

NC STATE UNIVERSITY

College of Agriculture & Life Sciences

Family and Consumer Sciences



This document contains a definition of terms and answers the following questions:

- What are bioaerosols?
- Can bioaerosols cause health problems?
- What are the sources of bioaerosols in the home?
- What measures can be taken to control bioaerosols in the home?
- How can I control the causes of bioaerosols?

Mold, dust mites, fungi, spores, and pollen: Bioaerosols in the human environment

What are bioaerosols?

A healthy indoor environment is important to you and your family. This includes keeping the air free of biological contaminants, which can cause health problems. Scientists call these airborne contaminants *bioaerosols*.

Bioaerosols are extremely small living organisms or fragments of living things suspended in the air. Dust mites, molds, fungi, spores, pollen, bacteria, viruses, amoebas, fragments of plant materials, and human and pet dander (skin which has been shed) are some examples. They cannot be seen without a magnifying glass or microscope.

Can bioaerosols cause health problems?

They can cause severe health problems. Some, like viruses and bacteria, cause infections (like a cold or pneumonia). Others cause allergies. Both allergic responses and infections may be serious or even fatal.

An allergic reaction occurs when a substance provokes formation of antibodies in a susceptible person. We call substances which will cause an allergic reaction in some people *antigens* or *allergens*. Bioaerosols may cause allergic reactions on the skin or in the respiratory tract. Rashes, hay fever, asthma (tightness in the chest, difficulty in breathing), and runny noses are common allergic reactions.

A few people develop a severe allergic reaction in the lung, which can destroy lung tissue. This is called *hypersensitivity pneumonitis*. It is not an infection, but repeated episodes can lead to infections of the lung, such as bacterial pneumonia.

Hypersensitivity pneumonitis can be triggered by exposure to very small amounts of the allergen, once a person is sensitive to it. Symptoms can range from tightness in the chest, cough, and difficulty in breathing, to low-grade fever, muscle aches, and headaches.

What are sources of bioaerosols in the home?

Molds, mildews, bacteria, and dust mites like the same conditions that we do--warmth and moderate to high humidity. They need little more than a constant moisture supply for survival. You may find bacteria, molds, and mildews in air conditioning equipment, humidifier reservoirs, dehumidifier drip pans, shower heads, toilets, and ice machines. Water damaged carpets, ceiling panels, walls, and paneling are prime sites for new growth if they are allowed to stay damp. When molds, mildew, dust mites, and bacteria are disrupted or release their spores into the air, this results in bioaerosol formation.

Molds and mildews develop from spores, which are in the air all around you. As soon as spores settle in an area with the right conditions for growth, they establish colonies, which are often visible to the naked eye. These colonies are a source of more spores, can cause unsightly stains, and may release low levels of toxic chemicals called *mycotoxins* into the air.

Humidifiers are such a common source of bioaerosols that cause health problems that doctors now use the term *humidifier fever*. Protozoa, amoebas, and strains of bacteria have been found in humidifiers, and these are readily released into the air with the moisture produced by humidifiers. These have been linked to allergic responses in sensitive people.

Mold and mildew may be found in the ductwork of your heating or cooling systems. If there are leaks in the ductwork, or places where moisture and outside air get into the system, mold and mildew can grow. Sometimes they are found in the coils of an air conditioner or in the connection between the unit and the ductwork. Moisture problems are worse where ductwork insulation is on the inside as opposed to the outside of the duct. The insulation's porous surface collects dust and moisture. Mold and mildew may also grow on dirty furnace and air conditioning filters. Plumbing leaks and dampness in attics, basements, and crawl spaces can increase humidity inside your home and promote the growth of agents that will be released as bioaerosols. Bathrooms without outside-vented exhaust fans, combustion appliances like kerosene space heaters, drying laundry indoors, and venting clothes dryers to attics or crawl spaces can also increase the humidity levels in your home.

Dust mites and their waste products are the most common allergens in indoor air. Dust mites eat human and pet skin (dander) as it is shed. It has been estimated that we shed about seven million cells per minute! Dust mites live in rugs and carpets, sheets, mattresses and pillows, and upholstered furniture. Ten to 15 percent of people are allergic to dust mites. Of the people who have other allergies, 40 percent are also allergic to dust mites.

What measures can be taken to control bioaerosols in the home?

First, lower the relative humidity in your home, basement or crawl space, and attic. Relative humidity is the amount of moisture in the air at a given temperature. You may want to see *Identifying and Correcting Moisture Problems in Homes*. The humidity fluctuates in your home, depending on:

- How warm or cool the air is indoors.
- How many moisture-producing activities (drying clothes indoors, showers) are taking place.
- Whether there is a constant source of moisture (leaks, damp foundations and attics).
- How much moisture is being vented to the outside.

If you can keep relative humidity below 50 percent, you can reduce problems with dust mites, mold, and mildew. A hygrometer can be used to measure indoor humidity levels. You can buy a hygrometer from some nursery or garden stores, and from hardware stores.

There is little medical research supporting the use of a humidifier, so try to avoid using one. If your home is extremely dry and you must use a humidifier, a steam vaporizer or warm mist humidifier causes fewer problems. Do not humidify indoor air to a relative humidity level higher than 50 percent.

Ultrasonic and cool mist (impeller-type) humidifiers can send microorganisms from their water tanks into the air. Ultrasonic humidifiers use sound vibrations to create a cool mist. Impeller humidifiers create a cool mist by means of a high-speed rotating disk. If you do use a humidifier:

- Empty the tank, wipe all surfaces dry, and refill the water in portable humidifiers each day.
- Clean portable humidifiers every third day. Unplug the humidifier before cleaning and follow the manufacturer's recommendations on the use of cleaning agents or disinfectants.

If you have no specific instructions on cleaning your humidifier, use a 3 percent solution of hydrogen peroxide. Never use the humidifier with any of the cleaning agent or disinfectant in the tank. Rinse the tank thoroughly several times with tap water to keep cleaning or disinfecting chemicals out of the air.

How can I control the causes of bioaerosols?

Molds, mildew, and dust mites are the most common causes of problems in the home. These bioaerosols can be controlled relatively easily.

Molds and Mildews

- Reduce relative humidity.
- If you find mold or mildew in your home, try to find and eliminate sources of moisture, such as plumbing leaks.
- Dry the air. Use a chemical or mechanical dehumidifier. Empty collecting (drip) pan daily.
- Open closet doors to allow air to circulate. Use a 40-watt light bulb to dry and heat air in closets.
- Vent bathrooms and clothes dryers to the outside.
- Do not use humidifiers.
- Trim back trees and shrubs around the house to reduce shade.
- Remove debris from your yard, roof, and gutters.
- Clean mold and mildew growth from walls with water mixed with chlorine bleach, diluted three parts water to one part bleach. Commercial products can also remove mildew and mold. Follow product instructions carefully. Very moldy items should be replaced.
- Change heating and cooling system filters monthly.
- Vacuum air return covers or screens regularly.
- Check air conditioners for mold before each cooling season and have coils cleaned as needed.
- Have heating/cooling system ductwork checked for loose insulation, leaks, or signs of condensation where the system enters the house. Insulate ducts on the outside of the ductwork.
- Air cleaners and filters are other options. Electronic and HEPA (high efficiency particulate absolute) cleaners and filters are best at taking mold, mildew, and dust out of the air.
- Make sure that crawl space vents work and are not blocked. If your cooling ductwork runs through the crawl space, consider closing crawl space vents during summer cooling months.
- Using vent fans in crawl spaces during the summer when humidity is high may increase the relative humidity in the crawl space and inside the home. Use fans only when outside humidity is well below 50 percent.
- Mechanical dehumidifiers reduce humidity in basements, but they should not be used in crawl spaces when vents are open.
- Heating/cooling contractors or duct cleaning firms can clean the ductwork in your home to reduce mold and mildew growth.

Duct cleaning may involve compressed air-washing, vacuuming and/or scrubbing of duct surfaces. Some firms advertise disinfectants and sealants to prevent further fungal growth. It is uncertain whether these processes are appropriate for most homes. Have microbial contamination verified by an industrial hygienist or other environmental testing agency before sanitizing products are used in your ductwork. Commercial fogging or misting agents should not be used because of possible health problems from breathing these chemicals. Use of a sealant in the ductwork is generally not appropriate unless the mold, mildew, or dust source has been removed.

Dust Mites

It is not known how well any single measure controls dust mite populations. However, it is known that effective mite control requires that relative humidity be maintained below 50 percent. In addition,

since you spend about a third of each day in your bedroom, concentrate your efforts there.

- Wash sheets, pillowcases, and mattress covers frequently in hot soapy water. If someone in your family is allergic to dust mites, buy special vinyl covers for the pillow and mattress.
- Ordinary vacuuming does not remove or reduce mite populations. Mites are so tiny that they pass through the vacuum cleaner bag. High-efficiency filters for vacuum cleaners may be used in place of conventional filters.
- Remove stuffed animals and objects that collect dust. If carpeting is used, short-pile is best.
- Some new products may help reduce dust mite populations. Ask your doctor about control solutions for upholstered furniture and bedding.

SUMMARY. Bioaerosols, such as mold, mildew, and dust mites, are commonly found in indoor air. Control measures include reducing sources of moisture, reducing the relative humidity, and removing materials which contribute to the growth of these agents. Make your house a healthier house. Check periodically for moisture problems and maintain the air handling systems and filters.

For more information, see [Air Filters and Cleaners](#), or Identifying and Correcting Moisture Problems in Homes.

Definition of Terms

Allergens -- medical term for foreign proteins that cause allergic reactions in susceptible individuals

Biocides -- chemicals or processes that kill living cells

Dander -- skin and hair fragments shed by humans and other animals

Disinfection -- process of killing disease-causing organisms

Dust Mites -- microscopic organisms that feed on human and animal dander

Hygrometer -- instrument used to measure relative humidity

Mycotoxins -- toxic substances produced by fungi

Sanitizing -- process to reduce the number of disease-causing organisms

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