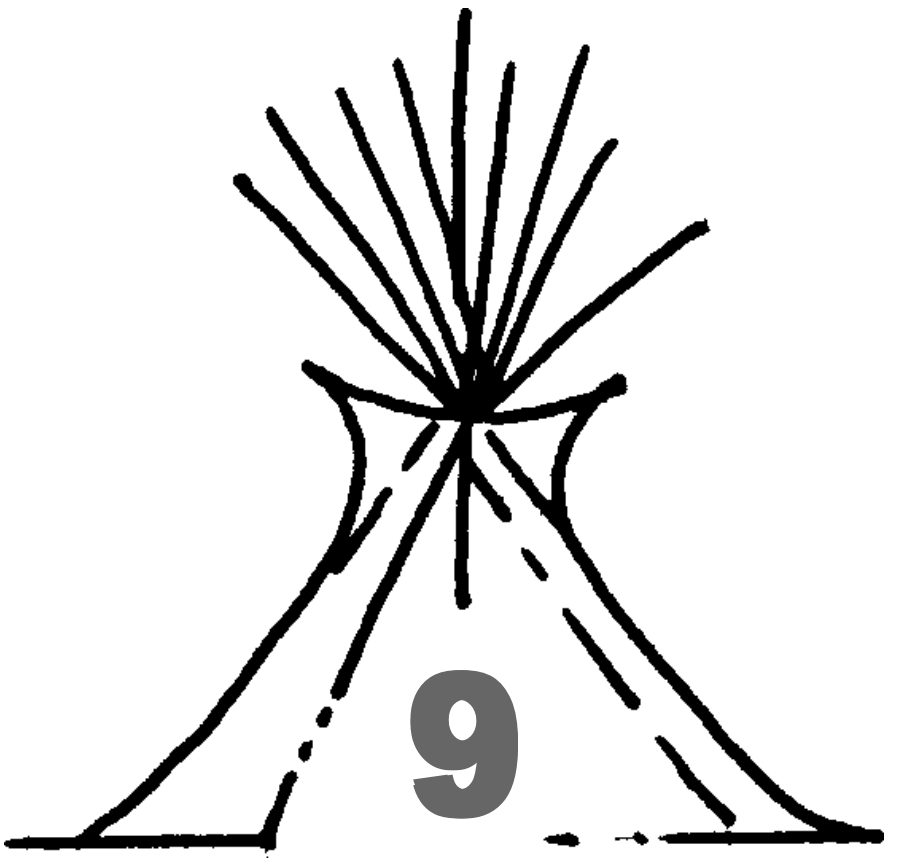
INDOOR AIR QUALITY:

Health Risks in the Air You Breathe



Health hazards related to indoor air quality can be serious, but there are many ways to protect your family.

This fact sheet tells where air problems come from and what can be done about them.

1. Finding and Fixing Indoor Air Hazards

- *Smoke and carbon monoxide*
- *Carpets, wood products and paints*
- *Cleaning solvents, adhesives and paint strippers*
- *Mildew, animal dander and dust mites*
- *Radon, a radioactive gas*

2. Ventilating Indoor Air

- *Ventilation*
- *Air cleaning*

Connected to the Earth

When you see a new trail, or a footprint that you do not know, follow it to the point of knowing.

—Grandmother of Charles Eastman, Santee Sioux

Home Air Quality Risks

Clean air is precious — It is fresh, full of oxygen, clean-smelling, and has no harmful pollutants. If you are like most people, you spend at least half of your life inside your home. But the air in many modern American homes may be harmful to breathe. It can be more dangerous to your health than outdoor air. Some air quality problems may simply be unpleasant. Others may lead to serious health problems.

Signs of Trouble

It is not always easy to notice air quality. You can smell paint vapors and see smoke, but many harmful pollutants—such as deadly carbon monoxide gas—are invisible and odorless. Common health problems, like irritated eyes and nose, headaches, dizziness, tiredness, asthma, viral infections and respiratory diseases may be caused by the air you breathe. Some serious effects of poor air quality, like lung cancer, may take years to develop. People react differently to contaminants depending on their age, sensitivity, health, and for how long and in what way they are exposed.

PART 1 • Air Quality Hazards: Finding and Fixing Them

Finding sources of pollutants is the first step to improving your indoor air quality. Correcting problems at their source is usually cheapest and most effective. Even if you don't fix everything, dealing with the most harmful sources of indoor air pollution can mean better health for everyone in your home. Poor air quality is usually not caused by one pollutant. To reduce health risks for your family, you may need to correct more than one problem.

Air pollution in your home

As you look for sources of air pollution in your home, think of one pollutant at a time, such as formaldehyde or carbon monoxide. Then track down its source—a furnace or damp crawl space, for example. This fact sheet can't cover every source of indoor air pollution, but it talks about common types to help you get started.

Part 1a - Things you burn

Fuel-burning appliances

Airborne ***combustion by-products*** come when you burn any kind of fuel: oil and gas furnaces; wood and coal stoves; fireplaces; kerosene and gas space heaters; gas ranges, cooktops, and water heaters; or automobiles (figure 9.1). Fuel-burning appliances release dangerous pollutants like carbon monoxide, nitrogen and sulfur oxides, formaldehyde and tiny breathable particles. They must be vented outside your house. **Never use unvented space heaters, gas stoves, or other fuel-burning equipment in an enclosed room.**

Carbon monoxide can kill. It is an odorless, colorless gas, so it is especially dangerous. When someone is exposed to it, it may be easy to mistake their symptoms—like headaches, dizziness, and nausea—for other causes. A malfunctioning furnace or blocked flue pipe can create deadly CO levels. Using a charcoal grill indoors is another dangerous source.

Some experts recommend that CO detectors be installed in all homes that have fuel-burning appliances. They look and work much like a smoke detector. But remember, a detector won't replace maintaining your heating system.

To find out if your fuel-burning appliances are safe, call the dealer or a service professional. Generally, you should have the equipment and chimney or flue inspected once a year. Like a car, your furnace needs tune-ups. Even a good system can become a hazard if the chimney or flue gets blocked and gases can't escape.

Be alert for ***backdrafting.*** This can happen when indoor air pressure is lower than outdoor air pressure and fuel exhausts are pulled back into the living space instead of being vented outside. Backdrafting is more likely to happen in well-sealed, energy-efficient homes, especially when you have an exhaust fan. (See fact sheet 10 of this packet, "Heating and Cooling Systems," for more information.)

Tobacco Smoking: Smoke from cigarettes, cigars, and pipes contains a wide range of throat and lung irritants, and hazardous and cancer-causing chemicals. A smoky home environment puts *everyone* at risk, not just the smoker.

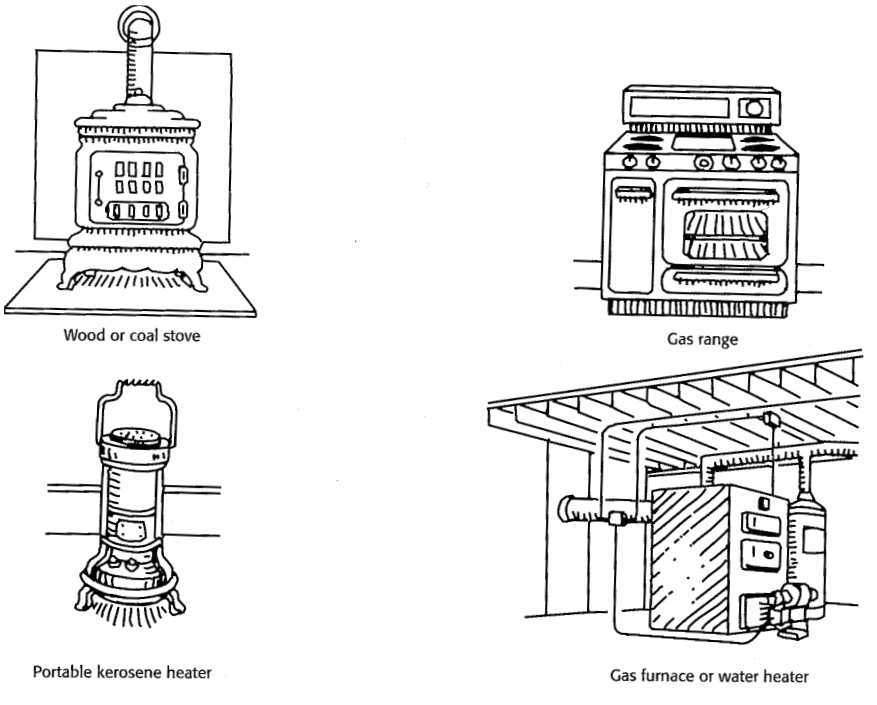


Figure 9.1 Some examples of fuel-burning appliances.

Do Table 1a - Things You Burn

In the table below, check the risks related to things you burn in your home. For each question, mark the risk level in the right-hand column that fits your situation best.

Responding to risks

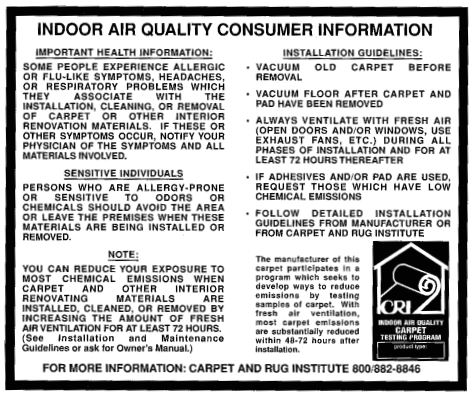
Try to lower your risks. Transfer any medium- and high- risks you found to the action checklist on the back page. Then make plans to reduce your risks.

Part 1b - Building products and furnishings

Products used to build and furnish a home may pollute indoor air. Four of the most common types are pressed wood products; carpet; paint, varnish and other finishes; and asbestos. These materials can release hazards such as formaldehyde and other volatile organic compounds into the air, especially when they are new. Heat and humidity can make the problem worse. Air pollution can also come from old or deteriorating materials, such as asbestos.

Pressed wood products

Pressed or manufactured products made from wood chips or sawdust are widely used in flooring, sheathing, shelving, cabinets and furniture. Harmful formaldehyde is used in the glues that hold these materials together. Formaldehyde will ***off-gas,*** or be released into the air, especially in new products. Some people are very sensitive to formaldehyde.


INDOOR AIR QUALITY CONSUMER INFORMATION

IMPORTANT HEALTH INFORMATION:

SOME PEOPLE EXPERIENCE ALLERGIC OR FLU-LIKE SYMPTOMS, HEADACHES, OR RESPIRATORY PROBLEMS WHICH THEY ASSOCIATE WITH THE INSTALLATION, CLEANING, OR REMOVAL OF CARPET OR OTHER INTERIOR RENOVATION MATERIALS. IF THESE OR OTHER SYMPTOMS OCCUR, NOTIFY YOUR PHYSICIAN OF THE SYMPTOMS AND ALL MATERIALS INVOLVED.

SENSITIVE INDIVIDUALS

PERSONS WHO ARE ALLERGY-PRONE OR SENSITIVE TO ODORS OR CHEMICALS SHOULD AVOID THE AREA OR LEAVE THE PREMISES WHEN THESE MATERIALS ARE BEING INSTALLED OR REMOVED.

NOTE:

YOU CAN REDUCE YOUR EXPOSURE TO MOST CHEMICAL EMISSIONS WHEN CARPET AND OTHER INTERIOR RENOVATING MATERIALS ARE INSTALLED, CLEANED, OR REMOVED BY INCREASING THE AMOUNT OF FRESH AIR VENTILATION FOR AT LEAST 72 HOURS. (See Installation and Maintenance Guidelines or ask for Owner's Manual.)

INSTALLATION GUIDELINES:

- VACUUM OLD CARPET BEFORE REMOVAL
- VACUUM FLOOR AFTER CARPET AND PAD HAVE BEEN REMOVED
- ALWAYS VENTILATE WITH FRESH AIR (OPEN DOORS AND/OR WINDOWS, USE EXHAUST FANS, ETC.) DURING ALL PHASES OF INSTALLATION AND FOR AT LEAST 72 HOURS THEREAFTER
- IF ADHESIVES AND/OR PAD ARE USED, REQUEST THOSE WHICH HAVE LOW CHEMICAL EMISSIONS
- FOLLOW DETAILED INSTALLATION GUIDELINES FROM MANUFACTURER OR FROM CARPET AND RUG INSTITUTE

The manufacturer of this carpet participates in a program which seeks to develop ways to reduce emissions by testing samples of carpet. With fresh air ventilation, most carpet emissions are substantially reduced within 48-72 hours after installation.

CRI INDOOR AIR QUALITY CARPET TESTING PROGRAM

FOR MORE INFORMATION: CARPET AND RUG INSTITUTE 800/882-8846

Figure 9.2 Carpet and Rug Institute (CRI) label that appears on carpet tested for low emissions. Reprinted with permission from the Carpet and Rug Institute.

Sealing the surface of a wood product, especially the edges, reduces the amount of formaldehyde that goes into the air. Some products are available that are formaldehyde-free or have low formaldehyde emissions (such as exterior-grade products).

Carpet

New carpets can release chemicals from its backing, padding, and fibers, and from its antistatic and soil-release finishes. The carpet industry is working to reduce these risks. The Carpet and Rug Institute (CRI) now tests carpets for emissions (figure 9.2). Carpets of any age can collect chemical and biological pollutants from the air or that are tracked in from outside. Damp, dirty carpet is a breeding ground for harmful biological pollutants. Vacuuming and cleaning your carpets regularly is important to your health.

Paint, varnish, and other finishes

Paints, varnishes and other finishes may pollute indoor air because they contain ***volatile organic compounds*** (VOCs). Oil-

TABLE 1a - Things You Burn

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Combustion appliances, venting	All combustion appliances are vented directly to the outside.	Unvented gas or kerosene heaters are used only in open spaces with a partially open window.	Kerosene or gas space heaters are frequently used in closed rooms.	❒ Low ❒ Medium ❒ High
Maintenance of combustion appliances, chimneys, and flues	Chimneys, flues, gas/oil furnaces, wood stoves, and other combustion appliances are inspected and cleaned at least once a year.	Chimneys, flues, gas/oil furnaces, wood stoves, and other combustion appliances have been inspected only once or twice in the past five years.	Chimneys, flues, and combustion devices are not inspected, or inspection record is unknown.	❒ Low ❒ Medium ❒ High
Carbon monoxide detectors (only in homes with combustion appliances)	A carbon monoxide detector is properly installed, and the battery is tested weekly (if applicable).	A detector is installed, but the battery is not tested regularly (if applicable).	No carbon monoxide detector is installed.	❒ Low ❒ Medium ❒ High
Tobacco smoking	Tobacco smoking is not permitted in the home.	Smoking is permitted occasionally, but only in areas well-ventilated to the outside.	Frequent smoking causes smoky indoor air.	❒ Low ❒ Medium ❒ High

based, solvent-based, or alkyd-based products release more harmful vapors than water-based products. If you aren't sure about a product, check its label. If it says to clean up with soap and water, it is water-based.

Provide lots of extra ventilation when paints, varnishes or other finishes are new, or paint outside and wait until the finished product is dry to bring it inside.

Lead was once used in household paint, and many homes still have it. Highly toxic lead dust can be released into the air as the paint wears or during renovations. See fact sheet 6, "Lead In and Around the Home," for more information.

Asbestos

Until about 1980, asbestos was used in roof and siding shingles, floor tiles, sound proofing materials, insulation around pipes, heating ducts and flues, and decorative finishes. When asbestos products get old, they can crumble and release tiny fibers into the air. Over time they can lead to serious lung problems.

Do Table 1b - Building products and furnishings

Use the table below to rate your risks. Mark the risk level in the right-hand column that fits best with your situation.

Responding to risks

Try to lower your risks. Turn to the action checklist at the back of this fact sheet to record the medium- and high-risk practices you identified. Then make plans to reduce your risks.

Tips for Installing New Carpet

- Choose a carpet that is certified by the Carpet and Rug Institute (CRI) as a lower-emissions carpet.
- Ask the carpet dealer to unroll the carpet and leave it in a well-ventilated area for at least 24 hours before it is brought to your home.
- Plan to install the carpet at a time of year when you can open windows during and for several days after installation.
- ***Arrange for chemically sensitive persons*** to be out of the house for the first few days after the carpet is installed.
- Thoroughly vacuum the old carpet before removal to minimize dust and biological pollutants in the air.

Part 1c - Molds, mites and other biological pollutants

Biological contaminants come from things that are (or once were) living. They include animal hair, dander, saliva and feces; molds and other fungi; dust mites; insect residues; pollen; and microscopic organisms. These can cause odors, damage household materials, lead to allergic reactions and cause infectious diseases and respiratory problems. Each person has a different sensitivity to them.

You can't eliminate biological pollutants from your home completely, but you can control their growth and numbers. Keep surfaces clean and moisture levels low (see the box, next page). Many biological contaminants increase in damp or humid spaces. Regular maintenance can control moisture and reduce the need for pesticides and disinfectants which may add pollutants of their own.

TABLE 1b - Building products and furnishings

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Combustion appliances, venting	New building materials, paints, varnishes and furnishings.	Low- or no-emission furnishings, building materials, paints, and varnishes are selected. New items are given adequate ventilation or sealed. New furnishings, building materials, paints, and varnishes are given increased ventilation.	There is no attempt to select low-emission products, and ventilation is inadequate.	❒ Low ❒ Medium ❒ High
Maintenance of combustion appliances, chimneys, and flues	Low-VOC carpet is selected and aired before and during installation. Carpet is vacuumed regularly using a vacuum cleaner with a high-efficiency filter; spills are cleaned immediately.	New carpet is installed without ventilation.	Old carpet is poorly maintained.	❒ Low ❒ Medium ❒ High
Asbestos (in homes built before the 1980s)	Asbestos is present but safely encased and isolated. Areas with asbestos are checked regularly.	Asbestos is present and intact but located in high-traffic areas.	Asbestos-containing material is in poor shape and crumbling. People are exposed to the dust and fibers.	❒ Low ❒ Medium ❒ High

Figure 9.3 Vacuum cleaners with high-efficiency (HEPA) filters trap more particles.

Controlling Dust

Household dust is partly biological matter that commonly causes allergies. Animal dander is shed from skin, hair and feathers. Dust mites are microscopic insects, and their feces can easily be carried in the air and cause allergies. ***Regular cleaning***—dusting; damp cleaning; and washing sheets, pillowcases and blankets with hot water—is needed to control these contaminants.

Vacuuming may help control dust, but some particles are so small that they go right through and into the air. Some vacuum cleaners have high-efficiency (HEPA) filters to trap more particles (figure 9.3).

If dust-related allergies are a problem, use fewer carpets, upholstered furnishings and "dust catchers" like window blinds and knick-knacks. Control dust and keep sleeping areas as clean as possible.

Do Table 1c—Molds, mites and other biological pollutants

Use the table below to rate your risks. Write your risk level in the right-hand column. Choose the response that fits best.

Responding to risks

Try to lower your risks. Transfer any medium- and high-risk from this table to the action checklist at the back of this fact sheet. Then make plans to reduce your risks.

TIPS FOR MOISTURE CONTROL

- Prevent standing water, such as in basements or the drip pans of refrigerators and air conditioners.
- Fix leaks and seepage problems immediately.
- Make sure rainwater drains away from your house.
- Use a moisture-proof ground cover (such as 6-mil plastic) on the floor of crawl spaces.
- Use fans to exhaust moisture to the outside when bathing, showering or cooking.
- Vent all fuel-burning appliances to the outside.
- Use dehumidifiers and/or air conditioners to remove excess moisture in warm, humid weather.
- Avoid oversized air conditioners.
- Limit the use of humidifiers.
- Limit houseplants.

Part 1d - Household chemical products and radon

Household chemical products

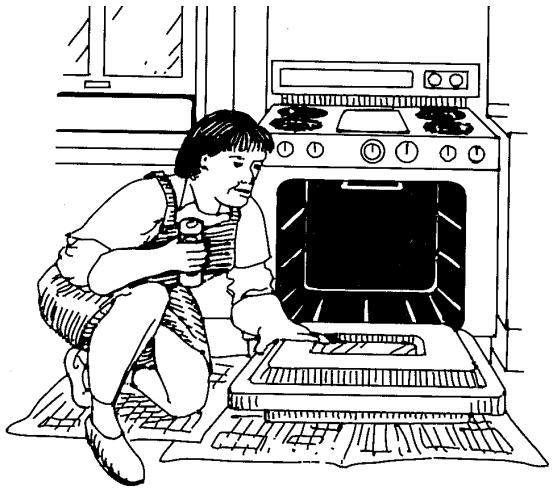
Some chemical products in your home may be hazardous. Products that come in spray cans can release chemicals or particles into the air. Other products may let off chemicals as they dry or cure (such as glues and paint). Or they may release gases as they age (such as plastics and air fresheners). Furniture waxes, paint strippers, adhesives, cleaning products, disinfectants, degreasers, cosmetics and hobby supplies are all things that may be harmful.

Products that contain petroleum distillates or other volatile organic compounds (VOCs) are more likely to harm air quality than water-based products. "Everyday" products like chlorine bleach, ammonia, boric acid and deodorizers should be used with care. Some products contain pesticides and other toxic chemicals. See fact sheet 5, "Hazardous Household Products," for more on this topic.

Table 1c - Molds, mites and other biological pollutants

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Dust control	House is cleaned regularly. No furry pets are kept in the home. Little or no carpeting is in the home.	Furry pets live in the home, but the house is cleaned regularly.	Pet hair and dust are allowed to accumulate in living and sleeping areas. House is mostly carpeted, and carpet is poorly maintained.	❒ Low ❒ Medium ❒ High
Moisture control	There is no evidence of condensation in high moisture areas or seasonally. Excess moisture is vented to the outside.	There is evidence of condensation in high moisture areas or seasonally. Exhaust fans are sometimes used.	Damp air is not exhausted. Crawl space does not have a ground cover or vents. There are leaks, drips, or standing water in, around, or under the house.	❒ Low ❒ Medium ❒ High

Figure 9.4 Provide plenty of ventilation when you use hazardous household products.



Reducing the hazard from household products

Choose the least hazardous product and the smallest amount that will do the job. Always follow label directions and provide enough ventilation (figure 9.4). Avoid having to store hazardous products, by buying only the amount you will need, then using it up. Give away leftovers or properly dispose of them. Reduce the need for many household chemicals by practicing preventive maintenance: give quick attention to spills and stains, and promptly remove food wastes to control odors and pests.

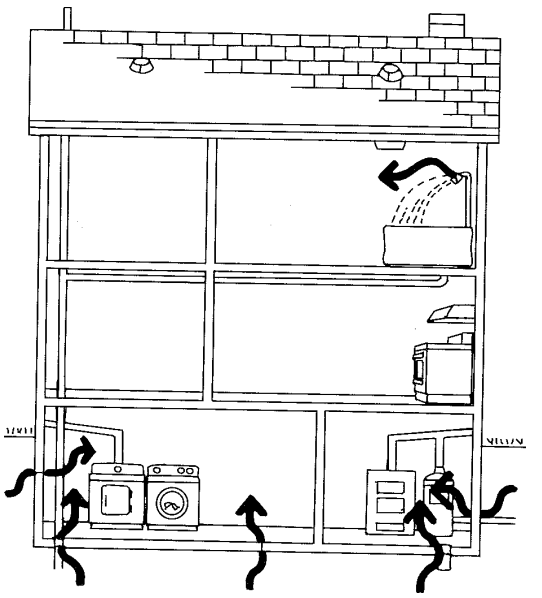
DO NOT MIX

Never mix household chemical products unless the label specifically instructs you to do it: Toxic chemicals may be released into the air through chemical reactions.

Radon: Is it present in your home?

Radon is a radioactive gas that occurs naturally in the rocks and soil in many areas. It enters the home through cracks and openings that are in contact with the ground—in a basement, for example (figure 9.5). Radon is a cause of lung cancer, but it is invisible, has no odor and has no early warning signs or health effects that show up immediately. Smokers are especially at risk from radon.

Figure 9.5 Radon gas enters a home through openings in contact with the ground and in household water.



Different parts of the country have different levels of radon. If you live in a high-risk area, or if neighbors have found high levels, you should take this hazard seriously. Neighboring homes can have very different levels. The only way to find out about radon in your home is by testing. In the United States the recommended level of radon in homes is below 4 picoCuries per liter (pCi/L) of air.

Radon testing and treatment

Look for radon test kits that say "meets EPA requirements." A screening test that lasts four to seven days and costs $5 to $10 can give a rough idea of how much radon is present. Do the test with windows and doors closed. If you find a high level of radon, you should do a long-term test (at least three months) to get more accurate information.

If you find an unsafe level of radon with the second test, you can do a variety of things. These involve either plugging the leaks—such as caulking cracks in basement walls—or changing the way your home is ventilated so that radon isn't drawn inside. Check with your state or Tribal Health Department or Cooperative Extension office for advice. A trained and certified radon mitigator can help you reduce radon in your home. If you plan to sell your home, check local and state laws to see if radon testing and treatment are required.

TABLE 1d—Household products and radon

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Household products and chemicals	Products with hazardous vapors are avoided or used only outdoors or indoors with proper ventilation and safety precautions. Hazardous products are not stored in the home. Products with hazardous vapors are used indoors without ventilation.	Only short periods of exposure occur. Products with hazardous vapors are used indoors with some ventilation.	Long periods of exposure occur. Hazardous products are stored in the home.	❒ Low ❒ Medium ❒ High
Radon	A radon test was conducted properly, and the radon level is below the threshold for action.	Radon is present at or near the threshold for action.	Radon is present in excess of acceptable levels —OR — radon level is unknown, no testing has been done.	❒ Low ❒ Medium ❒ High

Do Table 1d - Household products and radon

Use the table at left to rate your risks related to household chemical products and radon. Mark the risk level in the right-hand column that fits best with your situation.

Responding to risks

Try to lower your risks. Transfer any ***medium- and high-risk practices*** you identified to the action checklist on the next page. Then make plans to reduce your risks.

PART 2 • Ventilating Indoor Air

Removing or reducing pollution sources is the first step in improving the air quality in your home. The next step is to dilute air pollutants by ventilating your home.

Even homes with few sources of contamination need ventilation, especially during seasons when windows and doors are kept shut. Many homes "leak" air, which may help maintain freshness but wastes energy. Newer homes tend to have tighter construction, which makes it easier for pollutants to build up to dangerous levels. Tight homes may also be susceptible to humidity problems.

How well is your house ventilated?

Your nose and eyes can tell you a lot about your indoor air quality. Pay attention to persistent odors of chemicals, mildew, or tobacco smoke. Steamy windows are a sign of high moisture levels. Lingering grease and food odors may mean that your kitchen needs more ventilation.

Ventilation is usually measured in ***air changes per hour*** (ACH). This means how many times per hour the air in your home is replaced with outdoor air. Many things can affect the ACH rate: the structure of the home; weather; opening or closing doors and windows; heating, cooling and ventilating equipment; and your use of fans.

A ***blower door test*** administered by a professional can measure ventilation rates in your home. A blower door is a large fan mounted in a frame that forces air into or out of the home. Pressure readings from the test help in calculating air leaks and the ACH rate. The test can also help find where the leaks are.

Increasing the ventilation rate of your home will reduce the strength of air pollutants. Exhaust fans in kitchens and bathrooms help, as long as enough replacement air is available. Some ventilation equipment can conserve energy, too. For example, a ***heat recovery ventilator*** removes "stale" air from a house and brings in fresh air. The incoming air is warmed by heat removed from the outgoing air. If you think the ventilation in your home is poor, consult an energy or ventilation professional.

Air filters and air cleaners

Filters in your heating/cooling system need to be inspected and replaced or cleaned regularly. Dirty or clogged filters limit the efficiency of the equipment. Most air filters on heating and cooling equipment remove only the largest dust particles. More effective high-efficiency filters remove particles such as dust, smoke, pollen and some microorganisms. Gases generally go right through.

There are several types of air cleaners. Mechanical filters made of fibers or pleated papers trap small particles as air passes through. Electrostatic air cleaners use an electrical field to attract charged airborne particles; ion generators give particles a charge that makes them "stick" to surfaces in the home. Solid sorbent cleaners use carbon or charcoal and can capture gases.

Do Table 2—Ventilating indoor air

In the table below, mark the risk level in the right-hand column. that fits best with your situation.

Responding to risks

Try to lower your risks. Transfer any medium- and high-risks you found in table 2 to the action checklist on the next page. Then make plans to reduce your risks.

Table 2 - Ventilating Indoor Air

	LOW RISK	MEDIUM RISK	HIGH RISK	YOUR RISK
Air freshness	Indoor air usually smells clean, in all seasons. Extra ventilation is provided as needed.	Air sometimes has an odor or mustiness, especially during certain times of the year.	Air nearly always smells musty, damp, acrid, smoky, heavy, or like chemicals.	❒ Low ❒ Medium ❒ High
Ventilation	House is well-ventilated. Exhaust fans are used in the kitchen and bathroom.	"Leaky" house gives some uncontrolled ventilation.	House is poorly ventilated. No kitchen/bath exhaust fans are used.	❒ Low ❒ Medium ❒ High

TAKE ACTION

Go back over the assessment tables and make sure you recorded any medium- and high- risks in the checklist below. For each medium and high risk, write down the improvements you plan to make. Use this fact sheet and other resources to come up with actions you are likely to complete. Set a target date to keep you on schedule. You don't have to do everything at once, but try to eliminate the most serious risks as soon as you can. Often it helps to tackle the inexpensive actions first.

For More Information

Contact: Healthy Indoor Air for America's Homes
Project Director: Michael P. Vogel
OR Project Coordinator: Barbara Allen
at: 111 Taylor Hall, Bozeman, MT 59717
Phone: (406) 994-3451; Fax: (406) 994-5417
www.montana.edu/wwwcxair

About Air Filters and Cleaners

Remember that air filters and cleaners can't solve all your indoor air quality problems. If poorly maintained, they could actually cause more air quality problems. The success of filters and air cleaners depends on:

- what contaminants are removed from the air
- how much air passes through the device
- the kinds of airborne particles in your air
- where the filter is in relation to the source of pollutant
- regular maintenance of the system

Acknowledgments

This fact sheet has been revised from the original by Kathleen Parrott, Virginia Polytechnic Institute and State University.

ACTION CHECKLIST: Indoor Air Quality: Health Risks in the Air You Breathe

Write all high and medium risks below.	What can you do to reduce the risk?	Set a target date for action.
Sample: Chimney and furnace not given a " tune-up" for several years.	Call heating/cooling expert to inspect, clean, and tighten the system.	One week from today: September 1

4450-I — September 2001

To obtain additional fact sheets in the *Connected to the Earth* series, contact your local Extension office or call Montana State University's Extension housing program at (406) 994-3451.