a lot of options available when it comes to testing your home for mold, water damage, and other indoor pollutants. It can be hard to know where to put your ***time***, ***trust***, and ***money***.

Before testing your home, keep a few key points in mind:

- ✓ There is **no** single test that will tell you everything you need to know about your home. **Testing is one piece of the puzzle.**
- ✓ The type of test you run should match your goals and influence your next steps.
- ✓ There are **no** perfect tests. Every test has specific purposes and limitations.
- ✓ Testing must be done correctly, or it can offer incomplete and/or inaccurate data. (Sadly, this happens more often than it should.)
- ✓ There are currently **no** required thresholds regulating the amount of mold or bacteria that is safe or healthy for an indoor environment.
- ✓ **Any testing should be combined with a thorough investigation of the entire home, taking into account the history of the home and the health of the people in it.**

It is important to reiterate that there are *no* required thresholds regulating the amount of mold or bacteria that is safe for an indoor environment. Meaning, there is no standard (federal, health, or otherwise) that says that "X" amount of a mold or bacteria is safe while "Y" amount is not.

When it comes time to analyze your results, it is best to pay attention to the specific types of molds and their amounts in relation to your unique situation.

Whether you are testing as part of an initial inspection or post-remediation, you will need to work with your I.E.P., remediation company, and possibly a health care practitioner to determine thresholds for your unique situation. In the meantime, consider checking out this article by Michael Pinto where he advocates for zero tolerance for certain target spores in post-remediation verification (testing).

Finally, there is no one-size-fits-all approach when it comes to testing your home for mold, water damage, and other indoor pollutants.

Overview of the Mold and Water-Damaged Environment

Mold is a naturally occurring fungus that plays an important role in our ecosystem by breaking down organic matter. Mold is a bit like nature's garbage man. Without mold, debris and other organic material would overrun the planet.

While it is true that mold spores are everywhere, even inside your home, mold *growth* in your home or building is a problem. The only mold inside your home should be as a result of what has settled from the outside, such as from opening doors or windows. This is sometimes referred to as ***normal fungal ecology***.

What is considered normal fungal ecology for one building might be different for another building. This is because normal fungal ecology is influenced by several factors such as season and building location. That said, the normal fungal ecology of a building should not have target molds or elevated indicator molds (see explanation on page 47). If they do, further investigation of the building is needed.

When a building experiences water damage, a complex ecosystem can begin to grow *inside* the building. Mold, mycotoxins, mVOCs, and bacteria are just some of the bio-contaminants found in damp indoor spaces. It's not enough to simply stop the moisture source; these bio-contaminants pose a health risk to its occupants and need to be safely removed from the home or building.

To learn more about the complex ecosystem created by damp indoor spaces, we recommend this paper by Dr. Jack Thrasher and Sandra Crawley, and this paper by Dr. Janette Hope.

According to the Institute of Inspection Cleaning and Restoration Certification (IICRC), there are three mold conditions for which an indoor environment can be categorized. In layman's terms:

Condition 1: normal fungal ecology

- An indoor environment that may have settled spores or fungal fragments that are to be expected within a similar indoor environment.

Simply put, the samples do not indicate a source of mold growth in the home.

Condition 2: settled spores or fungal fragments

- An indoor environment that is contaminated with mold spores or fungal fragments as a result of a Condition 3 situation. There are elevated spore counts not because the area is a source of mold growth, but because it has been impacted by a *nearby* area of growth. This is sometimes referred to as cross-contamination.

Condition 3: actual mold growth

- An indoor environment that is contaminated with actual mold growth, spores, or fungal fragments. Growth can be active, dormant, visible, and/or hidden.

Under the right conditions, mold can grow in as little as *24 hours*. These conditions include:

- *Food source:* Organic material such as wood, drywall, dust, and paper.
- *Proper Temperature*: Growth can occur at a range of temperatures depending on species.
- *Water:* Moisture sources can include humidity, spills, leaks, floods, and condensation.

We can divide mold into three categories based on the level of moisture in the building material. The level of moisture is called *water activity* and determines the order in which various categories of mold appear.

Primary Colonizers: requires hours to start to grow

- Can grow in relatively dry conditions
- Examples may include Penicillium, Wallemia, Aspergillus, and Eurotium

Secondary Colonizers: require days to start to grow

- These molds suggest an active mold source somewhere
- Examples may include Cladosporium, Ulocladium, Alternaria, Phoma and some species of Aspergillus (A. flavus and A. versicolor)

Tertiary Colonizers: require weeks to start to grow

- These molds suggest a pretty significant water issue. Tertiary colonizers often out-compete other species, often by producing mycotoxins.
- Examples may include Stachybotrys, Chaetomium, Aureobasidium, Ulocladium, and Trichoderma.

We can classify mold into three classes based on health hazard:

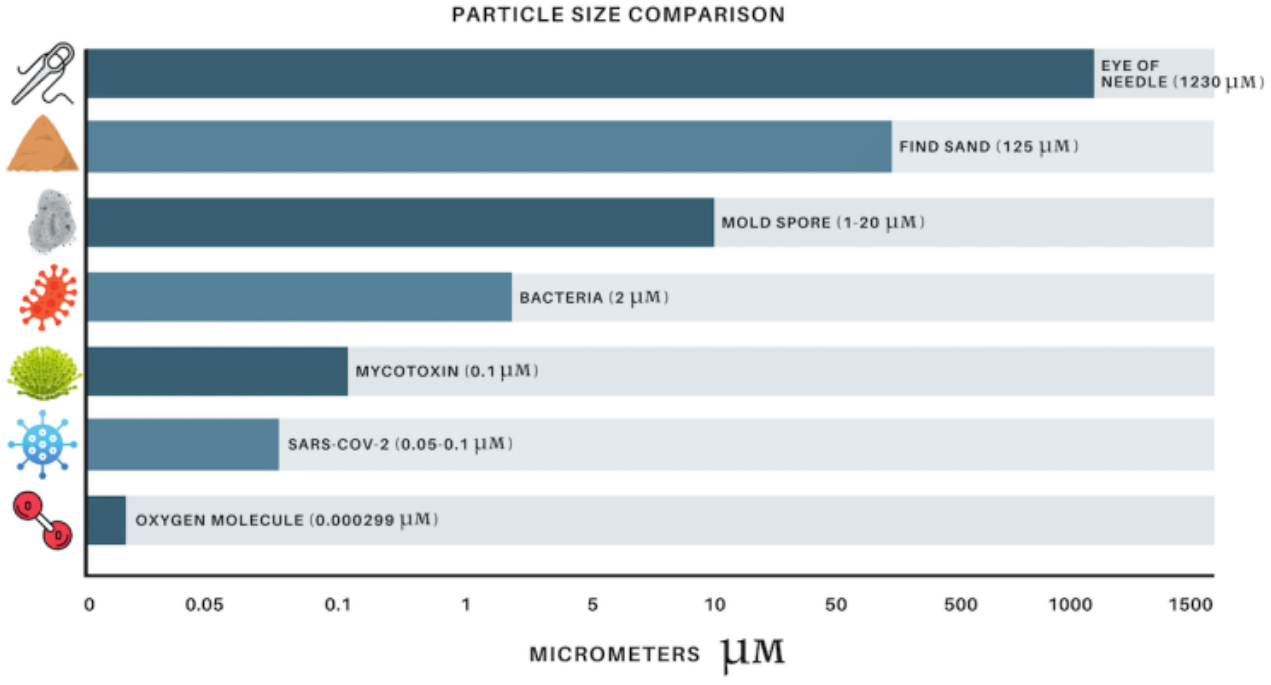
- *Allergenic molds:* Can trigger allergic reactions to those exposed.
- *Toxigenic molds:* Can produce toxins (such as mycotoxins) that pose a risk to human health and other organisms.
- *Pathogenic molds:* Can cause disease and infection in humans or other organisms.

Size Matters: The Problem With Mold and Water Damage

Have you ever heard of the saying “seeing is believing?” While it may come in handy sometimes, it is not particularly helpful when it comes to understanding mold and water damage in your home. Why? Because mold and water damage is often hidden behind walls, floors, and in hard-to-reach places such as attics, crawlspaces, basements, and HVAC systems. As a result, it can take years for people to make the connection between their *health* and their *home*.

To complicate matters, mold spores, mold fragments, mycotoxins, and bacteria are *microscopic*, meaning they cannot be seen with the naked eye.

These tiny particles are often measured in microns (µm). A micron is one-millionth of a meter or 1/26,000 of an inch. For comparison’s sake, the eye of a needle is roughly 1,230 microns and a single strand of human hair is roughly 70 microns in diameter. **Generally speaking, the naked eye cannot see anything smaller than 40 microns.** Mold spores are typically between 3-30 microns (in some cases as large as 100 microns) while fungal fragments are significantly smaller averaging 0.3-0.03 microns. Mycotoxins average 0.1 microns. Bacteria range in size from 1-10 microns. **In other words, we cannot see these pollutants!**



In fact, by the time you see mold *growth*, there are *a lot* of mold spores involved. **To put it into perspective, it has been estimated that 400,000,000 spores of Penicillium cover an area 2.5 cm in diameter!** That's a lot of mold for an area that is roughly the size of a quarter!

MOLD SPORES
Mold spores are like seeds. Their purpose is reproduction.

An additional consideration is that mold colonies and spores will often break into *fungal fragments*. Fungal fragments pose a particular challenge as they are even tinier (0.3-0.03 microns) and can bypass our body's natural defense systems. **Depending on the study, it is estimated that for every one mold spore there can be as many as 500 fungal fragments!**

Unfortunately, the health concerns aren't limited to mold spores and fungal fragments. Mold under *certain* conditions can create secondary metabolites called mycotoxins. **Mycotoxins are a poisonous chemical designed to kill other living things.** Similar to how thorns protect a plant or claws protect an animal, mycotoxins protect a mold colony.

When mycotoxins are created, they ooze out of the defending colony onto the immediate surface and are absorbed into any surrounding material. This is similar to how lava oozes out of a volcano. Mycotoxins are molecules that absorb into particles as small as 0.1 microns. **Mycotoxins can travel through the environment on mold spores, fungal fragments, dust, etc.** This is perhaps why some people *incorrectly* believe that mycotoxins are gasses.

Making mycotoxins is metabolically expensive, meaning it takes a lot of energy for a mold to produce them. As a result, mycotoxins are made only under certain conditions such as when certain other molds or bacteria invade the area. It is *not* possible to tell if a mold is producing mycotoxins simply by looking at it.

Another common misconception is to refer to a mold as "toxic mold." When something is toxic, it is always toxic. But mold doesn't always produce mycotoxins. As a result, a more accurate term is *toxigenic*, meaning it is sometimes capable of producing toxins. **Remember, just because a mold can produce mycotoxins doesn't mean it always will.**

To date, over 200 types of mycotoxins have been identified with many more likely to be discovered**. A *single* mold species may produce *multiple* types of mycotoxins. On the flip side, *multiple* species of mold may produce the *same* type of mycotoxin.** While people are not the intended target, mycotoxin exposure can lead to a wide range of negative health effects including immune suppression and cancer. Finally, mycotoxins are not living, thus they *cannot* be killed. Focus should always be on the removal of mold growth and any byproducts created by that growth.

To summarize, just because a mold can produce mycotoxins, doesn't mean it always does.

MYCOTOXINS
Mycotoxins are a poison. Their purpose is defense.

Now let's take a moment to talk about odor! Most people are familiar with the musty or earthy smell we typically associate with mold growth. So, does that mean if you don't smell mold then you don't have a problem? Not exactly.

When you smell mold, what you are likely smelling are microbial volatile organic compounds (mVOCs). These gases are "breathed out" by mold while it's actively feeding. Mold doesn't eat all the time, though. It goes in and out of feeding phases depending on the conditions. That's why some homes only have an odor occasionally such as after a heavy rain or during certain times of year.

mVOCs
mVOCs are a gas. They are a byproduct of digestion.

It's important to note that not all molds have a distinctive odor, and whether an odor is produced is determined by several factors such as the food source and the condition of the environment.

According to the EPA, a musty odor is a sign of a *current* mold problem and should be investigated. While more research is needed, mVOCs have been associated with adverse health effects and are largely considered irritants. Remember:

Mold smell = likely mold growth

No mold smell = you may or may not have mold growth

Finally, it's worth taking a moment to talk about the role of bacteria in a water-damaged home or building.

There are thousands of identified species of bacteria. Bacteria indoors can come directly from the occupant themselves as well as other sources that have been introduced into the home through avenues such as sewage back up, flooding, and stagnant water that has allowed airborne bacteria to thrive.

Bacteria is freely found in the air, soil, and water. It can survive a wide range of conditions and temperatures. Bacteria produce **endotoxins** and exotoxins, both of which are poisons designed to harm other living things. Bacteria also produce volatile organic compounds (VOCs). Exposure to any of these can lead to illness, irritation, and other diseases.

ENDOTOXINS
Endotoxins are a poison produced by gram-negative bacteria.

In recent years, there has been particular attention paid to **actinomycetes**, a group of gram-positive bacteria that produces various biotoxins as well as endotoxins, which are a poisonous component of gram-negative bacteria that is shed upon the death of bacteria.

ACTINOMYCETES
Actinomycetes are gram-positive bacteria that produce biotoxins.

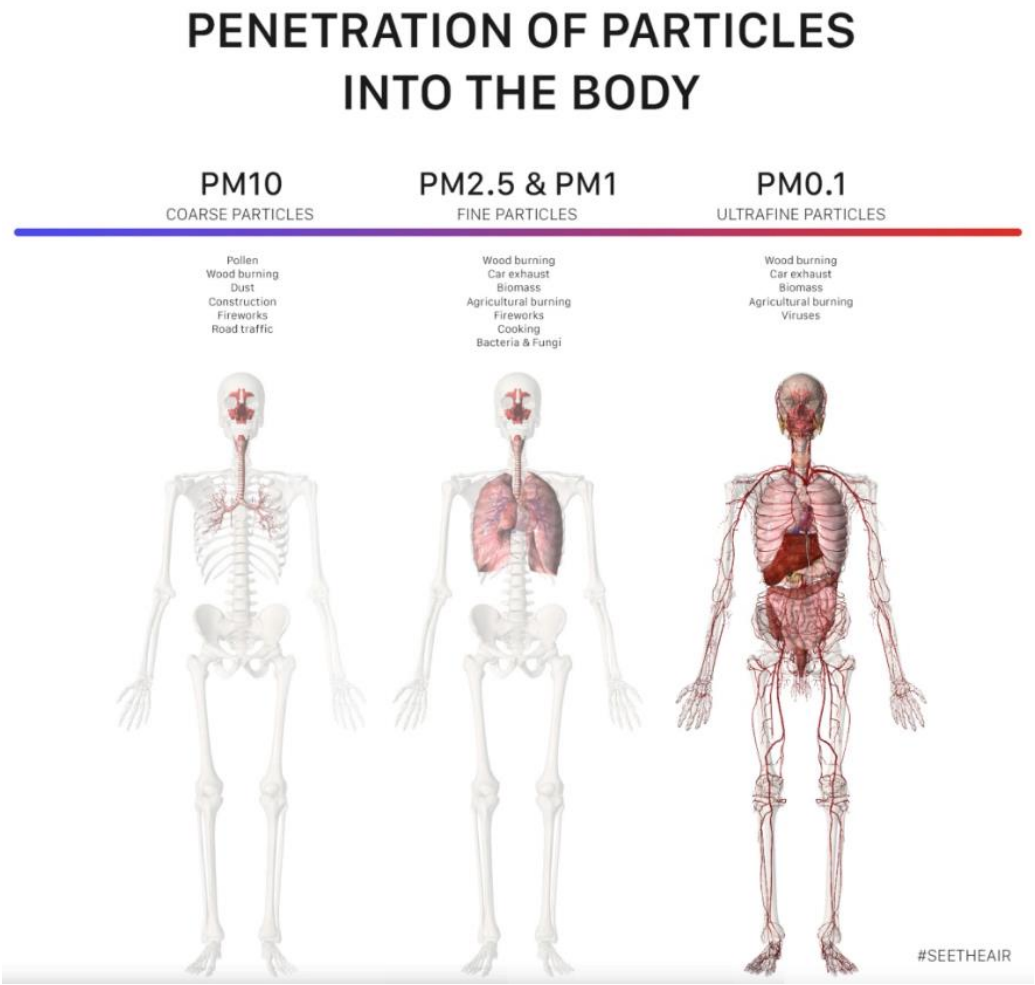
When remediating a home for mold and water damage, bacteria should be considered, even if only indirectly. This is because both mold and bacteria can thrive in water-damaged buildings.

When it comes time to analyze your test results, pay attention to the specific types of molds and their amounts in relation to your unique situation. This means you will need to work with your I.E.P., remediation company, and health care practitioner to determine thresholds for your unique situation.

The late Dr. Jack Trasher reminds us: "*[T]here are no current recommendations by the EPA, OSHA, NIOSH, WHO and the Medical and Toxicology professions as to what constitutes a safe level of indoor molds and bacteria and their toxins in a water-damaged indoor environment.*"

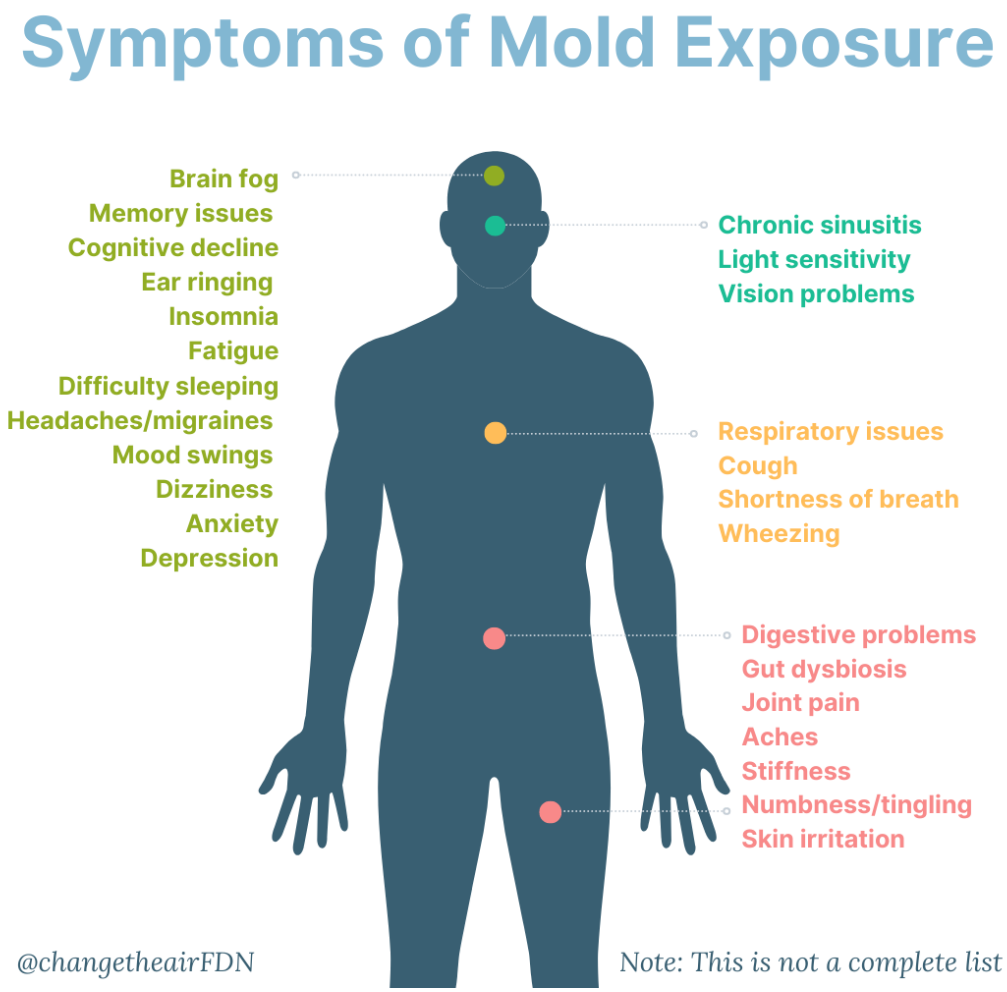
Most importantly, remember that size matters when it comes to indoor pollutants such as mold spores, fungal fragments, mycotoxins, mVOCs, and bacteria! Just because you can't see it, doesn't mean it's not there. Further, just because it's small doesn't mean it can't hurt you. **Think of it this way, the smaller the particle, the deeper it can go into your body!**

There are typically two particle sizes measured in studies when it comes to indoor air quality and their effect on human health: particulate matter that is 10 microns (PM10) and particulate matter that is 2.5 microns (PM2.5). **Particles that are PM10 or smaller can penetrate deep into the lungs, while PM2.5 and smaller can cross directly into your blood stream. Both pose a significant risk to your health, affecting many parts of the body.**



While it would be beyond the scope of this guide to cover all the health effects associated with living in a water-damaged building, there are a few points worth mentioning.

Mold, water damage, and other indoor pollutants can trigger a number of health conditions that can range from minor to severe. Exactly how a person will be affected is dependent on a number of factors including, but not limited to, dose, duration, genetics, and preexisting conditions.



In this paper, Dr. Janette Hope summarizes it well:

> *"It has been estimated that up to 50% of illness results from exposure to indoor air pollution, with exposure to water-damaged indoor environments likely being a significant contributor to this […] Symptoms and illness due to*

exposure result from varying mechanisms including infection, toxicity, allergy, irritant effects, and systemic inflammation […]While it is often difficult to determine the contribution of the many components of water-damaged buildings, studies on illness from exposure to damp/water-damaged environments have been consistent in identifying the overall exposure itself as being the main factor associated with adverse health effects."

Simply put, what's in your indoor air matters to your health.

Finally, the microscopic nature of mold spores, fungal fragments, mycotoxins, and bacteria is why it can be difficult to effectively and safely remove these contaminants from an indoor environment.

This is also why it's so important to hire someone who understands the biology of these bio-contaminants in relationship to indoor spaces and your health. But that's a topic worthy of a future guide! In the meantime, you can find more information on inspection and remediation practices by visiting our website here.

Remember, the problem with mold and water damage is:

- ✓ Mold and water damage is often hidden behind walls, under floors and in hard-to-reach places such as attics, crawlspaces, basements, and HVAC systems;
- ✓ Mold spores, fungal fragments, mycotoxins, mVOCs, and bacteria are microscopic and can pose a health hazard; and
- ✓ **Finally, there are currently *no* required thresholds regulating the amount of mold and bacteria that is safe for an indoor environment.**

Reasons to Test Your Home

Mold and water damage can have serious *financial*, *emotional, mental,* and *physical consequences* for you and your loved ones.

That's why it is important to understand *if* and *how* your home may be affecting your health. Strategic testing, when combined with other key elements of the inspection process, can answer those questions for you.

However, the unfortunate reality is that the way many tests are conducted (by professionals and renters/homeowners alike) offers inaccurate or incomplete information. (See page 7, "A Note About Testing Your Home," to learn more.)

Remember, testing is done to:

- Confirm suspected areas of microbial growth (source areas);
- Understand how far mold spores, fragments, etc. have traveled (sometimes referred to as cross-contamination) from the original areas of growth;
- Provide the data for a proper remediation plan and/or provide data for post remediation verification (testing); and
- Identify potential exposure to those living in the home or building.

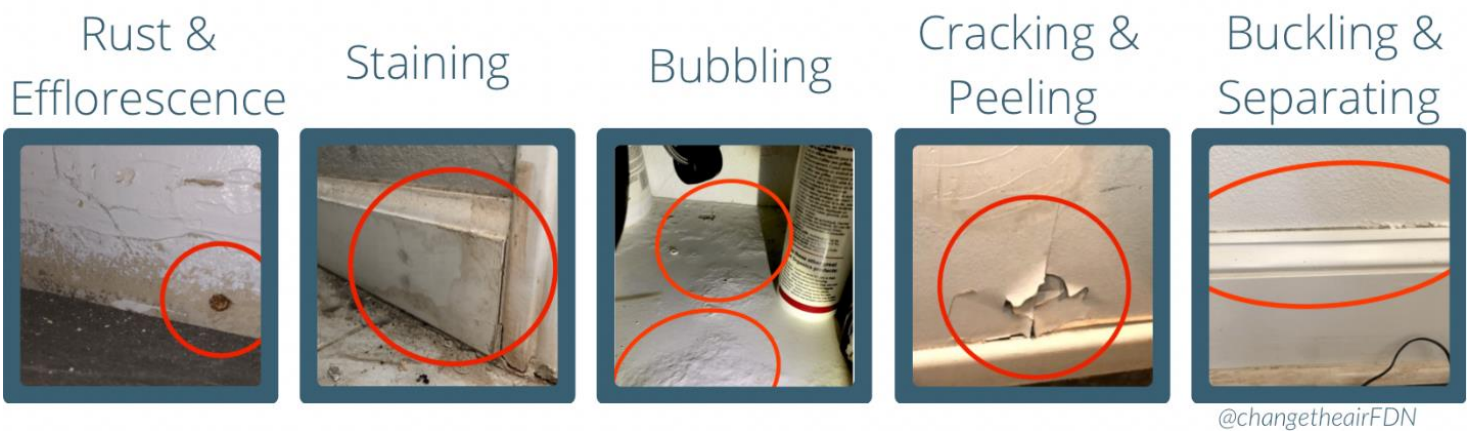
Some reasons you may choose to test your home include:

- ✓ You have visible water damage or mold **(Note: *Visible mold growth, regardless of the test results, should be removed safely following at a minimum the standards laid out by the IICRC S520).***
- ✓ You suspect your home might have a problem.
- ✓ Your home has a history of mold or water damage, or you are unsure of the history of the home.
- ✓ You or someone in the home has unexplained chronic health problems, environmentally acquired illness, autoimmune disease, or another condition that compromises your health.
- ✓ You have young children or elderly in the home.
- ✓ You are looking to buy or rent a home.
- ✓ You are considering legal action against a third party such as a landlord or builder.
- ✓ **You have any of the 5 Signs of Water Damage! (See page 19!)**

5 Signs of Water Damage

Most people know to look for the telltale signs of physical mold growth – often a green, white, or black substance that may even be confused as dirt or dismissed as mildew.

However, there is a secret to looking for hidden mold and bacteria. **That secret is as simple as looking for the signs of water damage!** Remember, mold can begin to grow in as little as **24-48 hours** while bacteria can grow even faster. If you see these signs of water damage (even if you don't see physical growth yet), it's wise to test rather than guess!



1. **Rust & Efflorescence**: Water causes chemical reactions resulting in rust on metal, or a white powdery substance (efflorescence) on concrete.

2. **Staining**: This may be the most obvious sign of water intrusion, but often times staining is overlooked because there is no visible mold growth.

3. **Bubbling**: When water soaks into certain building materials it creates a visible bubbling effect.

4. **Cracking & Peeling**: Water can also eat away at building materials causing them to crack, peel, or rot away.

5. **Buckling & Separating**: Water can cause building materials to warp. When this happens, they can pull away from each other or create a bowing effect.

Let's take a look at a few real-life examples…

Signs of Water Damage & Mold Growth Example #1 – Wall

Sample ID:	366939-13
Client Sample ID:	Mstr Bdrm W Wall Under Wndw 5
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	2,967	18,400	97
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	94	583	3
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**3,061**	**18,983**	
Hyphal Fragments	188	1,166	
Detection Limit	73		

Signs of Water Damage & Mold Growth Example #2 – HVAC Mini Split

Sample ID:	377034-04
Client Sample ID:	HVAC Mini Split AHU Interior
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	12	74	<1
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	—	—	—
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	107,152	664,509	100
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**107,164**	**664,583**	
Hyphal Fragments	1,884	11,684	
Detection Limit	73		

Signs of Water Damage & Mold Growth Example #3 – Window

Test: S001 Swab Analysis

Sample ID:	374584-24* **
Client Sample ID:	Window Tracks Bdrm Downstairs
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

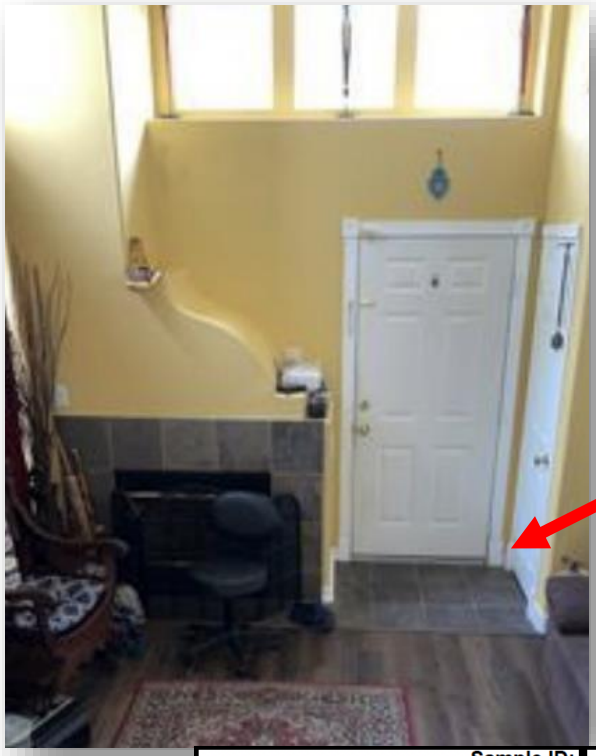
Spore Types	Raw Count	Count/cm²	%
Alternaria	2	12	1
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	—	—	—
Basidiospores	2	12	1
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	278	1,724	99
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Ophiostoma	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Scopulariopsis	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**282**	**1,749**	
Hyphal Fragments	22	136	
Detection Limit	12		

Signs of Water Damage & Mold Growth Example #4 – Refrigerator

Sample ID:	347914-02
Client Sample ID:	F Kitch Fridge Freezer Gasket
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	4[illegible]745	277,488	63
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	2[illegible]905	160,651	37
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Ophiostoma	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**70,650**	**438,140**	
Hyphal Fragments	11,775	73,023	
Detection Limit	73		

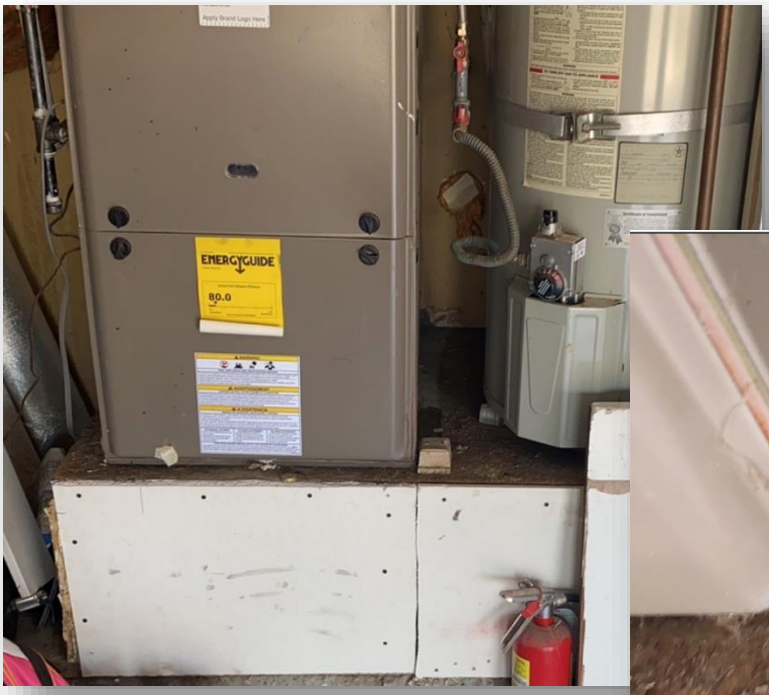
Signs of Water Damage & Mold Growth Example #5 – Wall



Sample ID:	389650-07
Client Sample ID:	Foyer R Wall Front Door B
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	—	—	—
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	—	—	—
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Ophiostoma	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	17,662	109,532	100
[illegible]	—	—	—
Ulocladium	59	366	<1
Unidentified Spores	—	—	—
Total Spores	**17,721**	**109,898**	
Hyphal Fragments	1,519	9,420	
Detection Limit	73		

Signs of Water Damage & Mold Growth Example #6 – HVAC



Sample ID:	390826-13
Client Sample ID:	Garage Water Htr/HVAC Platform
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	777	4,819	3
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	9,420	58,419	34
Cladosporium	—	—	—
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	17,662	109,532	63
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**27,859**	**172,769**	
Hyphal Fragments	212	1,315	
Detection Limit	73		

Signs of Water Damage & Mold Growth Example #7 – Kitchen

Sample ID:	343403-02*
Client Sample ID:	A Kitchen Cabinetry South Wall
Detection Limit:	15
Media:	Tape
Sample Analysis:	Analyzed at 600X Magnification

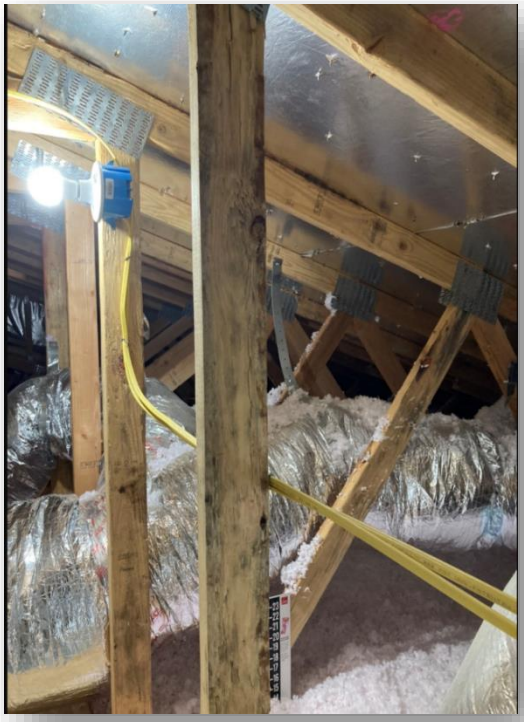
Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	17,000	261,800	72
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	6,500	100,100	28
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**23,500**	**361,900**	
Hyphal Fragments	5,500	84,700	

Signs of Water Damage & Mold Growth Example #8 – Wallpaper

Sample ID:	371574-27
Client Sample ID:	Master Bedroom West Wall B
Area Swabbed (cm^2):	6.45
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	3,132	19,423	10
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	—	—	—
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Spegazzinia	—	—	—
Stachybotrys	29,438	182,561	90
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**32,570**	**201,984**	
Hyphal Fragments	7,065	43,814	
Detection Limit	73		

Signs of Water Damage & Mold Growth Example #9 – Attic



Sample ID:	386909-04*
Client Sample ID:	Attic (Framing Composite) A
Area Swabbed (cm^2):	25.81
Media:	Swab
Sample Analysis:	Analyzed at 600X Magnification

Spore Types	Raw Count	Count/cm²	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	—	—	—
Aspergillus/Penicillium-Like	65,940	102,193	100
Basidiospores	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	—	—	—
Cladosporium	—	—	—
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	—	—	—
Torula	—	—	—
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**65,940**	**102,193**	
Hyphal Fragments	436	676	
Detection Limit	18		

* Bacteria Present.

Common Testing Options: Air Testing

(Spore Trap)

Air sampling is analyzed under a process called microscopy. Air is pulled into a cassette called a spore trap for a predetermined amount of time. The cassette holds a slide that contains a sticky media that captures spores and particulates. The cassette is then examined under a microscope by a lab technician who identifies genera of mold and counts the spores captured on the slide. Since mold is found everywhere, an outdoor air sample is typically taken for comparison to indoor ambient samples.

PROS…

- When used *properly*, it can help identify where mold sources are located by looking for abnormal amounts of spores and type of molds in the air sample.
- Can be used to take samples inside of walls to identify hidden sources of mold growth.
- Identifies viable and nonviable spores.
- Can be a helpful component of post-remediation verification (testing).
- More widely recognized than some other testing methods.

CONS…

- The further away from the source that you take the air sample, the less likely you are to find the source.
- It is a snapshot in time of the day, season, length of time the sample was collected.
- Identifies mold only at a genus level.
- It does not identify spores that have not yet become airborne.
- Heavier and stickier molds such as Stachybotrys tend not to show up as easily.
- It does *not* identify spore fragments. (It will identify hyphal fragments.)
- It is not a good indicator of cross-contamination.
- Cassettes can become overloaded with particulates making it difficult for the mycologists to see clearly what has been captured.
- Some molds are indistinguishable due to similar structure (i.e. Aspergillus and Penicillium spores look very similar and are thus reported together.)
- Typically requires a technician with specialized equipment to take the sample.

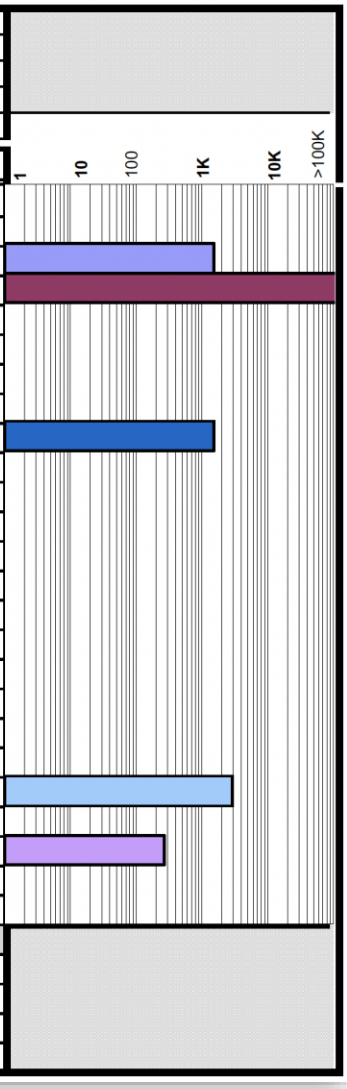
Air Testing

Sample Report

Spore Trap Analysis

Sample ID:	01
Client Sample ID:	Living Room (Ambient)
Volume Sampled (L):	15
Media:	Air-O-Cell
Percent of Trace Analyzed:	100% at 600X Magnification

Spore Types	Raw Count	Count/m³	%
Alternaria	—	—	—
Arthrinium	—	—	—
Ascospores	23	1,533	1
Aspergillus/Penicillium-Like	2,016 #	134,400	96
Basidiospores	—	—	—
Beltrania	—	—	—
Bipolaris/Dreschlera	—	—	—
Botrytis	—	—	—
Chaetomium	23	1,533	1
Cladosporium	—	—	—
Curvularia	—	—	—
Epicoccum	—	—	—
Fusarium	—	—	—
Ganoderma	—	—	—
Memnoniella	—	—	—
Nigrospora	—	—	—
Oidium/Peronospora	—	—	—
Pithomyces	—	—	—
Rust	—	—	—
Smut/Myxomyces/Periconia	—	—	—
Stachybotrys	44	2,933	2
Torula	—	—	—
Trichocladium	4	267	<1
Ulocladium	—	—	—
Unidentified Spores	—	—	—
Total Spores	**2,110**	**140,667**	
Hyphal Fragments	7	467	
Pollen	—	—	
Debris Rating	3		
Detection Limit	67		



To learn more about air testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ How to take an air sample;
- ✓ Strengths and limitations of air samples;
- ✓ When to use air sampling;
- ✓ How to read lab reports; and more!

Common Testing Options: Dust Testing

(ERMI, EPA-36, HERTSMI-2, EMMA, etc.)

The ERMI, HERTSMI-2, EPA-36 and EMMA are DNA-based sampling methods that use MSQPCR technology to analyze dust that is collected from around various parts of the home. For example, the ERMI was originally developed by the EPA using a cassette attached to a vacuum for the collection of dust in two rooms (typically the bedroom and living room carpet) to determine the mold burden in a home. This technology has been adapted into a number of commercial products that use a cloth or Swifter product to collect dust from around the home.

***ERMI*:** Analyzes 36 species of mold.

***EPA-36*:** Analyzes 36 species of mold.

***HERTSMI-2*:** Prioritizes five of the most common "water-damage" molds.

***EMMA*:** Tests for ten molds and 16 mycotoxins as well as candida.

PROS…

- Identifies mold at the species level.
- Identifies viable and non-viable spores.
- Gives an historical picture of what might be going on in the home.
- Can be used to see how contaminants from source areas are being dispersed throughout the home (cross-contamination).
- Does not require a professional to collect the sample.
- This DNA-based method analyzes the fragmentation of molds and spores in the dust which allows stickier molds such as Stachybotrys, that might be missed by other testing methods, to be captured.

CONS…

- It won't tell you where the mold growth is coming from or if it is from a past or current issue.
- For ERMI, the cloth method is used more commonly even though the original EPA study was done using the cassette-style collection method.
- HERTSMI-2 only looks at five organisms and may overlook other problematic molds.
- User error can be a factor, so samples should be collected in accordance with laboratory instructions.
- It is not an appropriate tool for confirming sources have been removed during post-remediation verification (testing).
- For ERMI, too much emphasis is placed on the total score, which can be misleading.
- Dust testing is not as widely used or recognized by those in the mold and water damage fields.

ERMI Testing

Sample Report

ERMI RESULTS

Group 1; Water Damage Molds	
Species	**SE/mg**
Aspergillus flavus/oryzae	25 *
Aspergillus fumigatus	6
Aspergillus niger	89 *
Aspergillus ochraceus	6
Aspergillus penicillioides	630
Aspergillus restrictus	27 *
Aspergillus sclerotiorum	6
Aspergillus sydowii	N D
Aspergillus unguis	N D
Aspergillus versicolor	311 * *
Aureobasidium pullulans	4,578 *
Chaetomium globosum	15
Cladosporium sphaerospermum	37
Eurotium (Asp.) amstelodami	507
Paecilomyces variotii	23 *
Penicillium brevicompactum	54 *
Penicillium corylophilum	52 *
Penicillium crustosum	N D
Penicillium purpurogenum	N D
Penicillium Spinulosum	N D
Penicillium variabile	11
Scopulariopsis brevicaulis/fusca	5
Scopulariopsis chartarum	5
Stachybotrys chartarum	4
Trichoderma viride	12
Wallemia sebi	55
Sum of Logs	32.2

Group 2; Common Indoor Molds	
Species	**SE/mg**
Alternaria alternata	80
Acremonium strictum	44 *
Aspergillus ustus	3
Cladosporium cladosporioides1	3,232
Cladosporium cladosporioides2	25
Cladosporium herbarum	1,150 *
Epicoccum nigrum	937
Mucor amphibiorum	29
Penicillium chrysogenum	152 *
Rhizopus stolonifer	7
Sum of Logs	19.4

SE = Spore Equivalents
SE/mg = SE/milligrams of sample
Logs = Logarithms
N D = None Detected

Sample Size	2.2	mg
ERMI Results= (G1-G2)	**12.8**	

(*) 10 fold higher than normal.
(**) 100 fold higher than normal.
(***) 1,000 fold higher than normal.

Note: The HERTSMI-2 score can be calculated from the ERMI score.

To learn more about ERMI testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ How to take ERMI samples;
- ✓ Strengths and limitations of ERMI samples;
- ✓ When to use ERMI sampling;
- ✓ How to read lab reports, and more!

EPA-36 Testing

Sample Report

Rapid Detection of Common Molds by Quantitative PCR

EPA 36

Lab Sample Number	1159-1
Client Sample ID	SA2613
Sample Location	Living Rm (Air Conditioning Unit)
Sample size	1Swab
EPA 36 Species Group -1	Spores E./Swab
Aspergillus flavus	3,324
Aspergillus fumigatus	6,000
Aspergillus niger	586
Aspergillus ochraceus	28,969
Aspergillus penicillioides	ND
Aspergillus restrictus	ND
Aspergillus sclerotiorum	ND
Aspergillus sydowii	4,415
Aspergillus unguis	373,208
Aspergillus versicolor	1,660
Eurotium (A.) amstelodami	29
Aureobasidium pullulans	10
Chaetomium globosum	5,881
Cladosporium sphaerospermum	3,629,354
Paecilomyces variotii	136
Penicillium brevicompactum	1,114
Penicillium corylophilum	189,330
Penicillium crustosum (group2)	ND
Penicillium purpurogenum	17
Penicillium spinulosum	95,677
Penicillium variabile	50
Scopulariopsis brevicaulis	ND
Scopulariopsis chartarum	ND
Stachybotrys chartarum	1,498
Trichoderma viride	7,509
Wallemia sebi	44
I-Total Spores Detected	4,348,809

Lab Sample Number	1159-1
Client Sample ID	SA2613
Sample Location	Living Rm (Air Conditioning Unit)
Sample size	1Swab
EPA 36 Species Group -2	Spores E./Swab
Acremonium strictum	1,210
Alternaria alternata	1,078
Aspergillus ustus	397,219
Cladosporium cladosporioides I	74,223
Cladosporium cladosporioides II	31,080
Cladosporium herbarum	2,628
Epicoccum nigrum	151
Mucor and Rhizopus group	ND
Penicillium chrysogenum	422
Rhizopus stolonifer	ND
II-Total Spores Detected	508,013

To learn more about EPA-36 testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ How to take EPA-36 samples;
- ✓ Strengths and limitations of EPA-36 samples;
- ✓ When to use EPA-36 sampling;
- ✓ How to read lab reports, and more!

EMMA Testing

Sample Report

ENVIRONMENTAL MYCOTOXIN PANEL REPORT FORM
06/03/2022

Procedure Type: Semi-quantitative procedure by ELISA

List of Mycotoxins tested in the Panel
Ochratoxin A
Aflatoxin Group: (B1, B2, G1, G2)
Trichothecene Group (Macrocyclic): Roridin A, Roridin E, Roridin H, Roridin L-2, Verrucarin A, Verrucarin J, Satratoxin G, Satratoxin H, Isosatratoxin F
Gliotoxin Derivative
Zearalenone

Results:

Code	Test	Specimen	Value	Result	Not Present if less than	Equivocal if between	Present if greater or equal
D8501	Ochratoxin A	Dust	1.87700 ppb	Equivocal	1.8 ppb	1.8-2 ppb	2 ppb
D8502	Aflatoxin Group: (B1, B2, G1, G2)	Dust	0.37100 ppb	Not Present	0.8 ppb	0.8-1 ppb	1 ppb
D8503	Trichothecene Group (Macrocyclic): Roridin A, Roridin E, Roridin H, Roridin L-2, Verrucarin A, Verrucarin J, Satratoxin G, Satratoxin H, Isosatratoxin F	Dust	0.10400 ppb	Present	0.07 ppb	0.07-0.09 ppb	0.09 ppb
D8510	Gliotoxin Derivative	Dust	0.53000 ppb	Equivocal	0.5 ppb	0.5-1.0 ppb	1.0 ppb
D8512	Zearalenone	Dust	0.22500 ppb	Not Present	0.5 ppb	0.5-0.7 ppb	0.7 ppb

To learn more about EMMA and mycotoxin testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ How to take mycotoxin samples;
- ✓ Strengths and limitations of mycotoxin samples;
- ✓ When to use mycotoxin sampling;
- ✓ How to read lab reports, and more!

Common Testing Options: Surface Testing

(Tape, Swab, or Bulk)

Surface testing involves taking a sample of suspected mold growth.

Tape and swab testing: Involves taking a sample from a surface then sending that sample to a lab to be analyzed under a microscope.

Bulk sampling: Occurs when an impacted material (such as a piece of drywall or insulation) is sent to a lab to be tested.

PROS…

- When used properly, it can help identify where sources are located.
- Identifies viable and non-viable spores.
- Analyzes visible substances directly on the areas of water damage, including actual mold growth, in order to find the types and quantities of mold.
- Tape or swab samples can be a helpful component of post-remediation verification testing.
- More affordable than other testing options.
- Fast turnaround times.

CONS…

- Only identifies mold in the immediate area, therefore missing other molds that may be growing in the environment.
- Heavy debris will make it difficult for the mycologist to read the sample. This makes it difficult to view and identify all the molds that may be present in the sample.
- May only identify the most dominant mold growing in the area due to heavy growth of that particular mold.
- It is not a good indicator of cross-contamination.
- Human error is a factor since samples are analyzed in a lab under a microscope.

Surface Testing

Swab Sample Report

Test: S001 Swab Analysis

Sample ID:	375608-48			375608-49* **			375608-50* **			375608-51* **		
Client Sample ID:	Kitchen Below Refrigerators E			Kitchen Right Dishwasher G			Kitchen Blw Left Dishwasher F			Laund/Ofc Washer Dryer Left H		
Area Swabbed (cm^2):	6.45			6.45			6.45			6.45		
Media:	Swab			Swab			Swab			Swab		
Sample Analysis:	Analyzed at 600X Magnification			Analyzed at 600X Magnification			Analyzed at 600X Magnification			Analyzed at 600X Magnification		
Spore Types	**Raw Count**	**Count/cm²**	**%**	**Raw Count**	**Count/cm²**	**%**	**Raw Count**	**Count/cm²**	**%**	**Raw Count**	**Count/cm²**	**%**
Alternaria	59	366	<1	—	—	—	2	12	1	—	—	—
Arthrinium	—	—	—	—	—	—	—	—	—	—	—	—
Ascospores	24	149	<1	—	—	—	2	12	1	—	—	—
Aspergillus/Penicillium-Like	12,952	80,322	99	5,511	34,177	99	82	509	52	84	521	71
Basidiospores	12	74	<1	—	—	—	—	—	—	—	—	—
Bipolaris/Dreschlera	—	—	—	—	—	—	—	—	—	—	—	—
Botrytis	—	—	—	—	—	—	—	—	—	—	—	—
Chaetomium	—	—	—	—	—	—	—	—	—	—	—	—
Cladosporium	12	74	<1	82	509	1	64	397	41	34	211	29
Curvularia	—	—	—	—	—	—	—	—	—	—	—	—
Epicoccum	—	—	—	—	—	—	—	—	—	—	—	—
Fusarium	—	—	—	—	—	—	—	—	—	—	—	—
Ganoderma	—	—	—	—	—	—	4	25	3	—	—	—
Memnoniella	—	—	—	—	—	—	—	—	—	—	—	—
Nigrospora	—	—	—	—	—	—	—	—	—	—	—	—
Oidium/Peronospora	—	—	—	—	—	—	—	—	—	—	—	—
Pithomyces	—	—	—	—	—	—	2	12	1	—	—	—
Rust	—	—	—	—	—	—	—	—	—	—	—	—
Scopulariopsis	—	—	—	—	—	—	—	—	—	—	—	—
Smut/Myxomyces/Periconia	—	—	—	—	—	—	—	—	—	—	—	—
Stachybotrys	—	—	—	—	—	—	—	—	—	—	—	—
Torula	—	—	—	—	—	—	—	—	—	—	—	—
Ulocladium	—	—	—	—	—	—	2	12	1	—	—	—
Unidentified Spores	—	—	—	—	—	—	—	—	—	—	—	—
Total Spores	**13,059**	**80,986**		**5,593**	**34,685**		**158**	**980**		**118**	**732**	
Hyphal Fragments	35	217		24	149		42	260		18	112	
Detection Limit	73			73			12			12		

* Bacteria Present.

** Yeast Present.

To learn more about surface sampling, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ How to take surface samples;
- ✓ Strengths and limitations of surface samples;
- ✓ When to use surface sampling;
- ✓ How to read lab reports, and more!

Common Testing Options:

Mold Plate Testing

(Petri Dish/Gravity Plate)

Mold plate testing, sometimes called gravity plate testing, works by placing a petri dish filled with a specific kind of agar (which is essentially mold food) on a dish and exposing it to the environment for a specific amount of time.

PROS…

- Cheapest of the mold testing options.
- Can be purchased online or at some home improvement stores.
- When placed close to a source it *may* be able to help pinpoint the location of problem areas.
- Some mold plates can be sent to a lab for analysis to determine the specific species of mold present.

CONS…

- It only looks at viable mold spores. It does not identify non-viable mold spores or fragments.
- These plates will almost always grow something unless the agar has gone bad. *Growth doesn't automatically equate to a mold problem*.
- You *cannot* look at the color or size of growth and conclusively determine species or hazard. You must send it into a lab to be analyzed (usually an additional fee).
- What grows on the plate depends on the kind of agar that is used. Often this means that only a few species will be able to grow, leaving many other mold species to be missed.
- It is less likely to pick up on heavier and stickier mold spores that are less likely to become airborne.
- It is not an appropriate tool for post-remediation verification (testing).

To learn more about mold/gravity plates, check out the bonus section of our bacteria mini class here or scan the QR code. Topics include:

- ✓ What is mold/gravity plate testing; and
- ✓ Strengths and limitations of surface samples.

Common Testing Options: Bacteria Testing

(Endotoxins & Actinomycetes)

Bacteria testing for endotoxins and actinomycetes is a newer technology designed to help identify the presence of bacteria in the environment. Both tests involve analyzing dust samples from the home.

***Endotoxins*:** Endotoxins are released as bacteria die off. There are many ways bacteria dies off but one of the ways is with the absence of water. Improperly remediated historic leaks could be the cause of elevated levels of endotoxins inside of a home.

***Actinomycetes*:** Actinomycetes are gram-positive bacteria that are found in places such as soil, drain lines, water-damaged buildings, and humans.

PROS…

- Measuring the results before and after remediation can help you to understand the changes present in several species of bacteria to determine if more investigation is needed.
- Knowing if actinomycetes are present may be helpful to your doctor.

CONS…

- Does not help indicate where the endotoxins came from.
- Does not help to indicate where the actinomycetes came from such as soil, drain lines, water-damaged areas, or from humans.
- Currently, bacteria testing for endotoxins and actinomycetes is limited and the tests themselves have not been fully validated. However, like all new technologies, testing is an entrance point into an understanding of how bacteria is part of the problem of a water-damaged home.

Endotoxins Testing

Sample Report

3.1 SETTLED DUST ENDOTOX

The results of the Swifter dust endotoxin detected in the samples collected from the property were tabulated as follows:

Reference Number	Locations	Result EU/mg
119082-5	Ambient Living Area Mid Level (Progressives)	**11,270**

Color-coded interpretation	
If 200 or below	Normal levels.
If between 200 to < 1000	Borderline. Further remediation and re-assessment is indicated.
If greater than 1000	Remediation is needed.

To learn more about bacteria testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ Types of bacteria;
- ✓ How to take bacteria samples;
- ✓ Strengths and limitations of bacteria testing;
- ✓ How to read lab reports, and more!

Actinomycetes Testing

Sample Report

3 RESULTS

The recommended Actino Score is 15 or less out of 40 Actinomycetes species, as found in non-water damaged buildings.

The score ranges from a value of 0 to 40 Actinobacteria species. Actino Score Standard Deviation is (S.D.) of +/-2. Other significant findings are listed as highlighted species in table 2 and table 6.

Actino Score

Actino Score	**25**

Color-coded interpretation	
10 or below	Indicative of a Healthy Building
Between 11 to 15	Further investigation needed
Greater than 15	Suggestive of Building Related Illness.

To learn more about bacteria testing, including how to interpret lab results, check out our mini class here or scan the QR code. Topics include:

- ✓ Types of bacteria;
- ✓ How to take bacteria samples;
- ✓ Strengths and limitations of bacteria testing;
- ✓ How to read lab reports, and more!

Deciding Which Tests to Run

It's *not* necessary or recommended for everyone to do all the tests listed in this guide. The type of testing that's right for your home depends on your unique situation and your goals. There is no one-size-fits-all approach.

The types of testing you perform depend on your goals.

- ✓ Are you trying to stay in the home?
- ✓ Are you trying to move, sell, or break a lease?
- ✓ Are you building a legal or insurance case?
- ✓ Are you looking to buy or rent a new home?

For more information on how to decide which testing options are best for your home, we strongly recommend you watch our mini class with Corey Levy on *"Developing a Sampling Plan to Identify Hidden Mold in Any Building"* here.

To learn more about "Developing a Sampling Plan to Identify Hidden Mold in Any Building", check out our mini class with Corey Levy here or scan the QR code. Topics include:

- ✓ What grows in a water-damaged building;
- ✓ How does mold move throughout a home;
- ✓ Acceptable sample types; and
- ✓ Deciding which test to run based on your goals as a renter, owner, house hunter, or if you are pursuing litigation.

Getting Started

While nearly all the tests discussed in this guide can be done by the homeowner or renter, we always recommend that you work with a knowledgeable *Indoor Environmental Professional (I.E.P.)* who can conduct a thorough investigation of the home and help you make the best choices about which tests are appropriate for your specific situation.

However, it is important to find the *right* I.E.P. to inspect your home because "I.E.P." is a general term used to describe someone who performs indoor environmental inspections and assessments of a building. **The requirements, qualifications, and skill sets vary greatly among I.E.P.s.** You cannot assume that because a person is an I.E.P. that they are bound by certain requirements, standards, laws, or operating procedures.

For step-by-step help navigating the inspection and remediation process, visit our "Start Here" tab at ChangeTheAirFoundation.org

Free Downloads

"Steps to Inspecting and Remediating Your Home for Mold & Water Damage"

"The 5 Signs of Water Damage"; "Moisture Basics"

"Checklist: Where to Look for Mold & Water Damage"

"Questions to Ask When Hiring an IEP"

"A Guide to Testing Your Home for Mold & Water Damage"

"Mold Remediation at a Glance"

"Questions to Ask When Hiring a Remediation Company"

"Mold Remediation Contracts"

"A Guide to Testing Your Home for Mold & Water Damage"

"HVAC & Duct Cleaning Basics"

ChangeTheAirFoundation.org/free-downloads

Free Mini Class Series

Testing Options for Your Home

Mold Remediation Mini Class Series (Coming Fall 2024)

ChangeTheAirFoundation.org/mini-classes

Mold FAQ

If I can't see mold, do I still have a problem?

This can be a difficult question to answer. The short response is: potentially. Not all mold growth and water damage in a home will be visible. It can be hidden behind walls and in places not often frequented such as attics, crawlspaces, and HVAC systems.

Keep in mind that mold spores are tiny! Measured in a unit called microns, these little spores are invisible to the naked eye and can fly right through your front door and settle into any surface or crack in the home.

When conditions are favorable, mold may begin to colonize an area. It may take some time for these tiny particles to accumulate to the point where the growth is visible. To put it into perspective, it has been estimated that 400,000,000 spores of Penicillium cover roughly one square inch! That's a lot of mold for an area that is roughly the size of a postage stamp.

How quickly does mold grow?

Fast! Time is not on your side. Certain species of mold can start to grow in as little as *24-48 hours*. That's why it's important to act quickly when addressing any new moisture-related problems!

Can the type of mold be identified by color or appearance?

With over 100,000 species of mold identified so far, this fungus comes in a variety of colors including pink, green, brown, black, red, white, grey, blue, and anything in between. To make it even more complicated, some species of mold can be several *different* colors. *And*, different species can be the *same* color! The color of mold can be impacted by several things, including its age and its food source. It's never a good idea to try and conclusively identify the type of mold simply by looking at it. The only way to know for sure the type of mold you are dealing with is to have it tested.

What does mold need to grow?

Mold needs four things to grow:

- Mold spore
- Food source
- Moisture source
- Time

Mold Spore: Mold spores are like plant seeds. Plants produce seeds as a method of reproducing. The seeds will remain dormant until they are given the things needed to grow into a plant. Similarly, colonized mold reproduces by creating spores, which are dormant until given the things it needs to grow.

Food Source: Mold can grow on just about any organic material. Porous building materials, such as insulation or drywall, are a few of its favorites! In fact, the materials used to build your home are essentially one big mold buffet. In some cases, dust and dirt buildup on inorganic material can provide enough food source to allow for mold growth.

Moisture Source: You don't need a flood or a leak to have a mold problem. Seemingly "small" water events such as toilets, children splashing in the tub, or spills can lead to mold growth if not dealt with properly. Certain types of mold can grow using the moisture from the humidity in the air! (This is why you should aim to keep the relative humidity of an indoor environment below 50%).

Time: Certain types of mold can start growing in as little as 24-48 hours. This is why it's critical to deal with any type of water damage quickly!

Where does mold grow?

If the conditions are right, mold can thrive and survive just about anywhere. It can even grow on materials we don't typically think of as habitable surfaces – such as metal. That's right! Mold can grow on dirt or dust sitting on top of those materials.

While it's true that some mold species prefer certain food sources, never assume a material is resistant to mold growth.

Is “dead” or “dormant” mold still a problem?

Yes, according to the EPA, “dead” and “dormant” mold can still cause problems. This is why you can’t just simply “kill” mold. Mold and its byproducts must be removed safely or they can get kicked up into the air making their way inside of our bodies, leading to continued exposure.

If I can’t smell mold, do I have a problem?

When you smell mold, you are likely smelling microbial volatile organic compounds (mVOCs), which are essentially gases released by mold while it’s actively feeding. Mold doesn’t eat all the time, though. It goes in and out of feeding phases depending on the conditions. That’s why some homes only have an odor once in a while, such as after heavy rain or during certain times of year. **You can’t rely on the “sniff” test alone to determine if you have a problem!**

According to the EPA, a musty odor is a sign of a *current* mold problem and should be investigated as soon as possible.

What’s the difference between mold and mildew?

Mildew refers to a certain kind of fungus. The term mildew is often used generically to refer to mold. Unfortunately, some people downplay mold growth by calling it mildew and saying it’s no big deal. Don’t be fooled. If the conditions are right, mold and mildew can grow and cause health issues.

Are all molds toxigenic?

Molds can be allergenic, toxigenic, and pathogenic.

Allergenic: Can trigger allergic reactions in people exposed to it.

Toxigenic: Can produce toxins (such as mycotoxins) that may pose a risk to human health.

Pathogenic: Can cause disease and infection in humans or other organisms.

Is mold the only thing I need to worry about in a water-damaged indoor environment?

Water-damaged environments are complex and mold spores are not the only thing you need to be concerned about. Mold fragments, mycotoxins, bacteria, microbial volatile organic compounds (mVOCs), etc. are just a few of the indoor pollutants that can thrive in a water-damaged building.

To learn more about the complexities of water-damaged buildings, check out Dr. Jack Thrasher and Sandra Crawley's paper here, and Dr. Janette Hope's paper here.

Quick Mold Reference Guide

The groups outlined below are from the "*Fungal Spore Identification and Information Guide*" created by Joyce Cialdella, Michael Pinto, and the team at Wonder Makers Environmental, which has been generously shared with their permission.

Target Fungal Spore Types

"Target fungal types are more frequently found growing indoors when excessive moisture is present, i.e., in water-damaged buildings. Target fungal types require high moisture content and/or water activity to grow, have the ability to naturally produce toxins, and degrade cellulose-containing materials. Spores from these target organisms are not typically found in dry, well maintained indoor environments. The identification of target spores in an indoor sample is a strong indication of water damage or significant moisture problems and a mold source within the structure."

- Stachybotrys
- Memmoniella
- Chaetomium
- Fusarium
- Trichoderma

Indicator Fungal Spore Types

"Spores from indicator fungal types that serve as an 'early warning system' that water damage exists indoors. These fungal types are typically recovered from water-damaged environments and materials, do not require chronic moisture, and thrive in temperature conditions that are suitable and comfortable for people. They are often primary colonizers on damp building material and contents."

- Aspergillus/Penicillium-like spores

Contributing Fungal Spore Types

"Mold types referred to as 'Contributing Fungal Spores' are not typically detected in outdoor air samples. Just as important, contributing fungal spores are typically only found growing indoors when the structure has suffered some sort of water

damage or occupants report mold related health effects. Conditions for indoor growth vary within this group and range from very wet, water damaged conditions to drier conditions found in normal indoor environments. They are designated as 'Contributing Fungal Spores' because they can contribute to the overall mold burden of a building. Generally, these spores are not present in a normal indoor fungal ecology."

- Arthrinium
- Ulocladium
- Wallemia
- Zygomycetes

Outdoor Fungal Spore Types - I

"Spores from fungal types typically found out-of-doors, but which can grow indoors under the right conditions, usually water-damaged areas."

- Acremonium
- Alternaria
- Aureobasidium
- Basidiospores
- Cladosporium
- Curvularia
- Epicoccoum
- Paecilomyces
- Scopulariopsis

Outdoor Fungal Spore Types - II

"Spores from fungal types that rarely grow indoors. Recovery indoors is typically from the normal influx of outdoor microbial particles."

- Ascospores
- Bipoloaris/ Dreschslera/ Exserohilum
- Myxomycetes
- Nigrospora
- Periconia
- Pithomyces
- Polythrincium
- Stemphylium
- Torula

Outdoor Fungal Spore Types - III

"Spores from fungal types that are obligate plant parasites. The spores would be amplified indoors only if a plant host is present."

- Botrytis
- Oidium
- Uredospore (rust)
- Ustilago (smut)

Source: Joyce, Cialdella. Fungal Spore Identification and Information Guide. Wonder Makers Environmental, 2022.

Mold Spotlight

Acremonium

Acremonium is a toxigenic mold. It can appear in a variety of colors including pink, grey, white, and orange. It can be found in household areas prone to condensation such as drain pans, window sealants, humidifiers, and HVAC coils. It has been found to grow with other molds like Stachybotrys.

Alternaria

Alternaria is the most commonly found allergenic mold in the world. Typically, it is dark green or brown and can grow wherever damp conditions occur, such as bathrooms and on window frames. This mold is known to spread quickly and should be promptly addressed. It is often associated with asthma-like symptoms.

Aspergillus

Aspergillus is a common indoor mold in the United States. There are over 180 species of Aspergillus that appear in a variety of colors and can grow in a wide range of places including walls, subflooring, and HVAC systems. Aspergillus is an example of a primary colonizer, meaning it can grow quickly with minimal moisture. High humidity alone can provide enough moisture for certain species of Aspergillus to grow. Certain species of Aspergillus can create a number of harmful byproducts such as mycotoxins and microbial volatile organic compounds. Aspergillosis is a serious lung disease caused by exposure to this type of mold.

Aureobasidium

Aureobasidium can be allergenic. It typically appears pink, brown, or black. It can sometimes be found on painted or wood surfaces and even behind wallpaper. It may be found in bathrooms and kitchens around tile grout, curtains, and textiles. It has been known to cause infections of the skin, eyes, and nails.

Chaetomium

Chaetomium is a toxigenic mold commonly found in water-damaged buildings. It can appear as a variety of colors including white, grey, brown, or black. It can be found in places such as leaky roofs, pipes, basements, and cellulose-containing

materials like drywall. It is an example of a tertiary colonizer requiring a fair amount of water and time to begin to grow. Due to its toxigenic nature, it can cause a variety of negative health effects.

Cladosporium

Cladosporium can be allergenic and is one of the most common types of mold worldwide. It can appear olive-green or brown in color. It's often found in soil and on decaying vegetation (plants, compost, and wood). It's also found growing inside buildings and on a wide range of materials such as carpets, fabrics, upholstery, and other water-damaged building materials. It is often the most common mold to show up on air sample lab reports. While Cladosporium is rarely pathogenic to humans, it can cause infections in the lungs, sinuses, and skin. When Cladosporium spores become airborne, they can cause severe allergic reactions. Certain types of Cladosporium can survive a wide range of temperatures.

Fusarium

Fusarium can be allergenic and toxigenic. It can appear pink, white, or red in color. It is often found in homes with water damage and can spread quickly. It has been found growing in places such as fabrics, carpeting, wallpaper, air conditioners, and duct insulation. This mold can produce mycotoxins and cause a wide range of health effects that can range from minor to severe.

Penicillium

Penicillium typically appears blue or green in color. It is often found in water-damaged buildings and occurs in a diverse range of habitats and various food products. It can spread quickly indoors, and some areas it has been found include carpets, wallpaper, and ducting. Similar to Aspergillus, high humidity alone can provide enough moisture for certain species of Penicillium to grow. It is responsible for a number of health conditions.

Stachybotrys

Stachybotrys is a well-known toxigenic mold. The media frequently refers to this mold as "black mold." It can appear black or dark green in color. Stachybotrys is an example of a tertiary colonizer. It requires a fair amount of water to grow and

can be slow to germinate. However, colonies can spread quickly. This mold is common in water-damaged buildings that have a continuous moisture source. It loves cellulose containing materials like drywall, ceiling tiles, paper, etc. Stachybotrys can produce mycotoxins, a poisonous secondary metabolite. Stachybotrys has been associated with a number of *serious* health conditions including dermatitis, sinusitis, nose bleeds, respiratory issues, fatigue, neurological issues, and more.

Trichoderma

Trichoderma can be allergenic and toxigenic. It can appear white and green. It is an example of a tertiary colonizer and is associated with water damage or high moisture content. It has been found on a variety of materials including carpet, HVAC systems, wallpaper, and wood high in cellulose. Not only is it hazardous to your health, but this mold is also particularly destructive to building materials.

Ulocladium

Ulocladium can be allergenic. It is often black in color. It is typically found in buildings with significant water damage and is sometimes seen around windows, behind wallpaper, and in areas like bathrooms, kitchens, and basements. Some health conditions associated with Ulocladium include respiratory and skin issues.

**Please note that this is not a complete list of locations where these molds are found or the potential health effects associated with them. It is simply meant to provide a general overview. When conditions are favorable, microbial growth may occur. Please always consult with the appropriate professional or health care practitioner.*

Mini Classes: Testing Options for Your Home

All Mini Classes are hyperlinked below. You can also access them through the QR codes or by heading to our website at https://changetheairfoundation.org/

Air Testing

Surface Testing

ERMI Testing

EPA 36 Testing

Mycotoxins Testing

Bacteria Testing & Bonus Q & A

Developing a Sampling Plan to Identify Hidden Mold

Glossary of Terms

- **Actinomycetes**: A group of gram-positive bacteria that produce various biotoxins.
- **Active mold growth**: Mold that has an active moisture source allowing it to continue through its life cycle.
- **Allergenic molds:** Allergenic molds can trigger allergic reactions in those exposed.
- **Dormant mold growth**: Sometimes referred to as inactive mold growth, this is mold that has had its moisture source has been removed. When visible, it can appear dry, powdery and can aerosolize very easily.
- **Endotoxins**: Components of graham-negative bacteria that shed upon the death of bacteria.
- **Microbial volatile organic compounds (mVOCs)**: A byproduct created by mold when its actively feeding. This gas is what we associate with a typical "musty" odor.
- **Mold spores**: Produced for the purpose of reproduction. Think of them as "seeds."
- **Mycotoxins**: Toxic secondary byproducts created by mold under *certain* conditions such as when a mold colony feels threatened. They are a chemical that oozes around the mold colony, spores, and sometimes the surrounding building materials.
- **Non-viable spores**: Mold spores that are not capable of growing.
- **Particulates**: Refer to small particles that become airborne and include mold spores, allergens, dust, pollution, etc.
- **Pathogenic molds**: Can cause disease and infection in humans or other organisms.
- **Toxigenic molds**: Can produce toxins, such as mycotoxins, that pose a risk to human health and other organisms.
- **Viable spores**: Capable of growing into a colony under the right conditions.

References

Allen, Joseph G., and John D. Macomber. Healthy Buildings: How Indoor Spaces Can Make You Sick--or Keep You Well. Harvard University Press, 2022.

ANSI/IICRC S520 Standard for Professional Mold Remediation. Third ed., Institute of Inspection, Cleaning and Restoration Certification, 2015.

Bennett, Joan & Inamdar, Arati. (2015). Are Some Fungal Volatile Organic Compounds (VOCs) Mycotoxins?. Toxins. 7. 3785-3804. 10.3390/toxins7093785.

EPA, Environmental Protection Agency, https://www.epa.gov/mold.

Górny, Rafał L et al. "Fungal fragments as indoor air biocontaminants." Applied and environmental microbiology vol. 68,7 (2002): 3522-31. doi:10.1128/AEM.68.7.3522-3531.2002

Harding, Cheryl F., et al. "Mold Inhalation Causes Innate Immune Activation, Neural, Cognitive and Emotional Dysfunction." Brain, Behavior, and Immunity, vol. 87, 2020, pp. 218–228., https://doi.org/10.1016/j.bbi.2019.11.006.

"The Hidden Threat of Mycotoxins - Mark Filidei DO." Great Plains Laboratory, Great Plains Laboratory, 19 Dec. 2022, https://www.greatplainslaboratory.com/gpl-blog-source/2022/the-hidden-threat-of-mycotoxins-mark-filidei-do.

Hope, Janette. "A Review of the Mechanism of Injury and Treatment Approaches for Illness Resulting from Exposure to Water-Damaged Buildings, Mold, and Mycotoxins." The Scientific World Journal, vol. 2013, 2013, pp. 1–20., https://doi.org/10.1155/2013/767482.

Joyce, Cialdella. Fungal Spore Identification and Information Guide. Wonder Makers Environmental, 2022.

Kung'u, Dr. Jackson. "The Phases of Fungal Growth in Indoor Environment." Mold & Bacteria Consulting Laboratories, 26 Jan. 2015, https://www.moldbacteria.com/mold/the-phases-of-fungal-growth-in-indoor-environment.html#.

Levy, Mark. "Mini Class Series: Testing Options for Your Home." Change the Air Foundation , 3 Oct. 2022, www.changetheairfoundation.org. Accessed 1 March 2023.

"Mycotoxins." World Health Organization, World Health Organization, https://www.who.int/news-room/fact-sheets/detail/mycotoxins.

Papathanasiou, Sotirios. "Particulate Matter (PM2.5) Mega Guide." See The Air, 21 Sept. 2022, https://seetheair.org/2022/05/16/particulate-matter-pm2-5-mega-guide/.

"Particulate Matter (PM) Basics." EPA, Environmental Protection Agency, 22 July 2022, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics.

Pinto, Michael A. Fungal Contamination: A Comprehensive Guide for Remediation. Wonder Makers Environmental, 2008.

Pinto, Michael A. "Why a Single Spore Matters: Failing Post-Remediation Air Sample Results Due to Low Levels of 'Target' Spores." Healthy Indoors, Feb. 2019.

Reponen, Tiina et al. "Fungal Fragments in Moldy Houses: A Field Study in Homes in New Orleans and Southern Ohio." Atmospheric environment (Oxford, England : 1994) vol. 41,37 (2007): 8140-8149. doi:10.1016/j.atmosenv.2007.06.027

Rubino, Michael. "Size of Mold Spores." HomeCleanse, 6 July 2022, https://www.homecleanse.com/size-of-mold-spores/.

Rubino, Michael. The Mold Medic: An Expert's Guide on Mold Removal. M. Rubino, 2020.

Thrasher, Jack D. and Sandra Crawley. "The Biocontaminants and Complexity of Damp Indoor Spaces: More than What Meets the Eyes." Toxicology and Industrial Health, vol. 25, no. 9-10, 2009, pp. 583–615., https://doi.org/10.1177/0748233709348386.

Thrasher, Jack Dwayne. "Fungi, Bacteria, Nano-Particulates, Mycotoxins and Human Health in Water- Damaged Indoor Environments." Journal of Community & Public Health Nursing, vol. 2, no. 2, 2016, https://doi.org/10.4172/2471-9846.1000115.

Special thanks to Brandon Chappo, Angela Crockette, Davide Fontaine, Brian Karr, Rebecca Lesan, Corey Levy, Mark Levy, Betsy Maldonado, Lissa Nilsson, Sotirios Papathanasiou, Michael Pinto, and Michael Rubino for their feedback and support during the creation of this document.

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