
Mold:
A Basic Guide at Florida Tech

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Introduction

Mold is one of the most common concerns that encompass an Indoor Air Quality (IAQ) program. There are misconceptions surrounding several topics that relate to mold. Having a stand-alone, user-friendly document that discusses this topic is beneficial for the Florida Tech community. Therefore, this document will serve as a supplement to the universities [Indoor Air Quality Plan](#) and is designed to assist individuals in understanding mold and its relationship with buildings (including residence halls) as well as people (specifically, our health).

References will be denoted throughout this document, rather than at the conclusion. This is for two primary reasons:

- 1. Data Integrity**

For a document to hold its validity, it's important for readers to know where the information is derived. Referencing sources in specific areas of the document allows for a more trustworthy understanding as to the statements made.

- 2. Additional Reading**

Siting references also allows for readers to dive deeper into specific topics, if they so choose to further self-educate themselves.

Although some aspects of IAQ can be subjective, this document strives to be driven by objective, scrutinized-based research from both the scientific community as well as advice from regulatory agencies and reputable organizations who comprise the industry's best practices and standards. Only reputable, and official, sources have been used to draft this document.

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Mold Basics

What is Mold?

Mold is a multicellular microorganism and type of fungus that thrives in wet places and produce tiny spores to reproduce. Mold is around us constantly, and these spores waft through both indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing. They can grow on many items including wood, paper, carpet, and foods.

Most molds are not harmful; however, some can be a health hazard by producing toxic gases called MVOCs (Microbial Volatile Organic Compounds) and mycotoxins. There is no practical way to eliminate all indoor mold. The way to control indoor mold growth is to control moisture.

[The National Institute of Environmental Health Sciences \(NIEHS\): Mold](#)

[EPA: What is Mold](#)

[CDC: Mold Health](#)

Mold vs Mildew

Mildew refers to certain kinds of mold (both are fungi). The term mildew is often used interchangeably to refer to mold growth. Molds can thrive on any organic matter including clothing, leather and paper, as well as ceilings, walls and floors. Mildew often lives on shower walls, windowsills, and other places where moisture levels are high, although can still grow on cloth, plants, paper, etc.

[EPA: What is the difference between mold and mildew?](#)

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Standards (Mold Exposure Limits)

There are no official standards for mold exposure limits for a variety of reasons. We are constantly exposed to mold, and that the everchanging natural environment makes it extremely difficult to set standardized (universal) limits. Mold exposure changes throughout the day, and factors such as temperature, humidity, and rain can impact mold counts tremendously, which would render any set limits useless.

[The American College of Allergy, Asthma & Immunology](#)

The below is what regulatory agencies state for mold exposure limits.

Centers for Disease Control (CDC)

There are no health-based standards for mold or other biological agents in indoor air and there are no set standards for mold levels in a home.

[CDC: Testing & Remediation](#)

Environmental Protection Agency (EPA)

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

[EPA: Testing for Mold](#)

[EPA: Who Can Test?](#)

Occupational Health & Safety Administration (OSHA)

Mold is addressed as sanitation in the sanitation standard without specific. Very general.

[OSHA: Sanitation Standard](#)

Florida Department of Health (FDEP)

There are no health or exposure-based standards that you can use to evaluate a mold sampling result. Very little is known regarding the actual health risks from breathing in or skin contact with mold.

[The Florida Department of Health](#)

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Mold Indoors

Mold spores are ubiquitous, and a very common part of our lives. Mold is found both indoors and outdoors, and mold being indoors (buildings and homes) is not a cause for alarm.

[The Florida Department of Health](#)

Mold can enter your home through open doorways, windows, vents, and heating and air conditioning systems. Mold in the air outside can also attach itself to clothing, shoes, and pets that can be carried indoors. Some mold species (*aspergillus*, for example) is very common indoors and opportunistic to its relationship with food products, paper products, window seals, and bathroom/shower crevasses. This mold also has the potential to cause adverse health effects in some individuals; however, completely eradicating it is impossible due to its prevalence in the environment (both indoors and outdoors).

It is impossible to get rid of all mold spores indoors as some float throughout the indoor air and in house dust. And in some cases, it can grow on or fill in the empty spaces and crevices of porous materials, making it difficult or impossible to remove completely.

[EPA: Mold Cleanup](#)

[EPA: How do I get rid of mold?](#)

One such type of mold—*Aspergillus*—can be extremely high outdoors during August-September as denoted in the [Journal of Allergy and Clinical Immunology](#). Another study from the Journal of [Investigational Allergology and Clinical Immunology](#) found that *Aspergillus* spores exceeded the levels found outdoors, even without obvious moisture problems during Florida's rainy season.

There are very few indoor areas free of mold as these specialized areas are intentionally environmentally controlled through specific behavioral procedures, policies, standard operating procedures (SOP's), along with very complex multi-million-dollar HVAC systems designed to render the environment free of living organisms to the degree possible (examples include pharmaceutical manufacturing areas, chemotherapeutic preparation labs, some digital manufactures, hospital surgery rooms, and specialized high containment biological labs).

In Summary:

“People are exposed to molds 24 hours a day, seven days a week, and 365 days a year.”

[Florida Department of Health: Indoor Mold & Health](#)

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Mold Outdoors

Although most individuals are concerned with mold indoors, it's important to understand that the outdoor mold spore levels and species truly sets the tone for what can, and what inevitably occurs indoors during normal conditions (assuming there is no underlying issue within a building—e.g., a water-pipe or roof leak).

We are exposed to mold every day outdoors. Sometimes, those levels are extremely high, and in many cases contain mold species in which there is evidence that research shows can pose health hazards (they are toxic to some degree). It is inevitable that some of those mold spores will enter the indoors.

Allergic reactions to mold are common and can be immediate. But in some cases, it may cause delayed symptoms. At times, people are exposed to thousands of spores outdoors; however, they start to notice the symptoms when indoors. This can sometimes lead to the false impression there is an issue with the indoor environment.

[Asthma and Allergy Foundation of America](#)

[EPA: Mold & Health](#)

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Sampling for Mold (Overall)

Should Sampling be Done?

One of the most common questions in mold concerns is whether tests should be conducted. The idea may sound straightforward, however, it's quite complicated and does not always result in direct answers. In most cases, sampling for mold is not necessarily an effective method for determining if there is a mold problem or whether health is being impacted by mold., and in cases where mold is visual, sampling is redundant.

Sampling is not definitive nor exclusive and should not be interpreted as a final assessment. It is utilized *at times* as just one piece of the puzzle for a more holistic investigation to finding the root-cause to an IAQ concern. Even when sample reports return results that are mixed, interpretation is a vital aspect to aid in the investigation.

What Do the Regulatory Agencies Say?

Regulatory agencies are united in the stance that sampling is not the overall action that should be taken to diagnose mold concerns, especially as it relates to health. Let's look at what each entity says...

Centers for Disease Control (CDC)

The CDC does not recommend mold testing. The health effects of mold vary from person-to-person; therefore., relying on sampling is not appropriate to determine someone's sickness. Spore counts, and culture results are often included in indoor air quality reports and do not capture the full range of exposures. Therefore, measured mold concentrations in short-term air samples cannot be interpreted in relation to health risks.

[CDC: Mold](#)

[CDC: Mold Control](#)

National Institute for Occupational Safety and Health (NIOSH)

NIOSH has found thorough visual inspections or detecting problems by musty odors are more reliable than air sampling. Additionally, according to NIOSH, finding and promptly correcting sources of dampness is more effective at preventing health problems than air samples for indoor mold.

[NIOSH: About Mold](#)

[NIOSH: Testing](#)

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Environmental Protection Agency (EPA)

Since no EPA or other federal limits have been set for mold or mold spores, sampling cannot be used to check a building's compliance with federal mold standards. Because there are no established safe levels, testing may be of limited use in helping to understand the problem. Mold assessment is mainly done through visual inspection of areas where there have been moisture problems or water damage.

[EPA: Testing for Mold](#)

[EPA: Who Can Test?](#)

[EPA: Test or Sampling for Mold.](#)

Occupational Health & Safety Administration (OSHA)

OSHA states that in many cases, it is not economically practical or useful to test for mold growth on surfaces or for airborne spores in the building. In addition, there are no standards for "acceptable" levels of mold in buildings, and the lack of a definitive correlation between exposure levels and health effects makes interpreting the data difficult, if not impossible.

[OSHA: Sampling for Mold.](#)

Florida Department of Health (FDEP)

The FDEP does not recommend mold testing or sampling to see if you have a mold problem, or to see what kind of mold might be growing.

[The Florida Department of Health](#)

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Sampling for Mold (At-Home Mold Tests)

At-home mold tests (often called, “DIY Mold Tests”) are extremely problematic and are not considered a reputable test method and are not recommended. The method for which samples are taken (passive sampling) and results interpreted are not utilized by professionals throughout the industry, and as such, are not recognized as credible by any organizational standard or regulatory agency. In fact, they are heavily criticized by professional Indoor Air Quality (IAQ) organizations.

At-home mold tests are misleading and often result in false positives and the inaccurate impression that there is a mold problem, when in fact there may not be, which leads to unnecessary concerns from the tenant—especially being that mold indoors is normal. There are a lot of factors involved that need considerable consideration for DIY mold test kits, and that must be placed under high scrutiny.

Examples include (but are not limited to):

1. Whether the samples were taken by an individual trained in appropriate sample methods (e.g., microbiologist, biologists, industrial hygienist, environmental technician, etc.).
2. Whether the samples were incubated in a certified—calibrated device at the appropriate temperature, at the appropriate pH level, and under what conditions... anaerobic, aerobic, etc.
3. Whether sample-grab, incubation, and handling, throughout the entire process was performed using aseptic techniques.
4. What methods determined there was indeed mold? Most importantly, what species and how many spores per cubic meter—compared to control samples?
5. Whether the results were analyzed by an individual experienced in Indoor Air Quality (e.g., a Certified Industrial Hygienist or Microbiologist).
6. Were control samples taken (specifically, outdoor samples, and in what environmental conditions)—this is one of the most important factors to determine if there is an indoor issue.
7. Was there a “blank” control to test the validity and integrity of the specific lot number for the petri dishes used?
8. What was the expiration date of the mold kit and what conditions has it been stored since manufactured?

The mishandling of such samples alone can ruin their integrity, leading to erroneous results. A report from the [Consumer Report](#) called, *‘Is poor indoor air quality making you sick?’* recommends avoiding home mold test kits due to their unreliability.

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When professionals conduct petri dish sampling (known as “viable” sampling), it’s done with a *sterile* petri dish and agar, and the samples are captured using a piece of equipment known as an “impactor”, which is connected to a high-volume sampling pump that actively samples a specified volume of air, allowing for an analytical result in a quantifiable unit, such as colony-forming units per liter of air (CFU/L). Using at-home mold kits do not offer this level of sampling, and therefore, produce incomplete, inaccurate, and invalid results.

Additionally, when sampling is performed, the method involves a proper chain of custody, and a third-party vendor (laboratory) who conducts advanced testing to effectively analyze the samples. To properly sample, ship, grow the samples, analyze those samples, and identify the material within those samples, takes a cumulative involvement of certified/calibrated equipment as well as professionally recognized procedures throughout the entire process. These laboratories are certified and accredited by a variety of regulatory agencies and organizational standards under stringent rules. Just two such references include the [Association Laboratory Accreditation Program \(AIHA-LAP\)](#) and [ISO-17025 Standards](#).

Lastly, mold growing on the agar is completely expected. This is because all indoor environments have mold to some extent—again, this is normal. There is an expectation it would indeed grow (assuming the media and environment is properly fostered) and would continue to propagate until such environment that allows the life cycle is interrupted or suppressed. After some time, the petri dishes would appear filled with “mold”, in turn, raising undue concern.

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Poor IAQ Sources (Not Related to Mold)

Although mold can cause symptoms related to sickness, some sources can contribute to poor IAQ, which can also cause symptoms and sickness—making identifying IAQ problems or whether there is a mold problem even more difficult.

Air Purifiers

Air purifiers don't treat mold growth, they only help reduce the number of spores in the air. Pre-filters and main filters must be cleaned or changed. HEPA filters become loaded over time. If maintenance is not performed, filters can harbor mold and other material that may disperse into the area.

[Research Study: Portable air purification](#)

[EPA: Guide to Air Cleaners](#)

Biological Pollutants

Biological contaminants include bacteria, viruses, animal dander, cat saliva, house dust, mites, cockroaches, and pollen.

[EPA: Biological Pollutants' Impact on Indoor Air Quality](#)

Consumer Products

Various research papers have found a correlation between consumer products (e.g., perfume, deodorants, air fresheners, detergent, food, etc.) and related symptoms. There is also evidence to show some of these factors can trigger adverse health effects. Other sources, related to activities like smoking, cleaning, or redecorating may release pollutants intermittently and can remain in the air for long periods after some activities.

[Research Study: Scented Products Emit a Bouquet of VOCs](#)

[Research Study: Fragranced consumer products: exposures and effects from emissions](#)

Fragrances

Although there is controversy among scientists as to whether the odor causing ingredients of some fragranced products actually “cause” the adverse physical impact, EPA's Indoor Environments Division (IED) understands that exposure to fragrances can cause some sensitive individuals to experience asthma episodes and other adverse health impacts and therefore notes this potential in several of their indoor air quality publications.

[EPA: Can the use of fragrances indoors cause health impacts?](#)

Scented candles can also apply:

[The American Chemical Society \(ACS\)](#)

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Plants (Indoors)

Although there have been studies that showed that plants can reduce some Volatile Organic Compounds (VOC's), the main research study frequently cited ([NASA Report](#)) was performed in a controlled chamber (~one cubic meter in volume) and does not accurately reflect the size of actual living spaces. A more [reputable study](#) determined that plants do not improve indoor air quality.

In fact, soil can grow mold, dead plant material can harbor spores, and pollen can be released. Also, mold can live on decaying plant matter.

[Research Study: Indoor Air Quality](#)

Potted plants kept in rooms may be a risk factor since soil may act as a reservoir for fungi.

[Research Study: Biotechnology Advances](#)

Pollen

Pollen, powdery substance, is created by certain plants as part of their reproduction process and can be a prominent source for allergies. Pollen allergens contribute to allergic disease and asthma. There is a great deal of publications linking pollen to health issues.

[National Institute of Environmental Sciences: Pollen](#)

[Lawrence Berkeley National Laboratory](#)

Poor Housekeeping

Performing routine cleaning of residences is one of the most important factors to good IAQ and to help reduce places where mold (and other matter, like pollen) can harbor. The Florida Tech's [University Housing Living Guide](#) is the universities reference for appropriate housing upkeep. Two sections (Appearance of Room and Climate Control) must be practiced.

Not properly and regularly cleaning can allow dust/dirt/grime/mildew to accumulate. This can harbor allergens and other sources that can be a source of food for insects and other vermin (e.g., dust mites).

[Research Study: When Mites Attack](#)

[U.S. Consumer Product Safety Commission](#)

[Asthma and Allergy Foundation of America](#)

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Thermostat Settings

Per Florida Tech's **University Housing Living Guide (Section "Climate Control")**, thermostats should be set between 72° and 76° Fahrenheit to avoid fostering an environment of excess moisture. When thermostats are set too low, this can cause a break in dewpoint, resulting in over-condensation of the area, which provides mold an optimal environment to thrive (whether on vents, walls, ceilings, furniture, and personal belongings). Keeping the temperature settings at the required level helps to avoid introducing excess moisture to the air.

[Research Study: Moisture control and ventilation](#)

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Room Supply Vents & AC Vents

A common concern from tenants stems from individuals seeing what appears to be black spots or smudge on room supply or air-conditioner unit vents (also called registers or diffusers). This does not necessarily represent an unhealthy environment and is not a cause for alarm.

Most smudging observed on or around supply diffusers (on the ceiling) result from entrainment (trapping) of dirt particles in the space that accumulate.

[OSHA: Indoor Air Quality](#)

Although a buildings HVAC prefilters are efficient at blocking most contaminants, they do allow some to enter the building. At times, this will result in minor buildup on vents. Due to the cool air being expelled out of the vent and immediately meeting the warmer air inside the room, some condensation can occur, leading to slight accumulation of particulate material on the vents, almost always visually appearing to be “black”. These particulates stick to the vent because condensation has given the material a place to reside (hold onto). This can be cleaned by the tenant using a damp rag consisting of a warm water/soap solution or general household disinfectant as a part of routine housekeeping per the **University Housing Living Guide (Section “Appearance of Room”)**.

Additionally, allowing the bathroom door to remain open when not in use. Also, allowing the exhaust fan to operate for a longer period after the shower is used is best practices.

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Other Factors to Consider

It's important to take into consideration other factors that may result in sickness-related symptoms; however, may or may not be directly related to mold from an IAQ stand-point. Seeking the attention of a licensed healthcare professional is advised if individuals are unsure.

Contamination of Food

Food that is contaminated with mold can impact health.

[FDA: Mycotoxins](#)

Immunocompromised Individuals

When areas are deemed not to be a health hazard, the assumption, as with industry standard, is taking into consideration for normal healthy individuals without otherwise underlying health conditions. Some mold species that would be of no concern for most people may be problematic for immunocompromised individuals. Some fungal diseases are only known to affect people with weakened immune systems.

[CDC: Fungal Risks](#)

Pre-existing Health Conditions

Individuals who have preexisting health conditions can be impacted more severe (e.g., exacerbating of asthma).

[Research Study: Mold, Mycotoxins and a Dysregulated Immune System](#)

Stress

Stress affects all systems of the body including the musculoskeletal, respiratory, cardiovascular, endocrine, gastrointestinal, nervous, and reproductive systems.

[American Psychological Association](#)

[Research Study: The impact of stress on body function](#)