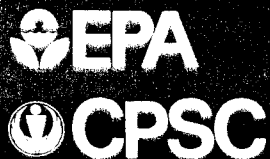


United States  
Environmental Protection  
Agency  
Washington, DC 20460

United States  
Consumer Product  
Safety Commission  
Washington, DC 20207

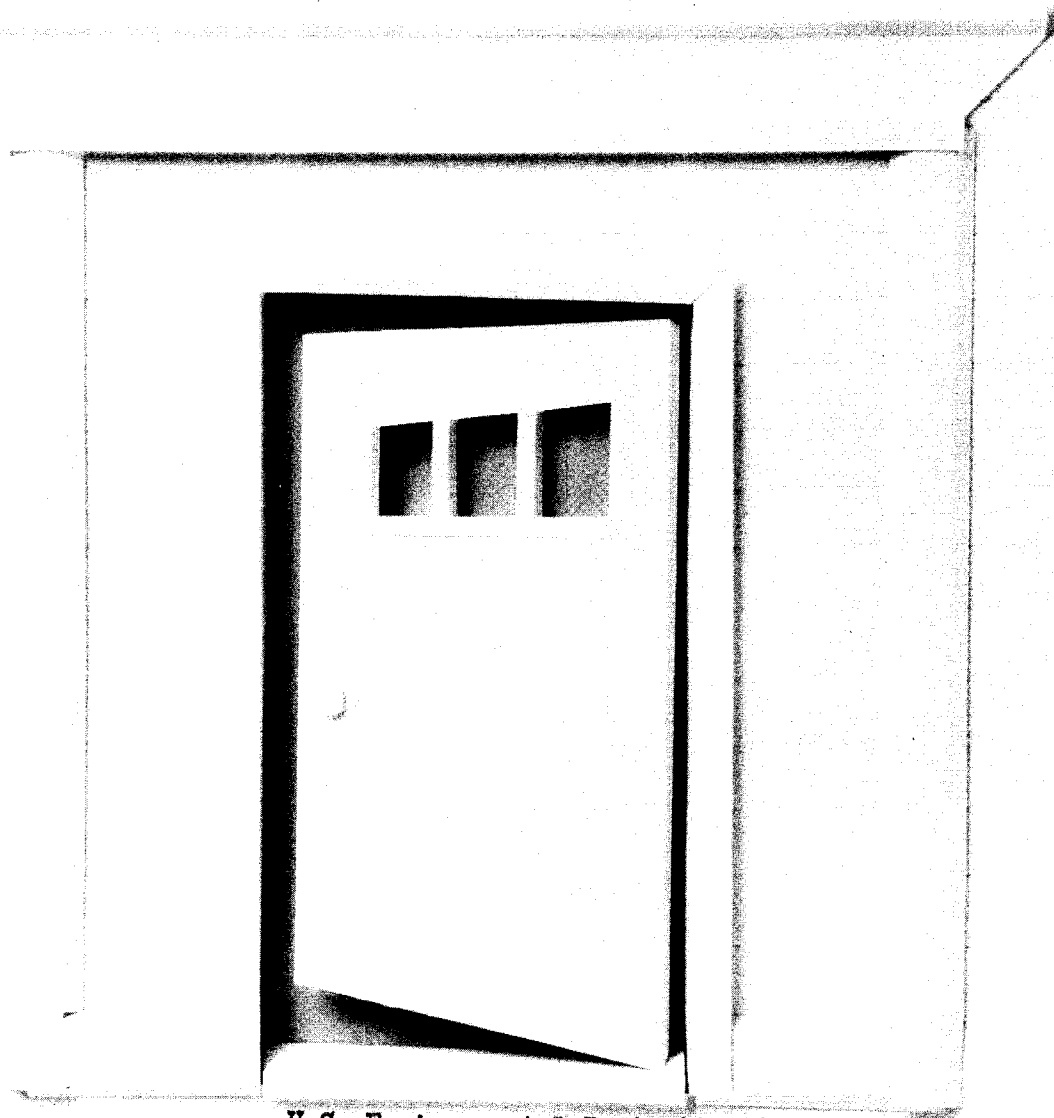
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EPA/400/1-88/004

Office of Air and Radiation



# The Inside Story

## A Guide to Indoor Air Quality



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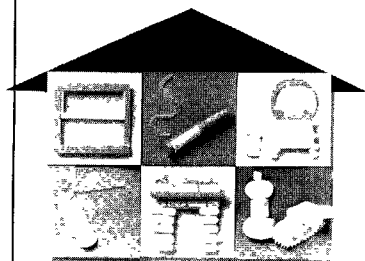
# CONTENTS



2  
Air Pollution Sources in  
the Home



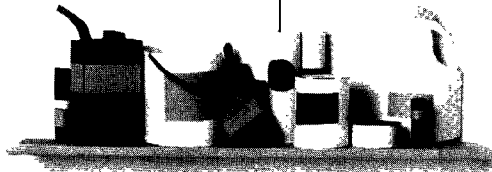
4  
Introduction



6  
Indoor Air Quality in Your  
Home

7  
What If You Live in an  
Apartment?

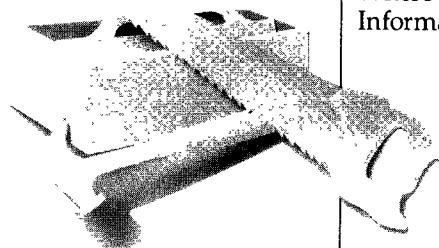
10  
What Can You Do To  
Improve the Air Quality in  
Your Home?



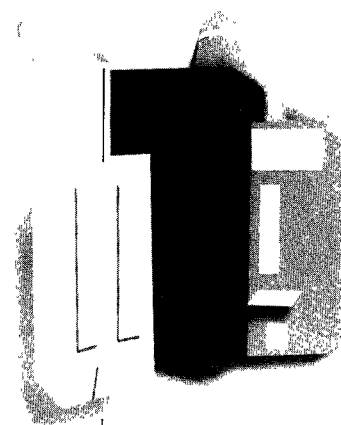
11  
A Look At Source-Specific  
Controls

- 11 Radon
- 12 Environmental Tobacco  
Smoke
- 13 Biological  
Contaminants
- 14 Stoves, Heaters,  
Fireplaces, and  
Chimneys
- 19 Household Products
- 21 Formaldehyde
- 22 Pesticides
- 24 Asbestos
- 25 Lead

15  
Reference Guide to Major  
Indoor Air Pollutants in the  
Home



26  
To Keep in Mind If You Are  
Building a New Home



27  
Does Your Office Suffer From  
"Sick Building Syndrome?"

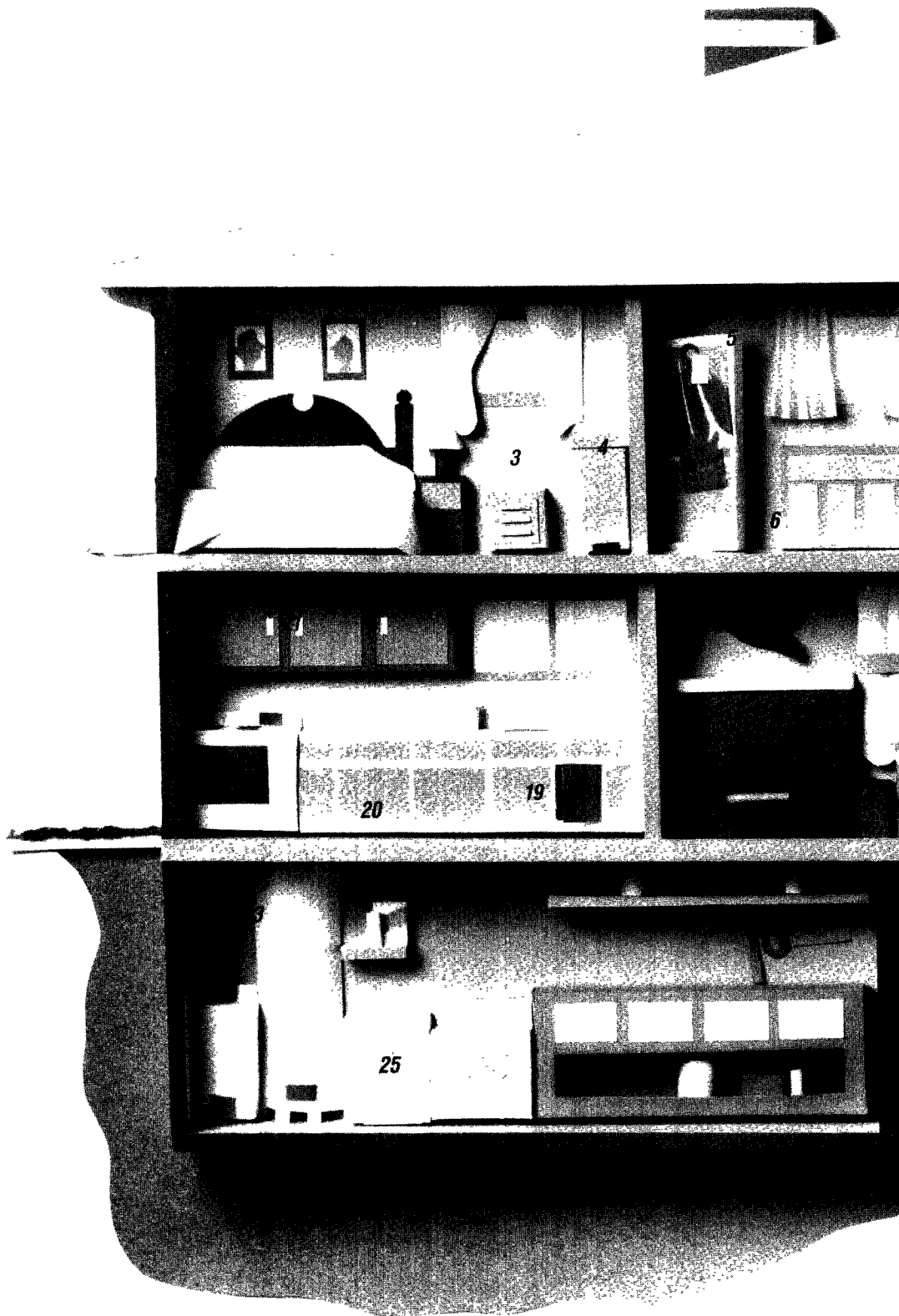


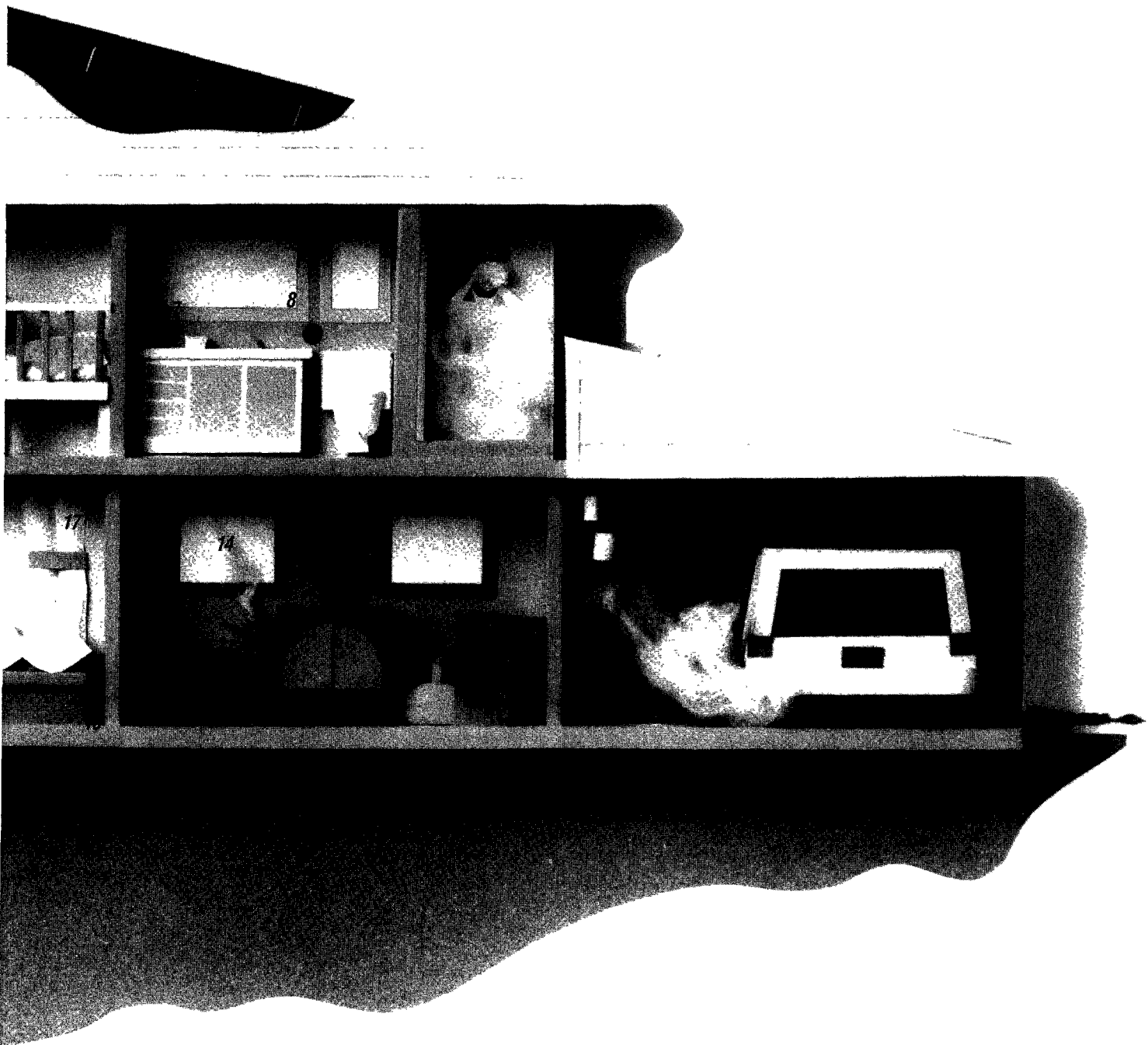
29  
Where To Go for Additional  
Information

32  
Glossary

# AIR POLLUTION SOURCES IN THE HOME

1. Moisture
2. Pressed Wood Furniture
3. Humidifier
4. Moth Repellents
5. Dry Cleaned Goods
6. House Dust Mites
7. Personal Care Products
8. Air Freshener
9. Stored Fuels
10. Car Exhaust
11. Paint Supplies
12. Paneling
13. Wood Stove
14. Tobacco Smoke
15. Carpets
16. Pressed Wood Subflooring
17. Drapes
18. Fireplace
19. Household Chemicals
20. Asbestos Floor Tiles
21. Pressed Wood Cabinets
22. Unvented Gas Stove
23. Asbestos Pipe Wrap
24. Radon
25. Unvented Clothes Dryer
26. Pesticides
27. Stored Hobby Products





## INTRODUCTION

### *SHOULD YOU BE CONCERNED ABOUT INDOOR AIR QUALITY?*

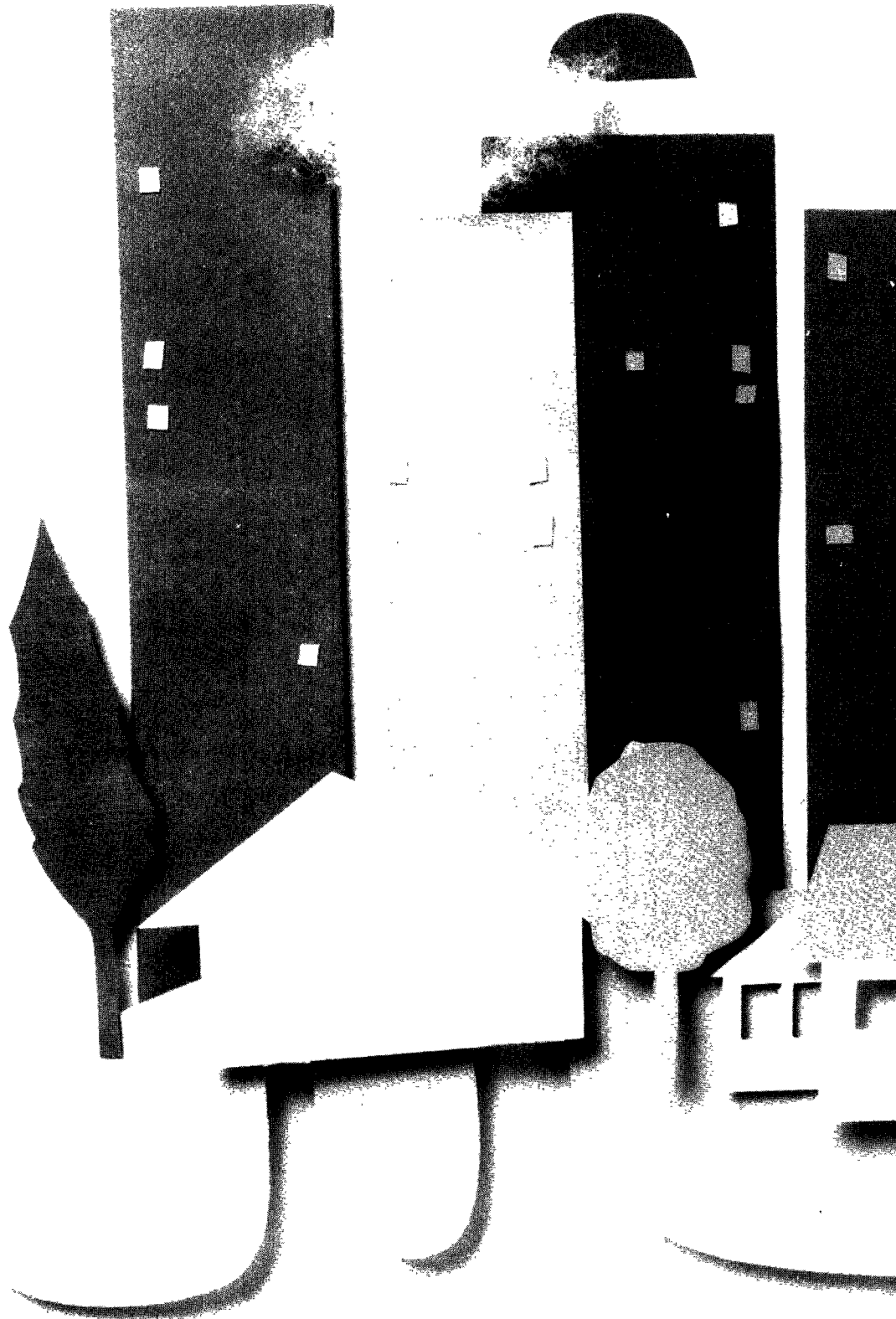
**A**ll of us face a variety of risks to our health as we go about our day-to-day lives.

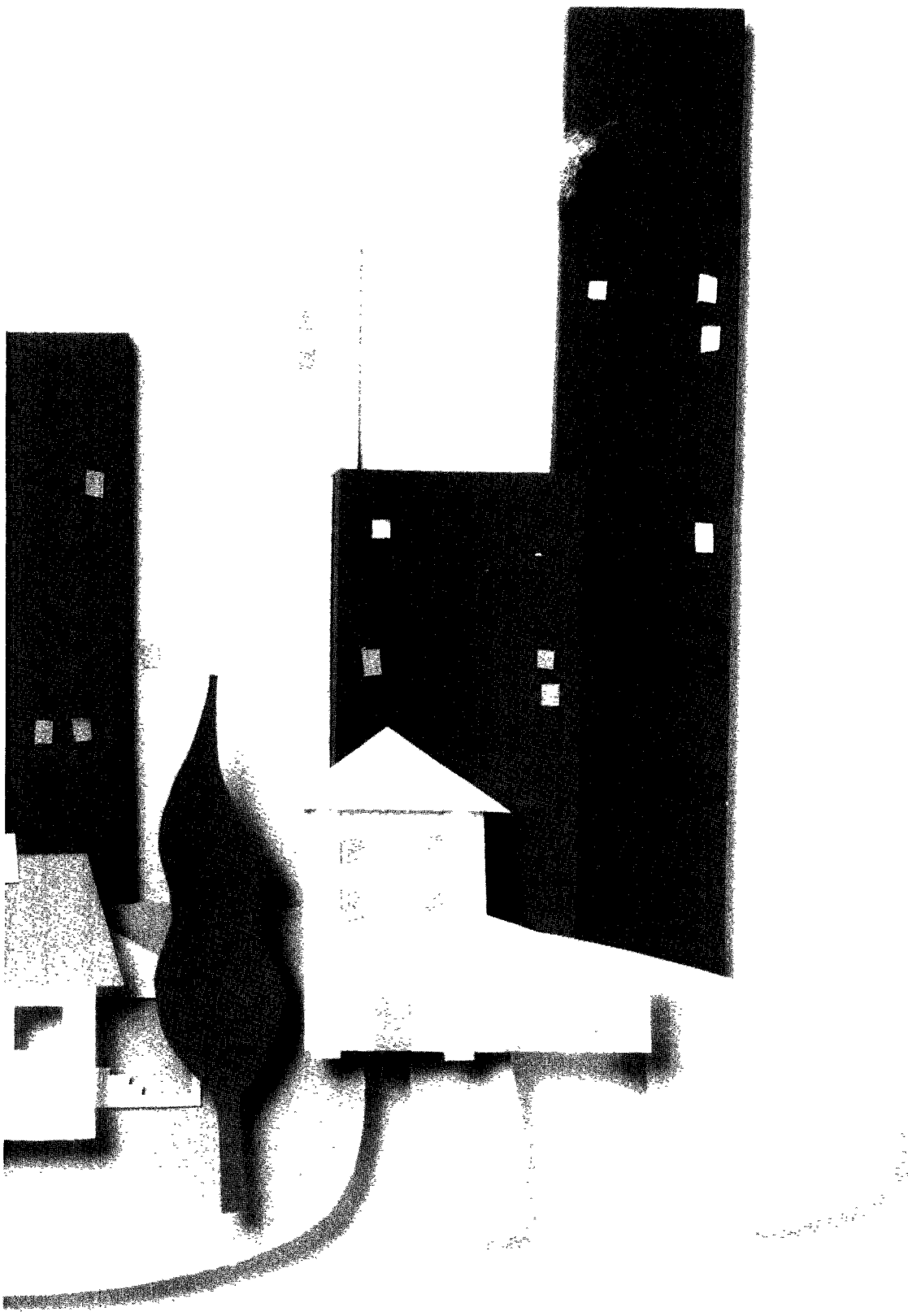
Driving in a car, flying in planes, engaging in recreational activities, and being exposed to environmental pollutants all pose varying degrees of risk.

Some risks are simply unavoidable. Some we choose to accept because to do otherwise would restrict our ability to lead our lives the way we want. And some are risks we might decide to avoid if we had the opportunity to make informed choices.

In the last several years, a growing body of scientific evidence has indicated that the air within homes and other buildings can be more seriously polluted than the outdoor air in even the largest and most industrialized cities. Other research indicates that people spend approximately 90 percent of their time indoors. Thus, for most people, the risks to health may be greater due to exposure to air pollution indoors than outdoors.

In addition, people who may be exposed to indoor air pollutants for the longest periods of time are often those most susceptible to the adverse effects of indoor air pollution. Such groups include the young, the elderly, and the chronically ill, especially those suffering from respiratory or cardiovascular disease.





## *WHY A BOOKLET ON INDOOR AIR?*

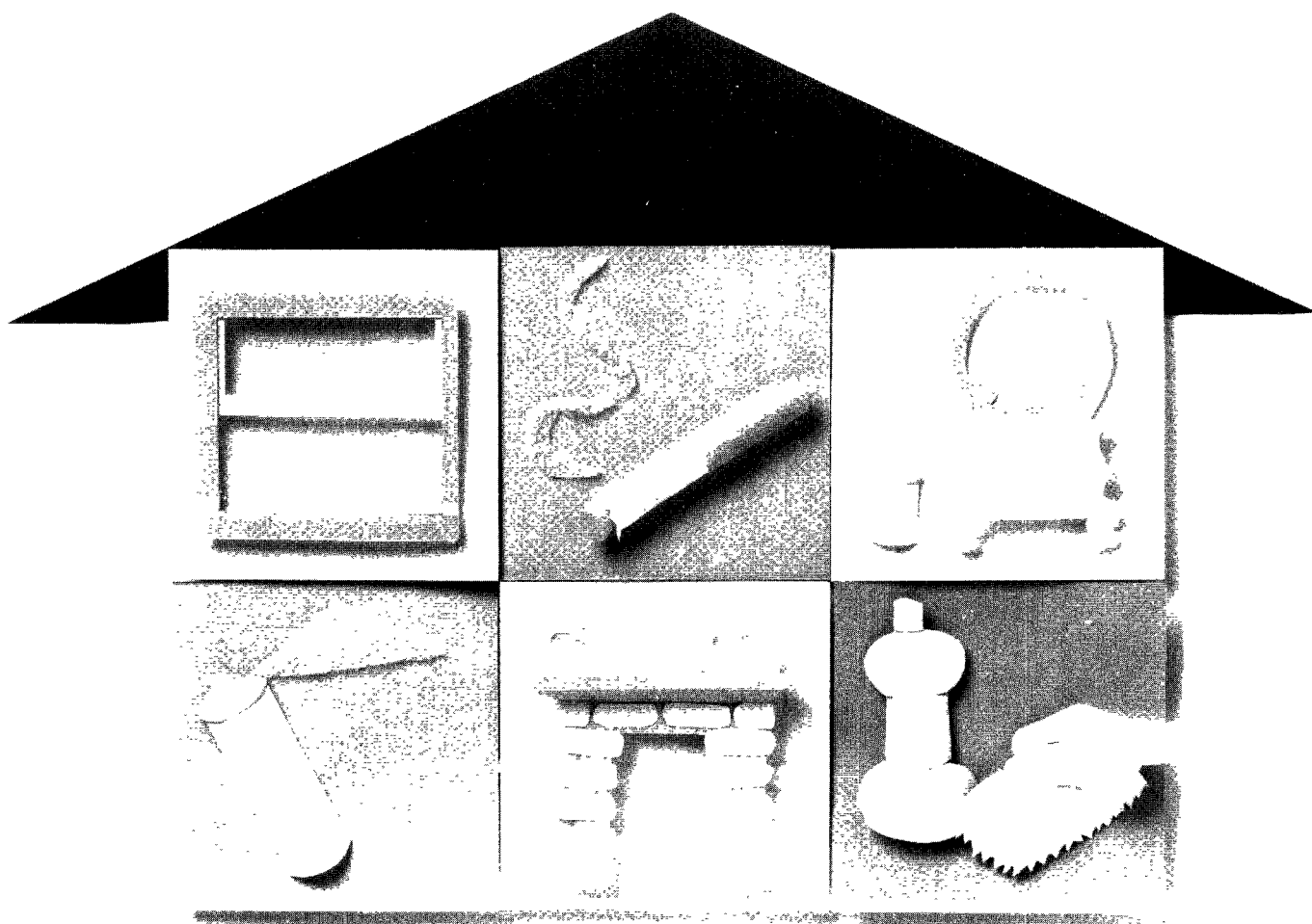
**T**he levels of pollutants from individual sources may not pose a significant risk to health by themselves. But most homes have more than one source that contributes to indoor air pollution. There can be a serious risk from the cumulative effects of these sources. Fortunately, however, there are steps that most households can take both to reduce the risk from existing sources and to prevent new problems from occurring.

This booklet was prepared by the U.S. Environmental Protection Agency (EPA) and the U.S. Consumer Product Safety Commission (CPSC) to help you decide whether to take actions in your home that can reduce the level of indoor air pollution.

Because so many Americans spend a substantial amount of time in offices with mechanical heating, cooling, and ventilation systems, there is also a short section on the causes of poor air quality in offices and what you can do if you suspect that your office may have a problem.

A glossary and a list of public and private organizations where you can get additional information are listed at the back of this booklet.

# INDOOR AIR QUALITY IN YOUR HOME



## WHAT CAUSES INDOOR AIR QUALITY PROBLEMS?

**I**ndoor pollution sources release gases or particles into the air and are the primary cause of indoor air quality problems in homes. Inadequate ventilation can increase indoor pollutant levels by not bringing in sufficient outside air to dilute emissions from indoor sources and by not carrying indoor air pollutants out of the home. High temperature and humidity levels can also increase concentrations of some pollutants.

■ **Pollutant sources:** There are many potential sources of indoor air pollution in any home. These sources fall into several general categories:

oil, gas, kerosene, coal, or wood combustion sources; building materials and furnishings as diverse as deteriorated asbestos-containing insulation, wet or damp carpeting, and cabinetry or furniture made of certain pressed wood products; products for household cleaning and maintenance, personal care, or hobbies; central heating and cooling systems and humidification devices; and outside sources such as radon, pesticides, and outdoor air pollution.

The relative importance of any single source depends on how much of a given pollutant it emits and how hazardous those emissions are. In some cases, factors such as how old the source is and whether it is properly main-

tained are significant. For example, an improperly adjusted gas stove can emit significantly more carbon monoxide than one that is properly adjusted.

Some sources, such as building materials, furnishings, and household products such as air fresheners, release pollutants more or less continuously. Other sources, related to activities carried out in the home, release pollutants intermittently. Such activities include smoking, the use of unvented or malfunctioning stoves, furnaces, or space heaters, the use of solvents in cleaning and hobby activities, the use of paint strippers in redecorating activities, and the use of cleaning products and pesticides in housekeeping. High pollutant

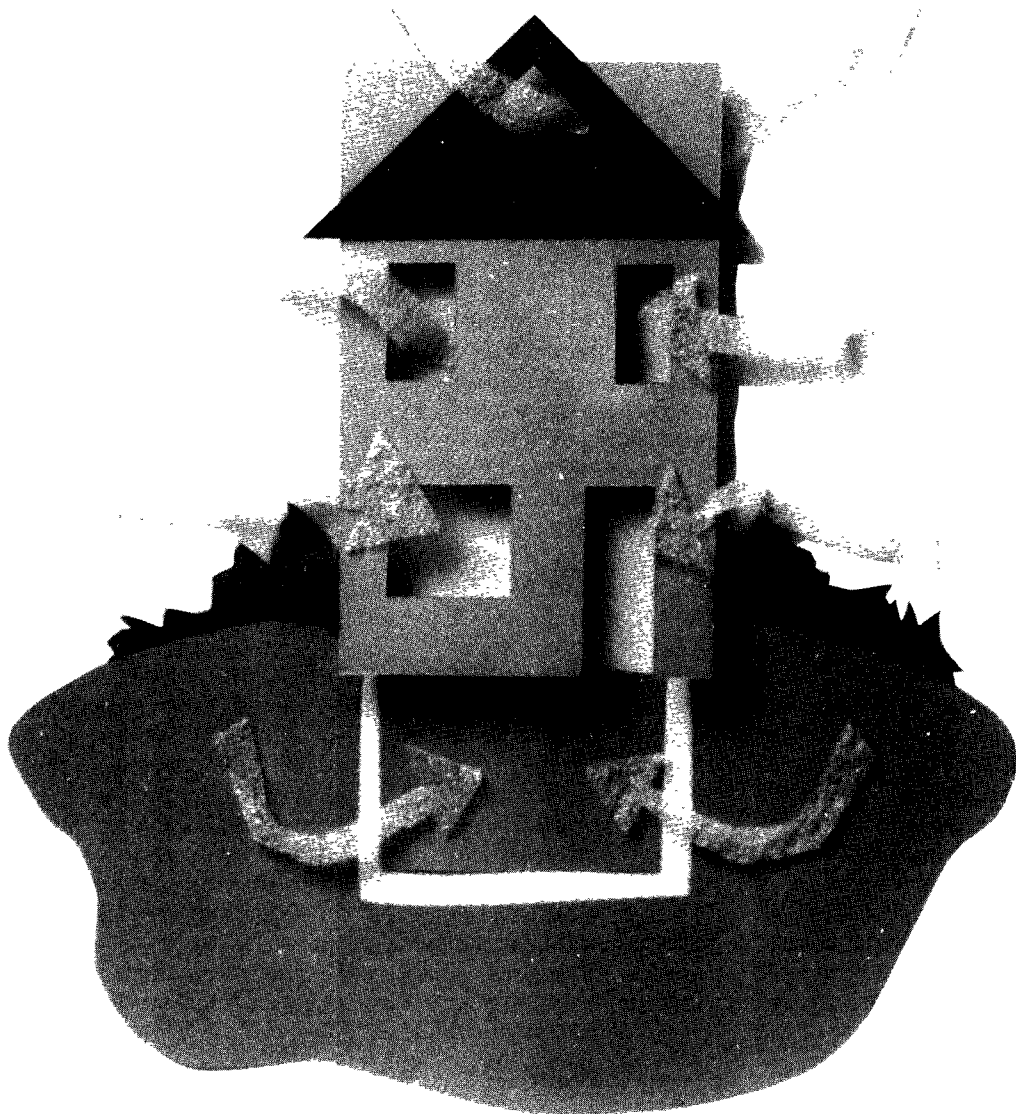
concentrations can remain in the air for long periods after some of these activities.

■ **Amount of ventilation:** If too little outdoor air enters a home, pollutants can accumulate to levels that can pose health and discomfort problems. Unless they are built with special mechanical means of ventilation, homes that are designed and constructed to minimize the amount of outside air that can "leak" into and out of the home may have higher pollutant levels than other homes. However, because some weather conditions can drastically reduce the amount of outside air that enters a home, pollutants can build up even in homes that are normally considered "leaky."

## HOW DOES OUTSIDE AIR ENTER A HOUSE?

**O**utside air enters and leaves a house in three ways. In a process known as *infiltration*, air flows through construction joints and cracks around windows and doors, in the foundation, or from crawl spaces underneath homes. In another process known as *natural ventilation*, air enters through opened windows and doors. Finally, there are a number of *mechanical ventilation* devices, from outdoor-vented fans that remove air from a single room to air handling systems that have fans that mix outdoor and indoor air or that remove polluted air from the whole house. The rate at which outside air replaces indoor air is described as the *air exchange rate*. When there is little infiltration, natural ventilation, or mechanical ventilation, the air exchange rate is low and pollutant levels can increase.

The average air exchange rate of homes in the United States today is 0.7 to 1.0 air changes per hour; in relatively tight homes, it can be as low as 0.2 to 0.3 air changes per hour; and in "leaky" homes, it may be as much as 2.0 air changes per hour. It is important to understand that an air exchange rate of 1.0 air change per hour does not mean that all pollutants will be removed in one hour. Ventilation is a process of dilution and removal that gradually gets rid of pollutants. In addition, pollutant removal is further slowed down by the fact that some pollutants are "trapped" by carpets, drapes, and other surfaces, only to be re-released into the air later.



## WHAT IF YOU LIVE IN AN APARTMENT?

**A**partments can have many of the same indoor air problems as single-family homes because many of the pollution sources, such as the interior building materials, furnishings, and household products, are similar. Indoor air problems similar to those caused in offices by such sources as contaminated ventilation

systems, improperly placed outdoor air intakes, or maintenance activities also can occur in apartments.

Solutions to air quality problems in apartments, as in homes and offices, involve one or more of the following actions: eliminating or controlling the sources of pollution, increasing ventilation, or installing air cleaning devices. Often a

resident can take the appropriate action to improve the indoor air quality by removing a source, altering an activity, unblocking an air supply vent, or opening a window to temporarily increase the ventilation; in other cases, however, only the building owner or manager is in a position to remedy the problem.





### **HOW DOES INDOOR AIR POLLUTION AFFECT YOUR HEALTH?**

**H**ealth effects from indoor air pollutants fall into two categories: those that are experienced immediately after exposure and those that do not show up until years later.

Immediate effects, which may show up after a single exposure or repeated exposures, include irritation of the eyes, nose, and throat, headaches, dizziness, and fatigue. These immediate effects are usually short-term and treatable by some means. Sometimes the treatment is simply eliminating the person's exposure to the source of the pollution, if it can be identified. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis, and humidifier fever, can also show up soon after exposure to some indoor air pollutants.

The likelihood of an individual developing immediate reactions to indoor air pollutants depends on several factors. Age and pre-existing medical conditions are two important influences. In other cases, whether a person reacts to a pollutant can be determined by individual sensitivity, which varies tremendously from person to person. Some

people can become sensitized to biological pollutants after repeated exposures, and it appears that some people can become sensitized to chemical pollutants as well.

Certain immediate effects are similar to those from colds or other viral diseases, so it is often difficult to determine if the symptoms are a result of exposure to indoor air pollution. For this reason, it is important to pay attention to the time and place the symptoms occur. If the symptoms fade or go away when a person is away from the home and return when the person returns home, an effort should be made to identify indoor air sources that may be possible causes. Some effects may be made worse by an inadequate supply of outside air or from the heating, cooling, or humidity conditions prevalent in the home.

Other health effects may show up either years after exposure has occurred or only after long or repeated periods of exposure. These effects, which include emphysema and other respiratory diseases, heart disease, and cancer, can be severely debilitating or fatal. More information on potential health effects from particular indoor air pollutants is provided in the section, "What Can You Do To Improve the Air Quality in

Your Home?"

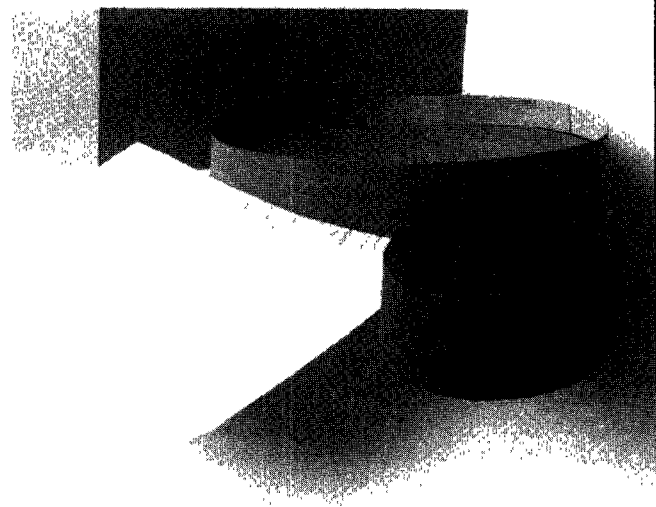
While pollutants commonly found in indoor air can be responsible for many harmful effects, there is considerable uncertainty about what concentrations or periods of exposure are necessary to produce specific health effects. People also react very differently to exposure to indoor air pollutants. Further research is needed to better understand which health effects can occur after exposure to the average pollutant concentrations found in homes and which can occur from the higher concentrations that occur for short periods of time.

The health effects associated with some indoor air

pollutants are summarized in the chart in the middle of this booklet entitled "Reference Guide to Major Indoor Air Pollutants in the Home." (This chart can be removed and used as a hand-out.)

### **HOW DO YOU KNOW IF YOU HAVE AN AIR QUALITY PROBLEM IN YOUR HOME?**

**S**ome health effects can be useful indicators of an indoor air quality problem, especially if they appear after a person moves to a new residence, remodels or refurnishes a home, or treats a home with pesticides. If you think that you have



symptoms that may be related to your home environment, you should discuss with your doctor or your local health department whether such symptoms could be caused by indoor air pollution. You may also want to consult a board-certified allergist or an occupational medicine specialist for answers to your questions.

It is prudent to try to improve the indoor air quality in your home even if symptoms are not noticeable. The earliest symptoms of long-term health problems, such as some respiratory illnesses and cancer, do not appear until years after the initial exposure.

Another way to judge whether your home has or could develop indoor air problems is to identify potential sources of indoor air pollution. Although the presence of such sources (see illustration at the beginning of this booklet) does not necessarily mean that you have an indoor air quality problem, being aware of the type and number of potential sources is an important step toward assessing the quality of air in your home.

A third way to decide whether your home may have poor indoor air quality is to look at your lifestyle and activities. As discussed earlier, human activities can be significant sources of indoor air pollution.

Finally, look for signs of problems with the air flow through your home. Things that can indicate your home may have an indoor air quality problem include smelly or stuffy air, dirty central heating and air cooling equipment, damaged flues and chimneys, moisture condensation on windows or walls, signs of water leakage, and areas where books, shoes, or other items become moldy.

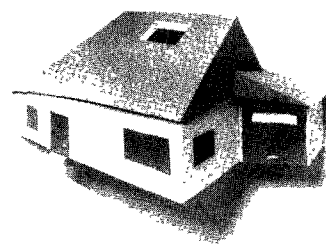
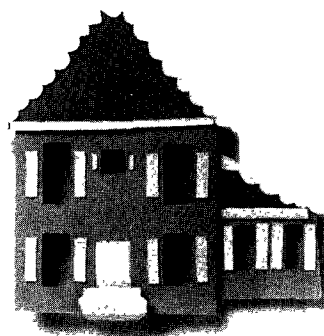
## SHOULD YOU MEASURE POLLUTANT LEVELS IN YOUR HOME?

**T**he federal government recommends that you measure the level of radon in your home. Without measurements there is no way to tell whether radon is present. Inexpensive devices are available for measuring radon. EPA provides guidance as to risks associated with different levels of exposure and when the public should consider corrective action. There are specific mitigation techniques that have proven effective in reducing levels of radon in the home. (See "Radon" section on p. 11 of this booklet for additional information about testing and controlling radon in homes.)

For pollutants other than radon, measurements are most appropriate when there are either health symptoms or signs of poor air flow and specific sources or pollutants have been identified as possible causes of indoor air quality problems. Testing for many pollutants can be expensive. Before monitoring your home for pollutants besides radon, consult with your state or local health department or with professionals who have experience in solving indoor air quality problems in non-industrial buildings.

## SHOULD YOU WEATHERIZE YOUR HOME?

**T**he federal government recommends that homes be weatherized in order to reduce the amount of energy needed for heating and cooling. While weatherization is underway,



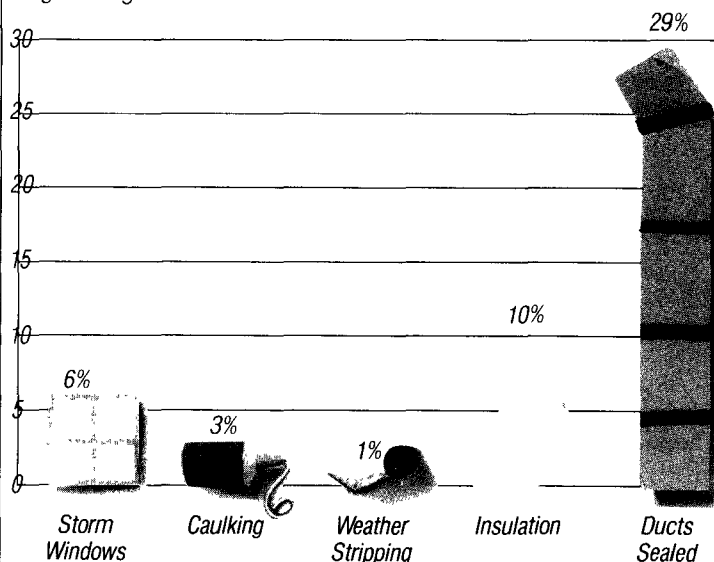
however, steps should be taken to minimize pollution from sources inside the home. (See "What Can You Do To Improve the Air Quality in Your Home?" for recommended actions.) In addition, residents should be alert to the emergence of signs of inadequate air flow, such as stuffy air, moisture condensation on cold surfaces, or mold and mildew growth. Additional weatherization measures should not be undertaken until these problems have been corrected.

Weatherization generally does not cause indoor air problems by adding new pollutants to the air. (There

are a few exceptions, such as caulking, that can sometimes emit pollutants.) However, measures such as installing storm windows, weather stripping, caulking, and blown-in wall insulation can reduce the amount of outdoor air infiltrating into a home. Consequently, after weatherization, concentrations of indoor air pollutants from sources inside the home can increase.

Some measures that reduce energy costs can actually *reduce* indoor pollutant levels. For example, sealing foundation cracks can save on energy bills while helping prevent the entry of radon gas into homes.

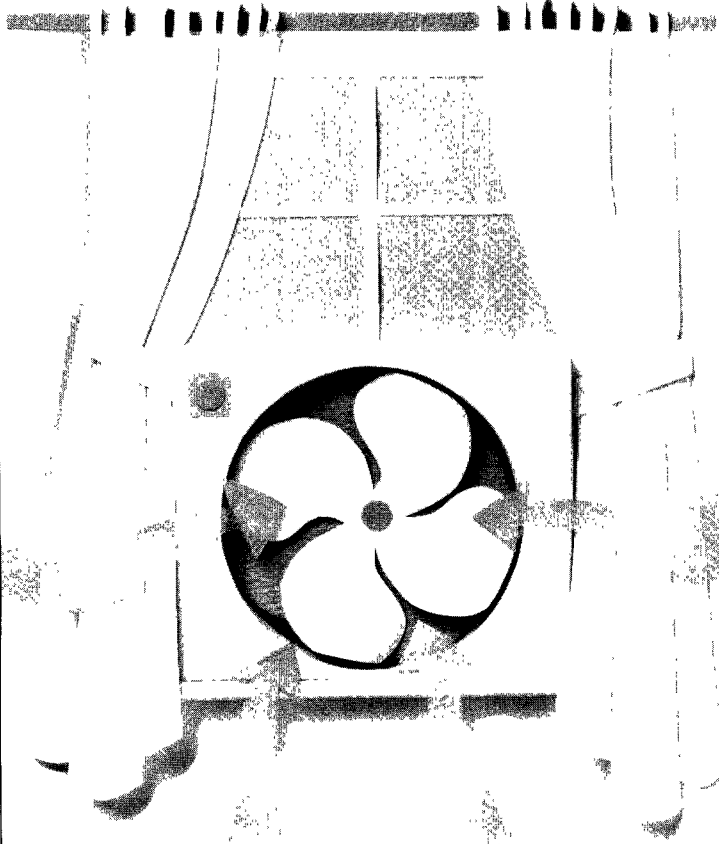
Percent Reduction in Air-Exchange Rate By House-Tightening Measures



Depending on which of these measures are used, a home's natural infiltration rate can be reduced by up to about 30 percent

Source: Bonneville Power Administration

# WHAT CAN YOU DO TO IMPROVE THE AIR QUALITY IN YOUR HOME?



## THREE BASIC STRATEGIES

**Source Control:** Usually the most effective way to improve indoor air quality is to eliminate individual sources of pollution or to reduce their emissions. Some sources, like those that contain asbestos, can be sealed or enclosed; others, like gas stoves, can be adjusted to decrease the amount of emissions. In some cases, source control is also a more cost-efficient approach to protecting indoor air quality than increasing ventilation because increasing ventilation can increase energy costs. Specific steps that you can take to control specific sources of indoor air pollution in your home are listed later in this section.

**Ventilation Improvements:** Another approach to lowering the concentrations of indoor air pollutants in your home is to increase the amount of outside air coming indoors. Opening windows and doors, when the weather permits, increases the natural ventilation rate. Turning on local bathroom or kitchen exhaust fans, if they are vented to the outdoors, can lower pollution levels by removing contaminants from the room where the fan is located. Where radon may be a problem, a window should be opened while bathroom or kitchen exhaust fans are in use. This keeps the amount of radon entering the house from increasing.

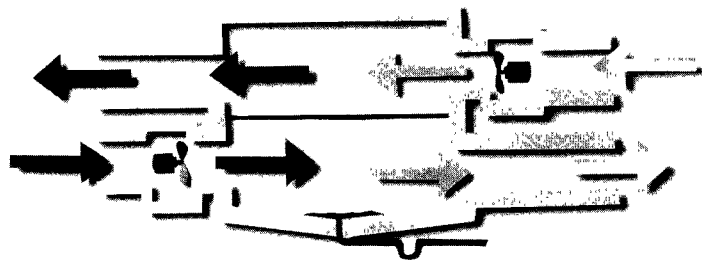
It is particularly important to take as many of these steps as possible while you

are involved in short-term activities that can generate high levels of pollutants — for example, painting, paint stripping, heating with kerosene heaters, cooking with gas stoves that are not vented to the outdoors, or engaging in maintenance and hobby activities such as welding, soldering, or sanding. You might also choose to do some of these activities outside, if you can and if weather permits.

Another way to increase the mechanical ventilation rate is to install heat recovery ventilators (also known as air-to-air heat exchangers) in homes. These devices, which can be installed in windows or as part of a central air system, increase ventilation by drawing outside air into the home and conserve energy by recovering the heat from air that is exhausted to the outdoors. Heat recovery ventilators are most easily installed in central air systems in new homes or during extensive remodeling; window units can be installed in existing homes.

Before you buy a mechanical ventilation device for your home, you should read books and articles on these devices and consult a mechanical engineer. Write Renewable Energy Information, P.O. Box 8900, Silver Spring, MD 20907 for the U.S. Department of Energy fact sheet, *Air-to-Air Heat Exchangers*. You can look in the yellow pages of a telephone directory under "Engineers" or write the American Society Of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) for the name of the president of the local ASHRAE organization in your community. (For ASHRAE's address, see p. 31)

**Air Cleaners:** There are many types and sizes of air cleaners on the market, ranging from relatively inexpensive tabletop models to sophisticated and expensive whole-house systems. Some air cleaners are highly effective at particle removal, while others, including most



### Heat Recovery Ventilator

A heat recovery ventilator draws stale, warm air from the house and transfers the heat in that air to the cold air being pulled into the house. This additional outdoor air can help dilute air pollutant concentrations indoors. If appropriately designed and installed, these devices can reduce the energy costs associated with the increased ventilation.

Source: U.S. Department of Energy

## A LOOK AT SOURCE-SPECIFIC CONTROLS

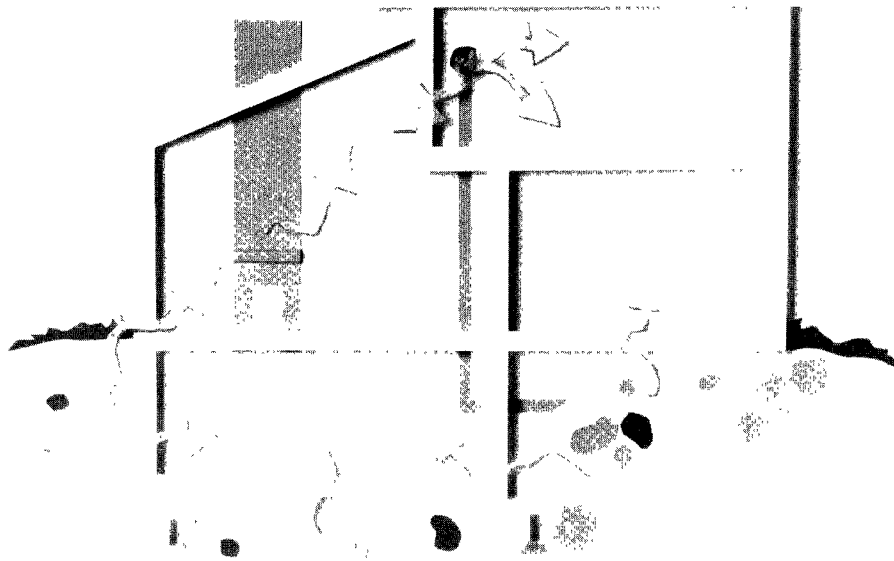
tabletop models, are much less efficient. Air cleaners are generally not designed to remove gaseous pollutants.

How well an air cleaner works depends on how well it collects pollutants from indoor air (expressed as a percentage efficiency rate) and how much air it draws through the cleaning or filtering element (expressed in cubic feet per minute). A very efficient collector with a low air circulation rate will not be effective, nor will a cleaner with a high air circulation rate but a less efficient collector. The long-term performance of any air cleaner depends on maintaining it according to the manufacturer's directions.

Another important factor in determining the effectiveness of an air cleaner is the *strength* of the pollutant source. Tabletop air cleaners, in particular, may not remove satisfactory amounts of pollutants from strong nearby sources. People with a sensitivity to particular sources may find that air cleaners are helpful only in conjunction with concerted efforts to remove the source.

Both EPA and CPSC plan to undertake more studies to evaluate the effectiveness of air cleaners that are on the market today and to identify improvements in the way air cleaners can be designed, operated, and maintained.

At present, EPA does not recommend using air cleaners to reduce levels of radon and its decay products. The effectiveness of these devices is uncertain because they only partially remove the radon decay products and do not diminish the amount of radon entering the home. EPA plans to do additional research on whether air cleaners are, or could become, a reliable means of reducing the health risk from radon.



**F**or most indoor air quality problems in the home, source control is the most effective solution. This section takes a source-by-source look at the most common indoor air pollutants, their potential health effects, and ways to reduce levels in the home. (For a summary of the points made in this section, see the chart in the middle of this booklet entitled "Reference Guide to Major Indoor Air Pollutants in the Home.")

### RADON

**R**adon is a colorless, odorless gas that occurs naturally and is found everywhere at very low levels. It is when radon becomes trapped in buildings and concentrations build up in indoor air that exposure to radon becomes of concern.

The most common source of indoor radon is uranium in the soil or rock on which homes are built. As uranium naturally breaks down, it releases radon gas, and radon

gas breaks down into radon decay products (also called radon daughters or progeny). Radon gas enters homes through dirt floors, cracks in concrete walls and floors, floor drains, and sumps.

A second entry route for radon in some areas of the country is through well water. In some unusual situations, houses are made of radon-containing construction materials; in such cases, those materials can release radon into the indoor air.

Studies by EPA indicate that as many as 10 percent of all American homes, or about 8 million homes, may have elevated levels of radon, and the percentage may be higher in geographic areas with certain soils and bedrock formations. Radon can be detected only by the use of measurement instruments called radon detectors.

### Health Effects of Radon

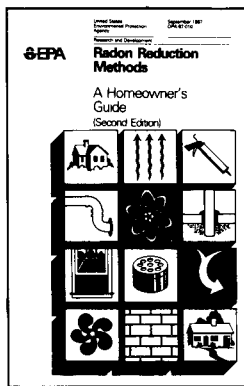
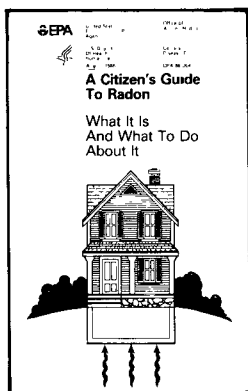
The only known health effect associated with exposure to elevated levels of radon is lung cancer. EPA estimates that about 5,000 to

20,000 lung cancer deaths a year in the United States may be attributed to radon. (The American Cancer Society estimates there will be a total of about 139,000 lung cancer deaths in 1988 from all causes.)

### Reducing Exposure to Radon in Homes

■ **Measure levels of radon in your home.** Two types of radon detectors are most commonly used in homes: charcoal canisters that are exposed for 2 to 7 days; and alpha track detectors that are exposed for one month or longer. (Some states recommend that residents use only the alpha track monitors.)

Your state radiation protection office can provide you with information on the availability of detection devices or services. Ask for materials specifically developed for your state and for EPA's *A Citizen's Guide to Radon*. States may also provide you with EPA's *Radon Measurement Proficiency Report* for your state. This publication lists firms and laboratories that have demonstrated



their ability to accurately measure radon in homes.

You can also get the booklets listed in this section from the EPA Public Information Center or the EPA regional office nearest you. (See p. 30 for a list of EPA headquarters and regional office addresses.)

- **Refer to the EPA guidelines in deciding whether and how quickly to take action based on your test results.** The guidelines are given in the booklet, *A Citizen's Guide to Radon*. The higher the radon level in your home, the faster you should take action to reduce your exposure. EPA believes that radon levels in homes can be reduced to about 4 picocuries per liter of air and sometimes less.

- **Learn about control measures.** An effective radon mitigation plan may include one or more of the following actions: sealing cracks and other openings in basement floors, ventilating crawl spaces, installing sub-slab or basement ventilation, or installing air-to-air heat exchangers. The EPA booklet, *Radon Reduction Methods: A Homeowner's Guide*, describes some possible reduction measures.

- **Take precautions not to draw larger amounts of radon into the house.** Increasing ventilation can be

an effective means of reducing exposure to many indoor air pollutants; in homes with elevated concentrations of radon, however, increasing ventilation may increase infiltration through the foundation and result in drawing even larger amounts of radon into the home. You can get the benefits of increased ventilation without increasing radon exposure by opening windows evenly on all sides of the home. Opening windows is particularly important when you are using outdoor-vented exhaust fans.

- **Select a qualified contractor to draw up and implement a radon mitigation plan.** EPA suggests that all but the most experienced "do-it-yourselfer" get professional help in selecting and installing radon reduction measures. The EPA booklet, *Radon Reduction Methods: A Homeowner's Guide*, offers advice about how to select a contractor and how to evalu-

ate proposals for radon mitigation. EPA does not certify contractor competency for planning or executing radon mitigation measures.

- **Stop smoking and discourage smoking in your home.** Scientific evidence indicates that smoking may increase the risk of cancer associated with exposure to radon.

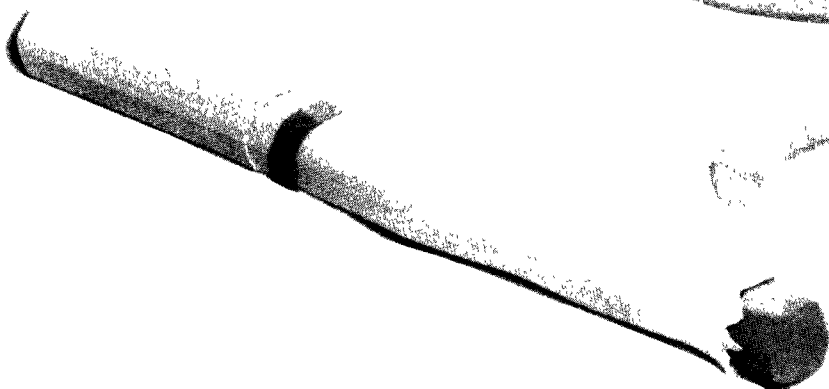
- **Treat radon-contaminated well water by aerating or filtering through granulated-activated charcoal.** Contact your state's radiation protection office or drinking water office for more information concerning radon in drinking water in your community.

## ENVIRONMENTAL TOBACCO SMOKE

**E**nvironmental tobacco smoke is composed of sidestream smoke (the smoke that comes from the burning end of a cigarette) and smoke that is exhaled by the smoker. It is a complex mixture of over 4,700 compounds, including both gases and particles. Non-smokers' exposure to environmental tobacco smoke is called "passive smoking," "second-hand smoking," or "involuntary smoking."

## Health Effects of Environmental Tobacco Smoke

According to reports issued in 1986 by the Surgeon General and the National Academy of Sciences, environmental tobacco smoke is a cause of



disease, including lung cancer, in both smokers and healthy non-smokers. Studies indicate that exposure to tobacco smoke may increase the risk of lung cancer by an average of 30 percent in the non-smoking spouses of smokers. Very young children exposed to smoking at home are more likely to be hospitalized for bronchitis and pneumonia. Recent studies suggest that environmental tobacco smoke may also contribute to heart disease.

### *Reducing Exposure to Environmental Tobacco Smoke in Homes*

■ **Give up smoking and discourage smoking in your home or ask smokers to smoke outdoors.** The 1986 Surgeon General's report concluded that physical separation of smokers and nonsmokers in a common air space, such as different rooms within the same house, may reduce—but will not eliminate—nonsmokers' exposure to environmental tobacco smoke.

Ventilation, a common method of reducing exposure to indoor air pollutants, also will reduce but not eliminate exposure to environmental tobacco smoke. Because smoking produces such large amounts of pollutants, natural or mechanical ventilation techniques do not remove them from the air in your home as quickly as they build up. In addition, the large increases in ventilation it takes to significantly reduce exposure to environmental tobacco smoke can also increase energy costs substantially.

Consequently, the most effective way to reduce exposure to environmental tobacco smoke in the home is to eliminate smoking there.

### *BIOLOGICAL CONTAMINANTS*

**B**iological contaminants ("biologicals") include bacteria, mold and mildew, viruses, animal dander and cat saliva, mites, cockroaches, and pollen. There are many sources for these pollutants. For example, pollens originate from plants; viruses are transmitted by people and animals; bacteria are carried by people, animals, and soil and plant debris; and household pets are sources of saliva and animal dander. The protein in urine from rats and mice is a potent allergen; when it dries, it can become airborne. Contaminated central air handling systems can become breeding grounds for mold, mildew, and other biological contaminants and can then distribute these contaminants through the home.

By controlling the relative humidity level in a home, the growth of biologicals can be minimized. A relative humidity of 30-50 percent is recommended for homes.

Standing water, water-damaged materials, or wet surfaces can serve as a breeding ground for molds, mildews, bacteria, and insects. House dust mites, one of the most powerful biologicals in triggering allergic reactions, can grow in any damp, warm environment.

### *Health Effects From Biological Contaminants*

Some biological contaminants trigger allergic reactions, including hypersensitivity pneumonitis, allergic rhinitis, and some types of asthma. Some transmit infectious illnesses, such as influenza, measles, and chicken pox. And some biologicals, such as certain molds and mildews, release disease-causing toxins. Symptoms of health problems caused by biological pollutants include sneezing, watery eyes, coughing, shortness of breath, dizziness, lethargy, fever, and digestive problems.

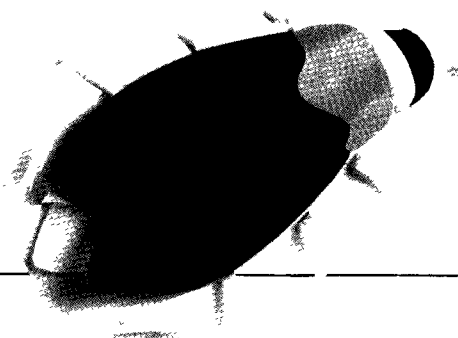
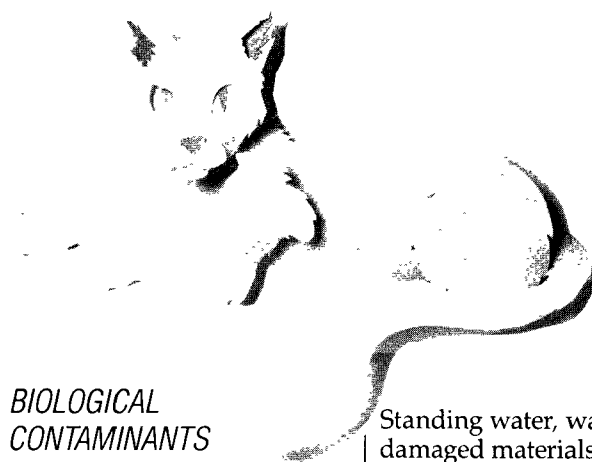
Many allergic reactions caused by biological aller-

gens occur immediately after exposure; other allergic reactions are the result of previous exposures that a person may not have been aware of. As a result, people who have noticed only mild allergic reactions, or no reactions at all, may suddenly find themselves very sensitive to particular allergens. Some diseases, like humidifier fever, have generally been associated with exposure to toxins from microorganisms that can grow in large building ventilation systems. However, these diseases can also be traced to microorganisms that grow in home heating and cooling systems and humidification devices. Children, elderly people, and people with breathing problems, allergies, and lung diseases are particularly susceptible to disease-causing biological agents in the indoor air.

### *Reducing Exposure to Biological Contaminants in Homes*

■ **Install and use exhaust fans that are vented to the outdoors in kitchens and bathrooms and vent clothes dryers outdoors.** These actions can eliminate much of the moisture that builds up from everyday activities. There are exhaust fans on the market that produce little noise, an important consideration for some people. (Another benefit to using kitchen and bathroom exhaust fans is that they can reduce levels of organic pollutants that vaporize from hot water used in showers and dishwashers.)

■ **Ventilate the attic and crawl spaces to prevent moisture build-up.** Keeping humidity levels in these areas between 30-50 percent can prevent water condensation on building materials.





■ **If using cool mist or ultrasonic humidifiers, clean water trays and fill with fresh, distilled water daily.** Because these humidifiers can become breeding grounds for biological contaminants, they have the potential for causing diseases such as hypersensitivity pneumonitis. Evaporation trays in air conditioners, dehumidifiers, and refrigerators should also be cleaned frequently.

■ **Thoroughly dry and clean water-damaged carpets and building materials (within 24 hours if possible).** Water-damaged carpets and building materials can harbor mold and bacteria. If health problems persist after you have tried to dry these materials, consider replacing them. It can be very difficult to completely rid such materials of biological contaminants.

■ **Keep the house clean.** House dust mites, pollens, animal dander, and other allergy-causing agents can be reduced, although not eliminated, through regular cleaning. People who are allergic to these pollutants should not vacuum (and may even need to leave the house while vacuuming is occurring), because vacuuming can actually increase levels of airborne mite

allergens and other biological contaminants. Using central vacuum systems that are vented to the outdoors may reduce allergic reactions to biologicals.

■ **Take steps to minimize biological pollutants in basements.** Clean and disinfect the basement floor drain regularly. Do not finish a subsurface basement unless all water leaks are patched and outdoor ventilation and adequate heat to prevent condensation are provided. Operate a dehumidifier in the basement if needed to keep relative humidity levels between 30-50 percent.

## STOVES, HEATERS, FIREPLACES, AND CHIMNEYS

**I**n addition to environmental tobacco smoke, other sources of combustion products are unvented kerosene and gas space heaters, woodstoves, fireplaces, and gas stoves. The major pollutants released from these sources are carbon monoxide, nitrogen dioxide, and particulates. In addition, woodstoves, fireplaces, and unvented kerosene space heaters emit polycyclic aromatic hydrocarbons. Unvented kerosene heaters may also generate acid aerosols.

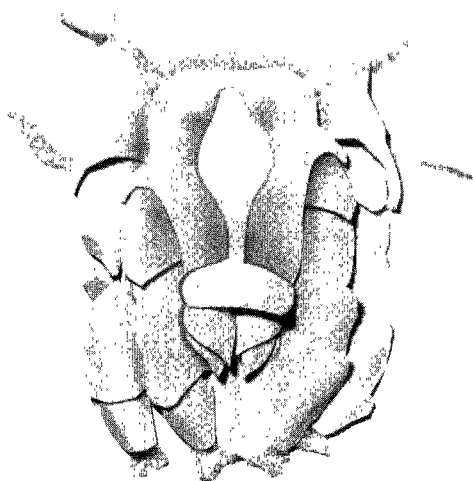
Other sources of combustion gases and particulates are chimneys and flues that are improperly installed or maintained and cracked furnace heat exchangers. Pollutants from fireplaces and woodstoves with no outside air supply vent can be "down-drafted" from the chimney back into the living space, particularly in "weather-tight" homes.

## Health Effects of Combustion Products

Carbon monoxide is a colorless, odorless gas that interferes with the delivery of oxygen throughout the body. At low concentrations, it can cause fatigue in healthy people and episodes of increased chest pain in people with chronic heart disease. At higher concentrations, carbon monoxide can cause headaches, dizziness, weakness, nausea, confusion, and disorientation. The symptoms of carbon monoxide poisoning are sometimes confused with the flu or food poisoning. At very high concentrations carbon monoxide can cause unconsciousness and death. Fetuses, infants, pregnant women, elderly people, and people with anemia or with a history of heart or respiratory disease can be especially sensitive to carbon monoxide exposures.

Nitrogen dioxide can irritate the mucous membranes in the eye, nose, and throat and cause shortness of breath after exposure to high concentrations. There is evidence that high concentrations or continued exposure to low levels of nitrogen dioxide can increase the risk of respiratory infection; there is also evidence from animal studies that repeated exposures to elevated nitrogen dioxide levels may lead, or contribute, to the development of lung disease such as emphysema. People at particular risk from exposure to nitrogen dioxide include children and individuals with asthma and other respiratory diseases.

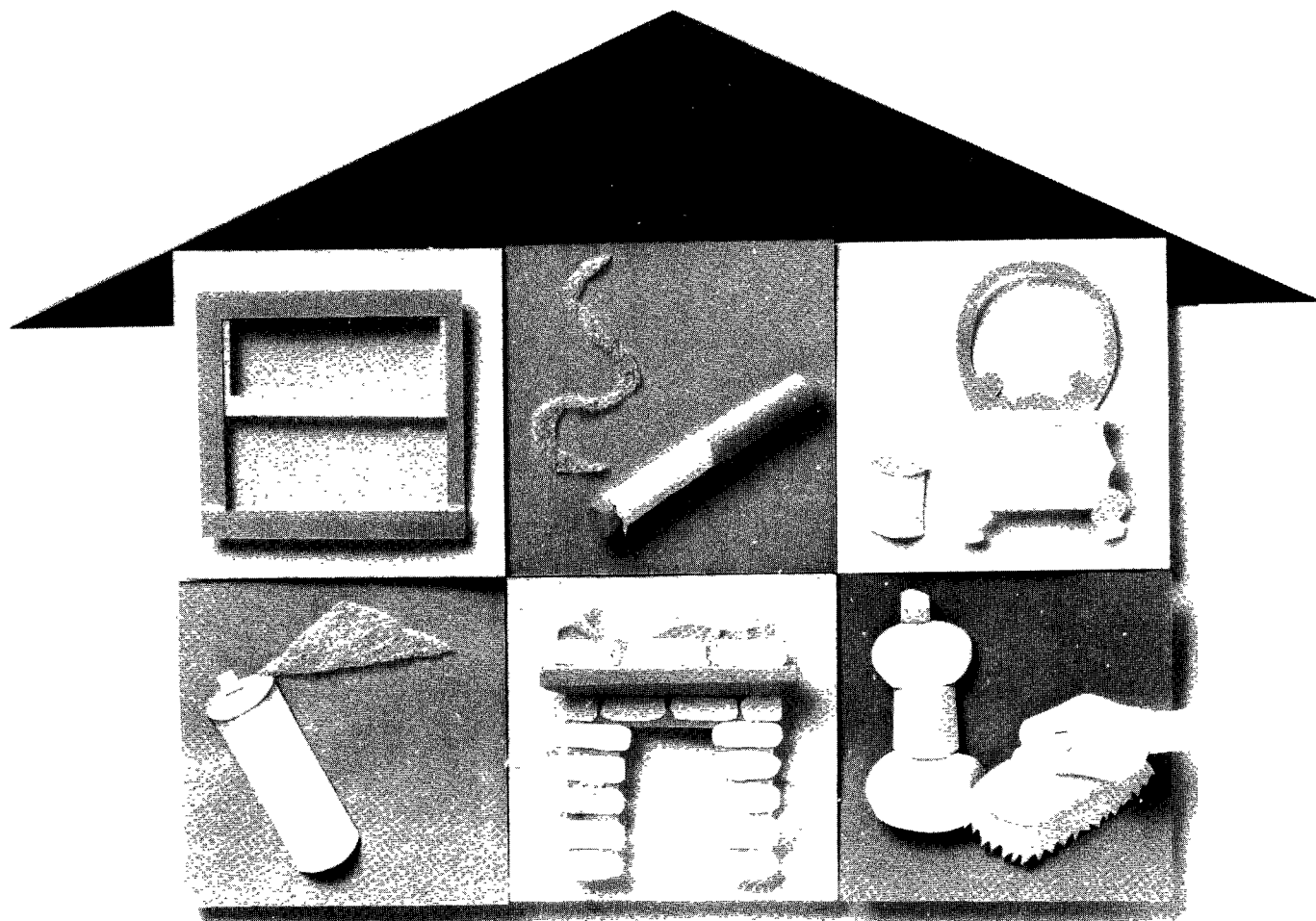
Respirable particles, released when fuels are incompletely burned, can lodge in the lungs and irritate or damage lung tissue. A number of pollutants, including radon (continued on page 19)



*Dust mites, microscopic animals found in household dust, produce a common allergen. Exposure to house dust mites, animal-related allergens (animal dander and cat saliva), and mold have been estimated to cause 200,000 or more emergency room visits a year by asthma patients. Humid or damp conditions usually lead to greater numbers of dust mites.*



# REFERENCE GUIDE TO MAJOR INDOOR AIR POLLUTANTS IN THE HOME



*The pollutants listed in this guide have been shown to cause the health effects mentioned. However, it is not necessarily true that the effects noted occur at the pollutant concentration levels typically found in the home. In many cases, our understanding of the pollutants and their health effects is too limited to determine the levels at which the listed effects could occur.*

## RADON

**Sources:** Earth and rock beneath home; well water; building materials.

**Health Effects:** No immediate symptoms. Estimated to cause about 10% of lung cancer deaths. Smokers are at higher risk of developing radon-induced lung cancer.

**Levels in Homes:** Estimated national average is 1½ picocuries per liter. Levels in homes have been found as high as 200 picocuries per liter. The higher the average concentration, the faster the corrective action should be taken. EPA believes that levels in most homes can be

reduced to 4 picocuries per liter of air and sometimes less.

### **Steps to Reduce Exposure:**

- Test your home for radon.
- Get professional advice before planning and carrying out radon reduction measures.
- Seal cracks and other openings in basement floor.
- Ventilate crawl space.
- Install sub-slab ventilation or a heat recovery ventilator (air-to-air heat exchanger.)
- Treat radon-contaminated well water by aerating or filtering through granulated-activated charcoal.

## ENVIRONMENTAL TOBACCO SMOKE

**Sources:** Cigarette, pipe, and cigar smoking.

**Health Effects:** Eye, nose, and throat irritation; headaches; bronchitis; pneumonia. Increased risk of respiratory and ear infections in children. Can cause lung cancer and may contribute to heart disease.

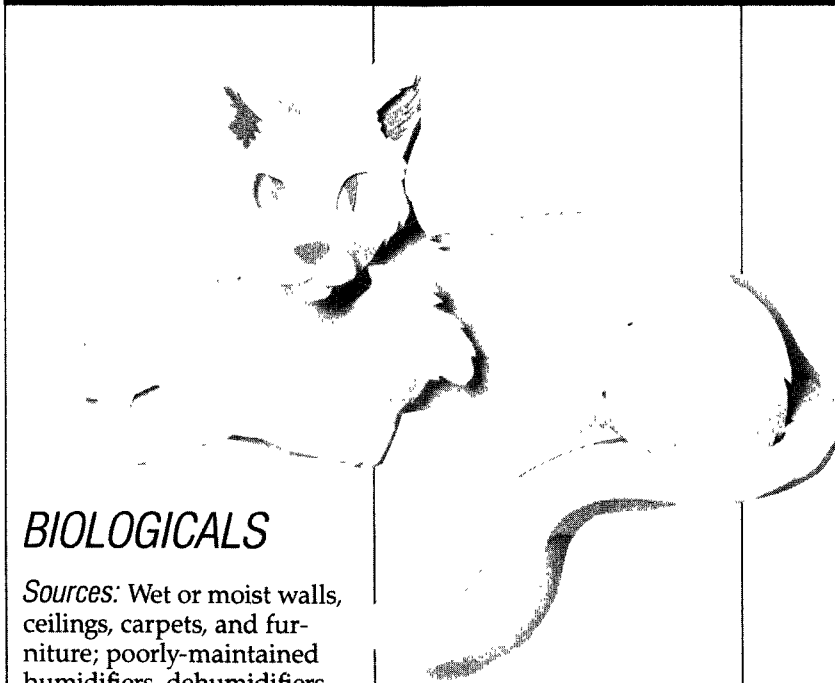
**Levels in Homes:** Particle levels in homes without smokers or other strong particle sources are the same as, or lower than, those outdoors. Homes with one or more smokers may have

particle levels several times higher than outdoor levels.

### **Steps to Reduce Exposure:**

- Stop smoking and discourage others from smoking.
- If you do smoke, smoke outdoors.





## BIOLOGICALS

**Sources:** Wet or moist walls, ceilings, carpets, and furniture; poorly-maintained humidifiers, dehumidifiers, and air conditioners; bedding; household pets.

**Health Effects:** Eye, nose, and throat irritation; shortness of breath; dizziness; lethargy; fever; digestive problems. Asthma; humidifier fever; influenza and other infectious diseases.

**Levels in Homes:** Indoor levels of pollen and fungi are lower than outdoor levels (except where indoor sources of fungi are present). Indoor levels of mites are higher than outdoor levels.

### **Steps to Reduce Exposure:**

- Install and use fans vented to outdoors in kitchens and bathrooms.
- Vent clothes dryers to outdoors.
- Clean cool mist and ultrasonic humidifiers daily and use only distilled water in them.
- Empty water trays in air conditioners, dehumidifiers, and refrigerators frequently.
- Clean and dry, or remove, water-damaged carpets.
- Use basements as living areas only if they are leak-proof and have adequate ventilation. Use dehumidifiers, if necessary to maintain humidity at 30-50 percent.

## CARBON MONOXIDE

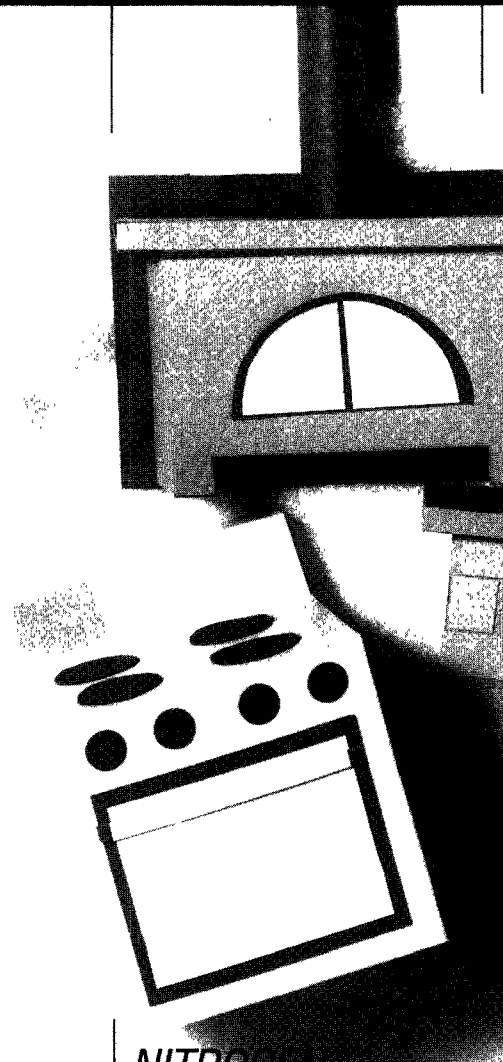
**Sources:** Unvented kerosene and gas heaters; leaking chimneys and furnaces; down-drafting from wood stoves and fireplaces; gas stoves. Automobile exhaust from attached garages. Environmental tobacco smoke.

**Health Effects:** At low concentrations, fatigue in healthy people and chest pain in people with heart disease. At higher concentrations, impaired vision and coordination; headaches; dizziness; confusion; nausea. Can cause flu-like symptoms that clear up after leaving home. Fatal at very high concentrations.

**Levels in Homes:** Average levels in homes without gas stoves vary from 0.5 to 5 parts per million (ppm). Levels near properly adjusted gas stoves are often 5 to 15 ppm and near poorly adjusted stoves may be 30 ppm or higher.

### **Steps to Reduce Exposure:**

- Keep gas appliances properly adjusted.
- Consider purchasing vented gas space heaters and furnaces.
- Use proper fuel in kerosene space heaters.
- Install and use exhaust fan vented to outdoors over gas stoves.
- Open flues when gas fireplaces are in use.
- Choose properly sized wood stoves that are certified to meet EPA emission standards. Make certain that doors on all wood stoves fit tightly.
- Have a trained professional inspect, clean, and tune-up central heating system (furnaces, flues, and chimneys) annually. Repair any leaks properly.
- Do not idle car inside garage.



## NITROGEN DIOXIDE

**Sources:** Kerosene heaters, unvented gas stoves and heaters. Environmental tobacco smoke.

**Health Effects:** Eye, nose, and throat irritation; may cause impaired lung function and increased respiratory infections in young children.

**Levels in Homes:** Average level in homes without combustion appliances is about half that of outdoors. In homes with gas stoves, kerosene heaters, or unvented gas space heaters indoor levels often exceed outdoor levels.

### **Steps to Reduce Exposure:**

- See steps under carbon monoxide.



## RESPIRABLE PARTICLES

**Sources:** Fireplaces, wood stoves, and kerosene heaters. Environmental tobacco smoke.

**Health Effects:** Eye, nose, and throat irritation; respiratory infections and bronchitis; lung cancer. (Effects attributable to environmental tobacco smoke are listed elsewhere.)

**Levels in Homes:** Particle levels in homes without smoking or other strong particle sources are the same as, or lower than, outdoor levels.

### Steps to Reduce Exposure:

- Vent all furnaces to outdoors; keep doors to rest of house open when using unvented space heaters.
- Choose properly sized wood stoves, certified to meet EPA emission standards; make certain that doors on all wood stoves fit tightly.
- Have a trained professional inspect, clean, and tune-up central heating system (furnace, flues, and chimneys) annually. Repair any leaks promptly.
- Change filters on central heating and cooling systems and air cleaners according to manufacturer's directions.

**EXTERIOR GRADE**

## ORGANIC GASES

**Sources:** Household products including: paints, paint strippers, and other solvents; wood preservatives; aerosol sprays; cleansers and disinfectants; moth repellents and air fresheners; stored fuels and automotive products; hobby supplies; dry cleaned clothing.

**Health Effects:** Eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.

**Levels in Homes:** Levels of several organics average 2 to 5 times higher indoors than outdoors. During and for several hours immediately after certain activities, such as paint stripping, levels may be 1000 times background outdoor levels.

### Steps to Reduce Exposure:

- Use household products according to manufacturer's directions.
- Use outdoors or in well-ventilated places.
- Throw away unused or little-used containers safely; buy in quantities that you will use soon.

## FORMALDEHYDE

**Sources:** Pressed wood products (hardwood plywood wall paneling, particleboard, fiberboard) and furniture made with these pressed wood products. Urea-formaldehyde foam insulation (UFFI). Combustion sources and environmental tobacco smoke. Durable press drapes, other textiles, and glues.

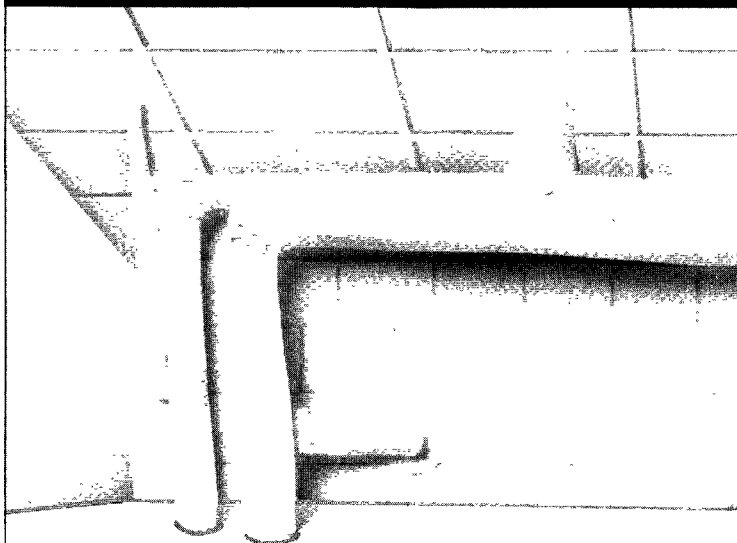
**Health Effects:** Eye, nose, and throat irritation; wheezing and coughing; fatigue; skin rash; severe allergic reactions. May cause cancer. May also cause other effects listed under "organic gases."

**Levels in Homes:** Average concentrations in older homes without UFFI are generally well below 0.1 (ppm). In homes with significant amounts of new pressed wood products, levels can be greater than 0.3 ppm.

### Steps to Reduce Exposure:

- Use "exterior grade" pressed wood products (lower-emitting because they contain phenol resins, not urea resins).
- Use air conditioning and dehumidifiers to maintain moderate temperature and reduce humidity levels.
- Increase ventilation, particularly after bringing new sources of formaldehyde into the home.

# REFERENCE GUIDE TO MAJOR INDOOR AIR POLLUTANTS IN THE HOME



## PESTICIDES

**Sources:** Products used to kill household pests (insecticides and termiticides). Also, products used on lawns and gardens that drift or are tracked inside the house.

**Health Effects:** Irritation to eye, nose, and throat; damage to central nervous system and kidney; cancer.

**Levels in Homes:** Preliminary research shows widespread presence of pesticide residues in homes.

### *Steps to Reduce Exposure:*

- Use strictly according to manufacturer's directions.
- Mix or dilute outdoors.
- Apply only in recommended quantities.
- Take plants or pets outside, where possible. Increase ventilation when using indoors.
- Use non-chemical methods of pest control where possible.
- If you use a pest control company, select it carefully.
- Do not store unneeded pesticides inside home; dispose of unwanted containers safely.
- Store clothes with moth repellents in separately ventilated areas, if possible.
- Keep indoor spaces clean and well-ventilated in order to eliminate or minimize use of air fresheners.

## ASBESTOS

**Sources:** Deteriorating or damaged insulation, fireproofing, or acoustical materials.

**Health Effects:** No immediate symptoms. Chest and abdominal cancers and lung diseases. Smokers are at higher risk of developing asbestos-induced lung cancer.

**Levels in Homes:** Elevated levels can occur in homes where asbestos-containing materials are damaged or disturbed.

### *Steps to Reduce Exposure:*

- Seek professional advice to identify potential asbestos problems. (Do not disturb materials suspected of containing asbestos.)
- Use trained and qualified contractors for control measures that may disturb asbestos and for cleanup.
- Follow proper procedures in replacing woodstove door gaskets that may contain asbestos.

## LEAD

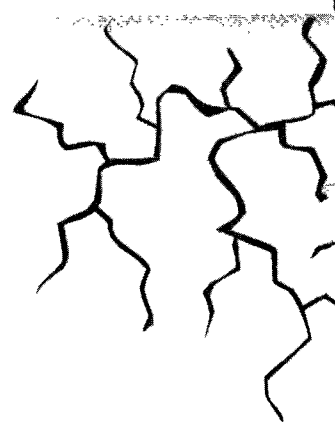
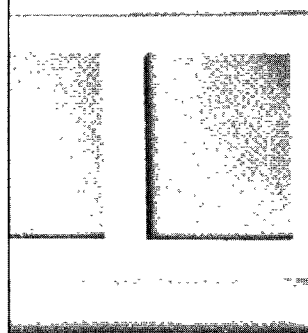
**Sources:** Automobile exhaust. Sanding or open-flame burning of lead-based paint. Activities involving lead solder.

**Health Effects:** Impaired mental and physical development in both fetuses and young children. Decreased coordination and mental abilities; damage to kidneys and nervous system, and red blood cells. May increase high blood pressure.

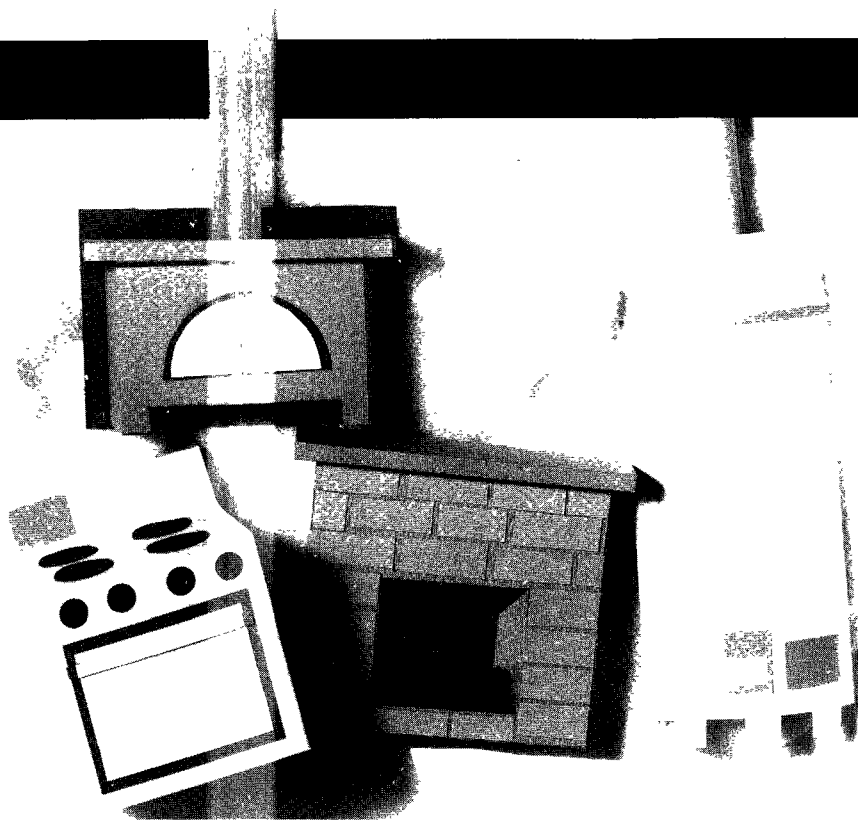
**Levels in Homes:** Lead dust levels 10 to 100 times greater in homes where sanding or open-flame burning of lead-based paints has occurred.

### *Steps to Reduce Exposure:*

- If you suspect that paint you are removing may contain lead, have it tested.
- Leave lead-based paint undisturbed. Do not sand or burn off.
- Cover lead-based paint with wallpaper or other building material. Replace moldings and other woodwork or have them removed and chemically treated off-site.
- Use well-ventilated areas for hobby and house maintenance activities involving lead. Consider using "no-lead" solder.



- If lead exposure is suspected, consult your health department about appropriate removal and clean-up procedures and have your blood lead levels tested.
- Have your drinking water tested for lead.



(continued from page 14)  
and benzo(a)pyrene, both of which can cause cancer, attach to small particles that are inhaled and then carried deep into the lung.

### *Reducing Exposure to Combustion Products in Homes*

- **Take special precautions when operating fuel-burning unvented space heaters.** Consider potential effects of indoor air pollution when you decide to use an unvented kerosene or gas space heater. Follow the manufacturer's directions, especially instructions on the proper fuel and keeping the heater properly adjusted. A persistent yellow-tipped flame is generally an indicator of maladjustment and increased pollutant emissions. While a space heater is in use, open a door from the room where the heater is located to the rest of the house and open a window slightly.

- **Install and use exhaust fans over gas cooking stoves and ranges and keep the burners properly adjusted.**

Using a stove hood with a fan vented to the outdoors can greatly reduce exposure to pollutants during cooking. Improper adjustment, often indicated by a persistent yellow-tipped flame, can result in increased pollutant emissions. Ask your gas company to adjust the burner so that the flame tip is blue. If you purchase a new gas stove or range, consider buying one with pilotless ignition because they do not have a pilot light that burns continuously. *Never* use a gas stove to heat your home and always make certain the flue in your gas fireplace is open when the fireplace is in use.

- **Keep woodstove emissions to a minimum.** Choose properly-sized new stoves that are certified as meeting EPA emission standards. Make certain that doors in old woodstoves are tight-fitting. Use aged or cured (dried) wood only, and follow the manufacturer's directions for starting, stoking, and putting out the fire in woodstoves. Chemicals are used to pressure-treat wood; such wood should never be

burned indoors. (Because some old gaskets in woodstove doors contain asbestos, when replacing gaskets refer to the instructions in the EPA and CPSC booklet, *Asbestos in Homes*, to avoid creating an asbestos problem. New gaskets are made of fiberglass.)

- **Have central air handling systems — including furnaces, flues, and chimneys — inspected annually and promptly repair cracks or damaged parts.** Blocked, leaking, or damaged chimneys or flues can release harmful combustion gases and particles and even fatal concentrations of carbon monoxide. Strictly follow all service and maintenance procedures recommended by the manufacturer, including those that tell you how frequently to change the filters. If manufacturer's instructions are not readily available, change filters once every month or two during periods of use. Proper maintenance is important even for new furnaces, because they can also corrode and leak combustion gases, including carbon monoxide.

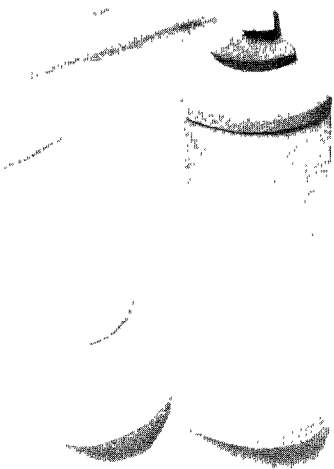
## HOUSEHOLD PRODUCTS

**O**rganic chemicals are widely used as ingredients in household products because of their many useful characteristics, such as the ability to dissolve substances and evaporate quickly. Paints, varnishes, and wax all contain organic solvents, as do many cleaning, disinfecting, cosmetic, degreasing, and hobby products. Fuels are made up of organic chemicals. All of these products can release organic compounds while you are using them, and, to some degree, when they are stored.

In research conducted by EPA, called the Total Exposure Assessment Methodology (TEAM) studies, levels of about a dozen common organic pollutants were found to be 2 to 5 times higher inside homes than outside, regardless of whether the homes were located in rural or highly industrial areas. Additional TEAM studies indicate that while people are using products containing organic chemicals, they can expose themselves and others to very high pollutant levels and elevated concentrations can persist in the air long after the activity is completed. Three out of four specific organic compounds mentioned later in this booklet — benzene, perchloroethylene, and paradichlorobenzene — are among the most prevalent organic compounds identified by the TEAM studies. The fourth organic compound, methylene chloride, is used widely in consumer goods.

### *Health Effects*

The ability of organic chemicals to cause health effects varies greatly — from



those that are highly toxic, to those with no known health effect. Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment are among the immediate symptoms that some people have experienced soon after exposure to some organics. At present, not much is known about what health effects occur from the levels of organics found in homes. Many organic compounds are known to cause cancer in animals; some are suspected of causing, or are known to cause, cancer in humans.

### *Organize Safe Collection Days for Household Hazardous Wastes*

The League of Women Voters of Massachusetts makes available a video and kit of materials giving tips on how to set up household hazardous waste collection days. (Write to the League of Women Voters of Massachusetts, 8 Winter Street, Boston, MA 02108, for a flyer and order form.) Another source of information is EPA's publication entitled *Household Hazardous Waste: A Bibliography of Useful References and List of State Experts*. To order copies, call EPA's RCRA/Superfund hotline at 1-800-424-9346.

### *Reducing Exposure to Household Chemicals*

■ **Follow label instructions carefully.** Products often have warnings aimed at reducing exposure to the user. For example, if a label says to use the product in a "well-ventilated" area, go outdoors or in areas equipped with an exhaust fan to use the product, if possible. Otherwise, open windows to provide the maximum amount of outdoor air possible.

■ **Throw away partially full containers of old or unneeded chemicals safely.** Because gases can leak even from closed containers, this single step could do much to lower concentrations of organic chemicals in your home. (Be sure that materials you decide to keep are stored not only in a well-ventilated area but are also safely out of reach of children.) *Do not simply toss these unwanted products in the garbage can.* Find out if your local government or any organization in your community sponsors special days for the collection of toxic household wastes. If such days are available, use them to dispose of the unwanted containers safely. If no such collection days are available, think about organizing one.

■ **Buy limited quantities.** In the future, if you use pro-

ducts only occasionally or seasonally, such as paints, paint strippers, and kerosene for space heaters or gasoline for lawn mowers, buy only as much as you will use right away.

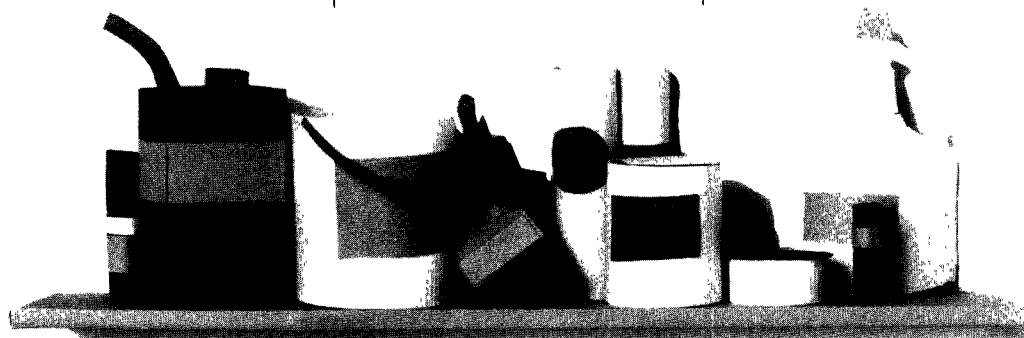
■ **Keep exposure to emissions from products containing methylene chloride to a minimum.** Consumer products that contain methylene chloride include paint strippers, adhesive removers, aerosol spray paints, and pesticide "bombs." Methylene chloride is known to cause cancer in animals. Also, methylene chloride is converted to carbon monoxide in the body and can cause symptoms associated with exposure to carbon monoxide. Carefully read the labels containing health hazard information and cautions on the proper use of these products. Use methylene chloride-containing products outdoors when possible; use indoors with as much ventilation as possible.

■ **Keep exposure to benzene to a minimum.** Benzene is a known human carcinogen. The main indoor sources of this chemical are environmental tobacco smoke, stored fuels and paint supplies, and automobile emissions in attached garages. Actions which will reduce benzene exposure include eliminating smoking within the home, providing for

maximum ventilation during painting, and discarding paint supplies and special fuels that will not be used immediately.

■ **Keep exposure to perchloroethylene emissions from newly dry cleaned materials to a minimum.** Perchloroethylene is the chemical most widely used in dry cleaning. In laboratory studies, it has been shown to cause cancer in animals. Recent studies indicate that people breathe low levels of this chemical both in homes where dry cleaned goods are stored and as they wear dry cleaned clothing. Dry cleaners recapture the perchloroethylene during the dry cleaning process so they can save money by reusing it and they remove more of the chemical during the pressing and finishing processes. Some dry cleaners, however, do not remove as much perchloroethylene as possible all of the time.

Taking steps to minimize your exposure to this chemical is prudent. If dry cleaned goods have a strong chemical odor when you pick them up, do not accept them until they have been properly dried. If goods with a chemical odor are returned to you on subsequent visits, try a different dry cleaner.



*Attached garages or workplace areas where petroleum products and old painting and cleaning supplies are stored can be major sources of organic air pollutants*

## FORMALDEHYDE

**F**ormaldehyde is an important chemical used widely by industry to manufacture building materials and numerous household products. It is also a by-product of combustion and certain other natural processes. Thus it may be present in substantial concentrations both indoors and outdoors.

Sources of formaldehyde in the home include smoking, household products, and the use of unvented, fuel-burning appliances, like gas stoves or kerosene space heaters. Formaldehyde, by itself or in combination with other chemicals, serves a number of purposes in manufactured products. For example, it is used to add permanent press qualities to clothing and draperies, as a component of glues and adhesives, and as a preservative in some paints and coating products.

In homes, the most significant sources of formaldehyde are likely to be pressed wood products made using adhesives that contain urea-formaldehyde (UF) resins. Pressed wood products made for indoor use include: *particleboard* (used as subflooring and shelving and in cabinetry and furniture); *hardwood plywood paneling* (used for decorative wall covering and used in cabinets and furniture); and *medium density fiberboard* (used for drawer fronts, cabinet doors, and furniture tops). Medium density fiberboard contains a higher resin-to-wood ratio than any other UF pressed wood product, and is generally recognized as being the highest formaldehyde-emitting pressed wood product.

Other pressed wood products, like softwood plywood

and flake or oriented strand-board, are produced for exterior construction use and contain the dark, or reddish-black colored phenol-formaldehyde (PF) resin. Although formaldehyde is present in both types of resins, pressed woods that contain PF resin generally emit formaldehyde at considerably lower rates than those containing UF resin.

Since 1985, HUD has permitted only the use of plywood and particleboard that conform to specified formaldehyde emission limits in the construction of prefabricated and mobile homes. In the past, some of these homes had elevated levels of formaldehyde because of the large amount of high-emitting pressed wood products used in their construction and because of their relatively small interior space.

The rate at which products

like pressed wood or textiles release formaldehyde emissions can change. Formaldehyde emissions will generally decrease as products age. When the products are new, high indoor temperatures or humidity can cause increased release of formaldehyde from these products.


During the 1970s, many homeowners had urea-formaldehyde foam insulation (UFFI) installed in the wall cavities of their homes as an energy conservation measure. However, many of these homes were found to have relatively high indoor concentrations of formaldehyde soon after the UFFI installation. Few, if any, homes are now being insulated with this product. Studies show that formaldehyde emissions from UFFI decline with time; therefore, homes in which UFFI was installed many years ago are unlikely to

have high levels of formaldehyde now unless the insulation is damp and there are cracks or openings in interior walls that expose the foam.

### *Health Effects of Formaldehyde*

Formaldehyde, a colorless, pungent-smelling gas, can cause watery eyes, burning sensations in the eyes and throat, nausea, and difficulty in breathing in some humans exposed at elevated levels (above 0.1 parts per million). High concentrations may trigger asthma attacks in people with asthma. There is some evidence that some people can develop chemical sensitivity after exposure to formaldehyde. Formaldehyde has also been shown to cause cancer in animals and may cause cancer in humans.





**EXTERIOR  
GRADE**

*Pressed wood products made with phenol-formaldehyde are sometimes stamped to indicate they are suitable for exterior use. In general, phenol-formaldehyde wood products emit less formaldehyde than wood products made with urea-formaldehyde.*

### *Reducing Exposure to Formaldehyde in Homes*

■ Ask about the formaldehyde content of pressed wood products, including building materials, cabinetry, and furniture before you purchase them. If you experience adverse reactions to formaldehyde, you may want to avoid the use of pressed wood products and other formaldehyde-emitting goods. Even if you do not experience such reactions, you may wish to reduce your exposure as much as possible by purchasing exterior-grade products, which emit less formaldehyde. For further information on formaldehyde and consumer products, call the EPA Toxic Substance Control Act (TSCA) assistance line (202-554-1404).

Some studies suggest that coating pressed wood products with polyurethane may reduce formaldehyde emissions for some period of time. To be effective, any such coating must cover all surfaces and edges and remain intact. Increase the ventilation and carefully

follow the manufacturer's instructions while applying these coatings. (If you are sensitive to formaldehyde, check the label contents before purchasing coating products to avoid buying formaldehyde-containing products, as they will emit the chemical for a short time after application.)

■ Maintain moderate temperature and humidity levels and provide adequate ventilation. The rate at which formaldehyde is released is accelerated by heat and may also depend somewhat on the humidity level. Therefore, the use of dehumidifiers and air conditioning to control humidity and to maintain a moderate temperature can help reduce formaldehyde emissions. (Drain and clean dehumidifier collection trays frequently so that they do not become a breeding ground for microorganisms.) Increasing the rate of ventilation in your home will also help in reducing formaldehyde levels.

### *PESTICIDES*

**A**ccording to an EPA survey, 9 out of 10 U.S. households use pesticides. One study by EPA suggests that 80-90 percent of most people's exposure to pesticides in the air occurs indoors and that measurable levels of up to a dozen pesticides have been found in the air inside homes. The amount of pesticides found in homes appears to be greater than can be explained by recent pesticide use in those households; other possible sources include contaminated soil or dust that floats or is tracked in from outside, stored pesticide containers, and household surfaces that collect and then release the pesticides.

EPA registers pesticides for use and requires manufacturers to put information on the label about when and how to use the pesticide. It is important to remember that the "-cide" in pesticides means "to kill." These products are *dangerous if not used properly*.

In addition to the active ingredient, pesticides are also made up of ingredients which are used to carry the active agent. These carrier agents are called "inerts" in pesticides because they are not toxic to the targeted pest; nevertheless, some "inerts" are capable of causing health problems. For example, methylene chloride,

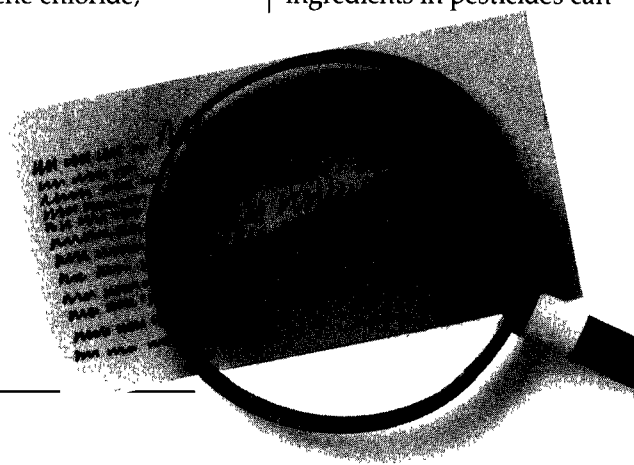
discussed under "Household Products," is used as an "inert."

Pesticides used in and around the home include products to control insects (insecticides), termites (termiticides), rodents (rodenticides), and fungi (fungicides). They are sold as sprays, liquids, sticks, powders, crystals, balls, and foggers or "bombs."

Chlordane, and three other related termiticides (the "cyclodienes") — heptachlor, aldrin, and dieldrin — deserve special attention because of their ability to remain active for long periods of time. In recent studies, air samples taken in homes soon after well applied termiticide treatments contained residues of these chemicals. As a result of these studies, EPA has taken a series of actions that led to the removal of these chemicals from the marketplace. All use of aldrin and dieldrin has been banned, while chlordane and heptachlor cannot be used until an application method that will not result in any measurable exposure to household occupants is successfully developed. Alternative termiticides are currently available, and EPA anticipates that manufacturers will soon apply to register others.

### *Health Effects From Pesticides*

Both the active and "inert" ingredients in pesticides can





be organic compounds; therefore, both can add to the levels of airborne organics inside homes. Both types of ingredients can cause the effects discussed in this booklet under "Household Products." However, there is little understanding at present about what concentrations are necessary to produce these effects.

Exposure to high levels of cyclodienes, commonly associated with misapplication, has produced various symptoms, including headaches, dizziness, muscle twitching, weakness, tingling sensations, and nausea. In addition, EPA is concerned that cyclodienes might cause long-term damage to the liver and the central nervous system, as well as increased risk of cancer.

### *Reducing Exposure to Pesticides in Homes*

- **Read the label and follow the directions.** It is illegal to use any pesticide in any manner inconsistent with the directions on its label. Unless you have had special training and are certified, never use a pesticide that is restricted to use by state-certified pest control operators. Such pesticides are simply too dangerous for application by a non-certified person. Use only the pesticides approved for use by the general public and then only in recommended amounts; increasing the amount does not offer more protection against pests and can be harmful to you and your plants or pets.

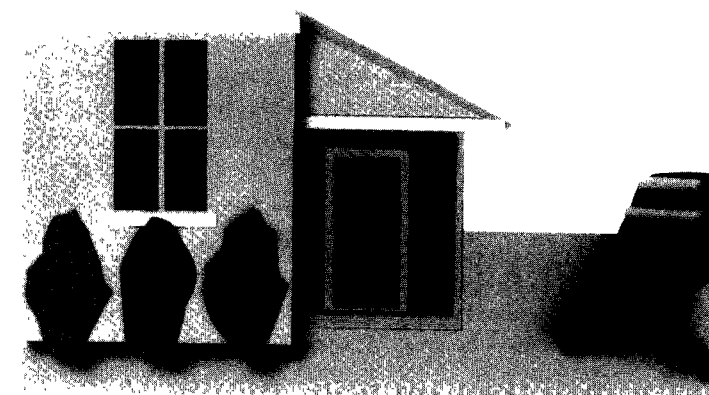
- **Use in well-ventilated areas.** Open windows when applying pesticides. Mix or dilute pesticides outdoors or in a well-ventilated area and only in the amounts that will

be immediately needed. If possible, take plants or pets outside when applying pesticides to them.

- **Use alternative non-chemical methods of pest control.** Since pesticides can be found far from the site of their original application, it is prudent to reduce the use of chemical pesticides outdoors as well as indoors. Depending on the site and pest to be controlled, one or more of the following steps can be effective: use of biological pesticides, such as *Bacillus thuringiensis* for the control of gypsy moths; selection of disease-resistant plants; and frequent washing of indoor plants or pets. Termite damage can be reduced or prevented by making certain that wooden building materials do not come into direct contact with the soil and by storing firewood away from the home. By appropriately fertilizing, watering, and aerating lawns, the need for chemical pesticide treatments of lawns can be dramatically reduced.

- **If you decide to use a pest control company, choose one carefully.** Ask for an inspection of your home and get a written control program for evaluation before you sign a contract. The control program should list specific names of pests to be controlled and chemicals to be used; it should also reflect any of your safety concerns. Insist on a proven record of competence and customer satisfaction.

- **Dispose of unwanted pesticides safely.** If you have unused or partially used pesticide containers you want to get rid of, dispose of them according to the directions on the label or on special household hazardous waste collection days. If



*There are simple steps people can take to prevent, reduce, or control pest infestations. Such techniques can become part of an overall pest management program (sometimes called "integrated" pest management) that relies on many techniques, not just chemicals.*



there are no such collection days in your community, work with others to organize them. (See suggestion under "Household Products.")

■ **Keep exposure to moth repellents to a minimum.** One pesticide often found in the home is paradichlorobenzene, a commonly used active ingredient in moth repellents. This chemical is known to cause cancer in animals, but substantial scientific uncertainty exists over what may be the effects, if any, of long-term human exposure to paradichlorobenzene. EPA requires that products containing paradichlorobenzene bear warnings such as "avoid breathing vapors" to warn users of potential short-term toxic effects. Where possible, paradichlorobenzene, and items to be protected against moths, should be placed in trunks or other containers that can be stored in areas that are separately ventilated from the home, such as attics and detached garages.

Paradichlorobenzene is also the key active ingredient in many air fresheners (in fact, some labels for moth repellents recommend that these same products be used as air fresheners or deodorants). Proper ventilation and basic household cleanliness will go a long way toward preventing unpleasant odors — thereby reducing or eliminating the need for air fresheners.

■ **Call the National Pesticide Telecommunications Network (NPTN).** EPA sponsors the NPTN (1-800-858-PEST) to answer your questions about pesticides and to provide EPA publications on pesticides. Two such EPA publications are *A Citizen's Guide to Pesticides and Termiticides Consumer Information*.

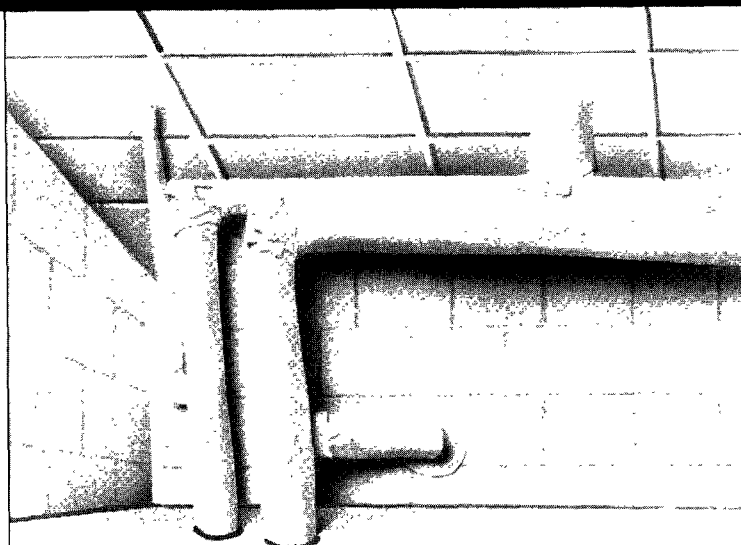
## ASBESTOS

**A**sbestos is a mineral fiber that has been used commonly in a variety of building construction materials for insulation and as a fire-retardant. EPA and CPSC have banned several asbestos products. Manufacturers have also voluntarily limited uses of asbestos. Today asbestos is most commonly found in older homes in pipe and furnace insulation materials, asbestos shingles, millboard, textured paints and other coating materials, and floor tiles.

Elevated concentrations of airborne asbestos can occur after asbestos-containing materials are disturbed by cutting, sanding, or other remodeling activities. Improper attempts to remove these materials can release asbestos fibers into the air in homes — increasing asbestos levels and endangering people living in those homes.

### Health Effects of Asbestos

The most dangerous asbestos fibers are too small to be visible. After they are inhaled, they can remain and accumulate in the lungs. Asbestos can cause lung cancer, mesothelioma (a cancer of the chest and abdominal linings) and asbestosis (irreversible lung scarring that can be fatal). Symptoms of these diseases do not show up until many years after exposure began. Most people with asbestos-related diseases were exposed to elevated concentrations on the job; some developed disease from exposure to clothing and equipment brought home from job sites.



### Reducing Exposure to Asbestos in Homes

■ **Learn how asbestos problems are created in homes.** Read the booklet, *Asbestos in the Home*, issued by CPSC and EPA. To order a copy of this publication send a postcard to *Asbestos in the Home*, Washington, DC 20207.

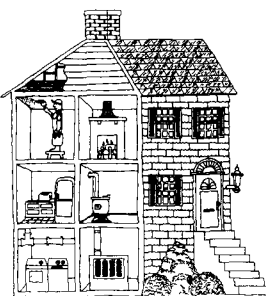
■ **If you think your home may have an asbestos problem, ask a trained professional to help determine whether your home has asbestos-containing materials and whether those materials are damaged or deteriorating.** Look to trained contractors, the manufacturer or installer of particular products or

materials in your home, your state asbestos program (if there is one), and your state health department for information on how to identify and remedy asbestos problems in your home.

■ **Do not cut, rip, or sand asbestos-containing materials.** Leave undamaged materials alone and, to the extent possible, prevent them from being disturbed, damaged, or touched. Inspect periodically for damage or deterioration.

■ **When you need to remove or clean up asbestos, use a professional, trained contractor.** Select a contractor only after careful discussion of the problems in your home and the steps the contractor will take to clean up or remove them. Consider the option of sealing off the materials instead of removing them. Call the EPA TSCA assistance line (202-554-1404) to find out whether your state has a training and certification program for asbestos removal contractors and for information on EPA's asbestos programs.

### Asbestos in the Home



U.S. Consumer Product Safety Commission U.S. Environmental Protection Agency

## LEAD

**L**ead has long been recognized as a harmful environmental pollutant. There are many ways in which humans are exposed to lead, including air, drinking water, food, and contaminated soil and dust. Airborne lead enters the body when an individual breathes lead particles or swallows lead dust once it has settled. Until recently, the most important airborne source of lead was automobile exhaust.

Lead-based paint has long been recognized as a hazard to children who eat lead-containing paint chips. A 1988 National Institute of Building Sciences (NIBS) Task Force report found that harmful exposures to lead can be created when lead-based paint is removed from surfaces by sanding or open-flame burning. The NIBS Task Force called for development of better and safer techniques to remove lead-

based paints and effective clean-up methods.

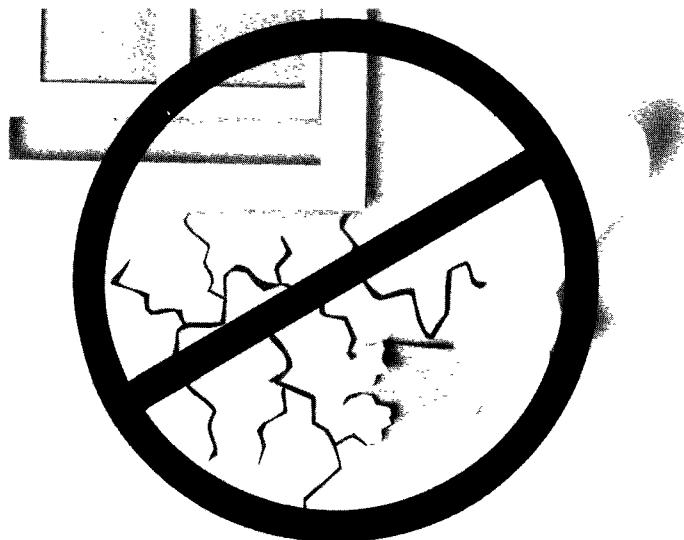
High concentrations of airborne lead particles in homes can also result from the lead dust from outdoor sources, contaminated soil tracked inside, use of lead in activities such as soldering, electronics repair, and stained glass art work.

### *Health Effects of Exposure to Lead*

Lead is toxic to many organs within the body at both low and high concentrations. Lead is capable of causing serious damage to the brain, kidneys, peripheral nervous system (the sense organs and nerves controlling the body), and red blood cells. Even low levels of lead may increase high blood pressure in adults.

Fetuses, infants, and children are more vulnerable to lead exposure than adults since lead is more easily absorbed into growing bodies, and the tissues of small children are more sen-

*Do not remove lead-based paint by scraping, sanding, or burning it off. Such removal techniques can result in lead levels in the air that are 10 to 100 times higher than normal.*



sitive to the damaging effects of lead. In addition, an equal concentration of lead is more damaging because of a child's smaller body weight. Children may also have higher exposures since they are more likely to get lead dust on their hands and then put their fingers or other lead-contaminated objects into their mouths. The effects of lead exposure on fetuses and young children include delays in physical and mental development, lower IQ levels, shortened attention spans, and increased behavioral problems.

### *Ways to Reduce Exposure to Lead*

■ **If you suspect that paint in your home contains lead, have it tested.** It has been estimated that lead paint was used in about two-thirds of the houses built before 1940; one-third of the houses built from 1940 to 1960; and some housing built since 1960. Consult your state health or housing department for suggestions on which private laboratories or public agencies may be able to help test your home for lead in paint.

■ **Leave lead-based paint undisturbed if it is in good condition and there is little likelihood that it will be eaten by children — do not sand or burn off paint that may contain lead.** Ordinary household cleaning methods are ineffective at removing lead dust produced by sanding and burning; vacuuming does not sufficiently reduce lead dust levels because the particles pass through the filtering system in ordinary vacuums. Repainting areas covered with lead-based paint is not recommended because steps to prepare the surface area, such as sanding or removing cracked paint, produce lead dust.

If paint is cracked or peeling, cover with wallpaper or some other building material or replace the painted surface. Also, consider having painted woodwork such as doors and molding taken out of the house and sent off-site for chemical removal.

If on-site removal of lead-based paint cannot be avoided, then everyone not involved in doing the removal should leave the building during the period that removal takes place — no matter whether it involves

*Since 1975, there has been a 95 percent reduction in the use of lead in gasoline due to the EPA lead-in-gasoline phasedown program and the replacement of older cars with newer cars that require the use of unleaded gasoline*

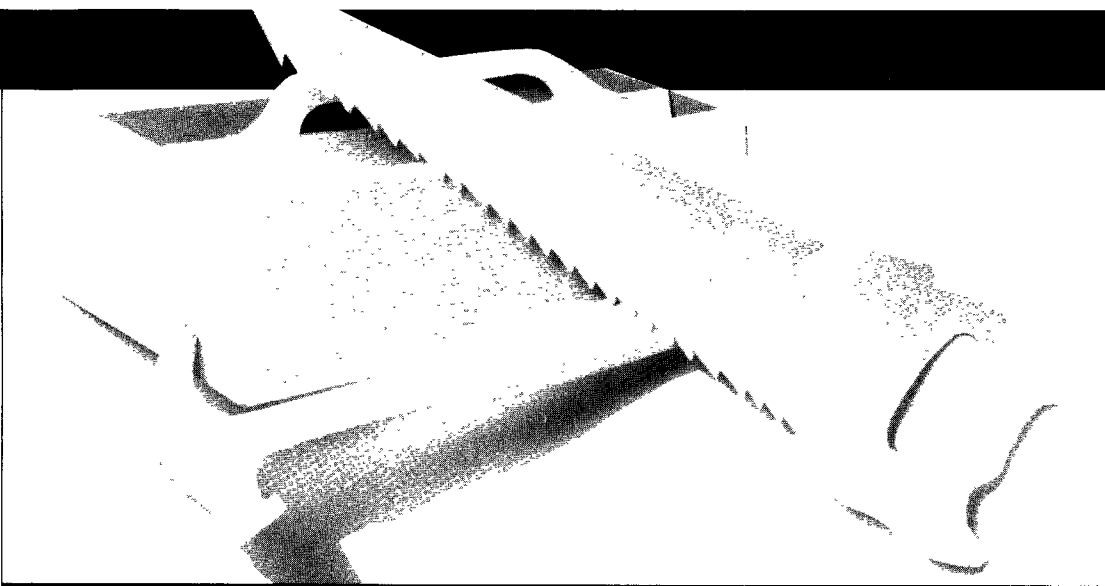
sanding, burning, or chemical stripping. Workers should be protected and thorough clean-up should follow removal.

■ People who may have been exposed to lead dust recently should have the lead levels in their blood tested by their doctor or local health department. If exposure occurred some time previously, a blood test may not be a reliable indicator of exposure and it may be advisable for exposed children or adults to have neurological tests done. If either test shows lead exposure has occurred, follow the advice of your doctor or health department.

■ Keep surface areas clean. Frequent cleaning of smooth surfaces, especially food preparation areas, with a wet cloth or mop can reduce the amount of lead dust that drifts or is tracked in from outdoors. However, lead dust will remain in carpeting and on furnishings.

■ Choose well-ventilated areas to engage in activities that involve the use of lead. As with other activities, increasing ventilation can reduce potential health effects by reducing the concentrations of indoor air pollutants. Consider using "no-lead" solder.

■ Have the drinking water in your home tested for lead. Homes most likely to have high lead levels in their water are those with lead-soldered plumbing that is less than 5 years old or those that have water service connections or interior plumbing made of lead. Send for the EPA pamphlet, *Lead and Your Drinking Water*, for more information about what you can do if you have lead in your drinking water.



## TO KEEP IN MIND IF YOU ARE BUILDING A NEW HOME

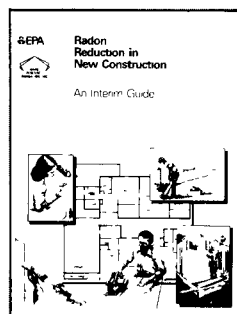
**B**uilding a new home provides the opportunity for *preventing* indoor air problems. However, it can also bring exposure to higher levels of indoor air contaminants if careful attention is not given to potential pollution sources and the air exchange rate.

Express your concerns about indoor air quality to your architect or builder and enlist his or her cooperation in taking measures to provide good indoor air quality. Talk both about purchasing building materials and furnishings that are low-emitting and about providing an adequate amount of ventilation.

The American Society of Heating, Refrigerating, and Air Conditioning Engineers recommends a ventilation rate of 0.35 ach (air changes per hour) for new homes, and some new homes are built to even tighter specifications. Particular care should be given in such homes to preventing the build-up of indoor air pollutants to high levels.

Here are a few important actions that can make a difference:

■ Use radon resistant construction techniques. Obtain a copy of the EPA booklet,



*Radon Reduction in New Construction: An Interim Guide*, from your state radon or health agency, your state homebuilders' association, your EPA regional office, or the EPA Public Information Center.

■ Choose building materials and furnishings that will keep indoor air pollution to a minimum. There are many actions a homeowner can take to select products that will prevent indoor air problems from occurring — a couple of them are mentioned here. First, use exterior-grade pressed wood products made with phenol-formaldehyde in floors, cabinetry, and wall surfaces. Or, as an alternative, consider using solid wood products. Secondly, do not permanently adhere carpets directly to cement floors because cement floors tend to be cold and moisture condenses on the carpet,

providing a place for mold and dust mites to grow. Also, carpets laid in this manner do not dry thoroughly if they get wet.

■ Provide proper drainage and seal foundations in new construction. Air that enters the home through the foundation can contain more moisture than is generated from all occupant activities.

■ Become familiar with how heat recovery ventilators (air-to-air heat exchangers) work and consider installing one. A whole-house heat recovery ventilation system permits occupants to enjoy the air quality benefits of drawing more outdoor air into the home while reducing the costs of heating or cooling this air.

■ Install exterior-vented air ducts into woodstove fireboxes and near fireplaces. The supplementary air supply from these ducts will provide adequate oxygen for complete combustion, minimize infiltration of cold outside air into the rest of the house, and prevent backdrafts from bringing combustion products back down the chimney. Do not close the duct until all embers are extinguished.

## DOES YOUR OFFICE SUFFER FROM "SICK BUILDING SYNDROME?"

**I**ndoor air quality problems are not limited to homes. In fact, many office buildings have significant air pollution sources. In addition, these buildings may be inadequately ventilated. For example, mechanical ventilation systems may not be designed or operated to provide adequate amounts of outside air. Finally, people generally have less control over the indoor environment in their offices than they do in their homes.

Some indoor air pollutants in office environments pose long-term risks (for example, the cancer risk from asbestos). In recent years, however, there has been an increase in the incidence of immediate health problems related to indoor air pollutants in office environments.

### HEALTH EFFECTS

**A** number of well-identified illnesses, such as Legionnaire's disease, asthma, hypersensitivity pneumonitis, and humidifier fever, have been directly traced to specific building problems. These are called *building-related illnesses*. Most of these diseases can be treated; nevertheless some can pose serious risks to some individuals.

Frequently, however, a significant number of building occupants experience symptoms that do not fit the pattern of any particular illness and are difficult to trace to any specific source. This phenomenon has been labeled *sick building syndrome*. People may complain of one or more of the following symptoms: dry or burning mucous membranes in the nose, eyes, and throat, sneezing, stuffy or runny nose, fatigue or lethargy, headache, dizziness, nausea,

irritability, and forgetfulness. Poor lighting, noise, vibration, thermal discomfort, and psychological stress may also cause, or contribute to, these symptoms.

There is no single manner in which these health problems appear. In some cases, problems begin as workers enter their offices and diminish as workers leave; other times, symptoms continue until the illness is treated. Sometimes there are outbreaks of illness among many workers in a single building; in other cases, health symptoms show up only in individual workers.

There are usually some occupant complaints about health and comfort in new buildings. In fact, the ventilation guidelines for indoor air quality set forth by the American Society of Heating, Refrigerating and Air Conditioning Engineers are intended to satisfy 80 percent of a building's occupants.

In the opinion of some World Health Organization experts, up to 30 percent of new or remodelled commercial buildings may have unusually high rates of health and comfort complaints from occupants that may potentially be related to indoor air quality.

### WHAT CAUSES INDOOR AIR PROBLEMS IN OFFICES?

**T**hree major reasons for poor indoor air quality in office buildings are the presence of indoor air pollution sources, poorly designed, maintained, or operated ventilation systems, and uses of the building that were unanticipated or poorly planned for when the building was designed or renovated.

### Sources of Office Air Pollution

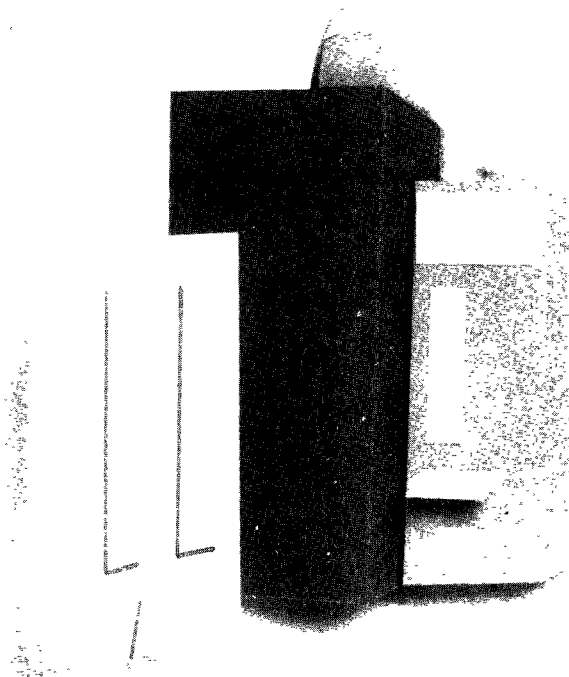
As with homes, the most important factor influencing indoor air quality is the presence of pollutant sources. Commonly found office pollutants and their sources include environmental tobacco smoke; asbestos from insulating and fire-retardant building supplies; formaldehyde from pressed wood products; other organics from building materials, carpeting, and other office furnishings, cleaning materials and activities, restroom air fresheners, paints, adhesives, copying machines, and photography and print shops; biological contaminants from dirty ventilation systems or water-damaged walls, ceilings, and carpets;

and pesticides from pest management practices.

### Ventilation Systems

Mechanical ventilation systems in large buildings are designed and operated not only to heat and cool the air, but also to draw in and circulate outdoor air. When they are poorly designed, operated, or maintained, however, ventilation systems can contribute to indoor air problems in several ways.

For example, problems arise when, in an effort to save energy, ventilation systems are not used to bring in adequate amounts of outdoor air. Inadequate ventilation also occurs if the air supply and return vents within each room are blocked or placed in such a



way that outside air does not actually reach the breathing zone of building occupants. Improperly located outside air intake air vents can also bring in air contaminated with automobile and truck exhaust, boiler emissions, fumes from dumpsters, or air vented from restrooms. Finally, ventilation systems can be a source of indoor pollution themselves by spreading biological contaminants that have multiplied in cooling towers, humidifiers, dehumidifiers, air conditioners, or the inside surfaces of ventilation ductwork.

### *Use of the Building*

Indoor air pollutants can be circulated from portions of the building used for specialized purposes, such as restaurants, print shops, and drycleaning stores, into offices in the same building. Carbon monoxide and other components of automobile exhaust can be drawn from underground parking garages through stairwells and elevator shafts into office spaces.

In addition, buildings originally designed for one purpose may end up being converted to use as office

space. If not properly modified during building renovations, the room partitions and ventilation system can contribute to indoor air quality problems by restricting air recirculation or by providing an inadequate supply of outside air.

### *Role of a Building Inspection in Correcting Problems*

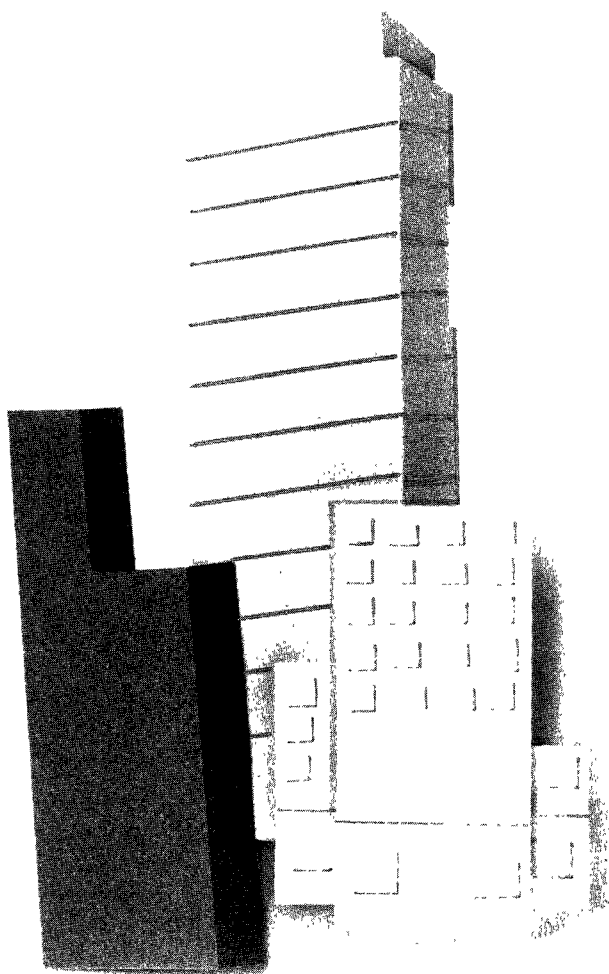
Frequently indoor air quality problems in large commercial buildings cannot be effectively identified or remedied without a comprehensive building investigation. These investigations may start with written questionnaires and telephone consultations in which building investigators assess the history of occupant symptoms and building operation procedures. In some cases, these inquiries may quickly uncover the problem and on-site visits are unnecessary.

More often, however, investigators will need to come to the building to conduct personal interviews with occupants, to look for possible sources of the problems, and to inspect the design and operation of the ventilation system and other building features. Because taking measurements of pollutants at the very low levels often found in office buildings is expensive and may not yield information useful in identifying problem sources, investigators may not take many measurements. The process of solving indoor air quality problems that result in health and comfort complaints can be a slow one, involving several trial solutions before successful remedial actions are identified.

### *WHAT TO DO IF YOU SUSPECT A PROBLEM*

If you or others at your office are experiencing health or comfort problems that you suspect may be caused by indoor air pollution, you can do the following:

- Talk with your own physician and report your problems to the company physician, nurse, or health or biosafety officer so that they can be added to the record of health complaints;
- Talk with your supervisor, other workers, and union representatives to see if the problems are being experienced by others and urge that a record of reported health complaints be kept by management, if one has not already been established;
- Ask the building manager to consider hiring a commercial company that conducts building investigations to diagnose the problem or problems and to suggest solutions. Carefully select such companies on the basis of their experience in identifying and solving indoor air quality problems in non-industrial buildings;
- Call the National Institute for Occupational Health and Safety (NIOSH) for information on obtaining a health hazard evaluation of your office (1-800-35NIOASH);
- Call your state or local health department or air pollution control agency to talk over the symptoms and possible causes; and
- Work with others to establish a smoking policy that minimizes non-smoker exposure to environmental tobacco smoke.



## WHERE TO GO FOR ADDITIONAL INFORMATION

### FEDERAL AGENCIES

**F**ederal agencies with indoor air responsibilities are listed below. Write to the addresses listed for the free materials mentioned earlier in this booklet.

**U.S. Environmental Protection Agency (EPA)**  
Public Information Center  
401 M Street SW  
Washington, DC 20460

**U.S. Consumer Product Safety Commission (CPSC)**  
Washington, DC 20207

#### *EPA Public Inquiry Phone Numbers*

**Public Information Center**  
202-382-2080  
Operates Monday to Friday  
from 8 to 5:30 Eastern Standard Time (EST).

**National Pesticides Telecommunications Network**  
National toll-free number:  
1-800-858-PEST  
In Texas:  
806-743-3091  
Operates 24 hours a day,  
every day of the year. Provides information about pesticides to the general public and the medical, veterinary, and professional communities.

**TSCA Assistance Information Service**  
202-554-1404  
Operates Monday through Friday from 8:30 to 5 EST. Provides information on regulations under the Toxic Substances Control Act and on EPA's asbestos programs.

**Safe Drinking Water Hotline**  
202-382-5533  
Operates Monday through Friday from 8:30 to 4:30 EST. Provides information on regulations under the Safe Drinking Water Act, radon in drinking water, and a list of state drinking water offices.

**RCRA/Superfund Hotline**  
National toll-free number:  
1-800-424-9346  
In Washington, DC:  
202-382-3000  
Operates Monday through Friday from 8:30 to 7:30 EST. Provides information on regulations under both the Resource Conservation and Recovery Act (including solid and hazardous waste issues) and the Superfund law.

#### *CPSC Public Inquiry Phone Numbers*

**CPSC Toll-free Hotline**  
Product Safety  
1-800-638-CPSC  
Teletypewriter for the hearing impaired (outside Maryland)  
1-800-638-8270  
Teletypewriter for the hearing impaired (Maryland only)  
1-800-492-8104

Recorded information is available 24 hours a day when calling from a touch-tone phone. Operators are on duty Monday to Friday from 10:30 to 4:00 EST to take complaints about unsafe consumer products.

### *CPSC Regional Offices*

**Eastern Regional Center**  
6 World Trade Center  
Vesey Street, 3rd Floor  
New York, NY 10048  
(212) 264-1125

**Central Regional Center**  
230 South Dearborn Street,  
Rm. 2944  
Chicago, IL 60604  
(312) 353-8260

**Western Regional Center**  
555 Battery Street, Rm. 401  
San Francisco, CA 94111  
(415) 556-1816

### *EPA Regional Offices*

Address inquiries to the  
Indoor Air Contacts in the  
EPA regional offices at the  
following addresses:

### **Region**

### **States in Region**

**Region 1**  
EPA  
John F. Kennedy  
Federal Bldg.  
Boston, MA 02203  
617-565-3232

Connecticut, Maine,  
Massachusetts, New  
Hampshire, Rhode  
Island, Vermont

**Region 2**  
EPA  
26 Federal Plaza  
New York, NY 10278  
212-264-2517

New Jersey, New York,  
Puerto Rico, Virgin  
Islands

**Region 3**  
EPA  
841 Chestnut Building  
Philadelphia, PA 19107  
215-597-9090  
215-597-4084 (radon)

Delaware, District of  
Columbia, Maryland,  
Pennsylvania, Virginia,  
West Virginia

**Region 4**  
EPA  
345 Courtland Street NE  
Atlanta, GA 30365  
404-347-2864

Alabama, Florida,  
Georgia, Kentucky,  
Mississippi, North  
Carolina, South  
Carolina, Tennessee

**Region 5**  
EPA  
230 S. Dearborn Street  
Chicago, IL 60604  
312-886-6054

Illinois, Indiana,  
Michigan, Minnesota,  
Ohio, Wisconsin

**Region 6**  
EPA  
Allied Bank Tower  
1445 Ross Avenue  
Dallas, TX 75202  
214-655-7214

Arkansas, Louisiana,  
Oklahoma, New Mexico,  
Texas

**Region 7**  
EPA  
726 Minnesota Avenue  
Kansas City, KS 66101  
913-236-2893

Iowa, Kansas, Missouri,  
Nebraska

**Region 8**  
EPA  
999 18th Street, Suite 500  
Denver, CO 80202  
303-293-1750

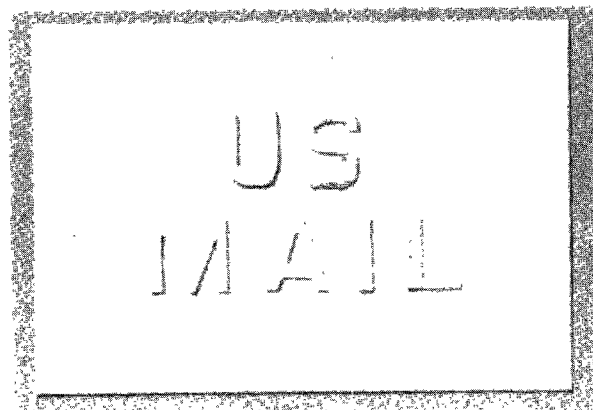
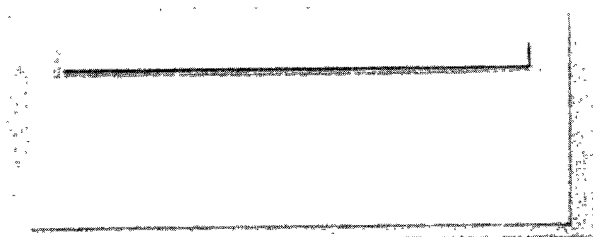
Colorado, Montana,  
North Dakota, South  
Dakota, Utah, Wyoming

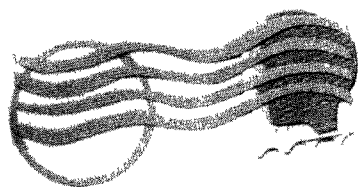
**Region 9**  
EPA  
215 Fremont Street  
San Francisco, CA 94105  
415-974-8381

Arizona, California,  
Hawaii, Nevada,  
American Samoa,  
Guam, Trust Territories  
of the Pacific

**Region 10**  
EPA  
1200 Sixth Avenue  
Seattle, WA 98101  
206-442-4226

Alaska, Idaho, Oregon,  
Washington





#### OTHER FEDERAL AGENCIES

**Bonneville Power Administration**  
Portland, OR 97208

**General Services Administration**  
18th and F Streets NW  
Washington, DC 20450

**Office of Conservation and Renewable Energy**  
U.S. Department of Energy  
1000 Independence Avenue SW  
Washington, DC 20585

**National Institute for Occupational Safety and Health**  
Hazard Evaluations and Technical Assistance Branch (R-9)  
Division of Surveillance, Hazard Evaluations and Field Studies  
U.S. Department of Health and Human Services  
4676 Columbia Parkway  
Cincinnati, Ohio 45226

**Office on Smoking and Health**  
U.S. Department of Health and Human Services  
Rockville, MD 20857

**Office on Energy and the Environment**  
U.S. Department of Housing and Urban Development  
Washington, DC 20410

**Occupational Safety and Health Administration**  
U.S. Department of Labor  
200 Constitution Avenue NW  
Washington, DC 20210

**Tennessee Valley Authority**  
Industrial Hygiene Branch  
328 Multipurpose Building  
Muscle Shoals, AL 35660

#### STATE AND LOCAL AGENCIES

**Y**our questions or concerns about indoor air problems can frequently be answered most readily by the government agencies in your state or local government. Responsibilities for indoor air quality issues are usually divided among many different agencies. You will often find that calling or writing the agencies responsible for health or air quality control is the best way to start getting information from your state or local government. The EPA publication, *Directory of State Indoor Air Contacts*, lists state agency contacts and is available at the EPA address listed on page 29.

#### PRIVATE SECTOR CONTACTS

**S**ome of the private sector organizations that have information for the public on indoor air quality issues are:

**American Institute of Architects**  
1350 New York Avenue NW  
Washington, DC 20006

**American Gas Association**  
1515 Wilson Boulevard  
Arlington, VA 22209

**Your local lung association or American Lung Association**  
1740 Broadway  
New York, NY 10019

**American Society of Heating, Refrigerating, and Air Conditioning Engineers**  
1791 Tullie Circle NE  
Atlanta, GA 30329

**Building Owners and Managers Association**  
1250 Eye Street NW, Suite 200  
Washington, DC 20005

**Consumer Federation of America**  
1424 16th Street NW, Suite 604  
Washington, DC 20036

**Edison Electric Institute**  
1111 19th Street NW  
Washington, DC 20036

**Safe Buildings Alliance**  
Metropolitan Square  
655 15th Street, NW  
Suite 12  
Washington, DC 20005

**National Association of Home Builders**  
Technology and Codes Department  
15th and M Streets NW  
Washington, DC 20005

**World Health Organization**  
Publications Center  
49 Sheridan Avenue  
Albany, NY 12210



## GLOSSARY



**Acid aerosol.** Acidic liquid or solid particles that are small enough to become airborne. High concentrations of acid aerosols can be irritating to the lungs and have been associated with some respiratory diseases, such as asthma.

**Allergen.** A substance capable of causing an allergic reaction because of an individual's sensitivity to that substance.

**Allergic rhinitis.** Inflammation of the mucous membranes in the nose.

**Animal dander.** Tiny scales of animal skin.

**Breathing zone.** The area of a room in which occupants breathe as they stand, sit, or lie down.

**Building-related illness.** Term that refers to a discrete, identifiable disease or illness. Can be traced to a specific pollutant or source within a building. (Contrast with "Sick building syndrome.")

**Chemical Sensitivity.** Evidence suggests that some people

can develop health problems characterized by effects such as dizziness, eye and throat irritation, chest tightness, and nasal congestion that appear whenever they are exposed to certain chemicals. People may react to even trace amounts of chemicals to which they have become "sensitized."

**Fungi.** Any of a group of parasitic lower plants that lack chlorophyll, including molds and mildews.

**Humidifier fever.** A respiratory illness that may be caused by exposure to toxins from microorganisms found in wet or moist areas in humidifiers and air conditioners. Also called air conditioner or ventilation fever.

**Hypersensitivity pneumonitis.** A group of respiratory diseases, including humidifier fever, that involve inflammation of the lungs. Most forms of hypersensitivity pneumonitis are thought to be caused by an allergic reaction triggered by repeated exposures to

biological contaminants. Humidifier fever may be an exception, distinguished from other forms of pneumonitis by the fact that it does not appear to involve an allergic reaction.

**Organic compounds.** Chemicals that contain carbon. Volatile organic compounds vaporize at room temperature and pressure. They are found in many indoor sources, including many common household products and building materials.

**Picocurie.** A unit for measuring radioactivity, often expressed as picocuries per liter of air.

**Polycyclic aromatic hydrocarbons.** A group of organic compounds. Some are known to be potent human carcinogens.

**Pressed wood products.** A group of materials used in building and furniture construction that are made from wood veneers, particles, or fibers bonded together with an adhesive under heat and pressure.

**Radon and radon decay products.** Radon is a radioactive gas formed in the decay of uranium. The radon decay products (also called radon daughters or progeny) are particles that can be breathed into the lung where they continue to release radiation as they further decay.

**Sick building syndrome.** Term that refers to a set of symptoms that affect a number of building occupants during the time they spend in the building and diminish or go away during periods when they leave the building. Cannot be traced to specific pollutants or sources within the building. (Contrast with "Building-related illness.")

**Ventilation rate.** The rate at which outside air enters and leaves a building. Expressed in one of two ways: the number of changes of outside air per unit of time (air changes per hour, or "ach") or the rate at which a volume of outside air enters per unit of time (cubic feet per minute, or "cfm").

Information provided in this booklet is based upon current scientific and technical understanding of the issues presented and is reflective of the jurisdictional boundaries established by the statutes governing the co-authoring agencies. Following the advice given will not necessarily provide complete protection in all situations or against all health hazards that may be caused by indoor air pollution.

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