



# Children's Health Safe Workplaces & Healthy Learning Places: Environmentally Healthy Schools Continuing Education Contact Hours



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## Table of Contents

- [Abstract and Objectives](#)
  - [Introduction](#)
  - [Toxicology](#)
  - [Children's Special Vulnerabilities](#)
  - [Why Indoor Air Quality Is Important](#)
  - [Pesticides](#)
  - [Integrated Pest Management](#)
  - [Asbestos](#)
  - [Formaldehyde](#)
  - [Radon](#)
  - [Carbon Monoxide](#)
  - [Mercury](#)
  - [Environmentally Preferable Products](#)
  - [Management](#)
  - [Health and Safety Committees](#)
  - [Conclusion](#)
  - [Resources](#)
  - [References](#)
- 

## Abstract and Objectives

Every school day, parents send their children to school with the hopes that they will be healthy and safe and will receive an education. A variety of environmental risks may be posed in some schools that can make them potentially unsafe and unhealthy, and hinder children's ability to learn. This independent study module (ISM) provides the reader with a brief overview of some of the key environmental health risks associated with schools. Information is presented about the environmental exposures, signs and symptoms of toxicity, and the nurse's role as an agent of change to help encourage and produce healthy and safe schools. Children's special vulnerabilities are described, as well as child-specific information regarding the toxicity associated with exposures. Pesticides,

mercury, asbestos, formaldehyde, radon and carbon monoxide poisonings are discussed. Because indoor air quality can be an important variable affecting the learning process, a general section on this issue is presented. Suggestions are provided addressing environmental health and safety problems, including the use of health and safety committees, as well as advocacy education approaches. A resource section provides a brief listing of resources; many of them are websites, which, in turn will link the reader to additional resources. The EPA's website will be found to be particularly helpful, especially the children's section and the Indoor Air Quality Tools for Schools section, as well as the healthy schools network website. The purpose of this independent study module is to introduce the reader to basic concepts and issues associated with environmental health risks to children in schools. The University of Maryland has created a new web site, [envirn.umaryland.edu](http://envirn.umaryland.edu), that contains links to all of the websites noted in this ISM.

## Objectives

1. Describe children's special vulnerabilities.
2. Identify three environmental hazards that may affect children's health in schools.
3. Explain the nurse's advocacy role related to children's environmental health in schools.
4. Specify two resources that can provide information related to children's environmental health.
5. Discuss the goals and characteristics of integrated pest management.
6. List three asthma triggers that may be found in schools.
7. Describe two pollutants that contribute to indoor air pollution, their sources, and associated health effects.
8. Name two variables that may determine a relationship between exposure to a stressor and a health effect.

## Introduction

There have been two shifts in our environmental concerns since the early environmental movement in the 1960's and 1970's. The first has been a shift from a strictly ecological focus, where concerns centered on man's negative effects on the natural world, to concern specifically about the risks posed to human health. Even more focused has been our interest in children's health. The second shift has been to be more attentive to the environmental risks associated with the "built" environment: our homes, office buildings, and schools. This shift has helped to raise awareness about indoor air quality; the existence of and manner by which we control pests (including insects, molds, fungus/mildew, and rodents); and the health risks associated with the products that we use to construct buildings and those products that we bring into our homes, schools, and offices. Increasingly, concerns are being raised about school buildings, the built environment that one sixth of the U.S. population can be found in, Monday through Friday, during the school year. Our concerns are further heightened because the majority of people found in school buildings are children, who may have distinct vulnerabilities to environmental health risks.

There are some quick fixes that can be accomplished for school-based environmental health risks but some environmental health problems will have existed for years; identifying and reducing them may take time. Some risks are quite complex and will require changes in purchasing practices; rehab and renovation specifications; and upgrades of ventilation systems. The best way to address any of the problems will be from an informed position and with the support of others in the education setting. Take time to read the section on health and safety committees; health and safety committees can create a win-win platform for creating environmentally healthy schools that will be safe workplaces and healthy learning places.

## Toxicology

Toxicology, a critical science in environmental health, is the study of the negative effect of a physical stressor (chemical, biological, or radioactive) on a biological system (a cell, tissue, organ, organ system, or organism). The key variables in determining the relationship between an exposure to a stressor and a health effect are: 1) the "dose" of the exposure; 2) the "duration" of the exposure; 3) the "toxicity" or strength of the toxin; and 4) a variety of

"host factors" (such as age, sex, health status, other exposures). Environmental toxins can enter the human body by ingestion, inhalation, and dermal exposure. People may ingest toxic chemicals in their drinking water, as well as foods and beverages. Air pollutants can affect many body systems. Some toxic exposures, such as solvents and some pesticides, can be absorbed through the skin.

In the same way that the desired effects of pharmacological agents are dose-dependent and depend on host factors, the effects elicited by toxic chemicals in our environment are dose-dependent and dependent on host factors. This concept is extremely important when discussing children's special vulnerabilities to environmental exposures because a number of variables influence the dose of toxic chemicals to which children are exposed.

## Children's Special Vulnerabilities

Children are not just little adults. They are different in many ways, particularly with regard to their exposures and responses to the environment. As nurses, we know that infants and young children breathe more rapidly than adults. This increase in respiratory rate may translate into a proportionately greater exposure to air pollutants. While infants' lungs are developing, they may also be susceptible to environmental toxicants. Behaviors characteristic of early childhood also affect a child's exposure to toxicants. In the first years of life, the young child spends hours close to the ground where he or she may be exposed to toxicants in dust, soil and carpets as well as to pesticide vapors in low-lying layers of air. (Visit [www.cehn.org/cehn/WhatisPEH.html](http://www.cehn.org/cehn/WhatisPEH.html).)

Infants and young children drink more fluids per body weight than adults, potentially increasing their dose of contaminants found in their drinking water, milk, and juices (particularly pesticides). For example, the average infant's daily consumption of six ounces of formula or breast milk per kilogram of body weight is equivalent to an adult male drinking 50 eight-ounce glasses of milk a day (Bearer, 1995). Children also eat more per body weight and they eat different proportions of food. How many adults could eat the same amount of raisins pound-for-pound as the average two-year-old? Children consume many more fruits and fruit juices than adults, which may result in larger doses of exposure to pesticide residues.

Children play on the floor, the grass, and the playground, placing them at increased risk for exposure to toxic chemicals that may be applied to or settle on the floors or ground, including lead-based paint dust, cleaning product residues, and horticultural/agricultural chemicals (fertilizers, herbicides, pesticides). The hand-to-mouth exploration of the infant and young child that helps them to learn about their world also places them at higher risk of exposures. This is particularly true in the case of lead-based paint dust when it is present in houses and schools. Because metabolic systems are still developing in the fetus and child, their ability to detoxify and excrete toxins differs from that of adults. This difference is sometimes to the child's advantage, but more frequently they are not able to excrete toxins as well as adults, and thus are more vulnerable to them.

Children's bodies also function differently than adults. The rate at which children absorb nutrients from the gastrointestinal tract is likewise different than the rate for adults, a fact that can impact their exposure to toxicants. For example, children have a greater need for calcium for bone development than do adults and will absorb more of this element when it is present in the gastrointestinal tract. When lead has been ingested into the gut, however, the body will absorb it in place of calcium. Consequently, an adult will absorb 10 percent of ingested lead, while a toddler will absorb 50 percent of ingested lead (Bearer, 1995). And finally, some of the protective mechanisms that are well developed in adults, like the blood-brain barrier, are immature in young children, thereby making them more vulnerable to the effects of some toxic chemicals.

## Why Indoor Air Quality Is Important

Most people are aware that outdoor air pollution can pose health risks, 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 most people spend about 90 percent of their time indoors. Perhaps the most sensitive of school building inhabitants are asthmatic children. Based on a 1997 National Health Interview Survey (CDC, 2001), it was estimated that 25.7 million people had been diagnosed with asthma by a health professional in their lifetime. That estimate increased to 26.3 million in 1998. The highest prevalence was seen in children 5-17 years of age, with 130.1 per 1,000 in 1997 and 135.0 per 1,000 in 1998 (CDC, 2001). Asthma accounts for an estimated 10.1 million lost school days annually (CDC, 2001).

<b>Asthma Triggers Include</b>	
<b>Allergic Reactions:</b>	pollens, feathers, molds, animals, some Foods, house dust, latex
<b>Infections:</b>	Influenza, Pneumonia
<b>Second Hand Smoke Cockroaches Emotional Stress &amp; Excitement Vigorous Exercise Cold Air</b>	
<b>Occupational Dust &amp; Vapors:</b>	plastics, grains, metals, wood, sulfur dioxide, auto exhaust, grains, ozone
<b>Sleep (Nocturnal Asthma)</b>	
<b>Household Products:</b>	paint, cleaners, sprays, drugs, aspirin
<b>Heart Medications</b>	
<a href="http://www.lungusa.org/asthma/astastrig.html">www.lungusa.org/asthma/astastrig.html</a>	

In recent years, comparative risk studies performed by EPA and its advisory board have consistently ranked indoor air pollution among the top five environmental risks to public health. Children may be especially susceptible to air pollution. The same concentration of pollutants can result in higher body burdens in children than adults because children breathe a greater volume of air relative to their body weight.

Over the past several decades, our exposure to indoor air pollutants has increased due to a variety of factors, including the construction and renovation 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 to "save" money, can lead to problems from sources and ventilation. Indoor air pollutants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, indoor air quality (IAQ) problems can arise, even if the heating ventilation and air condition (HVAC) system is properly designed, operated, and maintained. Air contaminants consist of particles, dust, fibers, bioaerosols, and gases or vapors.

Indoor air pollutant concentration levels can vary by time and location within the school building, or even a single classroom. Pollutants can be emitted from point sources, such as science storerooms, or from area sources, such as newly painted surfaces. Also, pollutants can vary with time, such as only when floor stripping is done, or continuously, such as mold growing in the HVAC system.

<b>Unique Characteristics of Schools</b>
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- Occupants are close together, with the typical school having approximately four times as many occupants as office buildings for the same amount of floor space.
- Budgets are tight, with maintenance often receiving the largest cut during budget reductions.
- There are a variety of pollutant sources, including art and science supplies, industrial and vocational arts, home economic classes, and gyms.
- A large number of heating, ventilating, and air conditioning systems place an added strain on maintenance staff. As schools add space, the operation and maintenance of each addition is often different.
- Schools sometimes use rooms, portable classrooms, or buildings, which were not originally designed to service the unique requirements of schools.

Heating, ventilation, and air condition system design and operation can impact the temperature, humidity, and contaminant level in the building. The heating, ventilation, and cooling system includes all heating, cooling, and ventilating equipment serving a school: boilers or furnaces, chillers, cooling towers, air handling units, exhaust fans, ductwork, and filters. A properly designed and functioning HVAC system:

- Controls temperature and relative humidity to provide thermal comfort
- Distributes adequate amounts of outdoor air to meet ventilation needs of school occupants
- Isolates and removes odors and other contaminants through pressure control, filtration, and exhaust fans.

Not all HVAC systems are designed to accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control.

Nurses are often the only health care providers in the school setting. School nurses are aware of the health status of the students and those with particular vulnerabilities. This knowledge and awareness places school nurses in a special position to make a link between health effects experienced by the school population and the environmental conditions within the school. School nurses have a tremendous opportunity to educate students, parents, and staff and provide resources regarding IAQ issues. By tracking and documenting symptoms, and association with particular rooms or areas in the school building, nurses can provide a crucial role in connecting health complaints to the school environment.

Indoor Air Quality problems are most likely to affect those with preexisting health conditions and those who are exposed to tobacco smoke. Student health records should include information about known allergies and other medically documented conditions, such as asthma, as well as any reported sensitivity to chemicals. Privacy considerations may limit the student health information that can be disclosed, but to the extent possible, information about students' potential sensitivity to IAQ problems should be provided to teachers. This is especially true for classes involving potential irritants (e.g., gaseous or particle emissions from art, science, or industrial/vocational education sources).

### **Common Sources of Indoor Air Pollutants**

**Outside Sources**

**Polluted Outdoor Air**

- pollen, dust, mold spores
- industrial emissions, vehicle emissions

**Nearby Sources**

- loading docks
- odors from dumpsters
- unsanitary debris or building exhausts near outdoor air intakes

**Under Ground Sources**

- radon
- pesticides
- leakage from underground storage tanks

**Components and Furnishings**

**Components**

- mold growth on soiled or water-damaged materials
- dry traps that allow the passage of sewer gas
- materials containing volatile organic compounds, inorganic compounds, or damaged asbestos
- materials that produce particles (dust)

**Furnishings**

- emissions from new furnishings and floorings
- mold growth on or in soiled or water-damaged furnishings

**Equipment**

**HVAC Equipment**

- mold growth in drip pans, duct-work, coils, and humidifiers
- improper venting of combustion products
- dust or debris in duct-work

**Non-HVAC Equipment**

- emissions from office equipment (volatile organic compounds, ozone)
- emissions from shops, labs, cleaning processes

**Other Indoor Sources**

- science laboratories
- vocational arts areas
- copy/print areas
- food prep areas
- smoking lounges
- cleaning materials
- emissions from trash
- pesticides
- odors and volatile organic compounds from paint, caulk, adhesives
- occupants with communicable diseases
- dry-erase markers and similar pens
- insects and other pests
- personal care products

**Pesticides**

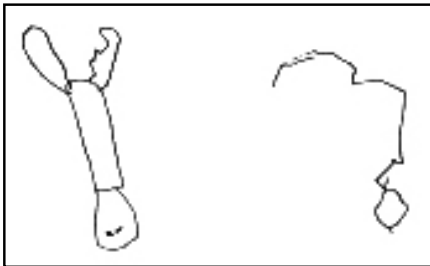
"Pesticides are substances intended to destroy, control or repel pests, such as insects, weeds, fungi, rodents, and bacteria. Depending upon the dose, pesticides may cause a range of harm such as cancer, acute or chronic injury to the lungs, nervous, reproductive, and endocrine and immune system damage and may accumulate in the environment. Children are at greater risk of pesticide exposure than adults because pound for pound of body weight, children not only eat more and breathe more, but they also have a more rapid metabolism than adults and they play on the floor and lawn where pesticides are commonly applied".

There is a growing body of scientific data about the harmful effects that pesticides have on children's health, both acute and chronic. Acute effects of exposure include eye and throat irritation, skin rashes, nausea, vomiting, diarrhea, headaches, flu-like symptoms, upper respiratory distress, and in extreme cases, death. Chronic effects (those that appear long after exposure) include an increased risk of some types of cancer, reproductive impairment, and neurological damage (US EPA, 1999). Several studies have examined the relationship between childhood cancers (brain cancer, Ewing's sarcoma, Wilm's tumor, acute lymphoblastic leukemia, non-Hodgkin's lymphoma) and pesticide exposures (McBride, 1998; Daniels, 1997; Buckley, 2000; Meinert, 2000; Infante-Rivard, 1999). The potential risks illustrated by these studies suggest a need for a precautionary approach when dealing with pesticide exposures and children.

Dr. Elizabeth Guillette (1998) identified two groups of Mexican children who were similar in all respects, but one, their exposure to pesticides. High levels of multiple pesticides were found in the cord blood of newborns that lived in an agricultural valley area as compared to children who lived in the foothills where pesticide use is avoided. Children in both groups were asked to draw a picture of a person. Their drawings (in [figures 1 and 2](#)) graphically illustrate the effect pesticides had on study participants' neurological development.

### 5-year-olds with sustained pesticide exposures

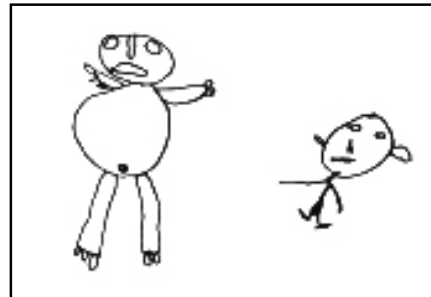
Draw a person



**Figure 1.**

### 5-year-olds without sustained pesticide exposures

Draw a person



**Figure 2.**

Routes of exposure to pesticides include inhalation, ingestion, and dermal penetration. Eighty percent of ambient exposures to pesticides occur indoors; measurable levels of up to a dozen pesticides have been found in the air inside of homes (US EPA, 1988).

## NURSING ACTIONS

### Obtain Indoor Air Quality: An Introduction for Health Professionals.

- Contact IAQ INFO, (800) 438-4318.

### Maintain Student Health Records

- Include information about sensitivities to IAQ problems in student health records.
- Allergies, including reports of chemical sensitivities.
- Asthma.
- Completed health records should exist for each student.
- Health records should be kept updated.

### **Track health-related complaints by students and staff.**

- Keep a log of health complaints that notes the symptoms, location and time of symptom onset, and exposure to pollutant sources.
- Watch for trends in health complaints, especially in timing or location of complaints.

### **Recognize indicators that health problems may be IAQ-related.**

- Complaints are associated with particular times of the day or week.
- Other occupants in the same area experience similar problems.
- The problem abates or ceases, either immediately or gradually, when an occupant leaves the building and recurs when the occupant returns.
- The school has recently been renovated or refurnished.
- The occupant has recently started working with new or different materials or equipment.
- New cleaning or pesticide products or practices have been introduced into the school.
- Smoking is allowed in the school.
- A new warm-blooded animal has been introduced into the classroom.

### **Inform students and staff about the importance of good hygiene in preventing the spread of airborne contagious diseases.**

- Provide written materials to students (local public health agencies may have information suitable for older students).
- Provide individual instruction/counseling where necessary.

### **Provide information to parents, staff and students about IAQ and health.**

- Help teachers develop activities that reduce exposure to indoor air pollutants for students with IAQ sensitivities, such as those with asthma or allergies (contact the American Lung Association [ALA], the National Association of School Nurses [NASN], or the Asthma and Allergy Foundation of America [AAFA]).
- Collaborate with parent-teacher groups to offer family IAQ education programs.
- Conduct a workshop for teachers on health issues that covers IAQ.

### **Establish an information and counseling program regarding smoking.**

- Provide free literature on smoking and secondhand smoke.
- Sponsor a quit-smoking program and similar counseling programs in collaboration with the ALA.

Environmental Protection Agencies' Indoor Air Quality Tools for Schools available on-line at [www.epa.gov/iaq/schools/toolkit.html](http://www.epa.gov/iaq/schools/toolkit.html).

## **Integrated Pest Management**

"Integrated pest management [IPM] is an increasingly useful approach to minimizing pesticide use while providing long-term pest control. It integrates both chemical and non-chemical methods to provide the least toxic alternative for pest control" (American Academy of Pediatrics, 1999). Traditional pest control has relied heavily on pesticides as the first plan of attack. IPM differs in that it does not automatically rely on pesticide application. Schools should

adopt an official IPM statement to serve as a guide for the process of development, implementation, and evaluation of a program. If no IPM program exists, a committee should be organized to develop a program.

## NURSING ACTIONS

- Know the signs and symptoms of pesticide poisoning and develop an emergency response plan for an acute poisoning. Information on the signs and symptoms of pesticide poisoning can be found in an EPA publication entitled *Recognition and Management of Pesticide Poisonings*. (Publication can be downloaded at <http://npic.orst.edu/rmppp.htm>)
- Influence pesticide management in schools by educating staff, parents, and students about the issues of pesticide exposure, alternatives to pesticide use, and IPM programs.
- Encourage school officials to adopt an official IPM approach to pest management.

**For more information on IPM in schools, the Environmental Protection Agency has the following resources available:**

**Pest Control in School Environments: Adopting Integrated Pest Management** is a brochure that identifies ways for schools to reduce dependence on pesticides in school buildings and landscapes and discusses alternative methods for managing pests commonly found in schools. To order a free copy, call (800) 490-9198.

[EPA's](#) web site on IPM in schools that provides information on EPA's efforts to reduce children's exposure to pesticide use in schools.

A national directory of IPM in schools web sites created to assist individuals with finding specific information about each state IPM program, as well as appropriate IPM state contacts is available at: [http://schoolipm.ifas.ufl.edu/ipm\\_org.htm](http://schoolipm.ifas.ufl.edu/ipm_org.htm).

**Other EPA publications include:**

- Recognition and Management of Pesticide Poisonings
- Pesticides and Food: What You and Your Family Need to Know
- Ten Tips to Prevent Pesticide and Lead Poisonings
- Citizen's Guide to Pest Control and Pesticide Safety

**To order free copies of the publications listed above, call (800) 490-9198.**

**The EPA has banned, or phased out the use of two older pesticides that do not provide an adequate margin of protection for children.**

**Chlorpyrifos** - On June 8, 2000, the EPA announced an agreement with chemical manufacturers to phase out the home and garden uses of this insecticide by the end of the year, but the agreement will allow existing stocks to be depleted. It will continue to be used on all foods (except tomatoes), golf courses, green houses, mosquitos, and for fire ant control. New home treatment for termites with chlorpyrifos will continue until December of 2005.

[More information](#)

**Diazinon** - The EPA has recently banned over-the-counter sales of the insecticide Diazinon. However, individuals may not be aware of this and may continue to use their inventories in homes and schools. The EPA has not yet eliminated all uses of Diazinon.

[More information](#)

**These chemicals should not be placed in the trash. Any inventories should be taken to a hazardous waste facility for disposal.**

### **General First Aid Guidelines For Pesticide Exposure:**

**Swallowed poison.** Induce vomiting ONLY if emergency personnel on the phone tell you to do so. It will depend on what the child has swallowed; some petroleum products or caustic poisons will cause more damage if the child is made to vomit. Always keep Syrup of Ipecac on hand (1 ounce for each child in the household) to use to induce vomiting if recommended by emergency personnel. Be sure the date is current.

**Poison in eye.** Eye membranes absorb pesticides faster than any other external part of the body; eye damage can occur in a few minutes with some types of pesticides. If poison splashes into an eye, hold the eyelid open and wash quickly and gently with clean running water from the tap or a gentle stream from a hose for at least 15 minutes. If possible, have someone else contact a Poison Control Center for you while the victim is being treated. Do not use eye drops or chemicals or drugs in the wash water.

**Poison on skin.** If pesticide splashes on the skin, drench area with water and remove contaminated clothing. Wash skin and hair thoroughly with soap and water. Later, discard contaminated clothing or thoroughly wash it separately from other laundry.

**Inhaled poison.** Carry or drag victim to fresh air immediately. If you think you need protection such as a respirator and one is not available to you, call the fire department and wait for emergency equipment before entering the area. Loosen victim's tight clothing. If the victim's skin is cyanotic or the victim has stopped breathing, give artificial respiration and call rescue service for help. Open doors and windows so no one else will be poisoned by fumes.

Additional pesticide product information can be obtained from the National Pesticide Telecommunications Network (NPTN) at (800) 858-7378. NPTN is a toll-free information service operated seven days a week from 6:30 a.m. - 4:30 p.m, PST (9:30 a.m. - 7:30 p.m. EST) , excluding holidays. [E-mail](#) | [Web site](#).

Also at NPTN is the National Antimicrobial Information Network (NAIN) which provides information about antimicrobial products - sanitizers, disinfectants, and sterilands. Telephone 1-800-447-6349, 6:30 a.m. - 4:30 p. m, PST excluding holidays. FAX: 1-541-737-0761. [E-mail](#) | [Web site](#) | Mailing address: NAIN, Oregon State University, 333 Weniger Hall, Corvallis, OR 97331-6502.

## Asbestos

Asbestos is a mineral fiber. It can be positively identified only with a special type of microscope. There are several types of asbestos fibers. In the past, asbestos was added to a variety of products to strengthen them and to provide heat insulation and fire resistance.

From studies of people who were exposed to asbestos in factories and shipyards, we know that breathing high levels of asbestos fibers can lead to an increased risk of lung cancer; mesothelioma, a cancer of the lining of the chest and the abdominal cavity; and asbestosis, in which the lungs become scarred with fibrous tissue. The risk of lung cancer and mesothelioma increases with the number of fibers inhaled. The risk of lung cancer from inhaling asbestos fibers is also greater for smokers. People who get asbestosis have usually been exposed to high levels of asbestos for a long time. The symptoms of these diseases do not usually appear until about 20 to 30 years after the first exposure to asbestos. Most people exposed to small amounts of asbestos, as we all are in our daily lives, do not develop these health problems. However, if disturbed, asbestos material may release asbestos fibers, which can be inhaled into the lungs. The fibers can remain there for a long time, increasing the risk of disease. Asbestos material that would crumble easily if handled, or that has been sawed, scraped, or sanded into a powder, is more likely to create a health hazard (Available on-line at [www.epa.gov/iaq/pubs/asbestos.html](http://www.epa.gov/iaq/pubs/asbestos.html)).

Intact, undisturbed asbestos-containing materials generally do not pose a health risk. They may become hazardous and pose increased risk when they are damaged, are disturbed in some manner such as during school renovation and repair, or deteriorate over time and thus release asbestos fibers into building air. In response to the Asbestos Hazard Emergency Response Act, EPA published the Asbestos-in-Schools Rule. The rule requires public and private elementary and secondary schools to inspect for friable (easily crumbled) and non-friable asbestos, develop management plans to address hazards, and conduct responses to eliminate the asbestos. The rule also specifies training, examination, and other requirements to accredit persons who do this work, and sets requirements for warning signs and transportation and disposal of materials containing asbestos. Additional information about the federal laws regulating asbestos in schools can be found on the EPA web site at [www.epa.gov/asbestos/pubs/asbestos\\_in\\_schools.html](http://www.epa.gov/asbestos/pubs/asbestos_in_schools.html).

## Formaldehyde

Formaldehyde is one in a large family of chemical compounds called volatile organic compounds or "VOCs." The term volatile means that the compounds vaporize at normal room temperatures. Some VOCs can cause watery eyes, burning sensations in the eyes, nose and throat, nausea, coughing, chest tightness, wheezing, skin rashes, and allergic reactions. Humidity and temperature will affect the off-gassing (release of gaseous chemicals from a solid material) of formaldehyde from products such as pressboard. Pressboard is commonly found in temporary school buildings. Although professional advice should be solicited to resolve concerns, the school can immediately respond to this concern by providing ventilation whenever possible.

## Radon

The EPA ranks indoor radon among the most serious environmental health problems facing us today. After smoking, it is the second leading cause of lung cancer in the United States causing an estimated fourteen thousand (14,000) lung cancer deaths a year. Radon is a naturally occurring gas that may seep into buildings from the surrounding soil. In some cases, well water may be a source of radon. You cannot see, taste, or smell radon. In fact, the only way to discover if high levels of radon are present is by testing.

The National School Radon Survey estimated 19.3 percent of U.S. schools, nearly one in five, have at least one

frequently occupied ground contact room with short-term radon levels above 4pCi/L - the level at which EPA recommends mitigation (US EPA, 1993). Radon can enter the school building or any other building when warm air rises, creating a vacuum in the lower areas of the school. Air seeps in from the soil around and under the school, and some air is sucked in through openings (cracks, doors, windows) on the lower levels. Radon gas decays into radioactive particles that can be trapped in the lungs. This can damage lung tissue and lead to lung cancer. An individual's risk of developing lung cancer from radon exposure depends on the dose and duration, as well as the presence of environmental tobacco smoke. [The EPA](#) recommends that all schools be tested for radon; as of February 1999 only 20 percent have been tested For additional information on radon, contact the National Safety Council at (800) SOS-RADON.

## Carbon Monoxide

### School Nurse Identifies Family's Chronic CO Poisoning

All the members of a family of four living in a Baltimore area townhouse were suffering from the symptoms of chronic carbon monoxide poisoning. These symptoms included: cold and allergy symptoms, headaches, dizziness, sinus pain and fatigue. The symptoms manifested slightly differently in each family member. The eight-year-old daughter was suffering recurrent headaches, dizziness and subsequent falls in school and became a frequent visitor to the nurse's office. The nurse became concerned, and after learning of the symptoms experienced by the rest of the family, instructed them to have the CO levels in their home checked. A Baltimore Gas & Electric technician verified that the levels in the home were very elevated.

Carbon monoxide is produced by the incomplete combustion of carbon materials; any flame or combustion device is likely to emit carbon monoxide. Carbon monoxide may be present in auto shops, home economics or other kitchen rooms, or in rooms that take in air from areas where buses or other vehicles idle. Carbon monoxide can get trapped inside an area when: appliances do not work properly; a stove or furnace is not working properly due to a clogged chimney or vent; a car or bus is left running in an enclosed space or near an air intake area; or a charcoal grill is used in a closed area (CPSC, 1993).

Carbon monoxide combines with hemoglobin to form carboxyhemoglobin, which is incapable of carrying oxygen, resulting in tissue anoxia. The health threat from exposure to CO is especially serious for those with cardiovascular disease. Healthy individuals may also be affected, but at higher levels of exposure. Early symptoms of exposure include flu-like symptoms (headache, fatigue, nausea). Principle manifestations of acute carbon monoxide poisoning are shortness of breath and a bright red color of mucus membranes (CPSC, 1993).

### CO Precautions:

- Make sure appliances are installed according to manufacturers' instructions and local building codes. Professionals should install most appliances. Have the heating system (including chimneys and vents) inspected and serviced annually.
- Install a CO detector/alarm. The label should reference UL standard 2034 or the requirements of the IAS 6-96 standard. A carbon monoxide detector/alarm can provide added protection, but is no substitute for proper use and upkeep of appliances that can produce CO.
- Be certain that cars and buses do not idle near the air intake vents for the school.

## Mercury

Mercury is a naturally-occurring element that is present throughout the environment. "Mercury contamination results from exposure through the air, water, food or soil, or through direct contact. Exposure to metallic mercury (as opposed to methylmercury that is ingested) occurs when it is not stored in a closed container. Contamination may include the spilling of metallic mercury on clothes, furniture, carpets, floors, walls, the natural environment, and even the human body. Metallic mercury and its vapors are extremely difficult to remove from items such as clothes, furniture, carpet, floors, and walls. The vapors will also accumulate in walls and other structures in contaminated rooms. The contamination can remain for months or years, posing a risk to exposed individuals" (Centers for Disease Control and Prevention, 1997).

"In the human body, mercury accumulates in the liver, kidney, brain, and blood. Mercury may cause acute or chronic health effects. Children exposed to metallic mercury for long periods may have trouble learning in school (Centers for Disease Control, 1997). Mercury is a recognized developmental neurotoxicant linked to mental retardation, gait and visual disturbances, neurological damage, and impairment of language, attention and memory. Repeated exposure to relatively low toxic levels can cause muscle tremor, irritability, personality changes or gingivitis." ( Reeder, R., 1995, p.2) Acute exposure (i.e., short term, high dose) is not common today due to greater precautions and decreased handling. However, acute effects may include severe gastrointestinal damage, cardiovascular collapse, or kidney failure, all of which could be fatal. Inhalation of 1-3 mg/m<sup>3</sup> for 2-5 hours may cause headaches, salivation, metallic taste in the mouth, chills, cough, fever, tremors, abdominal cramps, diarrhea, nausea, vomiting, tightness in the chest, difficulty breathing, fatigue, or lung irritation. Symptoms may be delayed in onset for a number of hours" (Michigan State University, 1996).

If a mercury spill occurs, there are specific methods that should be used for clean-up. First, notify the hazardous materials team, which may be part of the local fire department. A spill will require the evacuation of persons and animals from the contamination site, the use of special equipment and ventilation, and the need to assess the effects to people who have come in contact with the contamination site. For an explanation of this process see the website for [Health Care Without Harm](#).

## **NURSING ACTIONS**

Nurses can play a critical role in reducing mercury exposure from school settings, and consequently reducing mercury from our overall environment, including the waste stream. All mercury containing products in the school should be identified and replaced. Replace mercury thermometers with mercury-free ones. Make arrangements to safely dispose of whatever metallic mercury you might have in your school by calling your state department of the environment and asking for guidance from the hazardous materials section. Do not throw mercury products in the garbage. Garbage is incinerated or land-filled; both of these processes will release the mercury back to the environment. If no chemical management plan exists in the school, the nurse should advocate for the development of a health and safety committee (i.e. administrators, health care providers, staff, students, and parents) who can be responsible for the development and implementation of a chemical management plan, as well as an emergency response plan. Outside consultation should be obtained on areas that are beyond the scope of expertise represented in the committee.

### **Accident Spill Response**

Detailed instructions of how to clean up mercury spills can be found on the EPA web site at [www.epa.gov/epaoswer/hazwaste/mercury/faq/spills.htm](http://www.epa.gov/epaoswer/hazwaste/mercury/faq/spills.htm)

**[Possible Sources of Mercury in Schools](#)** (This list is not inclusive.)

<b>Product</b>	<b>Description</b>	<b>What To Do</b>	<b>Mercury-free Alternative</b>
Thermometers	Silver liquid in tube	Bring to hazardous waste facility	Alcohol or digital thermometer
Thermostats	All non-electrical models	When it needs replacing, call the national thermostat recycling program	Electronic "set back" models can help on energy bills
Fluorescent lights	Light bulbs in the form of long tubes	Continue to use these, but recycle them at the hazardous waste facility. Do not crush	None, although some new bulbs have less mercury than others
Old alkaline batteries	Bought before 1990	Bring to hazardous waste facility	Rechargeable batteries
Maze toys	contain a blob of mercury	Bring to hazardous waste facility	Mercury-free games
Old toys that light up or make noise	May contain mercury button batteries	Bring to hazardous waste facility	Toys that don't light up or make noise
Chemicals in school lab	May contain mercury products	Identify and bring to hazardous waste facility for disposal	Mercury free chemicals
Manometers on blood pressure cuffs	Contains mercury	Identify and bring to hazardous waste facility for disposal	Replace with non-mercury cuff
Arts and crafts supplies	May contain mercury	Identify and bring to hazardous waste facility for disposal	Mercury free supplies
Cleaning products	May contain mercury	Identify and bring to hazardous waste facility for disposal	Purchase non-toxic or less toxic cleaning products
Motion switches	May be found in cars in the auto shop	Use care not to break the switches if removing; bring to a hazardous waste facility	Use non-mercury switches if available

## **Environmentally Preferable Products**

The selection of building products, cleaning products, art and science supplies, and many other products that are used in schools can influence the health risks in the school. The use of less toxic products in schools is recommended by many as a zero to low-cost way to help protect indoor air quality in schools. In addition to creating indoor air quality pollution, hazardous chemicals often create pollution during their manufacture and disposal. Some pollute water and air; others must be disposed of as hazardous waste, or cause more harm when their containers are buried in landfills or burned in incinerators (Healthy Schools Network ).

Rubber cement, permanent felt tip markers, pottery glazes, enamels, spray fixatives, and other potentially hazardous materials are sold for use in schools, despite the fact that there are often animal and human studies demonstrating their toxicity. Chemicals used in arts and crafts supplies, and biological and chemical agents used for laboratory sciences, such as formaldehyde, may be toxic. Paints, glues, and other art, science, and vocational supplies contain chemicals that can be toxic to children and pollute the air. Industrial arts courses can expose children to metal dusts, fumes, and wood dust. Chemicals such as acetic acid, aminophenol, ammonia, hydrochloric acid, etc., are found in photo labs that often lack safety equipment and proper ventilation. Kiln firing can release clay dust, which can contain silica (known to cause fibrosis) and toxic gases such as carbon monoxide and heavy metals from the glazes. Home economics and theater exposures may include fabric dyes, oven cleaners, cosmetics, hairsprays, and fog and smoke effects generated from machines using glycols and mineral oil. Copy machines produce ozone that has been linked to lung problems and should be run only in well-ventilated rooms.

Of the 80,000 chemicals in commercial use today, only a very small fraction have been individually tested for toxicity. Unless a chemical is a food, drug, or cosmetic, there are virtually no requirements for complete toxicity testing (animal or human). The 1996 Food Quality Protection Act now requires more extensive testing of pesticides than previously required. Tests on various chemicals acting in combination with one another are practically non-existent. Despite this, a wide variety of toxic or hazardous products are routinely used in buildings. Schools are no different, except the majority of school occupants are children packed very close together. Nurses or facility managers should obtain Material Safety Data Sheets (MSDS) for any chemicals used in building. These can be obtained from the chemical manufacturer.

### Helpful EPP Websites

[The Healthy Schools Network](#) offers an 8-page guide on healthier cleaning and maintenance practices and products that promotes "green" housekeeping

[The Environmental Protection Agency EPP web site](#)

[Federal Trade Commission](#) provides guidance on the laws interpreting environmental marketing claims

[Green Seal](#) is an independent, nonprofit organization dedicated to protecting the environment by promoting the manufacture and sale of environmentally responsible consumer products

## Management

Involvement in product selection for use in our schools is of critical importance. Environmentally preferable purchasing (EPP) is an effective management tool defined by the [Executive Order 13101](#) [PDF] as "products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose...". Some common examples of EPP include purchasing paper products and cleansers that do not contain chlorine, and non-toxic all purpose cleaners and art supplies. Nurses should advocate for the development of EPP standards to be included in school purchasing policies.

## Indoor Air Quality Management Plan

The Environmental Protection Agency has developed a guidance tool that is designed to allow you to prevent and solve the majority of indoor air problems. It is called Indoor Air Quality: Tools for Schools. This IAQ Management Plan involves implementing the following steps on a periodic basis, at least once each year. The IAQ coordinator and team can perform the steps as presented, or the steps can be tailored to the specific needs of your school. The steps are grouped into three categories: Assess Current Status, Perform Repairs and Upgrades, and Final Steps. A thorough [description](#) of this tool can be found online.

1. Initiate a checklist log
2. Activate the IAQ team (Can be the same as the health and safety committee.)
3. Receive and summarize the IAQ checklists
4. Perform a walkthrough inspection
5. Assess radon status
6. Assess pest control program
7. Assess lead status
8. Identify recent changes that affect IAQ
9. Set repair and upgrade priorities
10. Gain consensus and approvals
11. Distribute status report
12. Perform repairs and upgrades

## Health and Safety Committees

Nurses who work in school settings and nurses who are parents to children in school settings can play a significant role in affecting the environmental quality of schools. Because there is no single person who can "make" a school environmentally healthy and safe, a good place to start is with a committee of people who may each play a role in improving the school's environment. In many workplaces, health and safety committees provide the structure through which to address conditions that may pose risks to health. Because schools are both workplaces for adults and learning places for children, creating a health and safety committee can provide a forum in which a multidisciplinary team can learn about health and safety issues; develop and exercise assessment capabilities; prioritize concerns and issues; develop an intervention plan; and provide a feedback loop regarding the success of the remediation and other intervention activities. A health and safety committee can also propose policies. Some of the people who could be considered for a school health and safety committee would be teachers, principals, parents, custodial staff, facilities managers, a school board representative, and even a student.

The Environmental Protection Agency has created an action kit entitled Indoor Air Quality Tools for Schools that provides a complete program that schools can implement to assess and address indoor air quality concerns. To obtain a kit at no cost, call the EPA clearing house at (800) 438-4318.

### **Some of the issues that should be addressed when considering the development of a health and safety committee in a school include:**

1. Who will chair the meetings? Will the group elect a chair? Will it be a member of the school's management? Should it be shared by a parent, employee, and principal (or other manager)? Should facilitation of the meetings be rotated? Who will take notes and how will they be distributed?
2. How often will the committee meet, for how long, and where? Will you include facilities "walk-through" as part of your meeting? Every meeting?
3. Once a problem is identified and an intervention suggested, who is responsible for its implementation? What is the recourse of the committee if the intervention is not implemented?
4. What is the appropriate mechanism for communicating to the whole school and parent community when a problem has been identified or any other finding or decisions of the committee, including recommendations for actions?

### **A Healthy and Safe Nurse's Office**

What a nurse can do in his or her immediate domain:

- Eliminate the mercury thermometers and mercury blood pressure cuffs. Replace them with non-mercury ones. (Make sure that the mercury containing ones are disposed of properly because they are considered hazardous waste.) See [www.noharm.org](http://www.noharm.org)
- Eliminate latex-containing products, particularly latex gloves. Many children and adults are allergic to latex. See [ANA's latex](#) web site.
- Request that the health suite NOT be routinely sprayed with pesticides, especially if your school has a regularly scheduled pesticide application. Employ IPM techniques if pests are noted. See: [www.childproofing.org/poisonedschoolsmain.html](http://www.childproofing.org/poisonedschoolsmain.html)
- Check the ventilation in the health suite. Are the vents free from obstruction? Do you know where the "fresh air" intake is located? Check to make sure that the intake is in a location that is as healthy as possible. See: [www.epa.gov/iaq/schools/tfs/guide5.html](http://www.epa.gov/iaq/schools/tfs/guide5.html).
- If there are any signs of moisture problems, request that maintenance repair the problem.
- Check to see if there is lead-based paint in your suite.
- Since sick students and staff frequent the health office, it is important to take steps that can help prevent transmission of airborne diseases.
  - Ensure that the ventilation system is properly operating.
  - See that air filters are clean and properly installed.
  - Question whether air removed from the health suite circulates through the ventilation system into other occupied areas. If so, request that this situation be addressed.
  - Obtain Material Safety Data Sheets (MSDS) for any chemicals used in building from the chemical manufacturer.

## **Conclusion**

Nurses are becoming increasingly involved in environmental health issues. In this article, some of the key environmental health risks found inside schools have been presented, including pesticides, mercury, asthma

triggers, formaldehyde, and carbon monoxide. Children's special vulnerabilities to environmental exposures were explored, especially as they pertain to the school-aged children. Nursing actions to reduce environmental exposures in schools were outlined, including directions for creating an environmentally-healthy nursing suite. Additionally, guidance was provided regarding collective action and advocacy through the creation of and participation in environmental health and safety committees.

Nurses are vital members of the community in identifying and addressing environmental health issues and must begin to prepare themselves better for this role. There are several great resources that can assist you in your quest for an environmentally healthy school. The ANA's health and safety staff are a wealth of information. The Office of Children's Health Protection and the Indoor Environments Division at the EPA are extremely helpful, as are the national non-profit organizations: The Children's Environmental Health Network, the Healthy Schools Network, The Children Health and Environment Coalition, and The Center for Health and Environmental Justice (See the [resource section](#) for web site addresses). And finally, the University of Maryland has created a unique [web site](#) for nurses on environmental health.

Nurses in the community (school nurses, public and community health nurses, and nurse-parents) can all play a significant role in the environmental health status of our schools. Nurses are trusted members of the community, seen as having the best interest of the community in mind. This trust can help nurses be educators and agents of change on environmental issues.

## Resources

[EnviRN.umaryland.edu](#): a one-stop shop created by the University of Maryland School of Nursing for nurses interested in environmental health.

American Nurses Association: see [RN noharm/Pollution page](#) for more on environmental health issues.

United States Environmental Protection Agency (EPA)

- A free copy of EPA's IAQ Tools for Schools call: (800) 438-4318
- IAQ Tool for Schools: [www.epa.gov/iaq/schools](http://www.epa.gov/iaq/schools)
- Safe Drinking Water Hotline: (800) 426-4791
- Safe Water Web Site: [www.epa.gov/safewater](http://www.epa.gov/safewater)
- Surf Your Watershed" Database: [www.epa.gov/surf](http://www.epa.gov/surf)
- Info on private wells: [www.epa.gov/safewater/pwells1.html](http://www.epa.gov/safewater/pwells1.html)
- Office of Pesticides, telephone: (703) 305-5017; web site: [www.epa.gov/pesticides](http://www.epa.gov/pesticides)
- Integrated Pest Management (IPM) in Schools, online at: [www.epa.gov/pesticides/ipm](http://www.epa.gov/pesticides/ipm)
- Healthy School Environment Resources, Chemical Cleanout: [http://cfpub.epa.gov/schools/top\\_sub.cfm?t\\_id=361&s\\_id=365](http://cfpub.epa.gov/schools/top_sub.cfm?t_id=361&s_id=365)
- Children's page: [www.epa.gov/children](http://www.epa.gov/children)
- The National Lead Information Center: (800) 424-LEAD
- EPA Lead Programs: [www.epa.gov/lead](http://www.epa.gov/lead)
- HUD Lead Programs: [www.hud.gov/offices/lead](http://www.hud.gov/offices/lead)
- National Pesticide Telecommunications Network: 1-800-858-7378
- Mold Remediation in Schools and Commercial Buildings: [www.epa.gov/mold/intro.html](http://www.epa.gov/mold/intro.html)
- Healthy School Environments Assessment Tool (HealthySEAT) is a unique software developed by EPA to help school districts evaluate and manage their school facilities for key environmental, safety and health issues: [www.epa.gov/schools/healthyseat](http://www.epa.gov/schools/healthyseat)

Children's Environmental Health Network: [www.CEHN.org](http://www.CEHN.org)

Healthy Schools Network: [www.healthyschools.org](http://www.healthyschools.org)

Center for Health, Environment and Justice: [www.chej.org](http://www.chej.org)

National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC) NCEH Provides expertise in environmental pesticide surveillance and disease outbreak investigations. Visit [www.cdc.gov/nceh/default.htm](http://www.cdc.gov/nceh/default.htm)

Consumer Product Safety Council: [www.cpsc.gov](http://www.cpsc.gov)

Agency for Toxic Substance Disease Registry (ATSDR): For fact sheets and information on pesticides: [www.atsdr.cdc.gov/toxfaq.html](http://www.atsdr.cdc.gov/toxfaq.html)

[ATSDR](http://www.atsdr.cdc.gov) Information Center toll-free at 1-888-422-8737 or e-mail [ATSDRIC@cdc.gov](mailto:ATSDRIC@cdc.gov)

Preventing Harm:

This is a resource and action center on children and the environment. Visit [www.preventingharm.org](http://www.preventingharm.org)

Health Care Without Harm: [www.noharm.org](http://www.noharm.org)

The American Lung Association: [www.lungusa.org](http://www.lungusa.org), (800) LUNG-USA

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