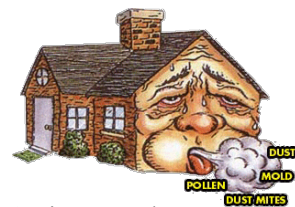


MOD 50: INDOOR AIR POLLUTANTS

For many years the study of air pollution was almost entirely confined to outdoor air. Indoor air was generally ignored because the outdoor air problems were much more visible and considered to be much more serious. Acid rain, smokestack emissions, dust, automobile and truck exhaust, and the smog and haze that plagued metropolitan areas placed heavy demands on the attention of scientists and the government.



Eventually, problems associated with the air we breathe indoors began to attract attention. Legionnaires' Disease and a variety of other human ailments led to such phrases as "sick buildings." Many health experts began calling for studies of the hazards of indoor air. Once the issue was raised, it was found that concerns about indoor air pollution in large buildings ran parallel to other concerns. For example, second-hand tobacco smoke carried by indoor air has been implicated as a significant health hazard for nonsmokers.

Most people are aware that outdoor air pollution can damage their health but many do not know that indoor air pollution can also have significant health effects. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels. These levels of indoor air pollutants may be of particular concern because the average American is indoors nearly 90 percent of the time (working in offices, factories, stores, schools, and other enclosed indoor spaces), and more than half of this is spent in the home.

Just as uncontrolled industrial processes can foul the air outside, many of industry's products, wonderful as they are, can contribute to air pollution in our homes. And this pollution can be trapped indoors. In past years, our need to save energy encouraged us to conserve it where we could. So we made our houses airtight, adding storm windows and insulation. We applied weather-stripping and caulking to seal cracks, and have increasingly turned to kerosene, wood and coal to help heat our homes. However, we have often ignored the effects of these measures on indoor air quality. This is the reason, researchers have found air pollution can be much greater inside the home than outside.

In recent years, comparative risk studies performed by EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top five environmental risks to public health. Good indoor air quality is an important component of a healthy indoor environment.

Failure to respond promptly and effectively to indoor air quality problems can have serious health consequences. Indoor air problems can be subtle, and do not always produce easily recognized impacts on health, wellbeing, or the home. In some cases, only one or a few individuals may be strongly affected by what appears on the surface to be psychosomatic in nature because the majority of the people living in the house do not appear to have any symptoms.

The people who are especially susceptible are the very ones who spend the most time at home. Children, pregnant women, the elderly, and people with lung disease become the major victims of indoor air pollution. The same concentrations of pollutants can result in higher body burden in children than adults because children breathe a greater volume of air relative to their body weight. For this and other reasons, air quality in homes is of particular concern. Proper maintenance of indoor air is more than a quality issue, it encompasses safety and stewardship of our investment in our family and home.

What makes indoor air pollution worse is that many of the contaminating substances give no warning and produce vague and sometimes similar symptoms that are hard to pin down to a specific cause. Some produce symptoms years later, when it's even harder to discover the cause.

Fortunately, based on research already done and recent research done on a variety of indoor pollutants, we can identify many of these harmful substances.

1. Explain why indoor air for a long time was generally ignored.

2. What eventually brought the attention of indoor air to many health experts?



3. Compare the amount of human exposure to indoor and outdoor air pollution today.

4. Why are the levels of indoor air pollutants of particular concern?

5. Explain how our need to conserve energy has led to greater indoor air pollution.

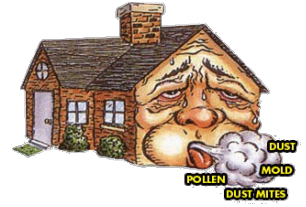
6. Identify the people who are most susceptible to indoor air pollution and why.

7. Why are children more susceptible to air pollution?

8. Explain why failure to respond promptly and effectively to indoor air quality problems can have serious health consequences.

SOURCES OF INDOOR AIR POLLUTION

Over the past several decades, our exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of personal care products, pesticides, and housekeeping supplies. In addition, our activities and decisions, such as deferring maintenance on home equipment to save money, can lead to indoor air problems.



The indoor environment in any building is a result of the interactions among the site, climate, building structure and mechanical systems (as originally designed and later modified), the construction techniques used, contaminant sources (what is outside, inside, and part of the building), and building occupants.

Indoor air pollutants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, indoor air quality problems can arise, even if the heating, ventilating, and air conditioning system (HVAC) is properly designed, operated, and maintained. Air contaminants consist of particles, dust, fibers, bioaerosols, and gases or vapors.

Biological contaminants are one of the major indoor air pollutants. These pollutants include bacteria, fungi (mold and mildew), viruses, animal dander, cat saliva, dust mites, and pollen, all from different sources. Bacteria are carried by people, animals, and soil and plant debris. Mold, mildew, and bacteria can grow in central air systems as well as in standing water or on water-damaged materials and wet surfaces. Viruses are transmitted by people and animals. House pets carry animal dander.

Dust mites are found in any damp, warm area. Pollen from outdoor plants is commonly found inside too. Health effects from biological contaminants can range from mild allergies to much more serious health problems. Dust mites are one of the most powerful biological contaminants, triggering allergic reactions, including severe asthma, in many people. They are related to ticks and spiders and thrive at temperatures around 25 degrees Celsius. These mites are found most commonly in house dust and in locations where organic debris, such as skin dander or insect parts, accumulates. They also are frequently found in food products. Humid or damp conditions usually lead to an increase in dust mites. Since dust mites are microscopic in size, they are easily overlooked. In a British study by Robert Harwood and Maurice James, a sampling of room air during and immediately following bed making found there were 44 to 136 mites per gram of airborne dust.

Although most bacteria are beneficial, there are a few forms of bacteria that are harmful, sometimes fatal, to humans. Transmission usually occurs indoors in two different ways. Bacteria can enter through the lungs when droplets that have been breathed, coughed, or sneezed out by an infected person are inhaled. Tuberculosis, diphtheria, whooping cough, and Legionnaires' Disease are a few of the diseases which can be contracted in this manner. Potentially pathogenic and allergy-causing bacteria have also been isolated from home and commercial heating and air conditioning systems.

Fungi are the plant group that includes molds, mushrooms, and yeast. They can grow as single cells (yeast) or as multicellular filamentous colonies (molds and mushrooms). Since fungi do not contain chlorophyll, they obtain their food by being either saprophytic (feeding on dead or decaying organic matter) or parasitic. High levels of potentially pathogenic or allergy-causing mold have been isolated from many buildings.

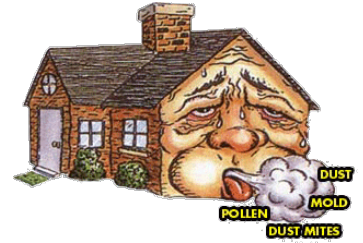
Large amounts of human skin (organic material) are shed each minute in most buildings. This material collects in air vents, rugs, and mattresses. These accumulations provide an excellent micro-climate for the growth and reproduction of mites, bacteria, and fungi.

Gas from small leaks and improperly used gas appliances can build up to hazardous levels. Certain types of building materials used in constructing homes can give off dangerous fumes, such as the formaldehyde which is emitted from some plywood. Stoves, heaters, and fireplaces give off smoke, soot, and gases that can be hazardous to human health.

Sometimes odors fool our senses; we may even deliberately create fumes that produce a pleasant atmosphere. Cooking food creates an enjoyable aroma, adding to our anticipation and enjoyment of the meal. However, some gases or particulate matter from cooking can add to indoor air pollution. Some may think the smell of a good pipe is linked to romance or masculinity, but second-hand smoke is dangerous. New leather smells good to many of us, but what we are smelling are the toxic chemicals used in leather production. Many so-called air fresheners are deliberately sprayed into the air or allowed to evaporate to add a pleasant odor, but they add pollutants to the indoor air.

Radon is a colorless, odorless gas that occurs naturally. It is found in all types of rock and soil at varying concentrations. It is found in most North American soils. Radon results from the radioactive decay of Radium-226. It can accumulate in basements and beneath buildings where there is little or no ventilation. At certain concentrations, it can cause an increased risk of cancer. It has been estimated that radon trapped in human living areas causes between 5,000 and 20,000 cases of lung cancer each year in the United States. Studies by the EPA indicate that as much as 10 percent of all American homes, or about 8 million homes, may have elevated levels of radon. Elevated radon levels can occur anywhere, even if you live in an area not noted for high radon levels. To find out if radon levels exceed normal standards, homes must be tested. EPA has developed for each state a publication, called "EPA's Radon Measurement and Proficiency Report," that lists firms and laboratories that have demonstrated their ability to accurately measure radon in homes.

1. Explain why over the past several decades, our exposure to indoor air pollutants has increased.



2. Describe the interactions that contribute to the indoor environment.

3. Identify one of the major indoor air pollutants and what it includes.

4. Describe dust mites.

5. Describe fungi.

6. Explain how large amounts of human skin can cause air pollution problems.

7. Explain how pleasant odors can often times fool our senses.

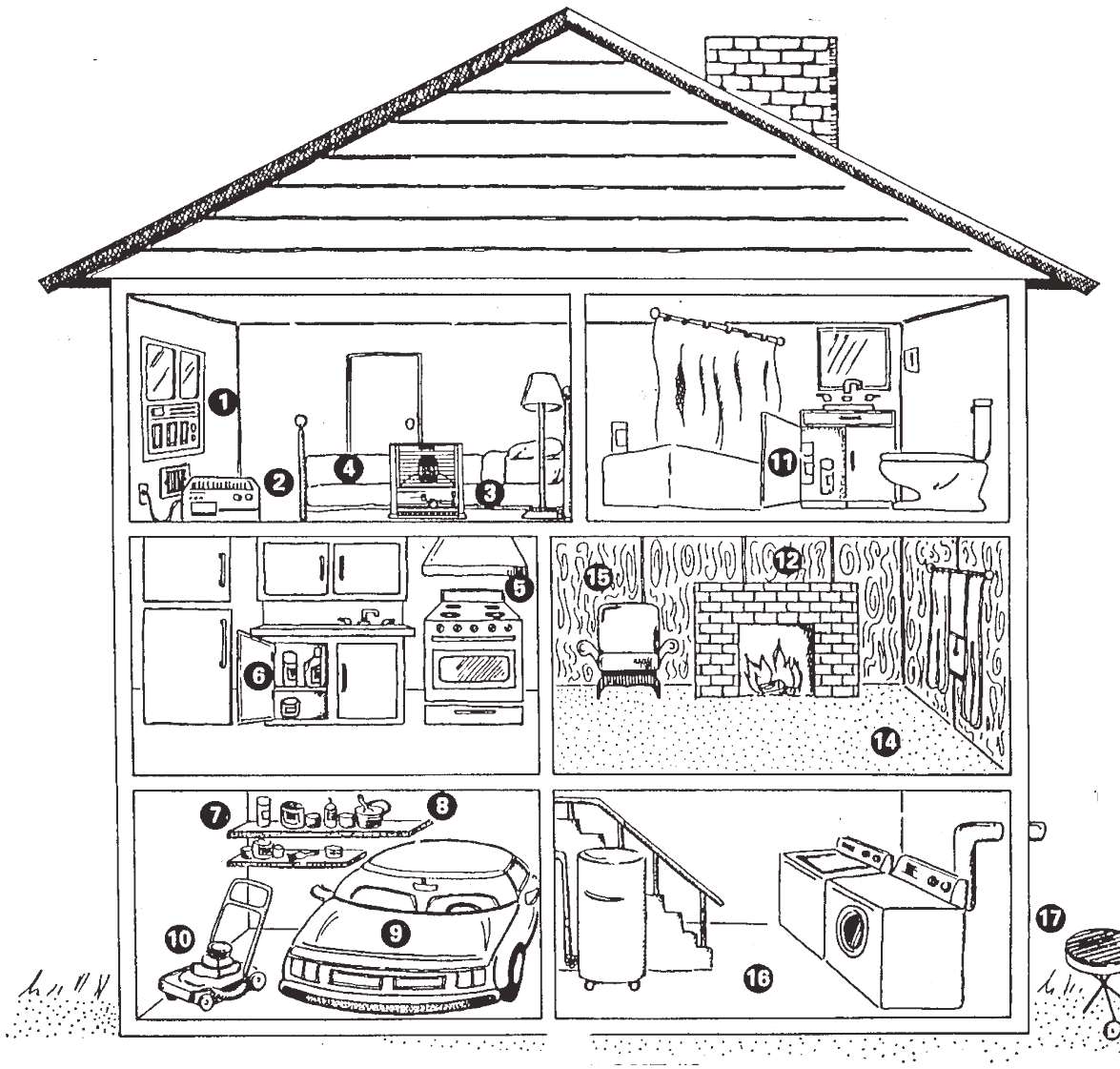
8. What is Radon and what are its dangers? _____

MAJOR INDOOR AIR POLLUTANTS

POLLUTANT	SOURCES	HEALTH EFFECTS	CONTROLS
NITROGEN DIOXIDE (NO₂) - Is a gas, an outdoor air pollutant, found in many homes. In some homes, indoor NO ₂ levels have been found to be much higher than outdoor levels.	Gas appliances (ranges, water heaters, clothes dryers, etc.), fireplaces, and wood and coal stoves can emit troubling amounts of nitrogen dioxide.	Nitrogen dioxide can contribute to eye and respiratory tract irritation and lower resistance to respiratory infection. Prolonged exposure to high levels of this gas can damage respiratory tissue and may lead to chronic bronchitis.	Don't use your gas oven to heat your home. Put a range hood over your gas range. Open a window and use a window exhaust fan while cooking. New gas appliances should use spark ignition rather than pilot lights, or select an electric appliance instead.
CARBON MONOXIDE - Is an odorless and colorless gas that also frequently pollutes the outdoor air. Some homes have concentrations above federal health standards.	Same indoor sources as nitrogen dioxide. It is also emitted by other combustion sources such as burning charcoal, gas engines running in attached garages or sheds, unvented kerosene heaters.	Reduces the ability of blood to deliver oxygen to vital tissues, affecting primarily the cardiovascular and nervous systems. Very high levels can cause death.	Have your gas range adjusted if the flame is yellow or orange instead of blue. Have gas or oil furnace, gas water heater and gas clothes dryer inspected at least once a year. Never leave an engine run in a garage.
FORMALDEHYDE (HCHO) - Is a gas that has a strong, unpleasant smell. Process of release is increased by high temperature and humidity.	Is found in dozens of household products and in cigarette smoke. The major sources in the home are the resins in particleboard, fiberboard, and plywood paneling; and some adhesives, carpet backing, upholstery, and drapery fabric.	Can cause headaches, dizziness, lethargy, nausea, and irritation of the eyes and upper respiratory tract. Lengthy and high level exposure may trigger an asthma attack and can cause permanent sensitization.	Remove the major sources; increasing ventilation; by using an appropriate air filter or heat exchanger; or by covering sources of the gas with appropriate coatings and sealers.
RADON (Rn) - Is a radioactive gas given off by soil or rock with trace amounts of uranium or radium, as these elements decay.	Is found in soil surrounding many homes, particularly uranium-containing soil such as granite, shale, phosphate, and pitchblende	Estimated to be the second leading cause of lung cancer, responsible for thousands of radon deaths each year in the U.S.	Testing is the only way to find out if a problem exists. Be sure to use a test kit that has passed EPA's testing program. Today, homes can be made to reduce radon by using radon-resistant construction features.
ASBESTOS - The name is given to a group of microscopic mineral fibers that are flexible, durable, and that will not burn. Asbestos fibers are light and small enough to remain airborne for long periods of time.	Many of thousands of asbestos products are found in the home—in roofing and flooring materials, wall and pipe insulation spackling compounds, cement, heating equipment, and acoustic insulation.	Can cause asbestosis (scarring of the lung tissue), lung cancer and mesothelioma, a relatively uncommon cancer of the lining of the lung or abdominal cavity.	Cover exposed, intact asbestos-containing material with plastic and duct tape to provide an airtight seal. If the asbestos materials is flaking or damaged, be sure to hire a professional to solve the problem.

POLLUTANT	SOURCES	HEALTH EFFECTS	CONTROLS
BIOLOGICAL POLLUTANTS - Many viruses, bacteria, molds, fungi and microscopic mites are common, even inevitable, indoor air pollutants.	Fungi and other microbes can be carried indoors by people and find nourishment in improperly maintained air conditioners, humidifiers, dehumidifiers, and air-cleaning filters. Plants, pets and pests are also potential sources of indoor allergens. High humidity levels indoors encourage the growth of microscopic dust mites, molds and mildew.	A host of illnesses and diseases may be cultivated in the circumstances just described under sources. These illnesses range from discomfort to severe illness.	Clean air conditioners, humidifiers
SECONDHAND SMOKE - This is the smoke a person may inhale from someone else's cigarette, cigar, or pipe.	Smokers not only endanger themselves, but others as well, through secondhand smoke. This kind of smoke contains carbon monoxide, formaldehyde, and many other gases and particles.	Secondhand smoke has been classified as a Group A carcinogen by the EPA, a rating used only for substances proven to cause cancer in humans. It is responsible for 3,000 lung cancer deaths. It is a health threat to those who have heart and lung disease.	Kick the cigarette habit. Refuse to allow smoking in your home.
TOXIC CHEMICALS - Potassium hydroxide, perchloroethylene, methylene chloride, mercury, paradichlorobenzene, and lead arsenate are just a few.	Cleaning agents, personal care products, pesticides, paints, hobby products and solvents. The average home contains some 45 aerosol products alone.	Can cause dizziness, nausea, allergic reactions, and eye, skin, and respiratory tract irritation.	Read all the print on the container and follow directions carefully when using products. Be sure to have adequate ventilation for the products you use. Use pump-type products instead of aerosols and substitute household products that contain non-toxic chemicals for ones with toxic chemicals.

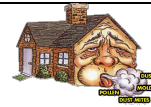
Source: Air Quality Environmental Resource Guide. Air & Waste Management Association, Pittsburgh, PA



Using the table of Major Indoor Pollutants with the diagram:

(a) Identify the numbered sources with their air pollutants.

(b) Identify health effects and controls for each.



	Air Pollutant	Health effects & Controls
Bedroom		
1. Air conditioner		
2. Humidifier/dehumidifier		
3. Kerosene space heater		
4. Bed		

Bathroom		
11. Personal care products		

Kitchen		
5. Gas appliances		
6. Cleaning products		

Garage		
7. Paints and hobby materials		
8. Pesticides		
9. Automobile engine		
10. Lawn mower		

Living Room		
12. Fireplace		
13. Wood or coal stove (not shown)		
14. Carpets and drapes		
15. Paneling		

Basement		
16. Furnace/gas water heater/gas clothes dryer		

Outdoors		
17. Charcoal grill		
18. Soil		