Examples of how occupants' behavior can affect indoor air quality (IAQ) and how IAQ can change their behavior

Ginger L. Chew, ScD
Senior Scientific Advisor, Division of Environmental Health Science and Practice

National Academies of Science, Engineering, and Medicine (NASEM)

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Examples of occupant behavior changing Indoor Air Quality (IAQ)

Home Characteristics and Asthma Triggers

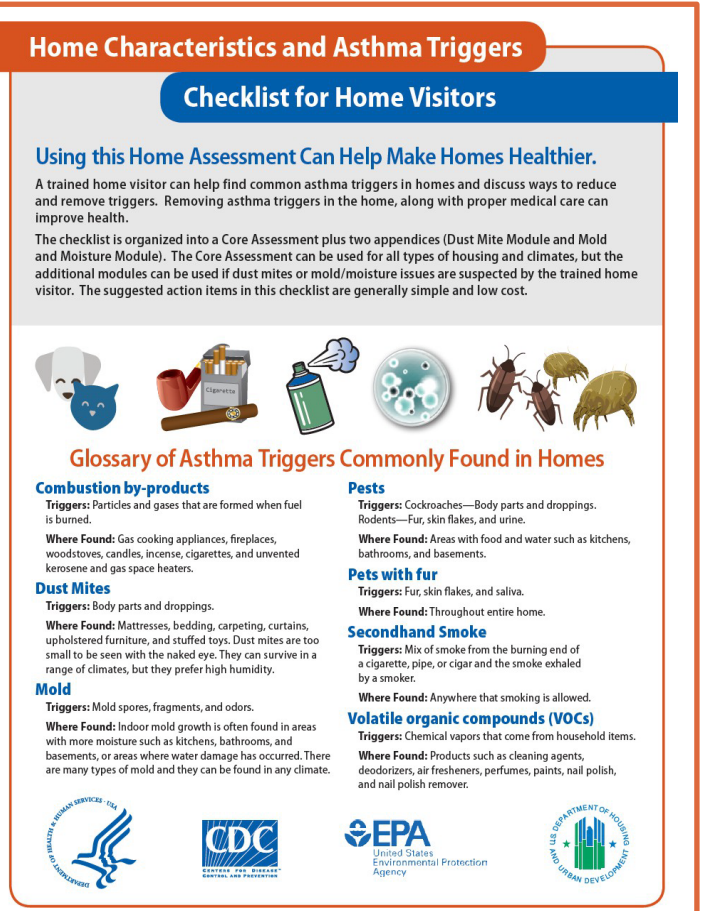
Training for Home Visitors

This training covers some of the most common asthma triggers found inside homes. The training can guide users of this checklist to understand triggers.

Learning Objectives

- To understand how exposure to common asthma triggers occurs in homes.
- To help residents find ways to reduce and remove triggers in their homes.

Home Characteristics and Asthma Triggers



Home Characteristics and Asthma Triggers

Checklist for Home Visitors

Using this Home Assessment Can Help Make Homes Healthier.

A trained home visitor can help find common asthma triggers in homes and discuss ways to reduce and remove triggers. Removing asthma triggers in the home, along with proper medical care can improve health.

The checklist is organized into a Core Assessment plus two appendices (Dust Mite Module and Mold and Moisture Module). The Core Assessment can be used for all types of housing and climates, but the additional modules can be used if dust mites or mold/moisture issues are suspected by the trained home visitor. The suggested action items in this checklist are generally simple and low cost.

Glossary of Asthma Triggers Commonly Found in Homes

Combustion by-products

Triggers: Particles and gases that are formed when fuel is burned.

Where Found: Gas cooking appliances, fireplaces, woodstoves, candles, incense, cigarettes, and unvented kerosene and gas space heaters.

Dust Mites

Triggers: Body parts and droppings.

Where Found: Mattresses, bedding, carpeting, curtains, upholstered furniture, and stuffed toys. Dust mites are too small to be seen with the naked eye. They can survive in a range of climates, but they prefer high humidity.

Mold

Triggers: Mold spores, fragments, and odors.

Where Found: Indoor mold growth is often found in areas with more moisture such as kitchens, bathrooms, and basements, or areas where water damage has occurred. There are many types of mold and they can be found in any climate.

Pests

Triggers: Cockroaches—Body parts and droppings. Rodents—Fur, skin flakes, and urine.

Where Found: Areas with food and water such as kitchens, bathrooms, and basements.

Pets with fur

Triggers: Fur, skin flakes, and saliva.

Where Found: Throughout entire home.

Secondhand Smoke

Triggers: Mix of smoke from the burning end of a cigarette, pipe, or cigar and the smoke exhaled by a smoker.

Where Found: Anywhere that smoking is allowed.

Volatile organic compounds (VOCs)

Triggers: Chemical vapors that come from household items.

Where Found: Products such as cleaning agents, deodorizers, air fresheners, perfumes, paints, nail polish, and nail polish remover.

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Mold

Triggers: Mold growth, including spores and odors.

Where Found: Often found in areas with more moisture such as kitchens, bathrooms, and basements. There are many types of mold and they can be found in any climate.

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DEPARTMENT OF HEALTH & HUMAN SERVICES · USA

CDC Centers for Disease Control and Prevention

EPA United States Environmental Protection Agency

U.S. Department of Housing and Urban Development

Home Characteristics and Asthma Triggers

Cooking

- Cooking can create indoor air pollutants, such as gases and particles.
- Cooking can also increase moisture in the air.
- Use exhaust fans or range hoods that vent to the outside, or open windows when cooking.

✓

Exhaust duct

✗

No exhaust duct

Changes that can affect pet allergen levels

- Changes by the residents (new furniture, new carpet, new pet).
- Changes in living situation (daycare, relative's home, vacation).

Other pets
Things to consider

- Other pets have allergens, too
- Pet food and water can attract and nourish bugs and rodents
- Litter boxes and cages can cause odors and mold growth that can irritate the lungs

Types of pests

Things that affect pest allergen levels

- Changes within the home — new roommates, parties with a lot of food, new pet.
- Changes in the building — new holes, recent pesticide application in neighboring buildings.
- Changes in weather — cold temperatures can drive pests indoors.

Specific examples of things that attract pests

Keep pesticides and traps away from children and pets

- Use gel bait application for insects (such as cockroaches).
- Use snap traps for mice and rats.
- Avoid spray pesticides, bombs, and foggers (these are asthma triggers).

Dust mites

- Dust mites burrow into textile furniture and bedding.
- They are microscopic and cannot be easily seen.

Dust mite intervention

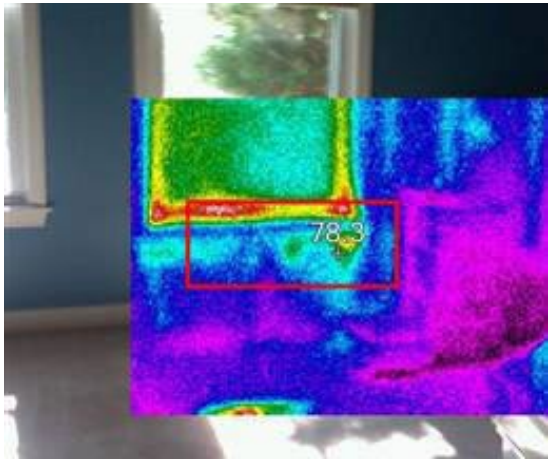
- Removing the allergens is not the same as decreasing the dust mite population.
- Use a device (hygrometer) to measure relative humidity.
- Keep relative humidity 30%-50%* to help keep dust mite population low.

Measure humidity in several locations in home throughout the year.

* Less than 30% can dry out mucus membranes and promote respiratory infections.

Condensation

- Surfaces can have different temperatures

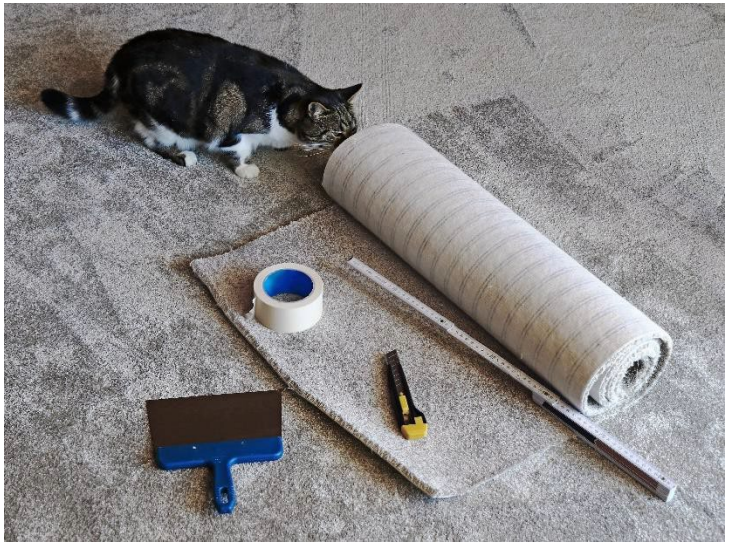


- Colder surfaces in contact with warm air leads to condensation

Mold growing on ceiling tile

Water leak under kitchen sink

Other than water leaks and condensation, how can mold get into a home?



- Changes by the residents (new pillows, new carpet, old pillows, old carpet)
- Seasonal differences
- Pets

Volatile organic compounds (VOCs)

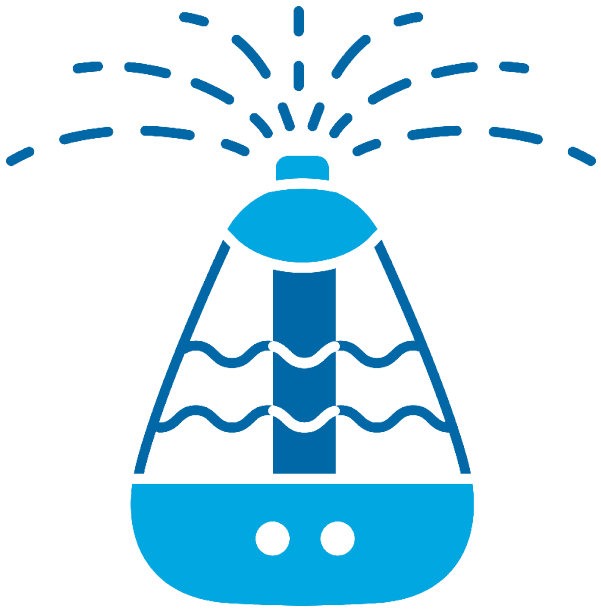
Chemicals commonly found in many household products

- Wood preservatives
- Aerosol sprays
- Cleansers and disinfectants
- Moth repellents and air fresheners
- Fuels and automotive products
- Hobby and craft materials supplies
- Paints, paint strippers, and solvents
- Dry-cleaned clothing
- Pesticides
- Building materials and furnishings
- Glues, adhesives, permanent markers, and photo chemicals

Examples of IAQ changing occupant behavior

Humidifiers

- Some residents use humidifiers when air is very dry.
- Humidifier use can cause moisture on walls and ceilings.
- Keep humidity between 30%-50%.
- Keep moisture from building up on surfaces.
- Clean humidifier often.
- Follow manufacturer's instructions, to prevent growth of mold and other microbes.



How to reduce mold growth

- Fix any water or moisture problems.

- Control humidity levels and increase ventilation.

- Clean up areas that have mold growth.

Unintended consequences of cleaning/ covering up mold growth

Mold growth

+

Cleaning products (with VOCs)

and/or

Air fresheners

=

Poor IAQ

When do people change their cooking behaviors (i.e., using exhaust fan)?

Highest 5-min $PM_{2.5}$ > 50 µg/m³	Houses		Apartments	
	Cooking Events	Any Hood Use *n* (%)	Cooking Events	Any Hood Use *n* (%)
Yes	58	30 (52%)	9	5 (56%)
No	57	37 (65%)	32	9 (28%)
p-value	0.19		0.23	

Zhao H, Chan WR, Delp WW, Tang H, Walker IS, Singer BC. Factors Impacting Range Hood Use in California Houses and Low-Income Apartments. Int J Environ Res Public Health. 2020. 17(23):8870.

Next steps/ The future

1. Smart buildings

2. Health communications

3. Youth education

4. Give results to building occupants

Smart buildings

"Low-cost sensors are a viable technology… $PM_{2.5}$ … demonstrated stability, durability, and robustness."[1]

"…the smart home was developed simply to enhance the energy-usage efficiency and optimize ventilation technology ... offer opportunities to reduce the negative impacts of IAP on human health."

Photo credit: Ginger Chew

[1] Morawska *et al.*, Mandating indoor air quality for public buildings. *Science. 2024.* **383**,1418-1420.

[2] Tran VV, Park D, Lee YC. Indoor Air Pollution, Related Human Diseases, and Recent Trends in the Control and Improvement of Indoor Air Quality. Int J Environ Res Public Health. 2020. 17(8): 2927-2954.

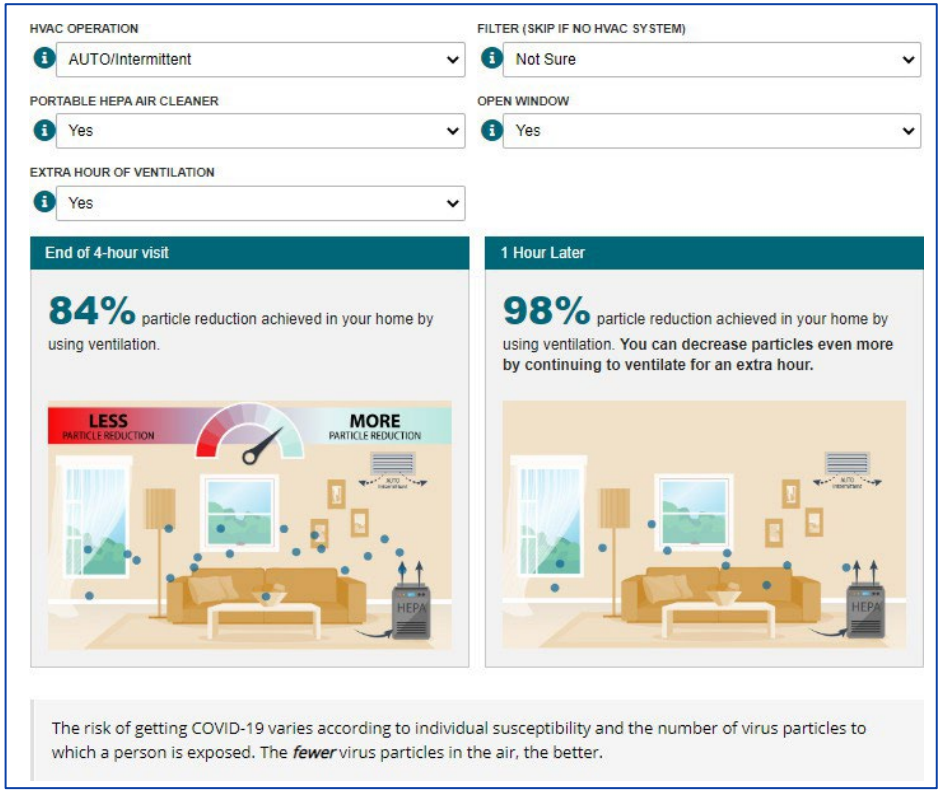
Health Communications

- Fact sheet was developed during COVID-19 response
- Still applicable

[Safety Tips for Using Foggers and Misters Indoors]

Health Communications (continued)

- Developed by CDC and the National Institute of Standards and Technology(NIST) during COVID-19 response
- Still applicable for many types of particles (e.g., smoke, allergens)



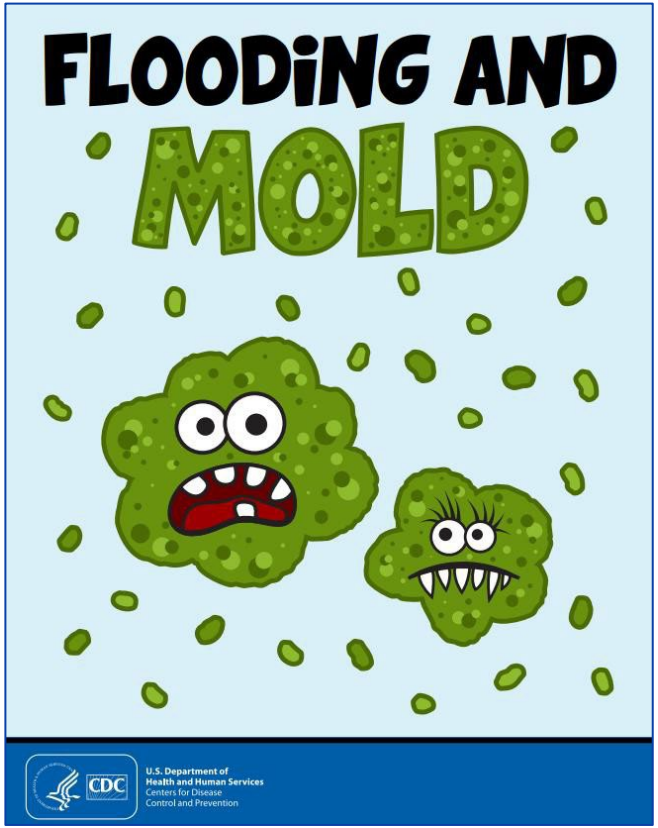
https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/interactive-ventilation-tool.html

Youth communication

- Developed by CDC during hurricane response

- EPA has materials for students

Lesson Plans, Teacher Guides and Online Environmental Resources for Educators | US EPA



https://www.cdc.gov/orr/readywrigley/documents/17_279940_Ready_Wrigley_mold_508_1.pdf

Giving results to people

"The VOC levels were reported in parts per million—a sometimes challenging concept; therefore, we demonstrated measurement of VOCs with a colorimetric detector tube and a commonly used window-cleaning agent containing isopropanol."

Photo credit: Ginger Chew

Ponder-Brookins P, Witt J, Steward J, Greenwell D, Chew GL, Samuel Y, Kennedy C, Brown MJ. Incorporating community-based participatory research principles into environmental health research: challenges and lessons learned from a housing pilot study. J Environ Health. 2014. 76(10):8-17

Giving results to people (continued)

"Experience shows that when personal results are returned with appropriate contextual information, report-back can increase environmental health literacy, ***promote individual actions****…"*

Korfmacher KS, Brody JG. Moving Forward with Reporting Back Individual Environmental Health Research Results. Environ Health Perspect. 2023. 131(12):125002.

Thank you

For more information, contact NCEH
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TTY: 1-888-232-6348 www.cdc.gov
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