

# Mold Basics

- **The key to mold control is moisture control.**
- **If mold is a problem in your home, you should clean up the mold promptly *and* fix the water problem.**
- **It is important to dry water-damaged areas and items within 24-48 hours to prevent mold growth.**

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## Why is mold growing in my home?

Molds are part of the natural environment. Outdoors, molds play a part in nature by breaking down dead organic matter such as fallen leaves and dead trees, but indoors, mold growth should be avoided. Molds reproduce by means of tiny spores; the spores are invisible to the naked eye and float through outdoor and indoor air. Mold may begin growing indoors when mold spores land on surfaces that are wet. There are many types of mold, and none of them will grow without water or moisture.



Mold growing outdoors on

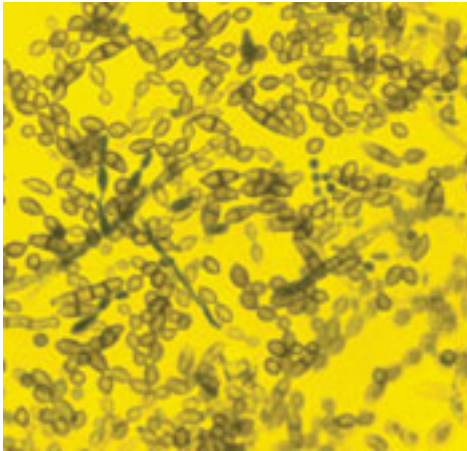
firewood. Molds come in many colors; both white and black molds are shown here. Click on the image for larger version.

## Can mold cause health problems?

Molds are usually not a problem indoors, unless mold spores land on a wet or damp spot and begin growing. Molds have the potential to cause health problems. Molds produce allergens (substances that can cause allergic reactions), irritants, and in some cases, potentially toxic substances (mycotoxins). Inhaling or touching mold or mold spores may cause allergic reactions in sensitive individuals. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Allergic reactions to mold are common. They can be immediate or delayed. Molds can also cause asthma attacks in people with asthma who are allergic to mold. In addition, mold exposure can irritate the eyes, skin, nose, throat, and lungs of both mold-allergic and non-allergic people. Symptoms other than the allergic and irritant types are not commonly reported as a result of inhaling mold. Research on mold and health effects is ongoing. This brochure provides a brief overview; it does not describe all potential health effects related to mold exposure. For more detailed information consult a health professional. You may also wish to consult your state or local health department.

## How do I get rid of mold?

### Magnified mold spores



**Molds gradually destroy the things they grow on. You can prevent damage to your home and furnishings, save money, and avoid potential health problems by controlling moisture and eliminating mold growth**

It is impossible to get rid of all mold and mold spores indoors; some mold spores will be found floating through the air and in house dust. The mold spores will not grow if moisture is not present. Indoor mold growth can and should be prevented or controlled by controlling moisture indoors. If there is mold growth in your home, you must clean up the mold **and** fix the water problem. If you clean up the mold, but don't fix the water problem, then, most likely, the mold problem will come back.

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# Aspergillus

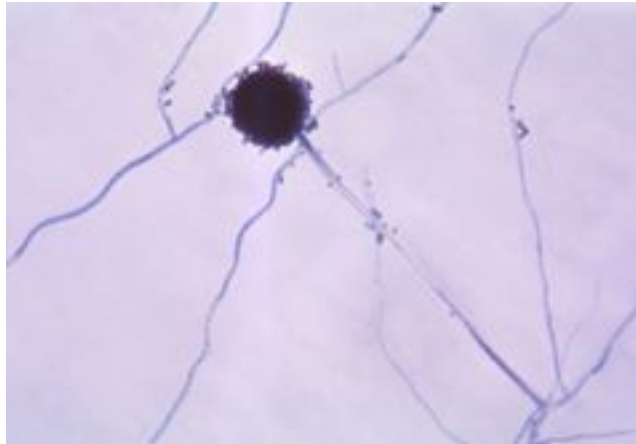
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## *Aspergillus*



[Conidial](#) head of *Aspergillus niger*

## Scientific classification

Kingdom: [Fungi](#)  
Phylum: [Ascomycota](#)  
Class: [Eurotiomycetes](#)  
Order: [Eurotiales](#)  
Family: [Trichocomaceae](#)  
Genus: *Aspergillus*

## Species

about 200, including:

[\*Aspergillus caesiellus\*](#)

[\*Aspergillus candidus\*](#)

[\*Aspergillus carneus\*](#)

[\*Aspergillus clavatus\*](#)

[\*Aspergillus deflectus\*](#)

[\*Aspergillus flavus\*](#)

[\*Aspergillus fumigatus\*](#)

[\*Aspergillus glaucus\*](#)

[\*Aspergillus nidulans\*](#)

[\*Aspergillus niger\*](#)

[\*Aspergillus ochraceus\*](#)

[\*Aspergillus oryzae\*](#)

[\*Aspergillus parasiticus\*](#)

[\*Aspergillus penicilloides\*](#)

[\*Aspergillus restrictus\*](#)

[\*Aspergillus sojae\*](#)

[\*Aspergillus sydowi\*](#)

[\*Aspergillus tamari\*](#)

[\*Aspergillus terreus\*](#)

[\*Aspergillus ustus\*](#)

[\*Aspergillus versicolor\*](#)

*Aspergillus* is a [genus](#) of around 200 [molds](#) found throughout much of nature worldwide. *Aspergillus* was first catalogued in [1729](#) by the Italian priest and biologist [Pietro Antonio Micheli](#). Viewing the fungi under a [microscope](#), Micheli was reminded of the shape of an [aspergillum](#) (holy water sprinkler), and named the genus accordingly.

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## [[edit](#)] Growth and distribution

*Aspergillus* species are highly [aerobic](#) and are found in almost all oxygen-rich environments, where they commonly grow as [molds](#) on the surface of a substrate, as a result of the high oxygen tension.

Commonly, fungi grow on carbon-rich substrates such as [monosaccharides](#) (such as [glucose](#)) and [polysaccharides](#) (such as [amylose](#)). *Aspergillus* species are common contaminants of starchy foods (such as bread and potatoes), and grow in or on many plants and trees.

In addition to growth on carbon sources, many species of *Aspergillus* demonstrate [oligotrophy](#) where they are capable of growing in nutrient-depleted environments, or environments in which there is a complete lack of key nutrients. *A. niger* is a prime example of this; it can be found growing on damp walls, as a major component of [mildew](#).

## [[edit](#)] Commercial importance

Species of *Aspergillus* are important medically and commercially. Some species can cause infection in humans and other animals. Others are important in commercial microbial fermentations.

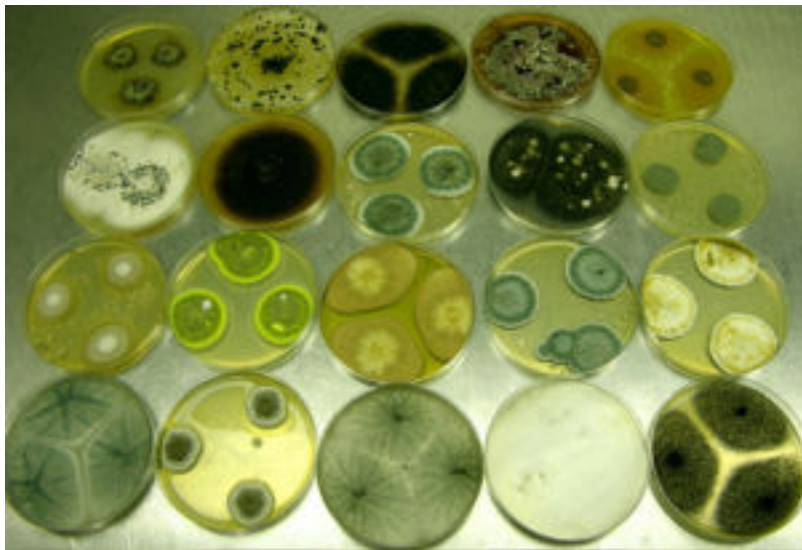
In some countries, alcoholic beverages such as Japanese [sake](#) are often made from rice or other starchy ingredients (like manioc), rather than from grapes or malted barley. The microorganisms which are used to make alcohol, such as yeasts of the genus [Saccharomyces](#), can only ferment simple sugars. Unlike grapes and other similar fruits, rice does not provide these simple sugars, but rather [starches](#), which consist of chains of [polymerized](#) sugars. Nor does it provide plant [amylases](#) to break down any starches present into sugars (in a process called [saccharification](#)), as does [malted](#) barley. Therefore, some other

source of amylase is needed to prepare the grain for fermentation. In ancient cultures (as well as a few isolated present-day ones, as in parts of Africa and South America) this saccharification was accomplished by the brewers actually chewing the starchy source of fermentables (thus introducing the amylase naturally occurring in human saliva), then spitting it out into a container, after which it could be fermented. Eventually, it was discovered that *koji* mold such as *Aspergillus oryzae* also produces amylases to convert the starch in the rice to sugars, thereby ending the necessity of having someone chew one's drink before one could ferment it.

Members of the genus are also sources of [natural products](#) that can be used in the [development of medications](#) to treat human disease.<sup>[1]</sup>

Perhaps the most well-known application of *A. niger* is as the major source of [citric acid](#); this organism accounts for over 99% of global citric acid production, or more than 4.5 million [tonnes](#) per annum. *A. niger* is also commonly used for the production of native and foreign [enzymes](#), including [glucose oxidase](#) and hen egg white [lysozyme](#). In these instances, the culture is rarely grown on a solid substrate, although this is still common practice in Japan, but is more often grown as a submerged culture in a [bioreactor](#). In this way, the most important parameters can be strictly controlled, and maximal productivity can be achieved. It also makes it far easier to separate the chemical or enzyme of importance from the medium, and is therefore far more cost-effective.

## [\[edit\]](#) Research



Various *Penicillium*, *Aspergillus* spp. (and some other fungi) growing in axenic culture.

*A. nidulans* has been used as a research organism for many years and was used by [Guido Pontecorvo](#) to demonstrate [parasexuality](#) in fungi. Recently, *A. nidulans* was one of the pioneering organisms to have its [genome](#) sequenced by researchers at the [Broad Institute](#). Now, many *Aspergillus* species have had

their genomes sequenced, including [A. fumigatus](#), [A. oryzae](#) and [A. niger](#).

## [\[edit\]](#) Pathogens

Some *Aspergillus* species cause serious disease in humans and animals, and can be [pathogenic](#). The most common causing invasive disease are [Aspergillus fumigatus](#) and [Aspergillus flavus](#). *Aspergillus flavus* produces aflatoxin which is both a toxin and a carcinogen, and which can potentially contaminate foods such as nuts. The most common causing [allergic](#) disease are *Aspergillus fumigatus* and [Aspergillus clavatus](#). Other species are important as agricultural pathogens. *Aspergillus* spp. cause disease on many grain crops, especially [maize](#), and synthesize [mycotoxins](#) including [aflatoxin](#).

## [\[edit\]](#) Aspergillosis

[Aspergillosis](#) is the group of diseases caused by *Aspergillus*. The symptoms include fever, cough, chest pain or breathlessness, which also occur in many other illnesses so diagnosis can be difficult. Usually, only patients with already weakened [immune systems](#) or who suffer other [lung](#) conditions are susceptible.

In humans, the major forms of disease are:

1. Allergic aspergillosis (affects [asthma](#), [cystic fibrosis](#) and [sinusitis](#) patients).
2. Acute invasive aspergillosis (risk increases if patient has weakened immunity such as some [AIDS](#) patients and those undergoing [chemotherapy](#)).
3. Disseminated invasive aspergillosis ([widespread](#) through body).

# Stachybotrys

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## *Stachybotrys*

### Scientific classification

Kingdom: [Fungi](#)

Phylum: [Ascomycota](#)

Class: [Sordariomycetes](#)

Order: [Hypocreales](#)

Family: Dematiaceae

Genus: *Stachybotrys*

### Species

[\*S. chartarum\*](#)

[\*S. cylindrospora\*](#)

*Stachybotrys* is a [genus](#) of [molds](#), or asexually-reproducing, filamentous [fungi](#). Closely related to the genus *Memnoniella*,<sup>[1][2]</sup> most *Stachybotrys* species inhabit materials rich in [cellulose](#).

The most infamous species, [\*S. chartarum\*](#) (also known as *S. atra*) is known as "black mold" or "toxic black mold," and is frequently associated with poor indoor air quality that arises after fungal growth on water-damaged building materials.<sup>[3]</sup> It is known to produce [trichothecene mycotoxins](#) including satratoxins.

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## [\[edit\]](#) Pathogenicity

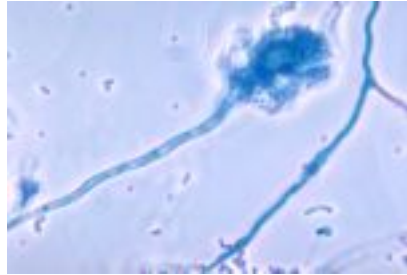
## [\[edit\]](#) Symptoms of Exposure to Stachybotrys in Humans

Exposure to the [mycotoxins](#) present in [Stachybotrys chartarum](#) or *Stachybotrys atra* can have a wide range of effects. Depending on the length of exposure and volume of spores inhaled or ingested, symptoms can manifest as chronic fatigue or headaches, fever, irritation to the eyes and mucous membranes of the mouth, nose and throat, sneezing, rashes and chronic cough. In severe cases of exposure or cases exacerbated by allergic reaction, symptoms can be extreme including nausea, vomiting, diarrhea and bleeding in the lungs or nose. <sup>[4]</sup>

# Mold health issues

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Light micrograph of the hyphae and spores of the human pathogen

*[Aspergillus fumigatus](#)*

[Molds](#) are ubiquitous in nature, and mold [spores](#) are a common component of household and workplace dust. However, when mold spores are present in large quantities, they can present a health hazard to humans, potentially causing allergic reactions and respiratory problems. Because of this, mold allergy has become a serious problem for many people. Research in the field of environmental health has yielded tests such as the [MELISA assay](#), which is capable of identifying whether or not a person is allergic to specific molds. If a person is found to be allergic, the remedies listed below are often helpful in reducing allergic reaction.

Molds that are harmful produce [mycotoxins](#) that can pose serious health risks to humans and animals. Exposure to high levels of mycotoxins can lead to neurological problems and in some cases death. Prolonged exposure, e.g. daily workplace exposure, can be particularly harmful. The term **toxic mold** refers to molds that produce mycotoxins, such as [Stachybotrys chartarum](#), and not to all molds in general.

The health hazards produced by mold have been associated with [sick building syndrome](#).

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## [[edit](#)] History

Since Biblical times it has been known that indoor mold growth can be a health hazard. In the 1930s, mold was identified as the cause behind the mysterious deaths of farm animals in Russia and other countries. *[Stachybotrys chartarum](#)* was found growing on wet grain used for animal feed.

In the 1970s, building [construction](#) techniques changed in response to the [energy crisis](#). As a result, homes and buildings became more airtight. Also, cheaper materials such as [drywall](#) came into common use. This combination of increased moisture and suitable substrates contributed to increased mold growth inside buildings.

Today, the agriculture industry keeps a close eye on mold and mycotoxin levels in grains in order to prevent the contamination of animal feed and human food supplies. In 2005 [Diamond Pet Foods](#), a US pet food manufacturer, experienced a significant rise in the number of corn shipments containing elevated levels of aflatoxin. This mold toxin eventually made it into the pet food supply, and dozens of dogs died before the food could be recalled.

## [[edit](#)] Health issues and symptoms

*See also:* [Category:Fungal diseases](#)

Environmental illnesses can be difficult for healthcare practitioners to diagnose. Those who are living in

houses contaminated by the mold may not be able to smell any odor and may be unaware that the problem exists.

## **[[edit](#)] Mold spores**

*See also:* [spores](#), [allergy](#), [allergens](#), [bioaerosol](#), and [Allergic bronchopulmonary aspergillosis](#)

Health problems associated with high levels of airborne mold spores include<sup>[1]</sup> allergic reactions, [asthma](#) episodes, irritations of the eye, nose and throat, infections, [sinus](#) congestion, and other respiratory problems. When inhaled, mold spores may germinate, attaching to cells along the [respiratory tract](#) and causing further problems in those with weak [immune systems](#).

Another serious health threat from mold exposure is systemic fungal infection. Immunocompromised individuals exposed to high levels of mold, or individuals with chronic exposure paired with mycotoxin exposure may become infected. Sinuses and [digestive tract](#) infections are most common; [lung](#) and [skin](#) infections are also possible. Alcohol and mycotoxin production may result from the fungal growth, leading to myriad symptoms. Sudden food allergies and digestive problems can mislead diagnosis. Treatment can be long-term (many years). Systemic infection may be of the environmental mold itself, or by other common food-related molds consumed under a weakened immune system. A weakened immune system may also give rise to opportunistic infections, for example bacterial infection.

## **[[edit](#)] Mold-produced mycotoxins**

Molds excrete liquids or gases as defecatory matter; not all can be detected by smell. Some molds generate toxic liquid or gaseous compounds, called [mycotoxins](#). Of these molds, some only produce mycotoxins under specific growing conditions. Mycotoxins are harmful or lethal to humans and animals when exposure is high enough. Serious neurological problems can result from prolonged exposure to mycotoxins. One example of toxic mold is [Stachybotrys chartarum](#) which has been associated with [sick building syndrome](#).

Some [mycotoxins](#) produced by molds are harmful to humans.<sup>[2]</sup> Other mycotoxins cause immune system responses that vary considerably, depending on the individual. The duration of exposure is a key factor in triggering immune system response. Farm animals often die or suffer from mycotoxin poisoning. Mycotoxins resist decomposition from cooking, and remain in the food chain.

Human bodies can tolerate mycotoxins in small quantities. At what point they constitute a health hazard depends on each individual. Immune system reactions vary; the health effects of mycotoxin exposure include chronic fatigue and irritability, flu-like symptoms, respiratory problems, headaches, cognitive problems, and skin problems. A stressed immune system results in a weakened individual.

## [\[edit\]](#) Causes / Growing conditions

*Main article: [Mold growth](#)*

Because common building materials are capable of sustaining mold growth, and mold spores are ubiquitous, mold growth in an indoor environment is typically related to an indoor water or moisture problem. Leaky roofs, building maintenance problems, or indoor [plumbing](#) problems can lead to mold growth inside homes, schools, or office buildings. Another common cause of mold growth is flooding.

Generally - removing one of the three requirements for mold reduces or eliminates the new growth of mold. These three requirements are 1) Moisture, 2) Food source for the mold spores (dust, dander, etc), and 3) Warmth (mold generally does not grow in cold environments).

HVAC systems can create all three requirements for significant mold growth. The A/C system creates a difference in temperature that allows/causes condensation to occur. The high rate of dusty air movement through an HVAC system may create ample sources of food sources for the mold. And finally, since the A/C system is not always running - the ability for warm conditions to exist on a regular basis allows for the final component for active mold growth.

Because the HVAC system circulates air contaminated with mold spores and sometimes toxins - it is vital to prevent any three of the environments required for mold growth. A) Highly effective return air filtration systems are available that eliminate up to 99.9% of dust accumulation (as compared to 5% elimination by typical HVAC air filters). These newer filtration systems usually require modification to existing HVAC systems to allow for the larger size of electrostatic 99.9% filters. However, thorough cleaning of the HVAC system is required before usage of high efficiency filtration systems will help. Once mold is established - the mold growth and dust accumulation must be removed. B) Insulation of supply air ducts helps to reduce or eliminate the condensation that ultimately creates the moisture required for mold growth. This insulation should be place externally on the air ducts, because internal insulation provides a dust capture and breeding ground for mold.