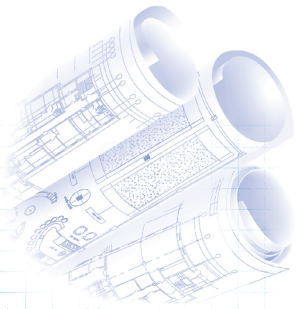
The Northeast Resource Recovery Association

NRRA School CLUB

SCHOOL HazMat 101

A Blueprint for HAZARDOUS MATERIAL MANAGEMENT in Schools

Activities and Information on Hazardous Material Management



Come forth into the light of things,
let Nature be your teacher.

—William Wordsworth

Brought to you by

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10. Producing reports on activities, achievements, problems identified and future goals.

Assisting schools, towns and districts to develop a cooperative effort to avoid the creation of different, uncoordinated databases.

PREFACE

Why a Hazardous Waste Manual for Schools?

Schools face increasingly complicated social and economic issues. As society acknowledges its connection to the environment, schools are adding environmental concerns to their issues lists. The National School Board Association says the school's environmental responsibility extends to three areas:

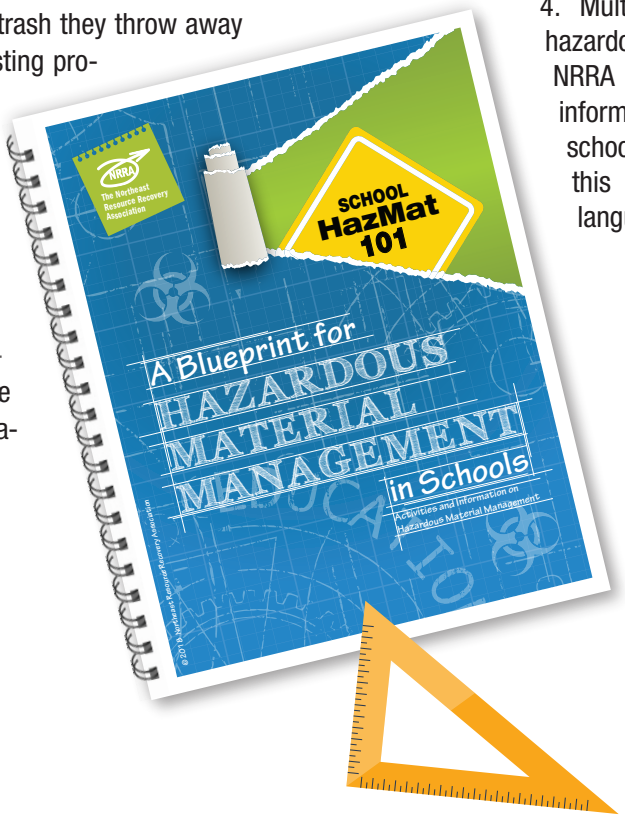
- Reducing or eliminating potential sources of risk to human health and the environment;
- Using natural resources responsibly; and,
- Educating students and the community on environmental issues.

Many schools incorporate environmental issues into the curriculum. They are reducing the amount of trash they throw away by recycling and, more recently, composting programs are becoming the materials management strategy for schools. Schools lead their communities in waste reduction efforts by redefining waste and proclaiming a commitment to natural resource management education. These are important first steps. Schools must continue to model environmentally responsible behavior in the classroom by looking at the types of materials they use and throw away.

How the Manual Developed

Developing the manual involved first-hand experience and research, including:

1. School visits to determine what hazardous materials are in use, estimate hazardous waste generation, and identify common issues among the staff.
2. Interviews with people within school systems and state agencies who want to create better hazardous materials management systems for schools.
3. Networking with professionals across the country to determine how other school systems manage hazardous materials.
4. Multitudes of technical resources on hazardous materials management exist. NRRA ascertained what management information was relevant to the school community and translated this information into less technical language.



How We Organized the Manual

Chapters I - III are for both the administration and the personnel who use hazardous materials. It discusses:

- Trends in hazardous materials use and waste management in schools.
- Common concerns surrounding hazardous materials use in schools.
- General hazardous materials management information.
- Strategies for long-term change.

Chapters IV - VII discuss hazardous materials management issues as they relate to the:

- maintenance department
- art department
- industrial art/vocational department
- science department

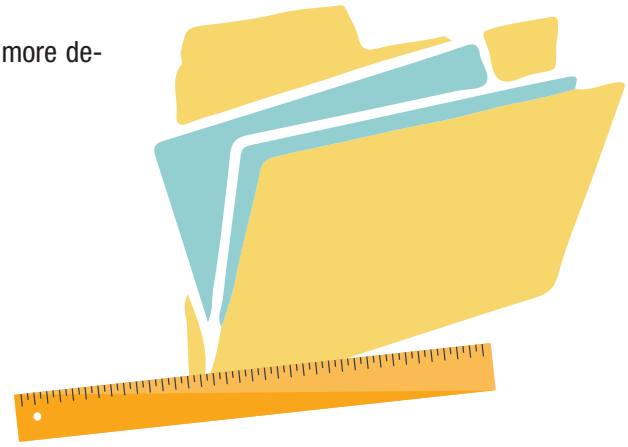
Chapter VIII, the Resource Section, lists where to get more detailed information from:

- federal regulatory agencies
- educational organizations
- business and industry associations
- books

The Manual Is the First Step

This manual is full of information and resources to help you make your school safe and environmentally responsible. It is a management tool: it does not contain everything you need to know about hazardous materials and it will not keep your school abreast of new information and regulation changes. Stay in contact with local and state agencies to ensure your school's practices adhere to current regulations. Use the Manual's Resource Section to find sources for more in-depth information on particular materials

This manual provides a starting point for hazardous materials management. It will help you design a structure for creating long-term change in how your school handles hazardous materials.

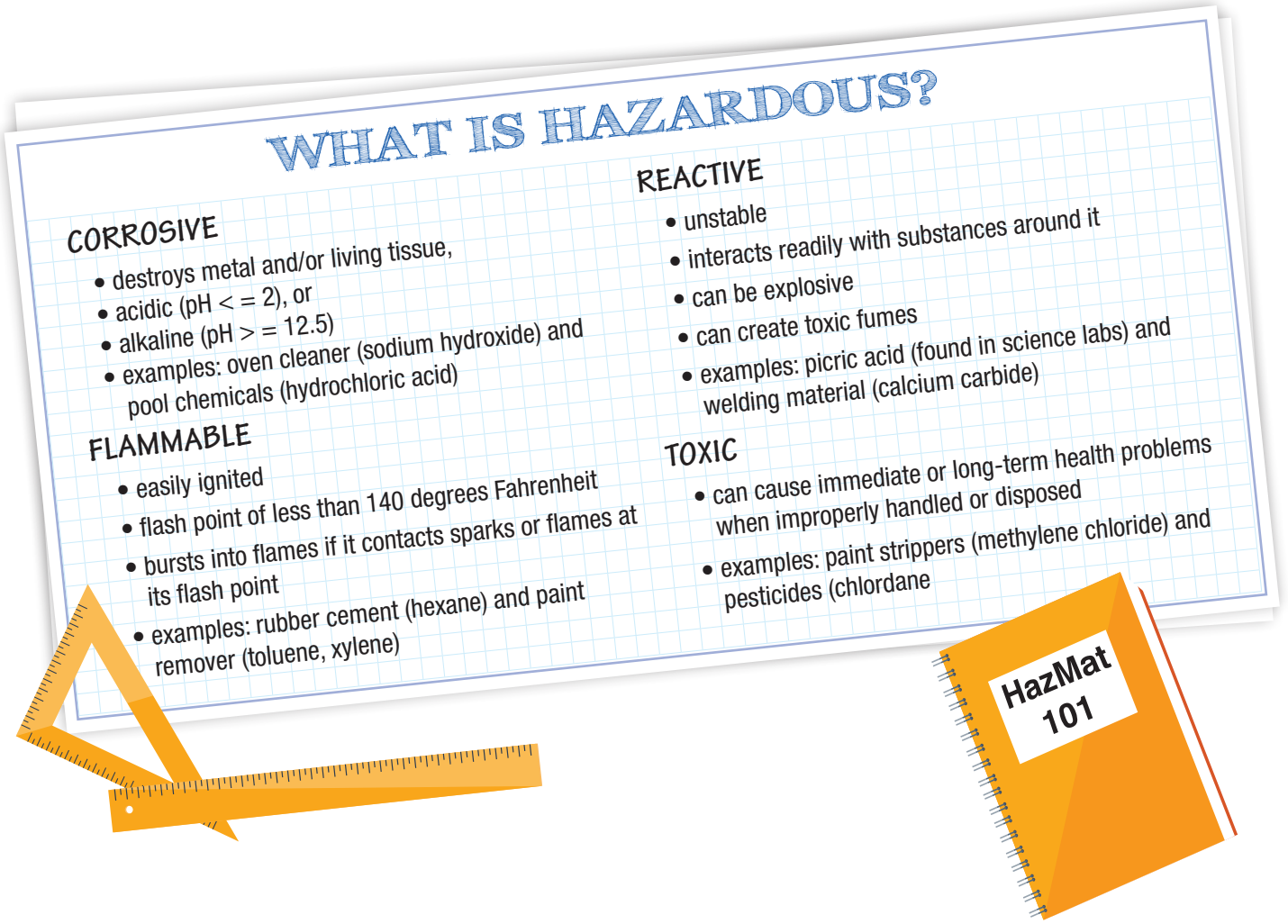


INTRODUCTION

As the focus of the waste management field has expanded to include toxicity reduction, NRRA is exploring ways that schools can make their wastes less toxic. Toxicity reduction may be an unfamiliar process that many schools hesitate to undertake without a user-friendly, comprehensive resource, written specifically for the school community. With this manual, NRRA is seeking to increase your school community's awareness of its hazardous materials, decrease the amount of hazardous materials used and discarded, and improve your school's indoor air quality. This resource, written specifically for the school community, provides information on:

- **Hazardous materials commonly found in schools.**
- **The agencies and regulations governing hazardous materials use and disposa**l.
- **Methods to decrease the amount of hazardous materials used.**
- **Safe, environmentally responsible management.**
- **Methods for creating long term change.**

This manual focuses on materials that are considered hazardous because they are corrosive, flammable, reactive, and/or toxic.



Conducting School Inventories

To get an overview of how schools presently manage hazardous materials, NRRA visited high schools and vocational schools in various geographic regions of New Hampshire and Vermont. School inventories involved opening cabinets, looking in basements, and asking the school personnel who use hazardous materials, questions about use and disposal practices. Learning about teachers' and staffs' concerns, their management methods, and the information they would want in a manual was the most valuable part of this survey. Synthesizing these ideas proved the most challenging. School personnel hold divergent views on priorities for hazardous materials management, and they need different information about regulations and background information.

WHAT IS HAZARDOUS IN SCHOOLS?

ART

- paint thinners and other petroleum-based solvents
- spray fixatives
- glues and adhesives
- photographic chemicals
- oil-based and heavy metal pigments found in some paints

SCIENCE

Many hazardous chemicals including:

- flammable liquids (acetone)
- oxidizers (bleach)
- corrosive material (sulfuric acid, hydrochloric acid, potassium and sodium hydroxide)
- reactives (sodium metal and phosphorus)
- toxic (cyanides, phenol, and formaldehyde)

INDUSTRIAL ARTS/VOCATIONAL

- waste motor oil
- waste antifreeze
- degreasing solvents
- lead-acid batteries
- petroleum-based solvents
- wood stains
- oil-based paints
- petroleum-based inks
- developers
- petroleum-based solvents and cleaners

MAINTENANCE

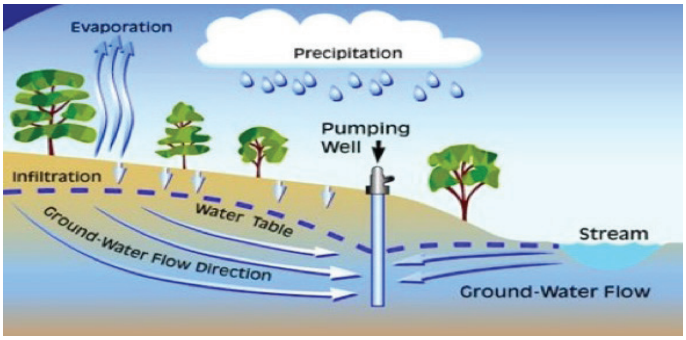
- toxic and flammable cleaning supplies, particularly petroleum-based floor strippers and finishers
- volatile organic compounds (VOCs) found in cleaning products and processes
- pests and pesticides
- scented products (perfumes, candles, air resheners, fragrances)

HazMat 101

VOC is the name given to a substance that contains carbon and that evaporates (becomes a vapor) or "off-gases" at room temperature. Found in aerosol products, paints, cleaners, disinfectants, pesticides, new carpeting, gasoline, furniture, scented candles, laundry soaps and other scented products, VOCs are also associated with asthma, cancer and other disorders.

Some types of waste generated by schools, households and small businesses are similar to the types of hazardous waste generated in greater quantities and more concentrated forms by large industry. The actual amount of hazardous waste generated by a single household, business or school may be small, but the amount from all sources may add up to a profound threat to the environment. When hazardous materials are not disposed of properly, environmental quality is threatened.

Hazardous waste, if thrown in the trash, enters either landfills, incinerators or composting facilities. If hazardous waste is poured down the drain, it goes to either a septic system or a centralized wastewater treatment facility. None of these facilities are designed to treat hazardous waste, and the waste can enter the groundwater and, ultimately, the water cycle.



WHEN HAZARDOUS MATERIALS ENTER THE ENVIRONMENT

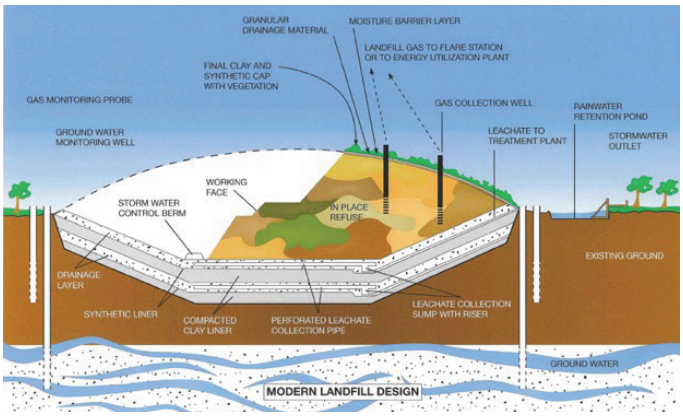
The ultimate fate of a hazardous material depends upon factors such as its particular toxicity characteristics, its pH, how long it remains active in the environment, and whether or not it is water soluble.

The negative consequences of hazardous waste in the water cycle can be far-reaching. One result, groundwater contamination, is a serious environmental problem because between 40-50% of the U.S. population depends on groundwater as their primary drinking water source.

LANDFILLS

Precipitation entering landfills mixes with its contents. If the hazardous waste in a landfill is water-soluble, it will be dissolved and carried wherever the water takes it. If it is not water soluble, it will probably remain intact and travel suspended in the water. This water (called leachate) moves through the layers of trash.

Unless it encounters a barrier, the leachate carries the hazardous waste into the environment. Newer lined landfills collect leachate to be treated. However, the liners may not be completely impermeable and some types of hazardous wastes may actually pass through the liners.



INCINERATORS

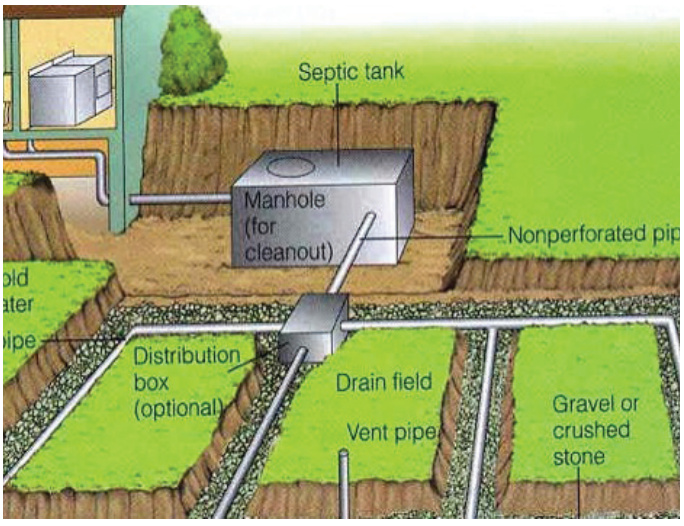
Although incinerators are equipped with pollution-control devices, some pollutants found in hazardous waste are difficult to capture. For example, the mercury found in some dry cell batteries, fluorescence light bulbs, and old paint is extremely difficult to capture at the high temperatures that occur during incineration.

CO-COMPOSTING

Many towns are considering co-composting (composting regular trash with such traditional compost materials as yard and food waste, and sludge). If hazardous wastes are not separated out of the trash before composting, the end product may be too contaminated for general application. Two of the button cell batteries used in watches and hearing aids, for example, in 2.2 pounds of compost may raise the compost's heavy metal content above a level suitable for general use.

SEPTIC SYSTEMS

An on-site septic system treats a building's waste water before releasing it back into the environment. Like incinerators and landfills, septic systems are not designed to treat hazardous wastes. Hazardous materials, including excessive amounts of drain openers and cleaners containing lye and strong bleach, might disrupt the system's natural cleansing process by destroying the bacteria that cleans the water. Without these bacteria, certain pathogens will travel through the system unchanged. Hazardous wastes pass through septic systems unchanged, enter the environment, and can contaminate groundwater.



WASTE WATER TREATMENT FACILITIES

Waste water treatment facilities operate on the same principles as septic systems, but on a much larger scale. Waste water from businesses and residences goes through a series of treatments at a central location before being released into local water sources. Waste water treatment facilities are not designed for treating hazardous wastes.

Remember...

When trying to change the way your school uses and disposes of hazardous materials, keep in mind that each accomplishment, no matter how small, is significant. Getting hazardous materials management on your school's agenda is an achievement in and of itself. Schools that address the use of hazardous materials today, avoid problems tomorrow.

ACKNOWLEDGMENTS

"Hazardous Materials Management: A Manual for Schools", was originally published in 1992 by the Association of Vermont Recyclers (AVR), a Vermont non-profit that led the New England solid waste education movement during the latter part of the 20th century. AVR collaborated with VT high schools, vocational schools, supervisory unions and state departments who gave their time, energy and ideas to create a manual full of information and resources to help schools be safe and environmentally responsible. The first edition was funded by the United States Environmental Protection Agency, the Vermont Agency of Natural Resources Solid Waste Division, and the Vermont Department of Education. When AVR dissolved, they recognized NRRA as their beneficiary, and transferred the rights to all their materials to NRRA. Thus, NRRA embarked on creating an updated second edition of a hazardous materials management resource that meets the 21st century school environment.

In addition to recognizing the original team of VT scholars including the Project Coordinator (Wendy Verrei-Berenback), Illustrator (Carolyn Shapiro), and Technical Reviewer (Dr. James Kaufman), NRRA would like to thank all of those who helped create the second edition of Hazardous Materials Management: A Manual for Schools, now entitled *School HazMat 101: A Blueprint for Hazardous Material Management in Schools.*

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Starting a Hazardous Materials Management Program

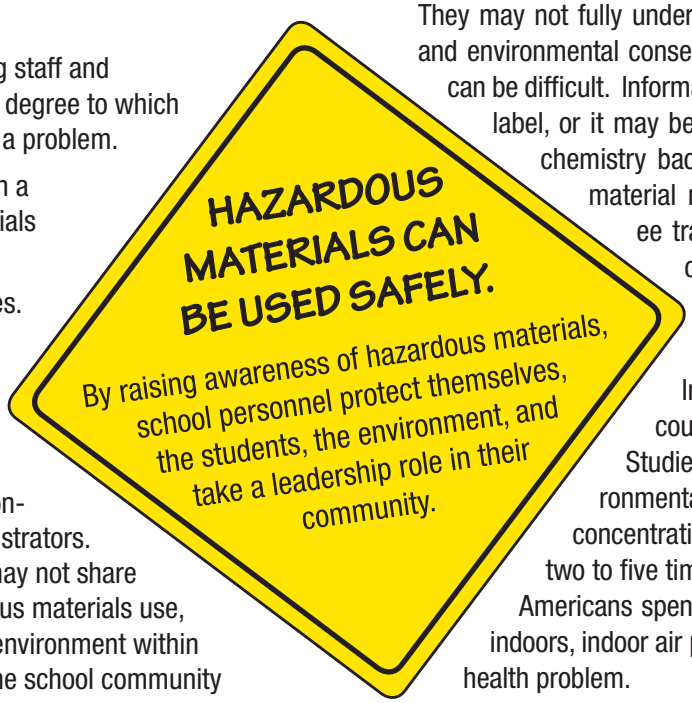
CHAPTER 1

Why is Starting a Hazardous Materials Management Program so Important?

Many issues about hazardous materials use interfere with a school's ability to employ sound management practices. Information about hazardous materials management is often not available to schools or, if it is available, the school may not have an internal structure for creating change. Other issues may hinder change, including:

- lack of consensus among staff and administration about the degree to which hazardous materials are a problem.
- ambivalence on how high a priority hazardous materials management should be.
- lack of financial resources.
- the building's physical limitations.

Chapter One discusses these barriers to change and some misconceptions and concerns of teachers and administrators. While everyone in a school may not share the same opinion on hazardous materials use, they do share the indoor air environment within the building. It is important the school community reaches consensus on how to manage their hazardous materials.



Being Pro-Active Saves

Too often schools initiate change in reaction to outside factors: after existing regulations are enforced, or an accident has resulted in personal injury or property loss. When a school anticipates these situations and develops a thoughtful management plan, it does not have to scramble for solutions.

By examining and evaluating hazardous materials use, schools can develop proactive management plans. Proactive management allows you to investigate all available options. Once a school establishes clear priorities and strategies, it can strive to reduce risks to human health and the environment.

It Is Educational

The entire school community benefits from addressing proper hazardous materials use. Many people are accustomed to using hazardous materials in their everyday lives and have become desensitized to the potential health and environmental risks.

They may not fully understand the short and long-term health and environmental consequences. Becoming an informed user can be difficult. Information may be missing from the product label, or it may be written in language that you need a chemistry background to understand. A hazardous material management plan, including employee training and student education, will increase people's awareness of the role hazardous material play in their lives and the associated risks.

Indoor air pollution is one of the country's major public health concerns. Studies conducted by the U.S. EPA (Environmental Protection Agency) indicate that concentrations of certain contaminants are often two to five times higher indoors than outdoors. With Americans spending an average of 90% of their time indoors, indoor air pollution is a significant environmental health problem.

Since all staff and students breathe the same air within a school building, using hazardous materials may expose the entire school community to unsafe conditions. Everyone is at risk when hazardous materials are used, especially when hazardous materials are used more often and for longer periods of time. Consistent exposure creates a greater chance of users suffering chronic (long term) health effects. Students are more susceptible to the acute (immediate) effects of hazardous substances because their bodies are still developing (especially under age 12) and they are more likely to use hazardous materials in ways that increase exposure (for example, eating while using hazardous material, or not using proper safety equipment, such as chemical splash goggles, when using a strong acid). Students may also

experience chronic health effects, such as silicosis from silica, the crystalline quartz found in some types of pottery clay.

Several factors make it difficult to measure the actual impact of hazardous substances on human health:

- Physiological reactions may vary greatly. A person's reaction depends on how much of a particular substance is taken into the body, the substance's concentration, the duration of exposure and that person's characteristics.
- Reactions may be vague (headaches, nausea, dizziness, etc.) or resemble common ailments, such as the flu.
- Long-term health effects are still unknown for many hazardous substances, and/or may take years to surface.
- It is almost impossible to trace health consequences to one contamination source.

Why We React the Way We Do?

- ✓ The individual characteristics of a hazardous material, the amount, and its concentration determine how a person reacts upon exposure.
- ✓ A person's age, genetic factors, lifestyle practices (smoking, alcohol consumption, obesity, and previous medical history, etc.), gender, and individual sensitivity affect his or her susceptibility.
- ✓ Many individuals are particularly sensitive to chemicals and experience allergic reactions to some toxic chemicals even in low amounts and concentrations.

Some Myths About Hazardous Materials And School

The quantity of hazardous materials used in schools is usually very small.

Some people believe that the quantity of hazardous materials used in some schools is not much different than the quantity used in the average household. They believe that since the quantity is small, a problem does not exist.

Wrong: Although the quantity of hazardous materials used in any one area of a school may be relatively small, the total amount may be surprisingly large. The variety of hazardous materials found in schools also can add up to an expensive disposal problem.

Although the amount of hazardous materials in use may be small, some schools stockpile hazardous materials in storage. This is most often found in chemistry, biology, and cleaning chemical supply rooms. Some science teachers inherited from their predecessor's chemical supply rooms filled with old, useless and dangerous hazardous chemicals.

"We've never had a problem. Why would we now?"

Many schools have been using hazardous materials for years and have not had a negative incident Some people do not understand why hazardous materials use should "suddenly" become an issue. They are concerned that hazardous materials use will become taboo in schools, and that if schools become too "regulation heavy," students may miss out on valuable learning experiences.

While a school may not have experienced any problems in decades, an accident could occur tomorrow. Here are some reasons to act now:

1. You have been fortunate.
2. Some schools learned too late that careless use, storage and disposal of hazardous materials is disastrous.
3. Often the consequences of hazardous materials cannot be known immediately. The health consequences for a teacher using an organic solvent three hours a day, five days a week for twenty years may be unknown. Schools pouring waste photography fixer down the drain might not cause significant environmental damage in one year, but what will occur over the course of twenty years?
4. Another factor to consider is that some schools stored the same hazardous materials (in particular, science lab chemicals) for those twenty years. Lab chemicals, such as some chlorates and peroxides, may not have posed significant hazards twenty years ago, but now have become dangerous explosives.

Schools do not use enough hazardous materials to worry about regulations.

"The times, they are a'changing."

Hazardous materials regulation is changing rapidly on both the state and federal levels. Before the advent of the Resource Conservation and Recovery Act (RCRA, 1976) and the Occupational Health and Safety Act (OSHA, 1970), hazardous materials and waste were not federally regulated. Enforcers first focused on industrial users of hazardous materials and generators of hazardous waste. Increasingly, they are scrutinizing hazardous materials users on the scale of schools. Laws restricting the use

How Risky Do You Want to Be?

When you evaluate the risks that hazardous materials use presents in schools, consider this:

A risk is generally defined as a "hazard, or chance of bad consequences occurring." In calculating risks, think about the possibility of an accident and how devastating its consequences could be. It may be prudent to give more weight to the consequences than its probability.

of hazardous materials and prohibiting particular types of hazardous waste disposal are also becoming more common. Such laws put more pressure on schools to examine their hazardous materials use thoroughly.

The use of hazardous materials is essential for bringing students to a true understanding of a subject.

Some topics cannot be taught without hazardous materials. It is difficult to teach oil painting without some heavy metal pigment oil paints; certain topics in organic chemistry are impossible to teach without hazardous chemicals; and automobile mechanics could not be taught without motor oil, brake fluid or antifreeze.

All this may be true but if a building is not suited for safe hazardous materials use, or the school cannot dispose of waste products in an environmentally responsible manner, that particular topic should not be taught. Teachers need to reassess their priorities considering new information on the environmental and health effects of hazardous materials and changing use and waste disposal regulations.

TEACHERS AND LIABILITY

Common ways to incur liability are through negligent instruction and/or supervision, and the failure to maintain the equipment and supplies students use.

Negligent instruction/supervision is behavior that falls below a standard of care established by law to protect others against an unreasonable risk of harm. According to law, if no *"standard of care"* has been specifically defined, the teacher's actions or failure to act will be measured against "what a reasonably prudent person would have done in the same circumstance. This is, of course, subjective: *What is a reasonably prudent person?"*

It is not MY responsibility to ensure hazardous materials are managed correctly.

School personnel usually have too many responsibilities and not enough hours to get all their work done. Developing a hazardous materials management plan may not be a priority. Teachers, administrators and school boards should be aware that they can be held liable for any harm classroom activities cause their students. The entire school community is responsible for ensuring that hazardous materials, if used at all, are used correctly.

In protecting students and themselves, teachers must anticipate accidents and take steps to avoid them. They must instruct students on the dangers and use proper precautions for classroom materials and processes, enforce safety rules and model safe practices.

What Stands In The Way Of Change

School communities recognizing the importance of hazardous materials management, can be frustrated when they begin to correct problems. The following are some common obstacles in schools.

Complicated Regulations:

Becoming familiar with federal and state regulations, and the agencies responsible for enforcing those regulations, is a time-consuming task, but an important one. Technical language and extensive paperwork can make researching and following up on these laws a discouraging process. It is most important to study state regulations. Federal laws set minimum standards; individual states can adopt more stringent provisions.

Limiting Factors | Space

Proper storage of hazardous materials requires adequate space. It is important that hazardous materials are not stored:

- crammed together on shelves,
- above eye level,
- on the floor,
- near chemicals with which they may react, or
- where students or uninformed staff have access.

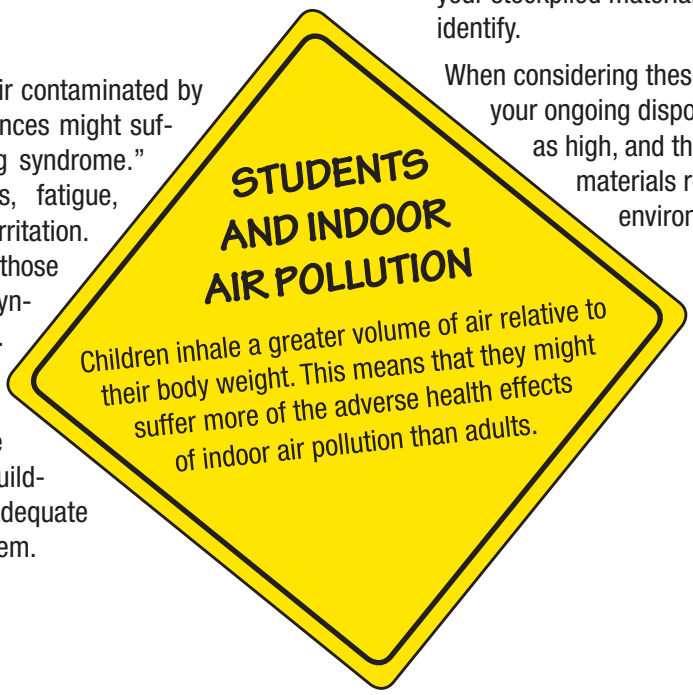
Building and Ventilation Design

Many school buildings were built with sealed windows and other energy conservation features and therefore may lack natural ventilation. Other schools have substandard ventilation systems for a number of reasons. The variety of hazardous materials used in schools can exacerbate design problems.

Effective ventilation is essential to prevent dangerous accumulation of hazardous air contaminants in buildings. Inadequate building design and ventilation can create indoor air pollution. U.S. EPA studies indicate that levels of certain contaminants are often two to five times more concentrated indoors than outdoors. Pollen, dust and bacteria are common natural indoor air pollutants. Chemical contaminants in schools can come from:

- hazardous materials used in the art, science and industrial art classrooms,
- methanol vapors from duplicating machines,
- off gassing of VOC's,
- custodial cleaning, polishing and waxing supplies,
- room deodorizers, or
- idling school buses.

Inhabitants of a building with air contaminated by chemical and biological substances might suffer symptoms of "sick building syndrome." Symptoms include headaches, fatigue, dizziness, throat and eye irritation. Since its symptoms resemble those of a cold or flu, sick building syndrome is not easily identified. Often the problem cannot be traced to a single contaminant, but may result from multiple contaminants, problems in building design, construction or inadequate maintenance of ventilation system.



Time

An effective hazardous materials management program requires that everyone using hazardous materials devote more time to planning. One person should assume additional responsibilities as the program's coordinator. Finding someone with the time and interest to coordinate the program may be difficult.

Money

Your hazardous materials management program might be expensive at first. You may need to:

- purchase storage cabinets for flammable and corrosive materials; and/or
- hire a licensed hazardous waste disposal firm to clean out your stockpiled materials and any chemicals you cannot identify.

When considering these initial expenses, remember that your ongoing disposal costs will probably not be as high, and that neglecting to manage these materials responsibly can incur much greater environmental, financial and health cost.

Simple Solutions To Minimize Risks

CHAPTER 2

Decreasing the risks associated with hazardous material use involves two major steps:

1. Learning the basic principles of hazardous materials management; and,
2. Creating structures in your school that support the management changes you have undertaken.

Chapter 2 contains general suggestions for:

- Reducing the amount of hazardous materials in use
- Safe use
- Safe storage
- Environmentally responsible disposal

More specific information on the types of hazardous materials used in a particular subject area is in the chapters dedicated to classrooms and departments.

Reducing How Much You Use

You can reduce the trouble and expense of hazardous materials management by reducing the amount you use. If you use less, you need to worry less about:

- possible health consequences;
- storage; and,
- possible environmental consequences of waste disposal.

Substitute Products

Often you can substitute a product containing fewer or no hazardous ingredients for a hazardous product. The substitution may not be "perfect," BUT by evaluating the task you want to perform and asking yourself, "Can the task at hand be accomplished with a less toxic product?" is a good place to start ridding yourself of a toxic environment. Some common substitutions are:

- water-based solvents in place of petroleum-based solvents;
- glue sticks or wax applicators in place of rubber cement;
- citrus-based degreaser in place of petroleum-based degreasers;
- low to no VOC latex paint in place of oil-based paints;
- non-chlorinated cleaners in place of chlorinated cleaners, and;
- third party certified products (Ecologo, EPA Safer Choice, Art and Creative Materials Institute).

Consider The Curriculum

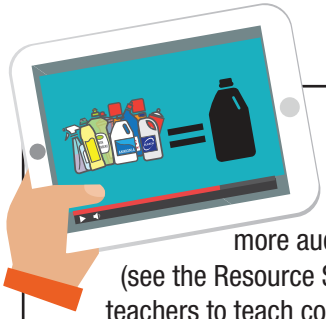
Teachers and administrators must evaluate the benefits of teaching a topic that requires hazardous material use against the potential harm. If a topic cannot be taught safely, then it should not be taught at all. Some key questions to ask yourself when making this decision include:

- Do we have to use carcinogens (those chemicals that cause cancer) to teach this topic?
- Is the school's ventilation system adequate?
- Is the proper safety equipment available?
  - Do we have the appropriate gloves?
  - Are there enough chemical splash goggles for the entire class?
  - Do we have an eyewash station and safety shower within reach?
  - Is the appropriate type of fire extinguisher and fire blanket nearby?

Hands-on experience plays a central role in students' comprehension, especially of scientific concepts. However, if hazardous materials are involved, it may not be appropriate. Teachers must carefully assess the value of hands-on experience against the

possible consequences of an accident. Instead of allowing students to use extremely hazardous materials, you may want to:

- Conduct a demonstration for the entire class.
- Show videos or films that demonstrate dramatic, real life hazardous material reactions.
- Conduct micro-labs.



Looking-Not Touching

With more stringent regulations, more audio-visual materials are available (see the Resource Section). These resources enable teachers to teach concepts without the headaches of using, storing and disposing of hazardous materials.

Managing Materials Safely

When it is not feasible to eliminate a hazardous product's use, it must be properly managed. This next section discusses general management strategies for:

- Shopping for Hazardous Materials.
- Using Hazardous Materials Safely.
- Knowing What It Is and How to Store It.
- When Hazardous Materials Become Hazardous Waste: Storage and Disposal.

Shopping For Hazardous Materials

Safe use of hazardous materials begins when you purchase them. Here are some guidelines for a sound purchasing policy.

1. **Buy Only What You Need**
   Purchase small volumes. In contrast to thrifty consumer values, bulk is NOT better for hazardous materials! Small volumes minimize storage risks and help to ensure that all materials are used before you replace them. The real costs of bulk purchases include disposal cost, and the liabilities associated with the health and safety risks of chemical exposure.

2. **Make Sure You Know What You Are Buying**
   Request the products' Safety Data Sheet (SDS) from the distributor or manufacturer as part of any bid procedure. The SDS is a technical document containing valuable information about the chemical hazards of its ingredients. The SDS enables you to choose the products which present the least worries in terms of use, storage and disposal. As OSHA requires schools to have an SDS for every hazardous chemical on site and distributors should be required to send an SDS with every hazardous product. If your distributor has failed to do so, a written request, telephone call, or requiring the SDS is sent before payment is made will remind distributors of their

OSHA and the Schools

The Occupational Safety and Health Administration (OSHA) regulates hazardous materials used in the work place. OSHA advocates for the community's right to know about hazardous materials in the community, and the employee's right to know about hazardous materials in the work place. The law allows employees and the surrounding community access to information on the hazardous materials used in industries, businesses and institutions. As OSHA standards only cover employees, students do not receive protection.

Schools should contact their state OSHA department to gain a clear understanding about relevant regulations. In general, a school should have:

- A written "Hazards Communication Plan," a "Chemical Hygiene Plan" (for science laboratories only), and an "Emergency Communication Procedure."
- A training program for faculty and staff to familiarize them with the acute and chronic health risks of the hazardous materials they use, and the first aid treatment for those materials. Training must include information on how to interpret chemical labels and Safety Data Sheets.
- A system to identify, contain and store hazardous materials.
- A system to notify the appropriate local authorities (fire department, OSHA) about what hazardous materials are used in the school.

What Is So Hard About Identifying Hazardous Materials?

Label information can be vague and misleading. Trade secrecy laws allow manufacturers to forgo listing or defining ingredients on labels if it could lead to an economic loss for them.

Petroleum distillates have varying degrees of toxicity, ranging from highly toxic benzene to non- toxic petroleum jelly. Specific ***organic solvents*** also have a wide range of toxicity and flammability.

Some labels describe the function of the chemical ingredient (grease cutter, corrosion inhibitor, polishing agent) rather than specifying what it is. Manufacturers often use generic terms or vague language instead of revealing the specific chemical identity of their products. Two common generic terms are petroleum distillates and organic solvents.

Terms used on labels, such as "active" and "inert," are misleading. "Active" refers to those ingredients that do what the product is intended to do. "Inert" refers to any other substances in the product that make the active ingredient easy to apply and allow it to perform the job. Consumers often assume that "inert" means nontoxic. Inert ingredients may be equally or more hazardous than the active ingredients.

legal responsibility. Many distributors now list their SDS sheets on the manufacturer website if you need to find a SDS promptly. Make sure the SDS sheet is up to date by referencing the revision date.

3. **Establish a Policy to Give Less Hazardous Products Equal Footing**
   The price tags on less or nonhazardous products are now more economically priced. They rarely cost more than their hazardous counterparts. If they do cost more, consider the money saved by alleviating adverse health effects, purchasing special storage units and hazardous waste disposal costs. You can write a policy that supports an Environmentally Preferable Purchasing Program (EPP) and allows faculty and staff to purchase a less hazardous item.

Using Hazardous Material Safely

Safe hazardous materials use demands knowledge, common sense and accessible safety equipment. A comprehensive management plan, including emergency procedures, will help to minimize risks associated with hazardous materials use.

Know Your Stuff

Everyone using hazardous materials, including students, should fully understand their characteristics, safe handling and disposal procedures. Look first for such information on the product label and the SDS. The latter is usually a more comprehensive source of information, although it may be more difficult to understand.

The SDS gives information about exposure limits for adults. To get a safe index for students, call the Department of Health, Environmental Health Section. Other resources for ascertaining the contents of a hazardous product include your state's Hazardous Material Division and OSHA.

Be Sensible.

The first rule of hazardous materials safety is very simple: ***Don't use it if it cannot be used safely!***

> *IT IS SIMPLE: If you need a respirator to use a hazardous product in the school, you probably should not use the product.*
>
> Respirators are difficult to fit to children. Therefore, their small faces cannot be adequately protected. Furthermore, OSHA requires all people using respirators to participate in technical training and fit testing. This level of training is not appropriate for students.

Outfit for Safety

Personal Protective Equipment (PPE). People using hazardous materials may need to wear PPE, such as:

- protective goggles
- gloves
- aprons
- face shields
- dust masks

The SDS for a product should tell you what safety equipment you need when you use that product. It is important to note that a certain type of safety equipment may not be appropriate for all hazardous materials used in the school. For example, a glove suitable for strong acids, might not be appropriate for solvent use.

Seconds count when someone has splashed a corrosive material in their eyes.

ACCESSIBLE EYEWASH STATIONS MAY PREVENT PERMANENT INJURY.

Safety suppliers have several types of eyewash stations. Most safety instructions recommend that you flush the eye with water for at least 15 minutes continuously. The best eyewash stations will provide a continual flow of water. The water coming into the station needs to stay at a pre-established temperature.

Some states may not accept bottle eyewash stations because they do not allow for continual water flow and, like all eyewash devices, can become contaminated by bacteria.

Ensure Adequate Ventilation

Schools may have outdated and inadequate ventilation systems. Teachers often try to compensate by opening windows. This practice, however, does not provide adequate ventilation for hazardous materials use and can even cause more problems if the air flows toward the users' face.

When you are determining whether your school's system is adequate for the materials in use, consult ventilation professionals.

If you are buying a new system, consider how a noisy system will affect the classroom environment. If a system is so loud that it hinders instruction, teachers might not use it. Whenever possible, you should locate ventilation fans and motors outside the classroom.

Maintaining your heating and cooling systems by cleaning air vents, repairing leaks, and replacing air filters regularly helps maintain good air quality. Keeping the humidity below 70 percent will improve air quality.

For further information about indoor air pollution and how your school can develop and implement an Indoor Air Quality Management Plan, contact The Office of Radiation and Indoor Air, Indoor Environments Division, U.S. EPA, Washington, DC 20460 or visit the website https://www.epa.gov/iaq-schools.

Teaching Toxics

Teachers are responsible for modeling safe behavior. Proper supervision is central to safe teaching. In addition to these essential components, all students must receive adequate instruction in emergency procedures and information on the characteristics of the materials in use. Students should learn to use an SDS, so they understand the hazardous materials they are using, and how to handle hazardous materials in their future work places.

Teachers must know their students physiological, emotional and psychological special needs, and how these needs relate to the hazardous materials in use. Teachers need to be aware that:

- Students might not understand the appropriate safety practices and the consequences of misuse. A student may have high hand/ mouth contact, for example, thus increasing the likelihood they will ingest a material accidentally.

What Kind of Ventilation Do You Need?

You first need some basic information about the two types of ventilation systems: general and local.

General (dilution) ventilation systems bring in fresh air to mix with the contaminated air in a room and dilute the contaminants to a safe level. These systems DO NOT remove hazardous air contaminants from the building but allow an exhaust fan to carry contaminants away from the user's breathing area.

General/dilution ventilation systems are most effective for the control of vapors produced by moderately toxic liquids but may not be adequate for highly toxic materials. Poorly designed systems can carry contaminated air into the users' breathing area and pull air contaminants around the building.

Local (exhaust) ventilation systems (canopy hoods, vents or fans) pull hazardous contaminants away from individuals and vent the contaminants to the outside. Local ventilation systems capture the contaminants where they are generated and remove them before they get into the room air and users' breathing zones.

Local systems remove contaminants from small areas. They control dusts, toxic vapors, substances used in large volumes, and the substances that evaporate quickly.

- Certain hazardous materials will aggravate existing health problems. A student who has epileptic seizures should not work with any organic solvents, for instance. Visually impaired students are more exposed to risks because they tend to work very close to their projects.
- Contact lens wearers need to take extra precautions when using volatile substances, as the lens can hold hazardous substances on the eye for a long time.
- Some hazardous materials can harm a pregnant woman and her fetus.

Teachers need to check with the school health personnel, parents, the student's doctor, and any other informed people to evaluate whether a student should be using certain hazardous materials.

Knowing What It Is and How to Store It

Labeling

The following general labeling guidelines minimize risks of hazardous materials storage:

- Keep hazardous products and chemicals in their original containers.
- Include information on a hazardous product's label about the:
  - chemical composition
  - common and scientific name
  - date product was received
  - hazardous characteristics
  - manufacturer's name, address and emergency phone number
  - manufacturer's precautions and warnings
- Facilitate quick visual recognition by creating a color code for labels to indicate the hazardous characteristics of a product or chemical. Common codes used by chemical companies include: red (flammable), blue (toxic), yellow (reactive), white (corrosive), and striped (indicates that the chemical is not compatible with others in its class). OSHA came out with the Hazard Communication Standard which identifies hazards by providing a uniform labeling system which includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category.
- If you are using a container for a chemical other than the one it came in, label it with the same information that was on the original container (see above list). Protect this label from wear and check it periodically for readability. These containers easily become mystery containers if they are not labeled properly. Mystery containers are a hazardous materials management nightmare.

Be certain that a chemical and the composition of the container you want to transfer it to are compatible. If you do not know what the container is made of, do not use it. Possible reactions are difficult to predict. For example, some strong oxidizing agents used in science labs can cause some plastics to crack. Make sure the container did not previously contain an incompatible chemical that could produce a reaction. If you are unsure, start with a new container.

Storage

The following general guidelines are only the first step to proper storage. Individual characteristics of each hazardous product determine its specific storage requirements. Look for these characteristics on the product's SDS.

General

- Store hazardous products in a protected location (preferably locked storage). Label the outside door with appropriate warning information.
- Restrict access to rooms where hazardous products are stored as movement increases the likelihood of a hazardous materials accident. DO NOT use storage areas as prep areas. Teachers can control their storage areas by making it off limits to unsupervised students, substitute teachers and other school staff.
- Decrease the risk of spills by not storing any hazardous materials on the floor or above eye level.
- Do not store chemicals under the sink. The gas from strong acids, for example, can attack piping and other plumbing fixtures.
- Label all shelves and cabinets about their contents.
- Secure gas tanks by chain to prevent them from falling over. Store and handle vertically.

Flammable Products

- Store flammable chemicals in National Fire Protection Association approved safety containers. For example, heavy metal safety cans have spark arresters in their necks to prevent sparks from reaching the flammable liquid within and have spring-loaded lids that close when the handle is released.
- Avoid storing flammable substances in glass containers because they can be easily broken.
- Ground all containers to prevent static charge.
- Store flammable materials in a location away from sources of heat (including electrical sources, sunlight and furnaces) and sparks (including friction).

Know Your Fires and Extinguishers

The type of fire determines which fire extinguisher must be used. There are basically four classes of fires:

- Class A fires (from combustible materials such as cloth, paper and wood)
- Class B fires (from flammable liquids such as grease, gasoline, paint and oil)
- Class C fires (from electrical equipment such as motors and switches)
- Class D fires (from heavy metals such as sodium, magnesium and potassium)

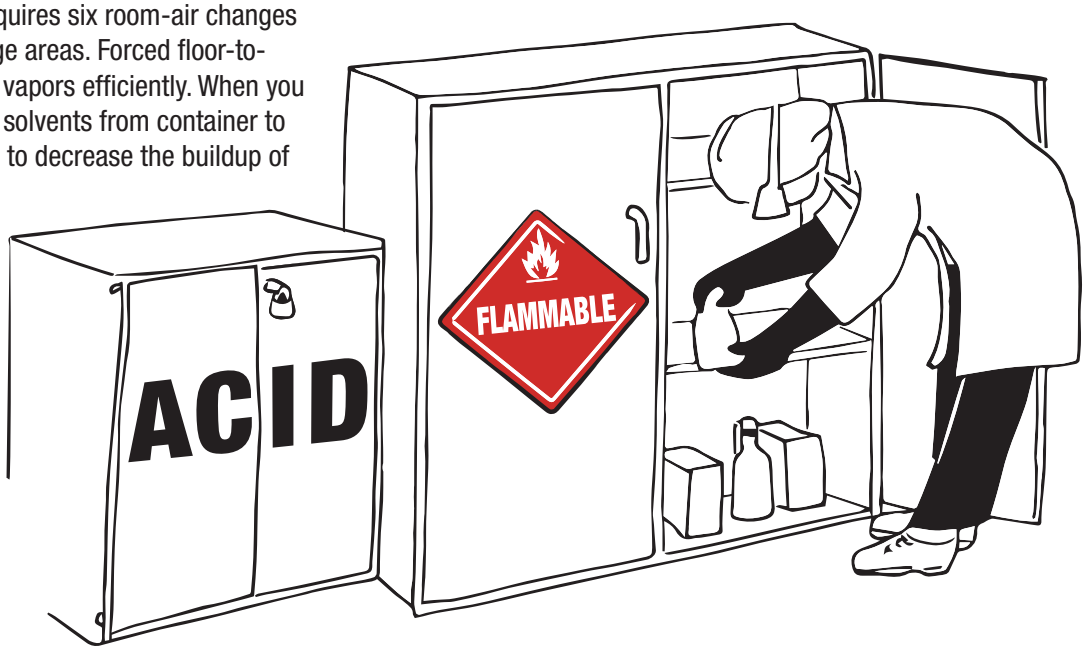
Water is only appropriate for extinguishing Class A fires. Never use water on electrical or metal fires (Class C and D fires).

Fire extinguishers using carbon dioxide are used during Classes B and C fires, and Multipurpose Dry Chemical is appropriate for Classes A, B and C fires. Commercially prepared granular formulas and sand are best for Class D fires.

Fire extinguishers must:

- be highly visible and accessible
- be regularly inspected and inspection dates marked
- have gauges checked to ensure the unit is working
- have periodic static pressure tests in accordance with NFPA Codes

- Store flammable products in a specially constructed "flammable cabinet." (Please see "Safety and Science Chemical Supply Companies" in the Resource Section for sources for these cabinets.)
- Store flammable products in a room at or above ground level.
- Ventilate the storage area properly to prevent buildup of volatile vapors. OSHA requires six room-air changes per hour in chemical storage areas. Forced floor-to-ceiling ventilation removes vapors efficiently. When you are transferring flammable solvents from container to container, use a fume hood to decrease the buildup of fumes in the air.
- Keep an appropriate fire extinguisher immediately accessible.
- Do not store any oxidizing substances near flammable products. Oxidizers also include some compounds with no oxygen, such as chlorine and fluorine.
- Remember that the vapors of all flammable liquids are heavier than air and can travel considerable distances. Even if flammable liquids are in use upstairs, an ignition source downstairs can start a fire. A flame can travel from ignition source to the flammable material along a continuous vapor path.



Toxic Products

- All toxic products should be kept in locked storage.
- Containers should be properly labeled with antidote information in case of poisoning.
- Toxic gases should be stored at or above ground level.
- Store toxic products on shelves made from impervious (non-absorbent) material.

Corrosive Substances

- Confirm that the container of a corrosive substance is made from material that will not react to the substance.
- Store any acids separately in a designated "acid cabinet." This cabinet should NOT be constructed from metal. (Please see "Safety and Science Chemical Supply Companies" in the Resource Section).
- Store acids separately from bases. Store nitric acid and perchloric acids separately from non-oxidizing acids.

Reactive Substances

- Store reactive substances away from sources of heat (electrical sources, sunlight and furnaces) and sparks (including friction).
- Do not store reactive substances near any substances that are likely to cause an explosion.
- Do not install a sprinkler system in places where water-reactive chemicals are stored.

How Does a Safe Storage Room Look?

- Large enough so that there is no crowding.
- Floor made of an impervious surface (i.e., not carpet).
- Well lit to decrease the likelihood of accidents.
- Explosion-proof lighting and fixtures only.
- Ventilation system separate from rest of building. A chemical supply closet should have a complete exchange of air 4-6 times per hour, and a forced-air system to keep air moving continuously from floor to ceiling.
- At least two clearly marked room exits.
- An accessible fire extinguisher, appropriate to the types of material being stored.
- Clearly labeled shut-offs for power, gas and water supplies.
- Shelves firmly secured to the wall. Avoid the "island shelf" assemblies that tend to fall over and could result in a disaster.
- Shelving low and deep enough to prevent containers from being easily dislodged. Raised edges will keep containers from rolling off the shelves.
- A clearly visible, accessible alarm or emergency phone contact list.

SIGNS FOR HAZARDS

A sign is not a substitute for hazardous material training, but it does provide an immediate visual reminder. Signs to post where hazardous materials are in use include:

- **No Food or Drink Permitted**
- **No Smoking or Open Flame Permitted – Flammable Storage Area**
- **Wear Gloves When Using This Material**

When Hazardous Material Becomes Hazardous Waste: Waste Storage and Disposal

Hazardous waste disposal is regulated on the basis of the amount generated and its origin. The federal and state governments strictly regulate industries and businesses that generate over 2.2 lbs. of acutely hazardous waste or 220 lbs. of hazardous waste per month but check with your state generation classifications.

Households are at the other end of the spectrum. Households must observe statewide landfill bans (such as oil paint, lead-acid batteries and waste motor oil), but are not federally regulated.

Schools are in the middle: They may use hazardous products that are also found in households, but their hazardous waste disposal is regulated differently than households.

Many industries generate hazardous waste. A generator is any person who produces a hazardous waste as listed or characterized in the Code of Federal Regulations (CFR). EPA regulates hazardous waste under the Resource Conservation and Recovery Act (RCRA) to ensure these wastes are managed in ways that protect human health and the environment. Even when managed properly, some listed wastes are so dangerous that they are called acutely hazardous wastes. Examples of acutely hazardous wastes include wastes generated from some pesticides and that can be fatal to humans even in low doses.

Generators of hazardous waste are regulated based on the amount of hazardous waste they generate in a calendar month, not the size of their business or facility.

Recognizing that generators produce waste in different quantities, EPA established three categories of generators in the regulations: large quantity generators (LQGs), small quantity generators (SQGs) and commercially exempt small quantity generators (CESQGs) now referred to as very small quantity generators (VSQGs).

In most states, schools, as institutions, are usually classified as CESQGs/VSQGs of hazardous waste. A CESQG/VSQG generates less than 220 lbs. of hazardous waste or 2.2 lbs. of acutely hazardous waste per month. You can estimate that 220 lbs. is less than 1/2 of a 55-gallon drum. The specific gravity of the waste determines its actual weight; for example, an oil-soaked Speedi Dry may weigh 800 pounds or more per drum.

CESQGs/VSQGs must comply with some state and federal regulations. Here is a general summary of those regulations. Call the Hazardous Materials Management Section of your state department of environmental protection/conservation for detailed information.

1. Your school must not accumulate more than 1,000 kilograms of hazardous waste at one time.
2. Your school must ensure that hazardous waste is delivered to a person or facility who is authorized to manage it.
3. Your school or supervisory union must notify the state and federal governments when it generates, stores, transports and disposes of hazardous waste. You can get an EPA Notification of Hazardous Waste Activity Form from the Hazardous Material Management Section of your state department. When you have completed the form, return it to the agency.
4. Your school will be assigned an ID number. Your hazardous waste disposal firm will use that ID number on shipping manifests to track your waste from cradle to grave. A hazardous waste disposal firm can help you obtain an ID number, but your school must assume responsibility for the accuracy of the form and any subsequent hazardous waste manifests. Most likely, your school will receive a temporary ID number each time it makes a shipment.
5. Your school can bring your hazardous waste to a Household Hazardous Waste (HHW) event for a fee and with special arrangements for disposal.
6. Your school must follow these storage requirements for hazardous waste
    - Store the waste in a manner that prevents its release into the environment.

- Use containers that will not react with their contents.
- Keep containers closed except when you add or remove waste.
- Handle containers in a manner that prevents leaking.
- Store incompatible wastes separately.
- Call the appropriate state agency for help if a spill occurs.

What Is Cradle to Grave Responsibility?

The Resource Conservation and Recovery Act (RCRA} contains federal definitions and standards for hazardous waste disposal, including a "cradle to grave" system. Cradle to grave means that your liability does not end when your waste leaves your building.

When the waste leaves, it then becomes the shared responsibility of the waste disposal firm and you, the generator. For this reason, you must know the track record of your hazardous waste disposal firm. You must also obtain written acknowledgment from the certified disposal facility that the waste was received. You are accountable for your waste even after it reaches its final destination. If, for any reason, a hazardous waste disposal facility should cause any environmental damage, everyone who sent waste to that particular site is responsible for a portion of the cleanup cost.

The ramifications of cradle to grave responsibility may discourage some hazardous waste generators from complying with RCRA. The consequences of disposing of hazardous waste in municipal landfills are just as severe. A business or institution that commits this kind of violation is held liable for a portion of the cleanup if the landfill becomes a hazardous waste site. No business of any size can dispose of any amount of hazardous wastes in the trash!

Storage Rules

Preventing accidents and containing spills when you are storing hazardous waste involves careful planning. The following suggestions are customary, but it is advisable to consult with your state environmental agency.

- Label waste containers clearly. Identify the material as "HAZARDOUS WASTE," its name, and the date it was first collected.
- Segregate wastes. Mixing different wastes together can be dangerous. Segregating waste can decrease the quantity of hazardous waste you generate, enable you to recycle some wastes and significantly decrease disposal cost.
- Inspect waste containers for leaks regularly.
- Avoid storing hazardous waste outside. Storage drums that have taken in water can burst or split seams under freezing temperatures. If you must store containers outside, tighten their lids, store on an impervious surface to prevent the bottoms from rusting, and cover the tops to keep them from collecting water.
- Find an appropriate site to store waste. When you are considering a site ask:
  - Is the site locked to ensure that only trained staff have access?
  - Can waste haulers get to the site easily?
  - Is the site far away from sources of sparks and heat?
  - Is the site large enough to hold the volume of waste you will generate?
  - Are the exits unobstructed in case of fire?
  - If you have incompatible wastes, are they separated within the main storage area by dike, berm or wall?
- Store waste to contain spills.

Store hazardous waste on an impervious surface. Such a surface helps to contain hazardous waste spills. Avoid storage near floor drains because you will find containing and cleaning up a hazardous waste extremely difficult if it goes down the drain.

Disposal

The final step in hazardous waste management is responsible disposal. There are limited opportunities for schools to treat their waste "in-house." "Hazardous Materials in the Art Classroom" describes the silver recovery units that treat photography wastes. "Hazardous Materials in the Industrial Arts and

What Is a Hazardous Manifest?

A manifest is a multiple, carbonless, eight-page form that accompanies a waste shipment from your school to the disposal firm, and then to the final treatment facility. The school is responsible for ensuring that all the information on the manifest is correct. A number of states have additional requirements regarding the use of the new EPA Uniform Hazardous Waste Manifest forms. Some states require copies to be submitted to the state and/or have state specific waste codes in addition to the federal waste codes that must be entered onto the new Uniform Hazardous Waste Manifest forms. You will need to check with your state agency to determine what, if any, additional requirements they stipulate.

Vocational Classroom" looks at ways to recycle some types of solvents and automotive hazardous waste. "Hazardous Materials and Science" explores how experienced science teachers can treat some of the waste generated in lab experiments.

Your school will have to contract with a licensed hazardous waste firm for much of its waste. Since this is likely be expensive, you should work to reduce the amount you generate in the first place. Check with your state hazardous waste department to verify that your school can bring its hazardous waste to an HHW event as long as you meet the CESQG/VSQG criteria. This will save you the cost of hiring the licensed hazardous waste contractor coming to your school to segregate and decommission the waste. Communicate with your local Transfer Facility or Solid Waste Districts which hold HHW days to make sure that the school can avail itself of that resource.

Who Gets All the Copies?

The school keeps several manifests at the time of shipment. Most often, the state hazardous materials department receives a copy. And, once the waste reaches its final destination, the school gets back another manifest copy to ensure the waste's arrival. You must do some investigative work if you do not get this form. Schools must keep all documentation on file.

Note: If the school joins a community HHW event, they need to attach their detailed list of their waste inventory sent to the licensed hazardous waste firm since the manifest will include ALL the waste collected at the HHW event, not just the school's waste.

Budgeting for Hazardous Waste Disposal

Include hazardous waste disposal in your school budget to ensure that funds are available when needed. You can establish an HHW disposal line item in the maintenance budget or require each department using hazardous materials to include disposal costs in their departmental budgets.

Choosing a Hazardous Waste Disposal Firm

Do some homework before you select a hazardous waste disposal firm. Your responsibility for waste generated at your school does not end when that waste leaves the school building. If your chosen firm fails to bring the waste to an appropriate destination, you will share the consequences for any illegal actions.

Protect your school by confirming that the firm and facility have U.S. EPA identification numbers and are registered with the state. Check out the company's performance record. Find out from other schools about the firms they have used. Call the Hazardous Materials Management Division of your state's environmental protection department to see if any complaints have been filed on a company you are considering using. Talk to your Town and Gown partner at the local Transfer Station.

To make sure a hazardous waste firm will meet your needs, ask them:

- Have they transported waste from schools before?
- What is their liability insurance coverage?
- Can they haul away the amount of waste you generate as often as you want?
- How much will it cost them to transport your waste?
- Is there any "pre-pick-up" work the school can do for reduced disposal cost?

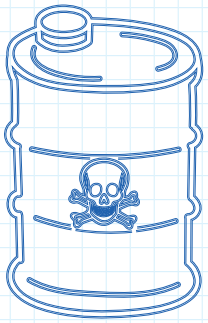
Why Does it Cost So Much to Get Rid of Hazardous Waste?

One of the reasons why it is expensive for schools to dispose of their hazardous waste is that schools usually dispose of small quantities of a huge variety of hazardous wastes. Packing these wastes takes a lot of time.

A hazardous waste hauler must "lab pack" small quantities of waste. A lab pack is a Department of Transportation- specified 55-gallon metal drum filled with waste containers.

Regulations specify than an inert packing material must be placed around each inside container to absorb any liquid released from broken or leaking containers.

Schools incur additional costs because the half-full containers they often dispose of occupy as much space in the lab pack as full containers. This is why joining efforts between schools and towns (if allowed by your state) can save money.



Milk-Run Pickups

Coordinating with other schools in your school district or city/town on a "milk-run pickup" can decrease hazardous waste disposal costs by reducing transportation costs.

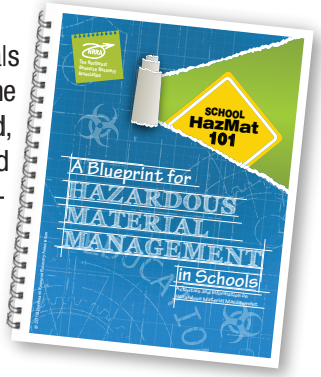
If schools have a lot of waste requiring disposal, you may have difficulty coordinating a pickup. Lab packing waste is time consuming and may require a disposal firm to spend a half day or more at one school. This would limit how many schools that company could visit in one day.

The Next Step In Creating Change

CHAPTER 3

By now you have many ideas for how to manage your school's hazardous materials. Before you launch a full-fledged management program, however, you will need an internal structure that supports the implementation of those ideas. Schools often have trouble finding models for such an infrastructure. This chapter outlines a workable system for primarily vocational and high schools due to the increased quantities of hazardous waste generated at the secondary level. This is not to say that elementary schools will not benefit from the information. Every school should have some combination of a Safety, Hazardous Waste, and Indoor Air Quality committee that sets policies for a safe school environment that supports a healthy environment through proper materials management.

Top Down and Bottom Up: Involving the Whole School Community



Responsible hazardous materials management involves all levels of the school community: the school board, superintendent, principals, staff and students. Remember that implementing a management plan will be an ongoing process, not an "event."

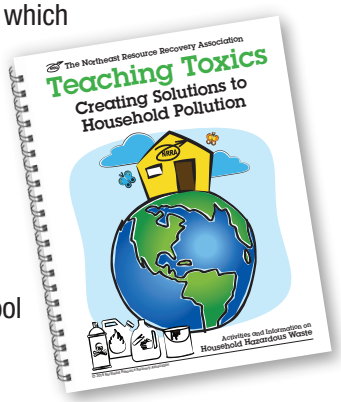
The school board and administration must set the stage for safe, environmentally responsible hazardous materials management by adopting policies. Policy statements send a clear message to the staff about the administration's commitment. The administration can work with the staff to develop realistic action plans to accompany policy statements. Staff involvement will lead to staff ownership and help the plans succeed. Staff are also the most capable of identifying concerns.

Teachers and staff can impress upon students the importance of hazardous materials management. Students can have an active role in the school's hazardous materials management program. Although it is not advisable to have students handling hazardous materials, they can assist in evaluating training programs, reporting unsafe conditions and contacting resource organizations.

NRRA's Teaching Toxics

Chapters 9 –12, pg. 107:

Hazardous Materials in Your School



- In small groups, have students discuss where they think hazardous materials are used in the school and for what purpose. For each area in which hazardous materials are used, have students list a contact person to talk to for more information.
- Hand out sample SDS's (Safety Data Sheets) for different hazardous products used at the school and the How to Read an SDS sheet (in curriculum, pg. 109). Have the groups discuss all the terms listed and the importance of this information in terms of use, storage and disposal. Ask students to record their ideas.
- Have students use the information listed on the SDS to write safety suggestions for the product's use and storage. Have the groups present the information to the class.
- Ask the student groups to design safety posters.

The Safety Committee

The school board and administration are ultimately responsible for ensuring that hazardous materials are managed in safe, environmentally responsible ways. An internal committee can help top administrators stay up to date on what is happening in the school. Some schools have already gathered concerned personnel into Safety Committees to solve general safety issues ranging from playgrounds to electrical wiring. Planning for hazardous materials management is a logical extension of a Safety Committee's responsibilities.

The Committee should consider the community's economic situation in its suggestions. For example, if safe use of a hazardous material requires expensive upgrading of the school's

ventilation system, the Committee might recommend that the material not be used at all.

If a school has the financial resources, it may wish to hire consultants if needed to take some of the work burden off the staff and Safety Committee.

NRRA's School Recycling CLUB
builds community action by directing students, teachers, schools and communities to a clear understanding of pertinent solid and hazardous waste issues and supporting sustainable waste reduction programs.
Contact theclub@nrra.net for assistance.

School Recycling CLUB

What the Safety Committee Does

Here are some of the tasks a Safety Committee can undertake:

1. Put a "Hazardous Materials Policy Statement" on the school board's agenda. Develop and present a draft policy statement at a meeting to the principal, superintendent and school board.
2. Work with school staff to identify all hazardous materials risks and liabilities in the school. Conduct an inventory and interview the staff who use hazardous materials. Depending on the size of the school and the extent of hazardous materials use, this can take some time. If your school can afford it, hire outside people to do this or involve the students.

   Schools can also bring in OSHA consultants to identify hazardous materials issues and suggest solutions. These visits are different from the regulatory visit that results from an employee complaint. However, the school must still correct any serious violations discovered during the OSHA consultant's visit.
3. Design a procedure to ensure that inventories are conducted annually. Computerized inventory systems, available from chemical supply companies, can facilitate this process.
4. Support the staff. Help staff find the resources to complete management tasks and seek staff opinion about the program's effectiveness. Furthermore, the Committee can publicly recognize staff contributions to the safer use of hazardous materials.
5. Monitor the hazardous materials policy implementation. See if the policy is being followed and advise the administration on ways to help staff adhere to the policy.
6. Assist in the record keeping requirements of hazardous materials management.
   - Obtain a U.S. EPA identification number whenever shipping hazardous waste.
   - File the proper notification papers, including OSHA logs and insurance carrier requirements.
   - Inform state agencies of changes in hazardous materials use.
   - Alert the local fire department to the identity and storage sites of the hazardous materials in the building.
   - Maintain hazardous waste manifests. A manifest must be kept for a minimum of three years, but it is wise to keep them longer.
7. Help the administration develop a hazardous materials training for staff.

Training ideas include:

- Presentations from local transfer station operator, liability insurance carrier, OSHA, hazardous waste disposal firm.
- First aid training about injuries possible in hazardous material use.
- Indoor Air Quality and Green Cleaning webinars produced by U.S. EPA and/or NRRA.

Revise curriculum to include safety instructions and hazardous materials understanding

Hazardous Communications Plan: A Requirement?

In most states, a Hazardous Communication Plan is required for schools because it provides a comprehensible method to hazardous materials management. If your state does not require such a plan, you may find it helpful to have one.

Hazardous Materials Management Coordinator

One person on the Safety Committee should be the "hazardous materials management coordinator." The coordinator assumes the responsibility for ensuring that all the Committee's tasks are completed.

SAMPLE INVENTORY FORM

Name of School _____
Address _____
_____
Phone Number _____
Date of Inventory _____

Name of Person(s) Conducting Inventory _____
_____
_____
_____

Name of Hazardous Product	Hazardous Class Info				Name of Hazardous Ingredients	Quantity	Location Stored	Date Purchased	Comments
	FLAMMABLE	TOXIC	CORROSIVE	REACTIVE					

Sample Policy Statement and Procedures

Sample Hazardous Material Policy

It is the policy of the Haznot Union School District that the school should provide an environment which is safe from chemical hazards. The Haznot School Board recognizes that with the use of hazardous materials, action must be taken to ensure the school community's personal safety and to protect the environment during use, storage and disposal.

The Haznot Union School District will comply with a management program outlined in the following Procedure Section. The procedures will comply with applicable local, state and federal laws and regulations pertaining to the safe use and disposal of hazardous materials.

Definition of Hazardous Materials

Hazardous materials are defined as those materials which exhibit one or more of the following characteristics:

- Ignitability
- Reactivity
- Corrosivity
- Toxicity

Definition of Hazardous Waste

Any waste exhibiting the characteristics of ignitability, corrosivity, reactivity and/or toxicity or that is specifically identified as hazardous in any State Hazardous Waste Management Regulations

Procedures for Managing Hazardous Materials

The goal of these procedures is to establish an ongoing program to identify and manage hazardous materials and waste.

The Haznot School Board is responsible for providing the necessary support for accomplishing the tasks listed below.

Reduction of Hazardous Materials

School personnel will be encouraged to reduce their use of hazardous materials. This can be achieved by finding less hazardous substitutions for hazardous material or eliminating programs that rely on the use of hazardous materials.

Purchase of Hazardous Materials

Purchase orders for hazardous materials must include a request for the Safety Data Sheet (SDS) for that product.

Donations/Free Samples

Acceptance of any donation of hazardous materials or vendor offer of a "free sample", must first be approved by the school. Such donation or sample cannot be accepted unless accompanied by its SDS, and assurance that the sample can be returned.

Tracking and Inventorying of Hazardous Materials

1. Ensuring that all hazardous products in use in the school building have a Safety Data Sheet (SDS) on file. The SDS will be on file in three places within the building: in the actual room where the hazardous product is being used; in the nurse's office; and in the files of the staff responsible for the facility management.
2. Ensuring that a hazardous materials inventory is completed each year. Inventory lists will be maintained and made available to appropriate public authorities (fire, emergency services).

Labeling and Storing Hazardous Materials

1. Ensuring that all hazardous materials are properly labeled as to their content and hazardous characteristic, the appropriate warning information, and the date received, shelf life and expiration date.
2. Ensuring that all hazardous materials are stored according to the instructions listed on its SDS. Hazardous materials will be separated and labeled according to hazardous characteristics and stored safely in areas appropriate to the risk posed by the materials. Where appropriate, storage cabinets will be locked and access to students or non-authorized staff limited.

Training of Staff and Students

Staff members and students using hazardous materials will receive training regarding:

- routine handling and storage
- spill containment
- who to call in the event of an emergency
- disposal
- reduction techniques

Students using hazardous materials in the classroom will also be instructed as to their proper handling, storage and disposal. Students will also be instructed about emergency procedures for an accident.

Disposal of Hazardous Materials

When a staff person believes that he/she has any waste that may qualify as hazardous, he/she will contact the administration for disposal arrangements.

The school will arrange for disposal in a manner that complies with applicable local, state, and federal laws and regulations.

Indoor Air Quality

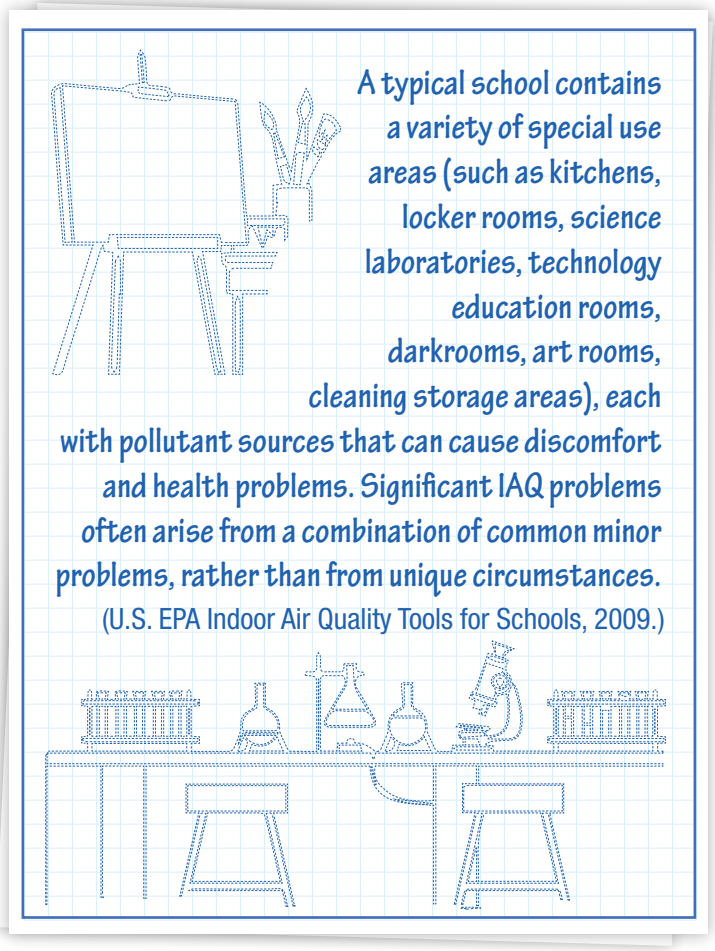
Now that we have focused on hazardous products and the motives behind a school Safety Committee let's talk about Indoor Air Quality (IAQ). The school's challenge with IAQ is that 20% of the U.S. population occupies elementary and secondary schools; Schools are four times as densely occupied as commercial office spaces and are used more hours per week; maintenance departments are routinely underfunded and understaffed; and, one-half of our schools nationwide have IAQ problems

A well-designed IAQ Management Plan yields substantial benefits for schools, employees and students. Using this plan can also reduce or avoid the expensive process of investigating and mitigating suspected IAQ problems.

(U.S. EPA Indoor Air Quality Tools for Schools, 2009.)

There are many practices that affect IAQ. Practices that many do not consider. Situations such as unvented office equipment, deferred maintenance (mold, water leaks), combustion products, volatile organic compounds (VOCs) found in cleaning products and processes, pests and pesticides, scented products (perfumes, candles, air fresheners, fragrances), art products and chemicals used in technical programs, should all be considered for IAQ assessment and remediation. VOC is the name given to a substance that contains carbon and that evaporates (becomes a vapor) or "off-gases" at room temperature. The compounds are found in aerosol products, paints, cleaners, disinfectants, pesticides, new carpeting, gasoline, furniture, scented markers/pencils, perfumes, laundry soaps and other scented products. VOCs are associated with asthma, cancer and other disorders.

In schools, we need to remember that children are at greater risk than adults when exposed to toxins because they metabolize and eliminate toxins more slowly than adults. Their rapidly developing systems are more sensitive to the effects of toxins. They live and play close to the ground where toxic residues collect in air and dust. Childhood exposures to chemicals in the environment are associated with asthma, attention deficit hyperactivity disorder (ADHD), autism, cancer, learning disabilities and mental retardation.



Whether it is in the form of a HazMat Coordinator or IAQ Coordinator or Safety Committee or IAQ Team, what is needed is a plan, administrative support, a coordinator and a team that look, smell, feel and listen for existing or potential chemical/ventilation related problems. The intent is to improve comfort, health and performance for staff and students by preventing exposure to toxic chemicals. School officials provide support, promote communication, and immerse their efforts in enrichment as they strive for improved school health resulting from implementing a hazardous materials management program.

Hazardous Materials and Maintenance

CHAPTER 4

The maintenance department is the first line of defense for student health. They can monitor and control chemical exposure to staff and visitors, toxins entering the environment, and replace toxic products with less-toxic cleaning products. Custodians often use a variety of hazardous products without generating significant amounts of waste. The department's concerns with management of these materials may focus more on health risks when using such materials (e.g., personal protection equipment), rather than potential environmental harm due to improper disposal. Maintenance has a special role in hazardous materials management because they are connected to all departments and have access to most materials and storage areas. They are the unsung heroes. When practicing good indoor air quality (IAQ), a healthier school community spawns' stellar attendance, enriched concentration and improved performance. It also reduces expensive, time-consuming cleanup and remediation activities.

This chapter discusses:

- Hazardous Materials in the Maintenance Department
- Indoor Air Quality
- Ways to Reduce Your Use
- Guidelines for Safer Use and Storage
- Guidelines for Environmentally Responsible Disposal

A building is characterized as "sick" when its occupants complain of health and comfort problems that can be related to working or being in the building.

Hazardous Materials in the Maintenance Department

Identifying Hazardous Products

Most schools use cleaning supplies containing toxic chemicals. Exposure to cleaning toxins can cause health risks to your employees and even greater risk to children whose vital organs are still developing. ***Do you know what toxic chemicals are in YOUR school?***

Always read the labels. It sounds simple but chemical labels can be confusing and the symbols can be hard to decipher, not to mention reading the fine print! Here are some common symbols and indicators to look for: Poison, Danger, Warning, Caution.

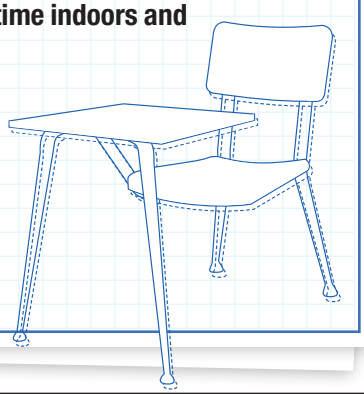
'Danger' and 'Poison' signify the material is highly toxic because a lethal dose is a few drops to a teaspoon. Typical label statement will read: "Fatal if …" This category may include such products as: oven cleaners, drain openers, rust removers and toilet bowl cleaners. 'Warning' indicates moderately toxic. A lethal dose is a teaspoon to a tablespoon. Typical label statement will read:

Impacts on Performance & Health at Schools

A child's developing organ systems are highly sensitive to environmental risk, and children are frequently more heavily exposed to toxic substances in the environment than are adults. **Children spend 90% of their time indoors and much of that time is spent in school.**

Schools in better physical condition report improved academic performance while schools with fewer janitorial personnel and higher maintenance backlogs report poorer academic performance.

A study of the costs and benefits of green schools for Washington State estimated a 15% reduction in absenteeism and a 5% increase in test scores.
https://www.epa.gov/schools/why-healthy-school-environments-are-important



"May be fatal if..." and includes such products as: floor cleaners and disinfectant sprays. 'Caution' implies low toxicity because a lethal dose is an ounce to more than a pint. The lethal dose within the Caution category is very broad. Thus, products within the Caution category have varying degrees of safety. Some products are very safe, while others may still contain one or more ingredients of concern. Typical label statement will read: "Harmful if..."

If there are no signal words on the label, then this product is the least toxic and no precautionary statements are required.

Always check the product's Safety Data Sheet (SDS) if you are unsure if it contains hazardous ingredients. The SDS should accompany all hazardous products that are sent to the school. If they are missing, be sure to notify your distributor to send replacements.

The SDS

Most maintenance departments recognize the value of keeping SDSs on file. However, many times these files are not updated on a regular basis, or not accessible to the entire staff. Even if the staff is aware of where the SDSs are filed, most do not receive training on how to read them. The school should ensure that everyone working with, or likely to be exposed to, hazardous materials know how to read and use SDS.

The following is a partial listing of hazardous materials commonly found in the maintenance department:

- Air fresheners and deodorizer (especially those containing paradichlorbenzene, commonly used in schools)
- Automotive or lawn equipment products
  - Motor oil
  - Lead-acid batteries
  - Lubricating greases
- Cleaning products
- Pesticides
  - Roundup® (glyphosate)
  - Insecticide sprays (containing chemical ingredients such as tetramethrin, petroleum distillates, methylene chloride, pentachlorophenol). Disinfectants are also technically classified as pesticides.

Monsanto's™ Roundup® on Trial

Roundup®, a common weed control pesticide used in schools, has recently gained attention. The primary or "active" ingredient, glyphosate, is listed by some states as "a chemical known to cause cancer" and by the World Health Organization as "a probable human carcinogen." In July of 2018, a former groundskeeper in the San Francisco Bay Area school district began asking Monsanto™ if their weed killer Roundup® causes cancer. The groundskeeper was diagnosed with non-Hodgkin's lymphoma in 2014. Until this incident, the primary concern with Roundup® was the other "inert" or filler ingredients. The inert ingredient, polyoxyethyleneamine (POEA), is much more of a serious health and environmental threat than the active ingredient. This illustrates a common problem with hazardous products labels. Terms such as "inert" are very misleading. Many people assume inert ingredients are harmless, as the name suggests. As Roundup® illustrates, this is not always the case.

- Paint and related products
  - Thinners
  - Turpentine
  - Stains
  - Wood preservatives
- Floor Care Products

Many types of cleaning products contain hazardous chemicals. There is a wide range of how "hazardous" these products are. Some "more toxic" products include:

- Any cleaner or degreaser containing petroleum-based solvents
- Carpet cleaners
- Drain openers
- Disinfectants
- Floor strippers
- Furniture polish
- Glass cleaners
- Graffiti remover
- Gum remover
- Septic tank additives
- Toilet cleaners

Green cleaning (using non-toxic products and substitutes, e.g., white vinegar) can save money, increase productivity, improve employee/student health and safety, and protect the environment by removing toxins from surfaces and the air. Ask your vendor about these cost competitive, non-polluting products. Septic tank additives may seem like a bargain compared to

pumping a septic tank. However, some products can damage septic systems, interfere with treatment of wastewater and contaminate groundwater. Inorganic additives, generally strong acids or alkalis, open clogged drains. The ingredients are like household drain cleaners and can destroy the biological function of the septic tank. During the subsequent days of sterilization, raw sewage flows directly into the drain field, potentially clogging pipes and soil pores. Research found hydrogen peroxide degrades soil structure in a drain field, reducing its ability to treat and absorb wastewater effluent. Equipment corrodes, beneficial bacteria and microbes are killed, and groundwater is contaminated. Money spent on additives would better be spent pumping your septic tank every three to five years.

Septic Tank Additives

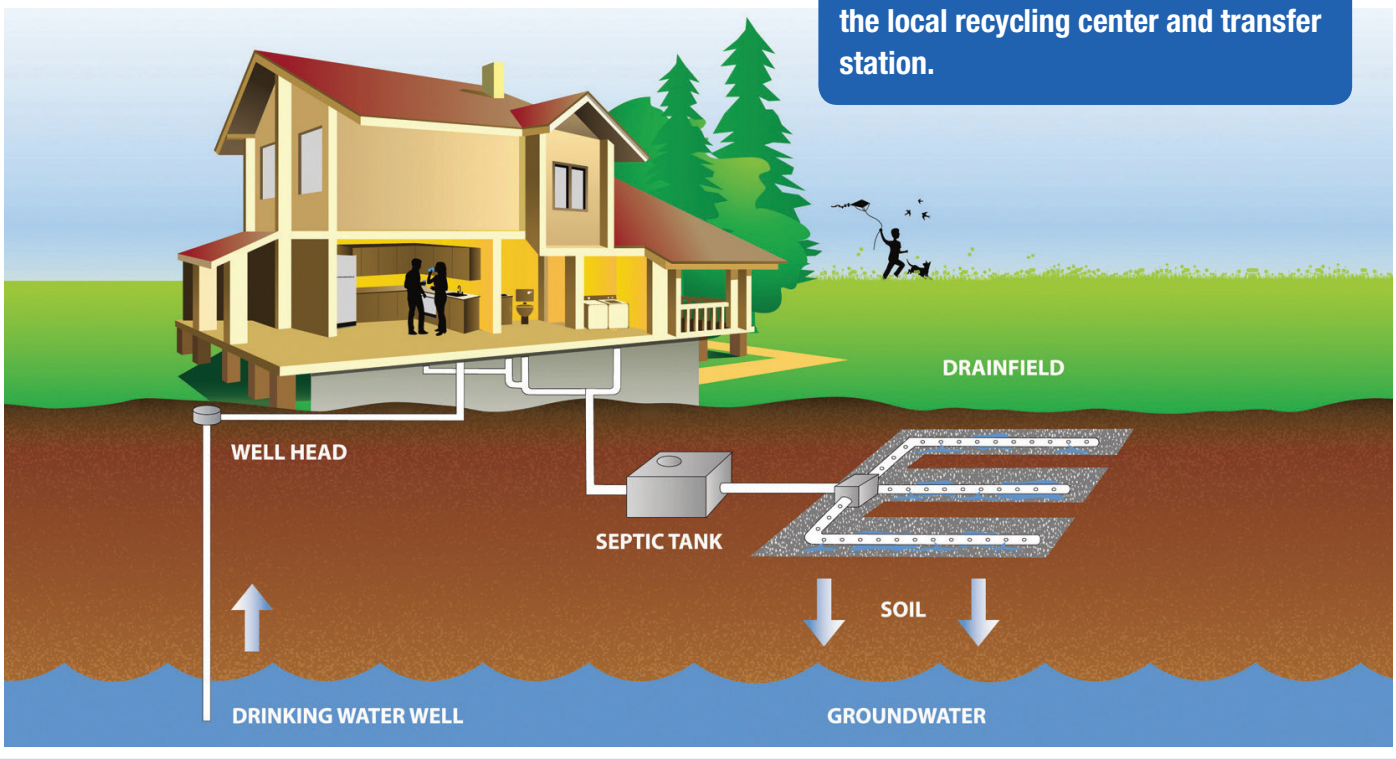
Septic tank additives, marketed as ongoing maintenance or remedies for septic tank problems, can actually do more harm than good. Some septic maintenance products are banned in many states, as they contain hazardous chemicals which can destroy a leach field and contaminate groundwater. Professionals should be consulted about leach field problems, rather than using hazardous additives.

It is important to know how your septic system works before considering using any additives.

1. Tanks are designed to keep solids, grease and oils from clogging the drain field. Bacteria in the tank break down organic solids into gas and liquid. Some solids in the tank, such as sand, gravel, dirt and bits of plastic, cannot be broken down by any enzyme or bacteria. These settle out and accumulate, creating a layer of sludge at the bottom of the tank and requires periodic pumping to remove.
2. Grease and oils rise to the surface as scum while the relatively clear liquid between these layers flows out into the drain field and infiltrates into the soil.
3. Eventually, the tank is pumped out and the cycle begins all over again.

While septic systems require bacteria to work, no special bacteria need to be added. The simple act of using the system promotes the growth of bacteria needed to make the system work.

Keep toxic chemicals from going down the drain. Properly dispose of solvents, paint, varnish, oil and pesticides at the local recycling center and transfer station.



Indoor Air Quality

High energy costs encourage the development of tight buildings and a reduction in the amount of outdoor air brought into school for ventilation. In addition, building operating and maintenance budgets are often reduced to minimal levels, particularly in schools. These actions, combined with the proliferation of indoor sources of contaminants – synthetic materials, cleaning agents, pesticides, printing and copying devices, combustion and humidification appliances, and other sources – reduce the quality of indoor air environments and consequently the health and comfort of building occupants.

The quality of indoor air is vital for human health because most of our exposure to environmental pollutants occurs by breathing the air indoors. Studies reveal that indoor air is 2 to 5 times more polluted than outdoor air. This is a concern especially when these same studies reveal that people spend 90% of their time indoors. Think about the many hours you spend sleeping, working in offices or at school, working out in a gym or shopping. In fact, the U.S. Environmental Protection Agency (EPA) estimates that the average person receives 72 percent of their chemical exposure indoors, which means the very places most people consider safest paradoxically expose them to the greatest amounts of potentially hazardous pollutants. Poor indoor air quality (IAQ) has been tied to symptoms like headaches, fatigue, trouble concentrating, and irritation of the eyes, nose, throat and lungs. Also, some specific diseases have been linked to specific air contaminants or indoor environments, like asthma with damp indoor environments. In addition, some exposures, such as asbestos and radon, do not cause immediate symptoms but can lead to cancer after many years.

Developing a comprehensive and effective IAQ Management Plan can help schools organize and implement their IAQ program. Schools across the nation have used EPA's IAQ *Tools for Schools* to implement successful programs. The EPA also has a plethora of webinars, meetings and reports for the public to remain educated and involved with protecting and improving indoor air. These are listed in the Resource Section.

What Affects Indoor Air Quality?

Unvented office equipment
Deferred maintenance (mold, water leaks)
Combustion equipment
Volatile organic compounds (VOCs) found in:

- Cleaning products and processes
- Paints
- Pesticides
- Scented products (perfumes, candles, air fresheners, fragrances)
- Art products
- Chemicals used in technical programs.

Ways to Reduce Your Use

To decrease the amount of hazardous materials used in the maintenance department:

- Replace a hazardous product with a less or nonhazardous one.
- Decrease the amount of hazardous materials used.
- Improve housekeeping standards and techniques.
- Solve the polluting problem at its source.

Significant IAQ and hazardous materials management problems often arise from a combination of common minor problems, rather than unique circumstances. For example:

A school is not getting enough air because a fan belt is broken or slipping and a seldom used drain trap dries out, resulting in sewer gases being drawn into the school.

The design of the school ceiling/roof allows significant air leakage through unintentional openings and stack effect (warm air rising) pushes indoor air out through these openings, causing radon to be drawn into the school through cracks and utility penetrations in the floor.

A housekeeping product is mixed at twice the recommended strength so it "does a better job" and the unused mix is placed in an inappropriate container and stored in a utility closet that is connected to the return air ductwork, which carries pollutants to other parts of the school. (EPA Indoor Air Quality *Tools for Schools*, 2009, pg. 2)

Product Substitution

Less and nonhazardous products are improving rapidly and becoming more readily available. As these product lines become further developed, they are becoming available in bulk and concentrated forms. Included in the Resource Section is a partial listing of sources for less and nonhazardous products. Third party certified green cleaning products meet certain specifications for safety and labeling including Green Seal, Ecologo and EPA's Safer Choice program.

Pesticides are Poisons

As poisons, pesticides can cause immediate and long-term negative health effects. It may be hard to determine if you are suffering from overexposure to pesticides because symptoms are generally common (headaches, dizziness, nausea) and wide-ranging. The pesticides commonly used in schools, called "neurotoxins," can cause learning problems or hyperactive behavior (in students) if used in large amounts and/or over long periods of time

Integrated Pest Management (IPM) Principles

Rather than simply eliminating the pests you see right now, using IPM means you'll look at environmental factors that affect the pest and its ability to thrive. Armed with this information, you can create conditions that are unfavorable for the pest. The most effective, long-term way to manage pests is by using a combination of methods that work better together than separately. These include: (1) Biological controls - the use of natural enemies (predators, parasites, pathogens and competitors) to control pests and their damage. Invertebrates, plant pathogens, nematodes, weeds and vertebrates have many natural enemies. (2) Cultural controls - practices that reduce pest establishment, reproduction, dispersal and survival. For example, changing irrigation practices can reduce pest problems, since too much water can increase root disease and weeds. (3) Mechanical and physical controls - kill a pest directly, block pests out or make the environment unsuitable for it. Traps for rodents are examples of mechanical control. Physical controls include mulches for weed management, steam sterilization of the soil for disease management, or barriers such as screens to keep birds or insects out. (4) Chemical controls - the use of pesticides. In IPM, pesticides are used only when needed and in combination with other approaches for more effective, long-term control. Pesticides are selected and applied in a way that minimizes their possible harm to people, nontarget organisms and the environment. With IPM you'll use the most selective pesticide that will do the job and be the safest for other organisms and for air, soil and water quality (e.g., use pesticides in bait stations rather than sprays, or spot-spray a few weeds instead of an entire area).

Cleaning and Polishing Products

Use cleaning products which are less toxic or nontoxic. Many new products, containing vegetable-based ingredients, are being marketed. For example, many schools have tried citrus-based degreasers to replace degreasers with a petroleum-base. Water-based products are generally less hazardous then petroleum-based. Water-based floor strippers do not give off the fumes associated with traditional strippers. In addition to being less toxic to those applying the strippers, water-based strippers and waxes do not pose a fire risk.

Paint and Related Products

There are a variety of "natural paints" and no or low VOC related products available.

Latex paint (water-based) is less hazardous than oil-based paints. Latex paint does not require the use of oil-based solvents (thinners, turpentine, etc.). Older latex paint, however, contained Phenyl mercuric acetate (PMA) and similar mercury compounds as "in-can" preservatives to extend the shelf life of water-based paints by controlling bacterial fermentation and as a fungicide. Use of mercury biocides in paint officially ended in 1991. In the U.S., prior to that, mercury compounds were used in 25 to 30% of all latex paints (interior and exterior). Between the mid-1960s and 1991, an estimated 250 tons per year of PMA and other mercury compounds were used in water-based paints in the U.S. These chemicals were not used in oil-based paints.

To Switch or Not to Switch

Consider the following when debating the importance of switching to less or nonhazardous products. Although the immediate health effects of overexposure to hazardous products are known, many of the long-term health effects have not been determined. Yet if we examine how hazardous cleaning products are used, we should be concerned. For example, the health consequences of inhaling small amounts of a furniture polish containing methylene chloride (suspected to cause cancer) on a weekly basis, over a twenty-year period is largely unknown. Using less or nonhazardous products decreases health risks.

Decrease the Amount of Hazardous Materials You Use

Pesticides

Scheduled applications of pesticides may result in overuse and may create a larger problem by killing the natural enemies of insects. Pests can also become resistant to sprays, creating a need for more spraying, but never solving the problem.

Scheduled application may also cost the maintenance department more money than necessary. If pesticides must be used, only apply when absolutely necessary. Develop an official integrated pest management (IPM) policy to provide guidance for changing from conventional pesticide use. Refer to Pest Control in the School Environment: Adopting Integrated Pest Management https://www.epa.gov/managing-pests-schools/pest-control-school-environmentadopting-integrated-pest-management for a complete description of indoor and outdoor sites and strategies for pest prevention.

Paint

Determine exactly how much paint you need to do the job, to avoid any leftover waste in the can. Calculate the total surface area to be painted and divide this figure by the spread rate (the product label should indicate the spread rate, which is generally 400 square feet per gallon) to calculate the amount of paint you need. (See the following diagram "Painting by Numbers.") Not only will this method avoid disposal problems, it will also save money.

Painting by Numbers

1.	_____	X	_____	=	_____	
	The width of all walls added together		Height of the wall		Total wall surface (Square feet)	
2.	_____	X	_____	=	_____	
	Height of window		Width of window		Window surface	
3.	Repeat Line #2 for each window and add together.					
4.	_____	X	_____	=	_____	
	Height of door		Width of door		Door surface	
5.	Repeat Line #4 for each door and add together.					
6.	_____	+	_____	=	_____	
	Total from Line #3		Total from Line #5		Total surface not painted	
7.	_____	-	_____	=	_____	
	Total from Line #1		Total from Line #6		Total surface to be painted	
8.	_____	÷	400	=	_____	
	Total from Line #7		Spread rate		Number of gallons needed for each coat of paint	

In general, you can expect 1 gallon of paint to cover about 400 square feet. You need slightly more than a gallon if the walls are unpainted drywall, which absorbs more of the paint. You also need to consider whether to paint more than one coat. If you're painting walls that are unfinished, heavily patched, or dark in color, plan on applying two coats of paint or a combination of primer and paint. There are also online calculators to help you with purchasing the correct amount of paint without too much waste. One such calculator is https://www.improvenet.com/r/paint-calculator.

Cleaning and Other Products

Read the directions carefully to make sure only the proper amounts of a hazardous product are used. Some companies now market products in containers which release pre-measured amounts of cleaner, to ensure overuse does not happen.

Improve Housekeeping

Insist on good housekeeping practices to avoid waste. For example, age alone won't detract from a paint's properties. However, an improperly sealed lid and excessive heat or cold can make paint not suitable for use. Paint that is subject to poor housekeeping practice becomes a waste product. Petroleum-based adhesives are also subject to the effects of poor housekeeping.

Solving the Problem at its Source: Alternatives Methods to Pesticide Use

Pesticides only treat the symptoms of a pest problem, and do not address the real problem. Going to the problem's source is a wise "long-term investment." Although it may require some additional costs, such as building repair, solving the problem at the source may save money formerly spent on pesticides. The real gain from decreased pesticide use, however, is improved human health and environmentally quality. Here are some tips for solving pest problems at their source.

- Make sure food preparation areas are cleaned up.
- Make sure food is stored in tightly sealed containers (no food left out).
- Caulk, seal or screen all cracks, holes and other openings to prevent pests from entering building.

Plant only native plant species around the school grounds. These species are the most suitable for weather conditions and naturally more resistant to insects.

- Develop a tolerance for certain types of "weeds" such as clover and dandelions.
- Use nontoxic sticky traps for crawling insects.
- Work with teachers to develop ways to include students in alternative pest control. Students can conduct research for non-toxic methods of controlling insects, such as using soap and water sprays, cayenne or cinnamon to control ants.
- Plant trees and shrubs away from building envelope to prevent pests from gaining access to building cracks and openings.

Alternative Methods May Save Money

The school may actually save money by decreasing the use of pesticides. For example, in 1985, the Montgomery County Public School System went from paying $ 2,400 per school using conventional chemical pest control to $ 575 per school using alternative methods which did not rely on hazardous chemicals.

Other recent examples: https://www.beyondpesticides.org/assets/media/documents/schools/publications/IPM_cost%20_FS.pdf

Guidelines for Safer Use and Storage

General guidelines for safe use and storage of hazardous materials are discussed in Chapter 2. This section discusses some points which are particularly relevant to the maintenance department.

Safer Use

Awareness is the cornerstone of safe hazardous materials use. Through training, all maintenance personnel can understand how to safely use hazardous materials and understand the consequences of improper use. Some hazardous products used in maintenance are encountered in daily activities (cleaners, paints, etc.). Since these products are so common, people frequently do not bother to read and follow the label directions.

Maintenance personnel should know how to read the Safety Data Sheet. Particular attention should be given to how hazardous substances can enter the body (absorption, inhalation, ingestion) so that the appropriate precautions can be taken.

Precautions for Health's Sake

- Make sure the area in which hazardous products are used is properly ventilated. This is especially important when using products which give off hazardous fumes. "Proper" ventilation does not necessarily mean an open window. It is imperative that fumes are removed from the area without being moved across people's breathing zones.
- Wear proper personal protective equipment (PPE) when working with hazardous products which are easily absorbed (petroleum-based solvents) or when using strong acids and bases (toilet cleaners, drain openers).
- Prohibit smoking when using any flammable materials.
- Prohibit eating and drinking when using any hazardous materials.

Storage Guidelines

For the most part, the main storage concern of hazardous materials used in the maintenance department, are flammable products. See Chapter 2 for a discussion of this topic. All chemicals should be properly labeled if transferred to a new container. OSHA requires proper labeling for all maintenance chemicals. For more information on proper labeling see the fact sheet: https://www.epa.gov/sites/production/files/2013-08/documents/fact_sheet_how_to_properly_label_a_cleaning_product_container1.pdf

Environmentally Responsible Disposal

It is important to be familiar with all hazardous waste storage and disposal regulations, as the responsibility for managing these wastes often is passed to the maintenance department. Also, other school staff may ask the maintenance department to dispose of hazardous waste that should not be thrown in the dumpster. Therefore, becoming familiar with the types of hazardous waste generated from other areas of the school is important to avoid sending hazardous waste to the municipal landfill.

For a general discussion on hazardous waste disposal, see Chapter 2. You will find information on disposal options and how hazardous waste must be stored in the school building. For waste generated on a regular basis, maintenance departments report waste associated with engine maintenance and painting.

Cleaning products pose less of a disposal problem. This is due, in part, to how cleaning products are used. Most products are completely used up before the container enters the trash.

Cleaners that are washed down the drain may be diluted to the point where they are not harmful. Excessive amounts, however, may pose environmental problems, especially to those schools using septic systems.

Even if the maintenance department does not generate hazardous waste on a regular basis, old and unwanted products may be lurking in storage. Some schools have unwanted dangerous or banned pesticides in need of disposal. One school we visited was storing 50 lbs. of the herbicide Diazinon, until they can afford its disposal costs. (Diazinon is now heavily restricted and even banned from some types of use.) Careful planning now will help you avoid such situations in the future. The table on the following page should help guide your storage practices.

SEGREGATION TABLE FOR COMMON HOUSEHOLD HAZARDOUS WASTES

CORROSIVES (ACIDS)

Boric Acid
Car Battery Acid
Copper Cleaners
Etching Solutions
Ferric Chloride
Hydrochloric Acid
Hydrofluoric Acid
Metal Cleaners
Muriatic Acid
Navel Jelly
Phosphoric Acid
Pool Acid
Sheep Dip
Sodium Bisulfate
Sulfuric Acid
Acid Toilet Bowl Cleaners *
Oxalic acid

CORROSIVES (BASES)

Ammonia and Ammonia-Based Cleaners
Battery Terminal Cleaner
Caustic Soda
Cess Pool Cleaners *
Alkaline Drain Cleaners (sodium hydroxide)
Household cleaners *
Lime
Lye
Oven Cleaners *
Sodium Hydroxide
Window Cleaners

FLAMMABLES & COMBUSTIBLES

Acetone
Adhesives *
Aerosols
Air Freshener
Alcohols
Artificial Snow
Asphalt Driveway Topping
Automotive Body Filler (Bondo)
Automotive Oils
Automotive Waxes
Bar-B-Que Lighter Fluid
Benzene
Brake Fluid
Butane
Camphor
Chrome-Silver Polishes *
Cutting Oil
Denatured Alcohol
Diesel Fuel
Disinfectants
Duplicator Fluid
Enamel Paint
Enamel/Oil-Based Paint
Epoxy Paint
Ethanol
Ether
Ethylene Glycol
Fiberglass Resins
Fingernail Polish and Remover
Floor/Furniture Polish
Formaldehyde Solution
Formalin
Gasoline
Glues *
Grease
Isopropyl Alcohol
Kerosene
Lacquer Thinner
Lacquer Paint (unsolidified)
Linseed Oil
Liquid Sandpaper *
Methanol
Naphtha
Oils (petroleum)
Organic solvents
Paint Thinners
Paint Strippers *
Paraffin Oil
Pentachlorophenol
Perfume
Petroleum Distillates
Plastic Roof Cement
Plastic Model Cement
Polyurethane Paint
Polyurethane Cement
Power Steering Fluid
Primers
Roofing Cement
Rug/Upholstery Cleaner
Sealers
Shellac Thinner
Silicone Sprays
Spot Remover/Dry Cleaning Fluids
Thinner
Tile Cement
Tire Black
Toluol/Toluene
Transmission Fluid
Transmission Oil
Tree Root/Stump Killer
Turpentine
Varnish
Wallpaper Cement
Waxes
Windshield Wiper Fluid
White Gas
Wood Filler/Putty
Wood Stain
Xylol/Xylene

REACTIVES

Adhesive Catalysts
Autobody Paint and Filler Catalysts
Hardeners or Activators

OXIDIZERS

Ammonium Nitrate
Bleach
Calcium Hypochlorite
Chlorates
Fertilizers *
Fluorine
Hair Coloring
Hydrogen Peroxide
Iodine
Nitric Acid
Plant Food
Potassium Permanganate
Sodium Hypochlorite
Toilet Bowl Cleaner with bleach

POISONS

Ant and Roach Killer
Anti-Freeze
Arsenic Compounds
Automotive Cleaners
Bacterial Pipe Cleaners
Bordeaux Mix
Boric Acid
Bug Remover
Chlordane
Chrome -Silver Polishes*
Chromium
Copper Sulfate
DDT
Diazinon
Dimethylamine Salts
Disinfectants*
Dog Repellent
Ethylene Glycol
Fertilizers
Flea Spray/ Powder
Fungicides *
Gopher Killer
Insect Sprays
Lead Compounds
Lice Powder
Lindane
Malathion
Methylene Chloride
Mole Killer
Moth Crystals
Pentachlorophenol
Pesticides
Pharmaceuticals
Plant Food
Pruning Paint
Pyrethrins
Rat Poison
Rose Dust
Sheep Dip
Snail /Slug Killer
Strychnine
Tar Remover
Weed and Grass Killer
Windshield Wiper Fluid

*Check Ingredients. Most products with * next to them will be OK to store in category they are in regardless of ingredients.

Hazardous Materials in the Visual Arts Classroom

CHAPTER 5

The art classroom can be the forgotten comer of a school's hazardous materials management plan. It commonly contains

toxic (oil paint), flammable (rubber cement), corrosive (photography chemicals) and reactive (intaglio and lithography) materials.

Hazardous art materials are also used in many other classrooms, especially in elementary schools. This chapter discusses:

- Identifying Hazardous Art Products
- Hazardous Art Materials: Problems and Solutions
- Guidelines for Safer Use and Storage
- Guidelines for Environmentally Responsible Disposal

Identifying Hazardous Art Products

Information appearing on an art product label can help you determine whether or not it is considered "hazardous." Some label information is mandated by federal law. All art supplies sold in the U.S. must bear the phrase, "conforms to ASTM D 4236," confirming that they have been properly labeled for chronic health hazards, in accordance with the federal Labeling Hazardous Art Materials Act (LHAMA).

Federal Labeling of Art Materials

The federal Labeling Hazardous Art Materials Act (LHAMA), passed in 1988, takes existing hazardous product labeling laws one step further. Labeling laws usually only discuss immediate (acute) health effects when determining if a product is toxic. Under LHAMA, art supplies must contain warnings if they cause acute hazards—such as "harmful or fatal if swallowed" or "may cause skin irritation" - as well as warnings if they could cause chronic health effects, such as cancer, sterility, blindness, birth defects or allergic reactions.

However, LHAMA does not mandate that manufacturers provide consumers with an ingredients list, so the substances in many art supplies are often kept from consumers. Toxicologists from the Consumer Products Safety Commission (CPSC) evaluate all U.S. art products for compliance with LHAMA at least every five years and whenever a product's formula is changed. LHAMA also states that the CPSC can use a court injunction to prevent schools from purchasing particular art materials covered by the Act for use by children in pre-kindergarten and grades K - 6. The CPSC "advises" schools not to purchase such materials for children under the age of 12. Seven states, including California, Florida, Illinois, Oregon, Tennessee and Virginia, have banned the use of toxic art supplies in grades K - 6.

Art product manufacturers may also participate in a voluntary labeling program. A Safety Data Sheet (SDS) (formally MSDS) provides full disclosure of the hazardous chemicals in a product. The SDS is produced by the manufacturer of the chemical and includes information on the health and physical hazards associated with the material and provides detailed information regarding its physical properties, reactivity and toxicity. It also details first aid, storage, disposal, exposure control and spill/leak procedures. These are particularly useful if there is a spill or a person has accidental contact with the material.

Picking Safer Products

Art material labeling programs assist artists in identifying nontoxic or less hazardous products. The Arts and Crafts Material Institute, Inc (ACMI) runs a nationally recognized certification program for the toxicological evaluation of art products. Art products approved by this program bear the following seal:

This label means a product "contains no materials in sufficient quantities to be toxic or injurious to humans or to cause acute or chronic health problems."

If a product contains potentially harmful ingredients, ACMI will mandate a CL label ("Caution Label"). Products bearing the CL seal of the Art & Creative Materials Institute contain ingredients that are toxic or hazardous, but they can be used safely with appropriate caution. Materials that bear the CL seal

should be used only by those persons who are able to read, understand and follow suggested safety precautions for handling those materials. This seal appears on only a small percentage of adult art materials in ACMI's certification program and on none of the children's materials. These products are also certified by ACMI to be labeled in accordance with the chronic hazard labeling standard, ASTM D 4236, and LHAMA. Many such art products cannot be made non-hazardous but are necessary for certain creative activities.

CAUTION: It is important to read the product label in full before opening a product that has the CL Seal. These products should never be given to children in grade 6 or lower or anyone with a physical or mental handicap who is unable to read and understand safety labeling on packages.

Products with the CL seal meet the AP requirements and "meet or exceed specific quality standards of material, workmanship, working qualities and color." In the past, the program issued an HL (Health Label) seal to identify products whose labels reflect the results of a medical expert's toxicological evaluation. They may or may not contain toxic ingredients. One thing to note is that the AP and CP labels do not indicate that a product is completely free of toxicants - rather, that it contains no chemicals "in sufficient quantities to be toxic or injurious to humans."

LABELING

The Federal Hazardous Substance Act (FHSA) requires labels to bear information regarding:

- a description of all hazards associated with the product (for example FLAMMABLE, TOXIC),
- a statement: "**KEEP OUT OF REACH OF CHILDREN"** or equivalent,
- hazard class signal words (**DANGER, WARNING, CAUTION**),
- first aid information,
- common chemical names for hazardous ingredients, and
- guidelines for safe use and handling. Under this law, hazardous products are regulated only in terms of their acute health.

Where Can I Find Certified Products?

Write to:
The Art and Craft Materials Institute
for a free listing of certified products:

The Art and Craft Materials Institute, Inc.,
99 Derby Street, Suite 200
Hingham, MA 02043.

Or call (781) 556-1044.
www.acmiart.org/index.php/contactus

Hazardous Art Materials: Problems and Solutions

Chemicals, compressed gases, machines and electrical hazards are the most common health and safety risks associated with the visual arts. Using a less or nontoxic art product is the easiest way to reduce risks. The nontoxic product may produce less "professional" results, but this is a tradeoff to keep nontoxic products out of the classroom.

If you do not know if a product contains hazardous materials, consult the Safety Data Sheet (SDS) which the distributor or manufacturer should have included with the product (see page 22 for more information on using the SDS).

Here are some hazardous products commonly found in art classrooms and some suggestions for less hazardous substitutes.

Adhesives

Many petroleum-based adhesives are flammable and toxic. The most common of these in schools is rubber cement which contains the highly toxic and flammable ingredient hexane. If you must use rubber

cement, look for products using heptane, which is less toxic than hexane. Glues that combine chemicals such as epoxy glue and polyurethane adhesives are also highly toxic. In secondary school visual (and theater) arts classes, adhesives are used in woodworking, painting and sculpture.

What Can You Use Instead?

Viable substitutions for petroleum-based adhesives include:

- preservative-free wheat pastes,
- glue sticks,
- low-temperature wax applications,
- double-sided tape, or
- white glue. (Although these glues are generally considered safer, they contain polyvinyl- acetate [PVA). Possible chronic health effects of acetaldehyde, a common contaminant, are one drawback of PVA glues.)

Homemade Non-Toxic Glue from Milk

The best all-purpose homemade glue is made using milk and other kitchen ingredients, much like how commercial non-toxic glue is made. Depending on how much water you add, the end result is a thick craft paste or a white glue.

Ingredients:

1/4 cup hot water
2 tablespoons powdered dry milk
1 tablespoon vinegar
1/8 to 1/2 teaspoon baking soda
Add more water, to reach desired consistency

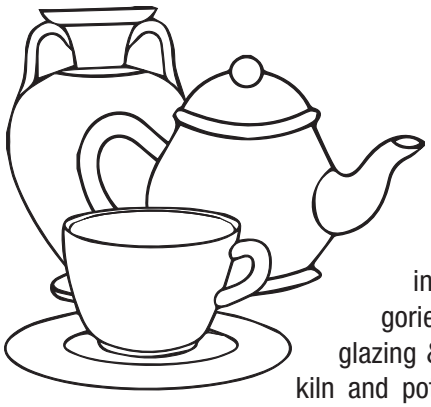
Directions: Dissolve the powdered milk in the hot tap water. (Another option is to use 1/4 cup of warm milk.)

Stir in the vinegar. You'll see a chemical reaction occur, separating the milk into curds and whey. Continue stirring until the milk has separated. Filter the mixture through a coffee filter or paper towel. Discard the liquid (whey) and keep the solid curd.

Mix together the curd, a small amount of baking soda (about 1/8 teaspoon), and 1 teaspoon hot water. The reaction between the baking soda and the residual vinegar will cause some foaming and bubbling. Adjust the consistency of the glue to suit your needs. If the glue is lumpy, you can add a bit more baking soda. If it is too thick, stir in more water.

Store the glue in a covered container. It will last 1-2 days on the counter, but 1-2 weeks if you refrigerate it.

(courtesy of www.thoughtco.com)



Ceramics

Hazards associated with ceramic arts fall into four general categories: working with clay, glazing & coloring, firing in the kiln and potential leaching of finished ware. The clay may contain silicates (aluminum, crystalline) and organic matter or sulfur compounds. Sometimes, grog (ground firebrick), sand, talc, vermiculite, perlite, and small amounts of minerals such as barium carbonate and metal oxides, are added to modify clay properties. Inhaling dust from dry clay can cause lung damage.

Clay is made by mixing dry clay with water in a clay mixer. Some clays contain talc, and could be contaminated with asbestos, which can cause cancer. The geography of talc is relevant. For example, talc from New York State is notoriously asbestos-contaminated. Vermont talc is not.

In addition to preventing back problems (by always lifting with knees bent) and carpel tunnel syndrome (by keeping wrists in unflexed position as much as possible when working at the wheel), other precautions include:

- Use premixed clay to avoid exposure to large quantities of clay dust.
- Clay storage and mixing should take place in a separate room.
- Bags of clay (and other pottery materials) should be stacked on palettes or grids off the floor for easier clean-up.
- All clay mixers should be equipped with local exhaust ventilation to remove fine silica dust particles from the air.
- Wear separate work clothes while in the studio. Choose clothes of material and design that don't trap dust. Wash these clothes weekly, and separately from other laundry.
- Avoid contact of clay with broken skin. Use a skin moisturizer.
- Recondition clay by cutting still-wet clay into small pieces, letting them air-dry and soaking them in water.
- Finish greenware while still wet or damp with a fine sponge instead of sanding when dry. Do not sand greenware containing fibrous talc. Wet mop floors and work surfaces daily to minimize dust levels and prevent dry scraps from becoming pulverized.

Glazes

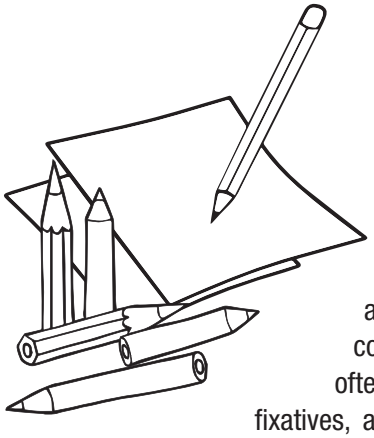
Glazes can contain free silica, often in the form of flint, silica, feldspar and talc, all of which can damage the lungs. Some glazes contain toxic metals such as lead, barium and lithium. Using glazes with "lead frits" does not completely eliminate exposure risks to heavy metals. Colorants can contain toxic metals such as antimony, chromium, manganese, uranium, cadmium and vanadium. These are not safe for classroom use.

Kiln firing produces toxic fumes and gases. Bisque firings can release toxic carbon monoxide, sulfur dioxide and formaldehyde from clays. Glazes also release toxic fumes during the firing process.

What Can You Use Instead?

Use wet clay whenever possible to avoid dust byproducts. Most art teachers have already switched to lead-free glazes. If the glaze does not state "lead-free" or "leadless" on the label, assume it contains lead until proven otherwise.

Ventilating the kiln to the outside will alleviate the hazards of firing.



Drawing

Several types of hazardous products are used in drawing. This includes dust-creating media such as charcoal and pastels which are often fixed with aerosol spray fixatives, and media such as crayons and oil pastels which do not create dust. Although charcoal is just considered a nuisance dust, inhalation of large amounts of charcoal dust can create chronic lung problems. A major source of charcoal inhalation is from the habit of blowing excess charcoal dust off the drawing. Colored chalks are also considered nuisance dusts. Some chalks are dustier than others. Individuals who have asthma sometimes have problems with dusty chalks, but this is a nonspecific dust reaction, not a toxic reaction. Pastel sticks and pencils consist of pigments bound into solid form by a resin. Inhalation of pastel dusts is the major hazard. Some pastels are dustier than others. Pastels can contain toxic pigments such as chrome yellow (lead chromate) which can cause lung cancer, and cadmium pigments, which can cause kidney and lung damage and are suspected human carcinogens. Blowing excess pastel dust off the drawing is one major source of inhalation of pastel pigments.

Crayons and oil pastels do not present an inhalation hazard and, thus, are much safer than pastels. Some oil pastels can contain toxic pigments, but this is only a hazard by accidental ingestion.

Both permanent and workable spray fixatives, used to fix drawings, contain toxic solvents. There is high exposure by inhalation to these solvents because the products are sprayed in the air, often right on a desk or easel. In addition, you can be inhaling the plastic particulates that comprise the fixative itself. Never try to spray fixative by blowing air from your mouth through a tube. This can lead to accidental ingestion of the fixative.

What Can You Use Instead?

Water-based markers are readily available. Avoid using the markers that smell like fruit because they encourage students to smell and taste art supplies. Carefully assess your use of spray fixatives. If you must use them, make sure the area is well ventilated. Remember an open window or using the product outside does not constitute proper ventilation. Wind can blow the fixative into your and your students breathing area. Use the least dusty types of pastels, chalks, etc. Asthmatics, in particular, might want to switch to oil pastels or similar non-dusty media. Don't blow off excess pastel or charcoal dust with your mouth. Instead tap off the built-up dust so it falls to the floor (or paper on the floor).

Painting

Hazards associated with paint and related products vary depending on the type of solvent (base), pigments used, and the form it is in (liquid or spray). Paints containing a petroleum (oil) base are generally toxic and flammable. Furthermore, you must use organic solvents (turpentine, naptha, etc.) to clean up oil-based paints.

The U.S. EPA says paint vapors are the primary indoor air pollutant. Oil-based paints and solvents are highly volatile. Their vapors build up in the air and increase the risk of lung damage. According to the Art Hazards Institute, 25-50% of the solvent in an uncovered container might evaporate over a three-hour period.

Pigments, or the coloring of the paint, can be toxic. Most artists know that lead pigments, especially in powder form, are dangerous. Other common heavy metal pigments are extremely toxic. In particular:

ARSENIC:
cobalt violet

ANTIMONY:
true naples yellow

CADMIUM:
all cadmium pigments

CHROMIUM:
zinc yellow
strontium yellow
chrome yellow*

COBALT:
cobalt violet (arsenic variety)
cobalt green
cobalt yellow*
cerulean blue

LEAD:
flake white *
lead white*
mixed white*
true naples yellow

MANGANESE:
manganese blue
manganese violet
brunt umber
mars brown

MERCURY:
true vermilion (mercuric sulfide)*
cadmium vermilion red

** The Center for Safety in the Arts recommends that you do not use these pigments in schools.*

Any paint products, in aerosol or spray form, are particularly dangerous because dispersed tiny particles are easily inhaled.

What Can You Use Instead?

Using water-based paints (acrylics, tempera, watercolors) dramatically decreases the number of hazardous products in the art classroom. When teaching oil painting, look for the following less toxic pigments:

alizarin crimson
alumina
barium white
burnt sienna
chalk
raw sienna
ultramarine blue
zinc white
cheines white
english red
Indian red
Ivory black
mares black
titanium oxide
green red violet
mares orange
mares red
mares violet
Paris blue
Prussian blue
titanium white
yellow ochre

When buying paint, look for paints that are labeled "non-toxic" or "natural (ACMI label)." Read the label to ensure they contain no extra solvents or additives and check for 5g/L or less of VOCs. It's important to understand everything that goes into the paint you're buying. Ask the retailer and do some research on your own about any brands you're considering

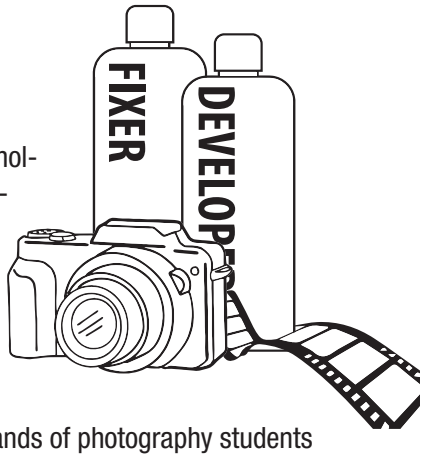
Schools often choose interior latex paint when creating scenery for plays. Use "Low VOC" or "No VOC" latex paint. VOC stands for "volatile organic compound." These chemicals are regulated by the government because they are unstable and let off gasses that are very harmful to people and the environment. VOCs are found in many building materials and are partially responsible for that new paint smell. Since VOCs are found in paints, they can also build up quite a bit in the home. According to the Environmental Protection Agency (EPA), "studies have found that levels of several organics average two to five times higher indoors than outdoors."

When inhaled, VOCs can contribute to several health problems, including irritation to your airways, headaches, nausea, and even damage to the liver, kidneys or central nervous system. Due to this, it's best to use products with minimal amounts of VOCs whenever possible. Many eco-friendly paints are making their way onto the market, including recycled paint, milk paint, and plant- or mineral-based paints. Be sure to check out these alternatives before buying.

If you use oil paints, try to mix them with linseed oil and clean brushes with baby oil followed by soap and water.

Avoid spray paints by using liquid paints that you apply by brushing, dripping or splattering.

Photography



New and emerging technologies are driving curriculum changes across many campuses. This change is most prevalent in the photography class. Many schools are placing digital cameras in the hands of photography students because it is more affordable. The loss is that techniques such as contrast, shadows, texture, framing, shape, and lighting are all attributes easily understood in black and white pictures. Although digital photography has taken over from developing rolls of film in a darkroom, there are schools that still teach the techniques of using an "analog" camera and paper prints.

Some schools offer students a choice between analog or digital. In this case, reports have shown that many students have an interest in analog because they feel they can do digital on their own with their phone. Teachers find that if students appreciate the process of shooting analog, they will put to good use the more general photography and camera skills when they pick up a digital camera (like how lens aperture and shutter speed help

Common Hazardous Chemicals

Product Type	Common Hazardous Chemicals	Health Risks	Comments
1. Developer	Hydroquinone and Metol (monomethyl p-aminophenol sulfate	Toxic, skin irritant; allergic reactions may occur. Hydroquinone may also cause eye damage and is a possible mutagen. Mixing developer powders increase risks of inhaling chemicals.	Developers are dissolved in solutions containing sodium sulfate and sodium carbonate or sodium hydroxide (which can cause skin irritation and burns).
2. Stop Bath	Glacial acetic acid	Severe burns in concentrated acid (or form; inhalation can irritate the respiratory system.	When diluting glacial acetic acid (or other concentrated acids) always add the acid to water, never the reverse. This will prevent a violent reaction with boiling and spattering. Add acid slowly with extreme caution and stir constantly. Always start with cold water.
3. Fixer	Sodium sulfite, sodium thiosulfite, acetic acid	Mixing sodium sulfite and acids produce sulfur dioxide gas, which is highly irritating to the eyes and respiratory system.	

determine the photo you're taking). Sometimes working with film in the darkroom teaches students the discipline, the patience, and the desire to capture the best image of the subject matter. Regardless, schools that offer the analog experience should be prepared to manage a hazardous material.

Photography chemicals are corrosive because they contain acids and bases. Some photo chemicals are very corrosive even in diluted working solutions. Black and white development usually involves fewer hazardous chemicals and wastes than color development. The cost of the equipment necessary for safe and environmentally responsible color development often puts it out of the reach of most high schools. Plus, many schools use digital for color.

Reducing Use of Photography Chemicals

To get the maximum life out of the photo chemicals, you can use the "two-bath fixing method." This involves setting up two trays of fixer and immersing the print in the first bath for half of the total fixing time. Then transfer the print to the second bath for the remainder of the time. This allows you to fix about twice as many prints than with a single bath. When you have exhausted the first fixing bath, transfer the second to the first position and make a new second bath.

Advanced Techniques Mean Taking Extra Precautions

Use discretion in determining whether to teach advanced black and white techniques because these methods involve additional hazardous materials and more risks. You must have proper ventilation if you teach techniques such as bleaching, reduction and toning. The most common reducer, Farmers Reducer, contains potassium ferricyanide which is slightly toxic under normal conditions. If the ferricyanide crystals come into contact with extreme heat, acids, or ultraviolet radiation, they will release extremely poisonous hydrogen cyanide gas.

Many toners contain highly toxic chemicals such as selenium, uranium, sulfide, gold and platinum. Avoid using toners containing thiourea (a suspected carcinogen). Sulfide, brown or sepia give off highly poisonous hydrogen sulfide gas and must be used with a fume hood or slot hood ventilation system. Hardeners and stabilizers often contain highly toxic formaldehyde.

Printmaking and Silk Screening

Pigments used in printmaking are similar to those in oil paints, including lead and other heavy metals. Petroleum-based inks require hazardous solvents for preparing and cleaning the screen.

Inks may contain up to 50% hazardous solvents.

The most hazardous inks contain aromatic hydrocarbons (benzene, toluene, xylene) and lacquer thinners (methyls, ethyls, ketones), and other mineral spirits.

Solvents are easily inhaled during screen preparation, printing and drying. During drying, the greatest volume of the solvent evaporates into the air in a short period of time. Clean-up also involves a high risk of exposure because of the toxicity of the screen washes.

Be Aware!

Try to avoid these highly toxic chemical ingredients used in spray paints and fixatives, adhesives, permanent markers and lacquers/ thinners:

- benzene (benzol)
- carbon tetrachloride
- methyl-butyl ketone
- methylene chloride
- n-hexane
- trichloroethylene

What Can You Use Instead?

As with paints, use inks with a water base.

This will eliminate two hazards in one step, because oil-based solvents will no longer be necessary.

How to Further Reduce Risks

Many art teachers worry that they lose essential components of their program when they stop using some hazardous art products. Determining what is truly essential means finding a balance between giving students a realistic representation of the art world and creating a learning environment that is safe. Teachers must consider that they themselves use art materials for longer lengths of time and might experience the effects of toxic materials more severely than the students.

Hazardous materials should not be used if the school cannot ensure safe and environmentally responsible use and disposal. These questions will help determine whether to use a hazardous product.

- Is the activity and hazardous materials appropriate for this age group?
- What safety hazards does using this product present?
- Is the appropriate safety equipment available: eyewash stations, fire extinguisher, gloves?
- Is the school's ventilation system adequate?
- Can the product be stored safely?
- Will there be an environmentally responsible way to dispose of the product?

Many art techniques do not require the use of hazardous materials. Redesigning the curriculum to match available safe resources will help ensure a healthy environment.

Guidelines for Safer Use and Storage

Teaching Art Safely

Art teachers must do some homework before allowing students to use hazardous materials.

- Know the chemical contents of the products you are using. Check the Safety Data Sheet on a product before you use it. Give the appropriate school personnel (nurse, safety committee) copies of the SDS of all hazardous products you use. Keep a copy on file in the classroom.

Note: When you use photography chemicals, read the "Reactivity Section" on the SDS carefully. Decomposition of fixers and toners are major hazards.

- Show students how to use the SDS. Testing students periodically on hazardous materials use helps reinforce the topic's importance.
- Minimize exposure risks of hazardous materials.
  - Do not allow eating or drinking in the classroom and where photo chemicals are mixed.
  - Insist students use tongs in photo chemical developer and other baths. Never put hands into any photo chemical. Wearing latex gloves may be appropriate.
  - Do not let volatile hazardous materials remain uncovered. For example, open containers of paint thinner, rubber cement, or open trays of photo chemicals will give off vapors. Cover the trays when they are not in use or pour the chemicals into containers (using funnels) for later use.
  - Label these containers with their contents and appropriate warning information.
- Verify that the art classroom, darkroom and kiln have specially designed ventilation systems. Darkrooms contain varying degrees of vapors, chemical dusts, fumes and gases. Gas kilns need canopy hoods with powered exhaust. Work areas and drying areas for silk screening and printmaking also require local exhaust ventilation to prevent accumulation of vapors.

- Be aware of fire safety when you use flammable art products. Make sure flammable materials are never used around ignition sources like sparks or the heat from a kiln, for example. Keep solvent-soaked rags in a metal can with a self-closing lid until disposal. For more information on using and storing flammable materials safely, see Chapter 2.
- Use liquid or prepared materials whenever possible. This is especially important for pregnant women. You can use premixed photography chemicals, for example, to minimize the danger of exposure to dusts, spills or splashes.
- Eyewash stations should be available when using any materials that can damage eyes. Eyewash stations are essential in darkrooms to expedite treatment.
- Use personal safety equipment when appropriate. Gloves, chemical splash goggles, protective aprons (approved by the American National Standards Institute) must be worn when mixing concentrated photo chemicals. Ordinary household gloves are an ineffective barrier.

Storing Art Materials Safely

Art teachers need to consider how to store toxic, flammable and corrosive materials safely (see Chapter II for more information). The safest way to store flammable and corrosive materials is in cabinets specifically designed for those materials. Since these cabinets are expensive, you may want to try sharing storage with the industrial arts department. Keep in the classroom only the amount you will use in one day.

The following are guidelines for storing hazardous materials.

- Take precautions against fire if you are storing flammable products like rubber cement and turpentine outside a specifically designed cabinet. Never store flammable products with combustible materials such as paper and cloth that abound in art classrooms. Never store flammable art material near a kiln.
- Lock up all toxic art supplies and limit students' access to them.
- Store all hazardous art products, especially concentrated photo processing chemicals, in a place where they cannot be knocked over. Arrange the storage area so that hazardous chemicals are not above eye level.
- Guidelines for storing photo processing chemicals:
  - Store corrosive chemicals in nonmetal, unbreakable containers.
  - Store concentrated chemicals on shelves at or below eye level.
  - Label diluted chemicals with the contents, appropriate warning information and date they were mixed.
  - Store acid, bases and organic chemicals in separate areas.
  - Keep acids and Farmers Reducer away from each other. They are not compatible.
  - Store photo chemicals in a dry, cool place (no lower than 40º degrees F.)

Environmentally Responsible Disposal

Using your entire supply of a material will reduce waste. Good housekeeping practices (such as keeping lids on tightly) can also reduce waste. With a little patience, you can recycle oil-based thinners and solvents. Allow material to settle to the bottom of a designated brush cleaning jar, then filter the solvent and reuse it.

Black and White Photo Processing Chemicals

Several factors will govern how you dispose of black and white photo processing chemicals: how much waste you generate on a daily, weekly or monthly basis, and if your school treats its waste water in a septic system or municipal sewer. Check with your state's guidelines.

Opinions vary on whether it is permissible to dispose of small amounts of photo chemicals into septic systems. There is a growing consensus that schools using septic systems should not put any potentially hazardous chemicals down the drain without pretreatment. If your school's water goes to a waste water treatment facility, call the facility before pouring even the smallest amount of photo chemicals down the drain. Whether the facility can handle your school's photo chemicals depends on other demands from the community. When in doubt save the material until it can be taken to an HHW collection event.

The usual limits for pH at treatment facilities are 5.5 (acidic) and 9.5 (basic/alkaline). Check photochemical waste pH values with pH indicator paper (ask your local science teacher). Adjust it to the appropriate level by adding vinegar to increase acidity, and borax to increase alkalinity.

Other factors complicating photochemical disposal include controlling oxygen demand and silver compounds concentration.

Waste Photography Silver Compounds and the Environment

The disposal of waste silver compounds from photography is regulated because significant amounts of these compounds will damage the environment. Check with local and state authorities

before you put any silver-containing waste down the drain.

Where Is Silver Found?

Silver remains on the dark areas of a black and white photograph. Silver compounds are in fixers, bleach fixes and washes.

Silver Recovery

Silver can be recovered from exhausted fixing baths and bleach-fix solutions. Local photography labs might accept these solutions from schools to recover the silver compounds. Recovered silver can be a source of revenue.

Schools can also purchase small silver recovery units. The available methods range widely in price and technology level. Electroplating and a metallic replacement (using steel wool cartridges) are the most common. Schools prefer metallic replacement because of its low set up cost and simple installation. The need to replace cartridges is one of a few drawbacks to this system. Your art department will need to research the appropriate method of silver recovery.

Checking with local state environmental or hazardous waste agency before dumping any photo chemicals down the drain is always recommended. Here are NHDES recommendations: https://www.des.nh.gov/organization/commissioner/pip/factsheets/hw/documents/hw-2.pdf

Get the Students Involved

Involve student photographers in exploring disposal options for waste photo chemicals. They can put what they learned in science class to use in real life. Work with the science department to create activities for testing photochemical waste pH and calculating oxygen demand. Students can also conduct the art department's research on the school's waste water treatment. Student involvement is critical to institutionalizing sound waste management practices.

Hazardous Materials in the Industrial Arts and Vocational Classroom

CHAPTER 6

This chapter focuses on raising awareness of hazardous materials use and disposal in industrial arts and vocational programs.

These programs tend to use hazardous materials on a regular basis. Vocational educators and students risk more accidents than the rest of the school community, and their programs generate more hazardous waste on a regular basis. This chapter will examine:

- Regulations for Vocational Labs
- Common Hazardous Materials in Vocational and Industrial Arts Programs
- Ways to Reduce Your Use
- Guidelines for Safer Use and Storage
- Guidelines for Environmentally Responsible Disposal

Regulations for Vocational Labs

Vocational Programs and Occupational Safety and Health Act (OSHA)

Most vocational schools know about their state OSHA regulations on hazardous material use. However, many high schools are unfamiliar with what actions are needed to comply.

In general, OSHA requires that schools have:

- a written comprehensive employee safety program that covers safe use of hazardous materials.
- a written inventory of all hazardous materials involved, including wastes like the welding and exhaust fumes generated in the work operations,
- informative labels and other forms of warning of associated hazards,
- a system for guaranteeing that all employees have access to Safety Data Sheets (SDS) for hazardous products, and
- an employee training program on using hazardous material safely.

OSHA has specific standards regarding hazardous materials use. Consult them before drafting any management plan. Complying with OSHA regulations is an ongoing process. You must review and update your procedures each year.

Resources for Compliance

As part of a voluntary program, OSHA consultants can visit schools and help administrators identify violations. Rather than levy immediate fines, they help schools find the most cost-effective methods for solving problems. The schools are obligated to correct any violations within a determined period of time.

Many trade associations provide sample hazards communication programs for the businesses they represent and might be willing to help vocational programs as well. Talk to the professionals in the field and see if their plans can be adapted to meet the needs of the school.

Common Hazardous Materials in Vocational and Industrial Arts Programs

Hazardous materials in the vocational and industrial art classes run the gamut from flammable liquids to corrosive and toxic materials. The following are common hazardous materials used in automotive and small engine repair, building trades and wood working, drafting, culinary trades, and graphic arts. Many vocational schools also offer programs in agriculture and horticulture, which may use pesticides.

Automotive and Small Engine Repair

- Carburetor cleaner (propane)
- Antifreeze (ethylene glycol)
- Power steering fluid (mineral oil)
- Brake fluid (polyglycol and glycol ethers)
- Brake and clutch pads may contain asbestos
- Motor oil (petroleum distillates, waste motor oil may be contaminated with heavy metals)
- Parts cleaner (petroleum distillates)
- Lead acid batteries (lead, sulfuric acid)
- Gases for cutting and welding including oxygen and acetylene, propane, nitrogen, hydrogen and carbon dioxide.

Building Trades/Woodworking

- Wood sealer (diethylene glycol, carbitol solvent)
- Wood stains (mineral spirits, dipentene)
- Wood finish (mineral spirits)
- Wood preservatives (trichloromethylene, pentachlorophenol)
- Wood glue (residual vinyl, acetate monomer)
- Strong adhesives ("Super Contact" types, methyl ethyl ketone, toluol, various types of petroleum distillates)
- Oil-based paint (various petroleum distillates and solvents, some heavy metals)
- Paint thinner (various types of petroleum-based solvents)
- Wood filler (isopropyl alcohol, acetone) wood dust (especially exotic woods)

Culinary Trades

- Stainless steel cleaner (methylene chloride)
- Glass cleaners (ammonia)
- Bleach (sodium hypochlorite)
- Drain cleaners (potassium hydroxide)

Drafting/Graphic Arts/Photography

- Ammonia
- Activators (sodium sulfite, hydroquininone or potassium hydroxide, sodium sulfite)
- Developer (sodium methanal, bisulfate, hydroquinone, sodium sulfite, boric acid)
- Rapid fixers (ammonium thiosulfate, sodium sulfite, acetic acid or alumnus sulfate)
- Developer B (potassium carbonate; sodium hydroxide, sodium bromide)
- Petroleum-based inks (could contain variety of organic solvents, pigments may contain heavy metals)
- Blanket solvent (various types of organic solvents)
- Stabilizer (acetic acid, ammonium thiocyanate, aluminum sulfate, sodium hydroxide)

Understanding Organic Solvents

Organic solvents make up a significant portion of the hazardous materials used by vocational and industrial arts programs. The generic term, organic solvent, refers to any substance that dissolves another substance and contains carbon. Although there is a wide range in organic solvents' chemical characteristics, most are toxic and flammable.

The term organic solvent appears on labels, but this will not enable you to assess the risks of using a product. The chemical family name you find on labels or SDS is also not sufficient for a fully informed decision.

Ways to Reduce Your Use

Reducing the amount of hazardous materials will consequently reduce exposure risks and the amount of hazardous waste generated. As larger industry is discovering, reduction can decrease costs, liabilities and regulatory burdens. Reduction techniques can potentially enhance efficiency and product quality. Vocational and industrial arts programs can reduce hazardous materials use by reevaluating curricula, using less hazardous materials, and improving housekeeping practices.

If your school does not have the resources to use hazardous materials safely and environmentally responsibly, then they should not be used. This simple maxim can eliminate most hazardous materials problems. For example, some schools have decided not to supply woodworking students with stains or paints because they do not have adequate ventilation. If students want to stain the final project, they must do it at home. Many vocational programs have discontinued their automotive painting course because they could not conduct it in a safe, environmentally responsible manner.

Toxicity Reduction

Avoid using these highly toxic and flammable organic solvents:

- **benzene/benzol** - may cause leukemia
- **carbon tetrachloride** - suspected of causing cancer
- **methyl n-butyl ketone** - suspected of peripheral neuropathy associated with inhalation
- **n-hexane** - suspected of nerve damage with chronicexposure
- **trichloroethylene** - suspected of causing cancer
- **1,1,2-trichloroethane** - suspected of causing cancer
- **chloroform** - suspected of causing cancer
- **ethylene dichloride** - suspected of causing cancer

This is a partial listing. For more information contact Americans for the Arts www.americansforthearts.org.

Identifying Organic Solvent Ingredients

Chemical Family	Specific Chemicals Included	Where Are They Found?	Comments
I. Aromatic hydrocarbons	benzene, toluene, xylene	Aromatic hydrocarbons may be used in: • permanent ink markers • paint and varnish removers • glues • lacquers and lacquer thinners • print making wash-up products • photography supplies	Aromatic hydrocarbons are one of the most hazardous families; try to avoid their use.Benzene in particular is highly toxic and can cause cancer.
II. Aliphatic hydrocarbons	mineral spirits, kerosene, gasoline, n-hexane	Aliphatic hydrocarbons may be used in: • paints • thinners • inks • fuels • propellants (aerosol products)	Napthas is the general name for a variety of solvents derived from petroleum and coal tar. Napthas contain aliphatic or aromatic hydrocarbons.
III. Chlorinated hydrocarbons	carbon tetrachloride, methylene chloride	Chlorinated hyrocarbons may be used in: • cleaning fluids • acrylic glues • waxes • metal degreasers • fixatives • aerosol propellants	Try to avoid the use of chlorinated hydrocarbons. Although carbon tetra-chloride has now been banned from many consumer products, it still may be found in stockpiled solvents.
IV. Ketones	acetone, methyl ethyl ketone, methyl n-butyl ketone	Ketones are low-cost solvents used in: • lacquers • pigments • varnishes • photography supplies • inks and paint removers • paint varnishes	
V. Alcohols	methanol, ethanol, methyl alcohol, ethyl alcohol, isopropyl	Alcohols may be used in such products as: • shellacs • paint removers • inks • varnishes • lacquer and paint thinners	Alcohols are one of the safer classes of organic solvents in terms of alcohol toxicity, but have lower flash points and therefore present a greater fire hazard.

Substitute Products

You can replace a hazardous product with a less or nonhazardous product in some vocational and industrial arts programs. Here are a few ideas for substitutions.

Automotive and Small Engine Repair Parts Cleaner

1. Use less hazardous solvents whenever possible. For example, there are solvents with a "low-flash naphtha" (flash point less than 140 degrees F) that are less flammable than the high- flash naphtha (flash point greater than 140 degrees F).
2. Try using an alkaline cleaning detergent and water solution to clean parts. Alkaline cleaning agents are used in either a heated dip tank, agitating tank or jet-spray washer. Lengthen the life of the solution by periodically strengthening and removing contaminants like oil. This cleaning solution itself is less hazardous, but once it has been contaminated with oil, etc. it is a hazardous waste. You might be able to remove contaminants from the solution and discharge the solution to the municipal sewer system. Contact the water treatment facility before putting anything down the drain. Dispose of the contaminants as hazardous waste according to regulations.
3. You can now get terpene-based citrus cleaning products. Use citrus-based thinners as a less hazardous solvent for degreasing. Exercise caution when you use these products especially if you use large amounts. Remember that once the cleaner becomes contaminated with hazardous material, the resulting mixture must be treated as a hazardous waste.

Antifreeze

Propylene glycol is a less toxic antifreeze. An ingredient in food and cosmetics, it is "generally recognized as safe" by the U.S. Food and Drug Administration. Some question whether propylene glycol is as effective an antifreeze as ethlyne glycol in cold climates.

Closing the Loop

Use recycled oil whenever it is available. Although recycled oil still contains the same hazardous constituents as virgin oil, purchasing recycled oil may stimulate the market, and eventually lower disposal costs for waste oil. In comparison studies, recycled motor oil maintained the same lubricating properties as a virgin oil.

Building Trades/ Woodworking

Paint/Stain and Related Product Alternatives

Less hazardous "natural stains and paints" are becoming readily available, including:

- herbal primers and oil finishes (high grade linseed oil-based, lead-free dryers),
- citrus-based thinners, (many of these use d-limonene, a fragrant chemical found in plants that has similar properties to mineral spirits), and
- low toxic wood glues (casein, sodium carbonate and calcium carbonate). Polyvinyl acetate (PVA) emulsion glues (such as Elmer's) require a longer setting time but are safer than solvent-based adhesives. Possible chronic health effects.
- acetaldehyde, a common contaminant, are one drawback of PVA glues.

The following organic solvents are considered to be safer:

- acetone (note that acetone is extremely flammable),
- propylene glycol,
- isopropyl alcohol, and
- ethanol alcohol.

Graphic Arts

Less toxic inks have the added benefit of requiring less hazardous cleanup products. There are now a variety of the vegetable-based inks on the market. Most of these use soybean oil instead of petroleum. Others use linseed, corn or canola oils. In the absence of standards related to vegetable oil content, however, some of these inks still contain significant amounts of petroleum products and can emit polluting volatile organic compounds (VOCs). When you purchase vegetable-based inks, look for those with VOCs below 5%. You can also use citrus-based solvents to clean print presses, machinery and other equipment.

Improve Housekeeping Practices

Cover volatile solvents, such as part-washing agents, at all times to reduce the chance of an accidental spill and prevent evaporation. Keeping container lids tightly closed on paints, stains and solvent-based adhesives, prevents them from becoming useless before their time. Insisting students use good housekeeping practices reduces waste, saves money and instills valuable work habits.

Reduce Wastes

Avoiding hazardous materials leaks and spills in programs such as automotive and small engine repair is almost impossible. You can work to reduce the amount of waste resulting from spills,

CAUTION:

Natural, But Not Necessarily Nontoxic

Although natural, d-limonene, the primary ingredient in citrus-based solvents, should not be considered "nontoxic." The National Toxicology Program has been studying its long-term health effects. Although these effects have not been fully determined, some links to cancer in male rats have been found.

however. Rather than rely on absorbent material for cleanup, for example, you could use a drip pan or other container to hold spills. You will then dispose of the drippings, not the soiled absorbent material. This decreases the amount of absorbent soaked with a hazardous material, and the amount of absorbent you need to buy.

Use Materials Safely

Take Steps to Minimize Exposure

Some topics in a vocational program involve extended use of hazardous materials that can be inhaled, ingested or absorbed into the body.

Decrease that risk by keeping in mind the following guidelines.

- Make sure the room is properly ventilated for the types of materials in use. Petroleum-based solvents are particularly volatile, thus are more likely to be inhaled. Ventilation systems should always pull hazardous contaminants away from the user's breathing zone. For detailed information about your school's system, consult professionals.
- Prohibit eating and drinking whenever hazardous materials are in use.
- Wearing protective clothing will greatly minimize contact with hazardous materials. For example, wear solvent-resistant gloves when working with solvents, especially when contact is likely, such as when washing metal parts in dip tanks. For the clothing to be effective, it must be the proper type for the particular hazard, the proper size and worn correctly.
- Never wash hands with organic solvents. This practice takes fats from the skin, increases the likelihood of absorption into the body and can cause skin irritation.

Educational Value of Addressing Hazardous Materials Issues

Incorporating hazardous materials safety instruction into the vocational and industrial arts curriculum will prepare students for their future work places. Your class may be the only time students see work habits that will keep them healthy. Also, students who are aware of safety and health regulations will be able to assert their rights as workers.

Vocational and industrial arts programs can model current trends in industry, such as technologies to minimize hazardous materials use and hazardous waste generation.

Minimizing Accidents

Accidents will happen. However, many preventive actions can be taken. Emergency planning will minimize the consequences of an accident.

- OSHA regulations require hazardous materials users to develop written emergency plans. This type of planning will reduce accident damage.
- Make sure all protective equipment (fire extinguishers, eye wash stations, body showers) is appropriate and in working order.
- When using flammable materials, be aware of all possible ignition sources. For example, never use electrical tools around flammable vapors or gases.
- Never mix chemicals together unless you are knowledgeable of the results. Mixing common cleaning products could create a deadly mixture.

Storage Guidelines for Hazardous Materials

The following storage information refers to materials found in vocational and industrial arts programs. Always consult the product's Safety Data Sheet for specific storage information.

- Store and charge batteries in well-ventilated areas and away from ignition sources.
- Make sure battery terminals are taped with electrical tape to avoid starting fires.
- Store flammable material (petroleum-based paints, thinners and turpentine) in cabinets specifically designed for this purpose.
- Gasoline is an extremely hazardous item to store in a school. Avoid storing large amounts. If you must have gasoline at the school, be sure:
  - the container is not completely full, as gasoline needs room to expand,
  - it is stored in an approved safety container,
  - it is stored preferably in an outside building, in an area with good ventilation, and
  - away from all sources of ignition.
- Store flammable solvent-soaked rags and paper in NFPA-approved metal containers with self-closing lids.
- Suggestions for storing photo developing chemicals:
  - store corrosive chemicals in nonmetal, unbreakable containers,
  - store concentrated chemicals on shelves at or below eye level, and
  - label dilute chemicals with the contents, appropriate warning information and the date it was mixed.
- Suggestions for storing compressed gas cylinders:
  - cylinders must be secured and kept erect both in use and in storage,
  - shut off valves and regulators when not in use,
  - make sure hoses, valves and regulators are tightly secure and in good repair,
  - store any spare cylinders in a well-ventilated area separated by a fire-resistant barrier, and
  - never use oil on an oxygen valve or regulator equipment.

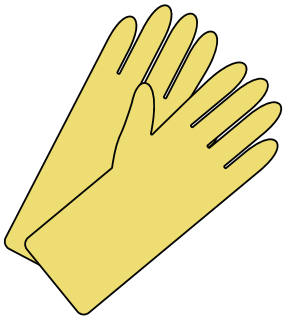
Gloves and Organic Solvents

When using organic solvents, wear the following types of gloves:

Aromatic hydrocarbons
- Buna-N or NBR Rubber
- Nitrile

Chlorinated hydrocarbons
- Neoprene Rubber
- Latex/Neoprene
- Nitrile

Ketones
- Natural Rubber or Latex
- Neoprene Rubber
- Butyl Rubber
- Latex/Neoprene



Alcohols
Any of the above listed types are appropriate.

Guidelines for Environmentally Responsible Disposal

This section discusses specific wastes that are likely to be encountered in vocational and industrial arts programs. As regulations are subject to change, contact your state's Hazardous Materials Division, or your local solid waste management authority to keep current and to receive technical assistance.

Automotive

A significant portion of waste generated in vocational and industrial arts programs comes from the automotive or engine repair program. As automotive maintenance involves draining and replacing fluids (at times accompanied by changing a filter), waste is generated.

Used Antifreeze

Antifreeze (ethylene glycol) is a regulated hazardous waste, that can be recycled, and its original properties replenished.

While recovery units are available, most schools do not generate enough used antifreeze to make this an economically viable option. Antifreeze can also be recycled "off- site" (not at the school) through an antifreeze recovery service, which picks up used antifreeze at the school. Most of these services mix in additives to replenish antifreeze's physical properties.

Used Motor Oil

Used motor oil is regulated as hazardous waste in most states. It is exempt of some regulation if it is:

- refined and reused on-site,
- burned on site in an approved system (energy recovery), or
- recycled off-site.

Schools generally can take advantage of one of these options.

Many schools send their used oil off-site to be burned for energy recovery in waste oil furnaces (designed specifically for this purpose). These furnaces must operate at 99% combustion efficiency and meet emission standards for various constituents set by your state's Air Pollution Control Division. In most cases, all used oil recycled as fuel must be tested before burning. This ensures it does not exceed contaminant levels set by the Hazardous Waste Management Regulations set by your state. If the used oil exceeds these levels, it cannot be used for energy recovery, except in specially permitted industrial furnaces. Hazardous waste disposal firms can be consulted for testing.

Storing Used Oil

Store drums of used oil in a designated area.

Label the drums and keep them covered at all times. It is imperative that nothing else is mixed in with the used oil. Used oil mixed with other types of hazardous wastes is no longer considered exempt waste and is not suitable for energy recovery or recycling. For example, if organic solvents are mixed with oil, then the resulting mixture must be treated as if it was solely composed of the most hazardous component. This can significantly increase the cost of disposal.

Used Oil Filters

Presently, used oil filters are exempt from most hazardous waste regulations, providing that:

- filters are “gravity drained” for a minimum of four (4) hours or are crushed (the longer filters are drained, the more oil will be recovered),
- the oil recovered from such processes are managed as used oil, and
- the filters are sent to a scrap metal recycler.

Parts Cleaning Solvents

Parts cleaning fluid can be recycled. One of the most convenient methods is contracting with a state-licensed company for pick-up of waste parts cleaning fluid and replacement. These companies lease part cleaning units and take full responsibility of any waste generated.

Absorbent Material

If Speedi-Dri or similar absorbent material is used to clean up a hazardous materials spill, it becomes hazardous waste and must be disposed of as such. To reduce the volume of waste absorbent, make sure you completely use it up before disposing. Store partially-used absorbent in clearly marked containers for reuse on a future spill.

Building Trades

Used solvents may make up a significant portion of the total waste generated from building trades programs. If the school uses the services of a licensed solvent recycling company, check with them to see if waste solvent from the building trades can also be accepted. Solvents can also be reused by allowing particles to settle out. The contaminants can be removed, and the remaining solvent used again.

Graphic Arts

Much of the solvent waste associated with graphic arts comes from paper towels soaked with cleaning solvent. Avoid the use of paper towels to clean machines by using cloth rags. Cloth rags can be sent to a laundering service for cleaning.

Hazardous Materials and Science

CHAPTER 7

Science labs are readily identified as the home of most school's hazardous materials. As a recognizable source of risk, there has been much emphasis on lab safety awareness. While this awareness has changed lab practices dramatically during the past several years, hazardous chemical storage and disposal issues may need some attention. This chapter discusses:

- Regulations Pertaining to Science Labs
- Hazardous Chemicals Used in School Labs
- Ways to Reduce Your Use
- Guidelines for Safer Use and Storage
- Guidelines for Environmentally Responsible Disposal

Regulations Pertaining to Science Labs: Elements of a "Chemical Hygiene Plan"

The Occupational Safety and Health Administration (OSHA) Title 29 of the Code of Federal Regulations

(CFR) 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories, covers all workers using hazardous chemicals in laboratories. "Laboratory use" means performing chemical procedures using small quantities of hazardous

chemicals on a laboratory scale and not as part of a production process in an environment where protective laboratory practices and equipment are in common use. Since January 31, 1991, academic labs need to have a written plan which includes "all the work practices, procedures, and policies to ensure that all employees are protected from potentially hazardous chemicals used in their work places" (U.S. Department of Labor). OSHA now enforces the Chemical Hygiene Plan (CHP) standard for all school laboratories. If your laboratory students (and staff) use hazardous chemicals, the school must develop and implement a written Chemical Hygiene Plan to protect them.

Developing a CHP is not only the law, it is in the best interest of students, science teachers and the entire school community.

The purpose of the Chemical Hygiene Plan (CHP) is to protect employees from health hazards associated with using hazardous chemicals in the laboratory. The CHP must be readily available to all employees and indicate specific measures employers will take to ensure employee protection. The following is a summary of the essential CHP components (in addition to appropriate safety and health procedures and hygiene practices for hazardous chemicals in laboratories).

1. Policies and procedures (referred to as standard operating procedures, or SOPs) must be developed. These policies and procedures include rules about the use of personal protective equipment, eating/drinking restrictions, housekeeping practices, accident response, disposal procedures and spill cleanup procedures.
2. The school must develop criteria to determine and implement control measures. The goal of these measures is to reduce exposure to hazardous chemicals. Examples of these measures include administrative and engineering controls, personal protective equipment and hygiene practices.
3. The school's CHP must have a requirement that fume hoods and other protective equipment are functioning properly before they can be used.
4. The CHP must include a training component for all those using hazardous lab chemicals. Training must include topics such as how to detect the presence or release of a hazardous chemical, the physical and health hazards of chemicals in the work area, and measures users can to take to protect themselves.
5. The CHP must contain provisions allowing teachers to receive medical consultation and examination if necessary.
6. The CHP must designate a person responsible for its implementation.
7. If particularly hazardous substances are going to be used in the lab (such as carcinogens, reproductive toxins and highly acute toxic chemicals), the CHP must contain provisions for extra protection, such as:
   - establishment of a designated area
   - use of containment devices such as fume hoods or glove boxes
   - procedures for safe removal of contaminated waste
   - decontamination procedures

Before developing a CHP, read the standard first hand to ensure you are fully aware of your responsibilities. Contact OSHA for more specific information on developing a CHP. The CHP must be evaluated and revised at least yearly.

The CHP Standard

The Occupational Exposures to Hazardous Substances in Laboratories (the "Lab Standard") can be found in the Federal Register Vol. 55 #21, Wednesday, January 31, 1991, pp. 33003335. Contact your state Occupational Safety and Health Administration for more information on the Lab Standard and developing a CHP.

Hazardous Chemicals Used in School Labs

The typical middle school or high school science lab stocks a variety of hazardous chemicals, some of which may be highly toxic, carcinogenic, corrosive, reactive or even explosive. One such chemical is elemental mercury which, through past releases from broken thermometers and spills, have shut down schools or disrupted classroom instruction. Another potential problem is chemical containers in poor condition coupled with inadequate storage room ventilation. This particular situation can lead to chronic exposure and health ailments in students, teachers and staff. Many of these problems can be avoided through proper management of laboratory chemicals from the time of purchase, to storage, use and ultimately disposal.

Space limitations do not permit the listing of all "common" hazardous materials. Briefly, any chemical having the following characteristics is considered hazardous:

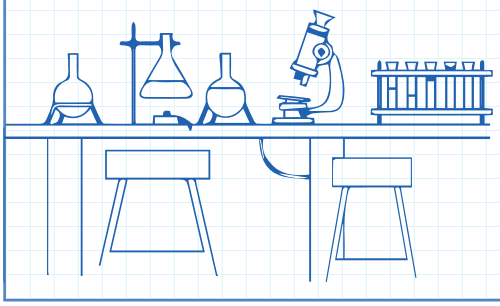
- toxic
- flammable
- corrosive
- reactive
- radioactive
- infectious

Laboratories use a variety of chemicals which are considered hazardous, including acids, bases and heavy metals.

Some schools may even be harboring long forgotten radioactive materials. The following list is an abbreviated list of some of the hazardous chemicals found in school labs.

Some Common Hazardous Lab Chemicals

Highly Toxic
- Mercury
- Potassium cyanide
- Mercuric nitrate
- Sodium cyanide
- Mercuric sulfate
- Phosphorous (white)
- Formaldehyde



Known Human Carcinogens
- Arsenic powder
- Arsenic pentoxide
- Arsenic trichloride
- Arsenic trioxide asbestos
- Benzene
- Benzidine
- Chromium powder
- Lead arsenate
- Sodium arsenate
- Sodium arsenite

Flammable
- Ether
- Acetone
- Benzene
- Xylene
- Alcohol

Reactive/Explosives
- Benzoyl peroxide
- Piric acid
- Ethyl ether
- Diisipropyl ether
- Potassium metal
- Perchloric acid
- Carbon disulfide
- Sodium metal

Laboratory Chemical Management Plan

Developing and maintaining a Lab Chemical Management Plan (LCMP) is NOT a regulatory requirement but rather is a best management practice for when the school embarks on a clean-out project. It is not to be a daunting task, but an exercise in a long-term commitment to continual improvement in on-site chemical management and waste prevention. While the Lab Chemical Management Plan may have some overlap with a Chemical Hygiene Plan it will not automatically bring your school into regulatory compliance with OSHA.

The LCMP has five (5) sections that are briefly described below:

SECTION I: Annual Review – As your school makes improvements, this will change from year to year. A form is helpful to document progress made to achieve the goals outlined in the Plan.

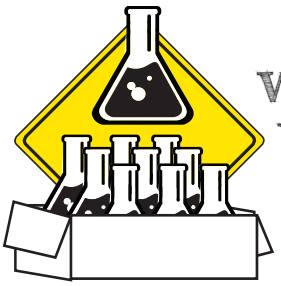
SECTION II: Policies – Before launching a full-fledged management program, an internal structure in the form of a policy that supports a healthy and safe environment for students, faculty and staff is needed.

SECTION III: Responsibilities and Duties – In order to implement a LCMP, it must be clear to individual faculty and staff what their specific roles are.

SECTION IV: Purchasing Procedures – Limiting chemical quantities and hazard-levels will almost certainly help minimize risk.

SECTION V: On-Site Chemical Management – An on-site chemical management program should include procedures for chemical storage, inventory, use, waste disposal and spill response. They should support the goals stated in the school's policy for laboratory chemical management.

Having an understanding of inherent hazards and learning how to be safe should be an integral and important part of science education. Don't forget to require every prelab discussion to include consideration of safety and health aspects. Then, at the end of the school year, take a look around and set safety improvement goals for the fall, which you can work toward and plan for during the summer.



Ways to Reduce Your Use

Bulk Is NOT Better

When ordering supplies, consider that "bulk is not better." The real cost of a chemical includes its initial purchase price plus the ultimate disposal costs. From the viewpoint of purchasing, the quantity actually used relative to the quantity purchased governs the unit purchasing cost. The perceived economy of purchasing chemicals in large quantity containers may be deceptive.

Only purchasing a year's supply of chemicals, will facilitate reduction through more controlled management. An annual purchase will decrease the likelihood of chemical "stock piling." A maintained inventory helps teachers keep track of usable lab chemicals. In this way, inventory will reduce chemical purchases and prevent waste.

Here are some other reasons why purchasing chemicals in smaller quantities is a sound management practice.

- Since smaller packages are emptied faster, there is less chance for decomposition of reactive compounds. According to the American Chemical Society, unused chemicals can constitute as much as 40% of the hazardous waste generated by laboratories.
- Breakage is less in smaller packages.
- Smaller packages take up less valuable storeroom space.
- Risk of accident and exposure to the hazardous material is less when handling smaller containers. Larger containers usually require that the material is transferred to smaller containers.

Reduce the Amount of Chemicals Used in the Experiment

Reducing quantities of chemical substances used in science labs will significantly reduce hazardous wastes and improve student safety. In many cases, substituting chemicals can completely eliminate hazardous waste generation. Also, hazardous waste can be reduced by developing experiments so that the products of one can be used again in other experiments.

Reducing the scale of the experiment by 50% generally does not change the desired results. This reduction scale can usually be performed using the same glassware as traditionally used for the 100% experiment. Such a reduction will lead to:

- a 50% reduction in the costs of chemicals for the experiment
- a corresponding reduction in the costs of waste disposal
- increased safety of the teacher and students.

This reduction technique will reduce quantities without requiring the purchase of new glassware.

Microscale Experiments

Microscaling can reduce cost of disposal without compromising the laboratory experience. True microscale techniques will significantly reduce hazardous waste production. A reduction of hazardous waste by one-one hundredth to one-one thousandth is not uncommon. When greater scale reductions are desired, the glassware usually must be changed. Other advantages of microscaling include reduced injury and glassware breakage,

reduced preparation and cleanup time, and increased time for development of higher level reasoning skills. There are many available microscale options which vary in cost and many resources available on using microscale techniques; lab supply and safety companies should be able to provide a list.

Substituting to Eliminate Hazards

Investigate less or nonhazardous chemicals that can be used in labs. For example, paper chromatography can be done quite effectively using Kool-Aid® or food coloring with water as the solvent thus avoiding the heavy metal salts often prescribed. Potassium chloride, NACl (aq), and Silver nitrate, AgNO3 (aq), in dilute solution, may be reasonable choices to avoid chromate and lead compounds in a Conservation of Mass experiment. Antacid tablets and dilute hydrochloric acid provide a reasonable recipe for a titration experiment.

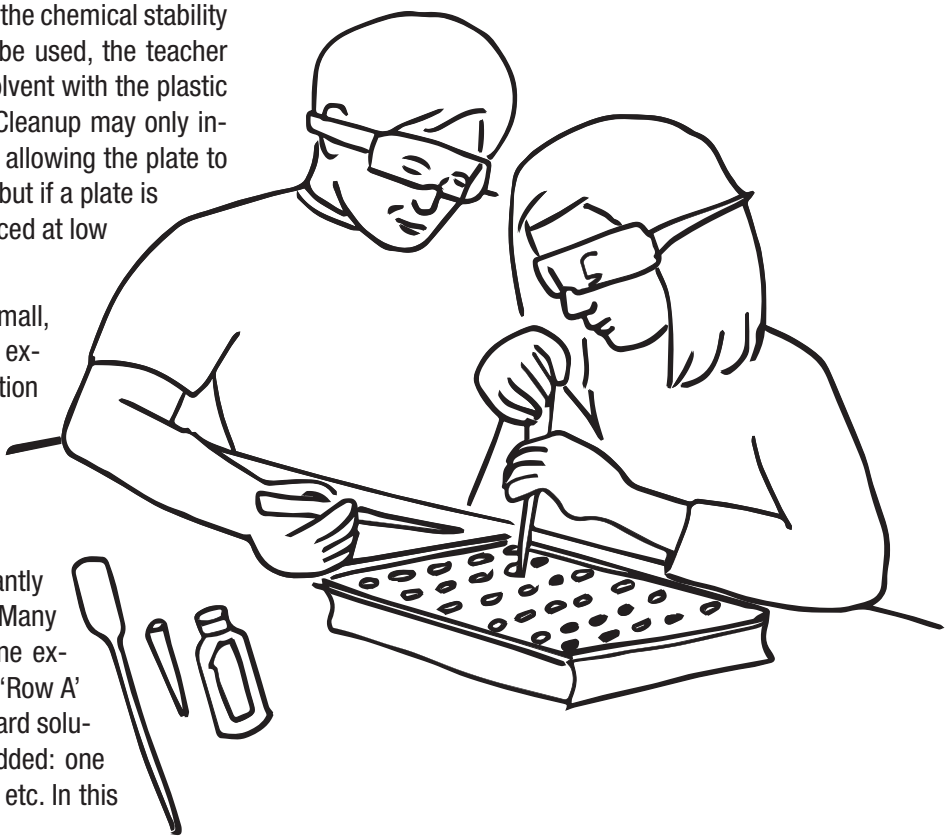
Plastic Ware

Probably the most cost-effective means of converting to microscale experiments is to use the plastic culture plates and plastic Beral pipets that are available from numerous suppliers. Since most high school experiments are performed using water as the solvent, there is little concern about the chemical stability of the plastic. If an organic solvent is to be used, the teacher should carefully test the reaction of the solvent with the plastic before any student tries the experiment. Cleanup may only involve rinsing the plate with tap water and allowing the plate to air dry. There will be little or no breakage, but if a plate is ruined from an experiment, it can be replaced at low cost (usually less than two dollars).

The "reaction" plate consists of a grid of small, uniform cylindrical containers in which the experiment takes place. Each of these "reaction chambers" has a capacity of about 1 ml. Many varieties of these plastic plates are available. Plates may have as few as 6 reaction chambers or as many as 96.

The experimental possibilities are significantly increased using microscale techniques. Many variations of a reaction can be tried in one experiment. For example, each container in 'Row A' might contain the same volume of a standard solution. Then a second reagent might be added: one drop to column 1, two drops to column 2; etc. In this way, if a color change or precipitate formation is involved, kinetic experiments can be performed. Solubilities may be readily determined. Comparative reactivities of various metals to the same acid could be quickly studied.

Microscale techniques require the use of instruments to deliver small quantities of reagent accurately and reproducibly. There are many excellent but expensive solutions to that problem. A very inexpensive solution rests in the use of the plastic "Beral" or less commonly glass "Pasteur" pipets. These pipets come in a variety of sizes and shapes. Most are made of polyethylene. The flexible bulb end typically is about 3-5 ml in capacity. The narrow tube can be stretched and then cut to provide a smaller opening which will produce a smaller drop. The pipet is usually held at about 45 degrees to the plane of the spot plate when adding drops. It is important to keep the pipet at the same angle, as drop volume varies with the angle which the pipet is held. However, once good technique is developed they become the microscale equivalent of a graduated pipet or titration burette. These Beral pipets can also be used as dispensing devices for premixed solutions or reactive chemicals. If the solution is air sensitive, the pipet can be easily heat-sealed to slow decomposition, and then the tip removed just before use. One 3 ml pipet can often contain the total supply of a reagent for a class of 20 - 25 students! The set of reagents for an experiment can be conveniently stored in Beral pipets kept in plastic audio cassette cases. In this way, one small shelf can hold all of the chemicals for a semester.



Creative Opportunities for Student Involvement

Real life hazardous materials issues can be incorporated into the classroom to help students better understand their school's management efforts. For example, students can be part of the safety committee or explore the chemistry involved in disposing of laboratory or cleaning waste or conduct behavioral studies to develop an Integrated Pest Management Plan for the school.

Microscale Glassware

The next more expensive option is to purchase very small test tubes (3" or smaller) and disposable Pyrex® Pasteur pipets. With this equipment, everything looks like it does in a present laboratory except it is much smaller. The same experiments can be run, the sample can be heated with a micro burner, and measurements are usually in numbers of drops or, less frequently, in milligrams measured on an electronic balance. For approximate work, the 9" Pasteur pipet can be 'calibrated' to deliver 2.0, 1.5, 1.0, 0.5, 0.25 and 0.1 ml with little difficulty.

Glassware Kits

While glassware kits are the most expensive option for high schools, they may be a good choice for the smaller, advanced classes. Glassware kits are more commonly used on the college level.

Chemistry Kits

Kits can also be purchased from school science providers that will provide the exact amount of chemicals needed for the experiment.

Guidelines for Safer Use and Storage

There are multitudes of resources on science lab safety. This next section only highlights safety suggestions related to hazardous lab chemical use and storage. For more information, consult the Resource Section for organizations dedicated to promoting lab safety.

Safe Use Begins at Purchasing

Develop a purchasing strategy for chemicals and hazardous materials. Purchase chemicals in smaller sizes and standardize chemical purchases across classes or laboratories. Designate a single person to be responsible for purchasing chemicals and monitoring inventories. When ordering lab chemicals, request the chemical's Safety Data Sheets (SDSs). SDSs are available through the chemical supply company. Keep a copy of the SDS on file in the room and distribute SDSs to the nurse and other personnel in the school with hazardous material management responsibilities. SDSs need to be updated annually.

Ensure that only those fully aware of the hazardous characteristics of the chemicals handle incoming shipments. Upon arrival, clearly mark the date when each chemical was received. Link purchasing requests into an inventory system so that excess chemicals in stock can be used before buying more. Most importantly, find a supplier who will accept unopened chemicals that are returned, or will otherwise support waste minimization efforts.

Keeping Track of Chemicals

In order to be in compliance with federal and state regulations, the science department must maintain an inventory system. Not only is this the law, it is also beneficial for the department. Inventories are an opportunity for evaluating and improving the present organizational system. Prior to inventorying, organize your chemical and waste storage systematically to keep like chemicals together. Then adopt a labeling procedure for chemicals and waste, using labels that are colorfast and permanent. Designate who is responsible for labeling and inventory control. If possible use tags, bar codes, or some other system to establish computer tracking of chemicals. These are tasks that can include your students.

Inventorying the science chemical storage areas tends to be more complicated than a general school inventory of maintenance chemicals. Since lab chemicals might be "stockpiled" from years past, the volume to be inventoried is greater. Also, there is a greater chance of encountering unidentified chemicals and old chemicals which are now explosives. Use a first-in/first-out policy and return expired material to your supplier. Perform regular inventory audits to identify chemicals that aren't being used.

Inventorying Chemical Supply Areas

When conducting inventories in the science chemical storage areas, keep in mind the following suggestions:

- Notify the school administration when the chemical inventory is to take place.
- Make sure the chemical supply room is properly ventilated.
- Make sure extra, empty containers are available in case broken containers are encountered.
- Have a supply of replacement caps available should you find containers with bad closures.
- Make sure a fume hood is available if temporary storage is necessary for an immediate hazard.
- Have emergency phone numbers on hand in case of an accident or detection of an immediate explosive danger.
- If an unknown chemical is encountered, contact state hazardous material division for assistance. If you have a strong chemical background, there are available resources (for example, The Flinn Scientific Catalog and Reference Manual) with detailed, step-by-step information on how to identify an unknown material.

Inventory systems range from "low" to "high tech." For example, most school science suppliers (see Resource Section) offer an inventory computer program, which provides teachers with chemical information as well as facilitating inventorying. Whatever method the department chooses, the primary purpose of the inventory is to identify and quantify chemicals in storage and to ensure they are properly stored.

Safe Use of Lab Chemicals

Everyone involved in the laboratory must be safety-minded. Safety awareness needs to become a part of everyone's work habits. It is the teacher's responsibility to set the tone on how to handle hazardous materials in the lab. Although students may receive detailed instructions on how hazardous materials are to be used, it does not necessarily ensure they will be used safely. Proper supervision is essential to ensuring safe lab practices and preventing accidents. Green Chemistry was introduced in the 1990s by the EPA which they defined as "the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances." You can find more information on Green Chemistry in the Resources section.

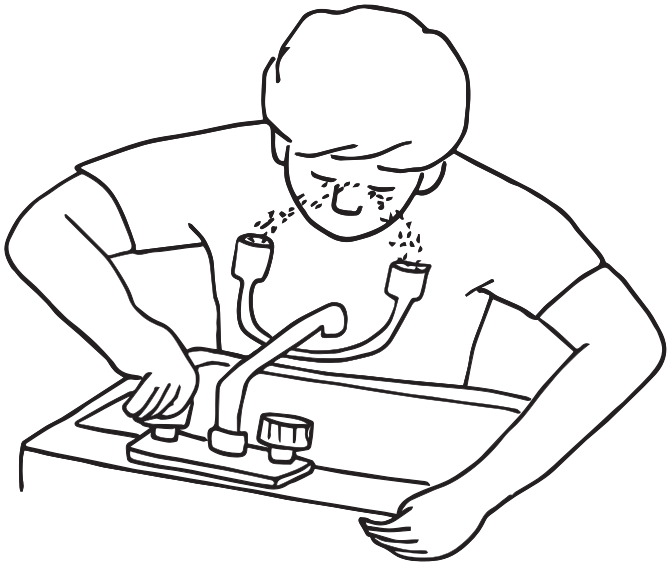
Prevention is the Best Medicine

Anticipating possible consequences of hazardous materials mismanagement and taking corrective actions is the safest approach. Some preventive actions include:

- conducting regular safety inspections of equipment and storage arrangements
- developing written emergency plans answering the "What would you do if...." question
- communicating emergency plans to everyone who uses hazardous materials, especially students, who need to understand what actions are to be taken. For example, do students know how to use a fire extinguisher or would they have to get a teacher first?

Safety Equipment Every Lab Needs

The general safety section on page 15 discusses the value of both personal safety equipment and equipment every room should have. Basically, every science lab should have the following equipment:



Eye Wash Stations

- Eye wash stations must allow for the continual flow of water for at least 15 minutes, and treatment of both eyes simultaneously.
- Depending on the size of the room, it may be necessary to have more than one eye wash station. Ideally no one should work with hazardous materials more than 25 feet away from an eye wash station.
- Signs must clearly mark the location of the eye wash station in the room.

Body Showers

- Ideally, no one should work with hazardous materials more than 50 feet away from a body shower station.
- Emergency showers must provide 30 gallons of water per minute for at least 15 minutes and have an on/off valve with a single-action lever which stays on until pulled/pushed off.

Fire Extinguisher

- No one should work with flammable materials more than 50 feet away from the appropriate type of fire extinguisher

Fire Blanket

- Ideally, no one should work with flammable materials more than 30 feet away from a fire blanket.

Guidelines for Storing Hazardous Materials

It is imperative that any hazardous materials used in science classes are stored safely. Some of the more common storage mishaps result from lack of safety equipment in storage areas, lack of adequate space and improper chemical organization. Segregate wastes by keeping hazardous waste separate from non-hazardous waste. Keep organic waste separate from inorganic waste. Keep different groups of solvent separated and always separate incompatible materials, such as ignitables and oxidizers, acids and bases, oxidizers and reducers, etc.

Safety Equipment for Storage Areas

The National Fire Protection Association (NFPA) places school science storage areas and class rooms in the "extra high risk" category. For this reason, special precautions must be taken.

- Install a smoke detector and appropriate fire extinguisher in the store room.
- Train teachers and students how to select and use fire extinguishers and how to differentiate between the types.
- Check fire extinguishers on a regular basis to make sure they are still operable.
- Limit your purchase of highly flammable materials.
- Store all flammable material in NFPA approved cabinets.

Space

Crowded storage shelves are accidents waiting to happen. If adequate space is not available; scrutinize your lab chemical needs to see if all purchases are necessary. Buying smaller quantities, as previously recommended, may also create more space. Shelves free of clutter will prevent accidents.

Organization

All chemicals must be stored so incompatible chemicals are not in close proximity of one another. Alphabetical storage patterns are not acceptable because they potentially place incompatible chemicals next to one another. Lab chemicals can be divided into inorganic families and organic families. This type of storage arrangement is not only safer, it will also facilitate better record keeping.

Organization by Chemical Family

Inorganic

1. Metals, hydrides
2. Acetates, halides, iodides, sulfates, sulfites, thiosulfites, phosphates, halogens
3. Amides, nitrates (except ammonium nitrate), nitrate, azides
4. Hydroxides, oxides, silicates, carbonates, carbon halogenated
5. Sulfides, selenides, phosphides, carbides, nitrides
6. Bromates, chlorates, percholorates, hydroperoxides, perchloric acid, chlorites, hypochlorites, peroxides, hydrogen peroxide
7. Aresenates, cyanides, cyanates
8. Borates, chromates, manganates, permanganates
9. Acids (except nitric, store this acid in an isolated place)
10. Sulfur, phosphorus, arsenic, phosphorus pentoxide

Organic

1. Acids, anhydrides, peracids
2. Alcohols, gylcols, amines, amides
3. Hydrocarbons, esters, aldehydes
4. Ethers, ketones, ketenes, hydrocarbons, ethylene oxide
5. Epoxy compounds, isocyanates
6. Peroxides, azides
7. Sulfides, polysulfides, nitrites
8. Phenols, cresols

*Inorganic acids should be stored in special designated cabinets (make sure that acetic and nitric acid are not stored in close proximity.

Avoid Alphabetical Arrangement

The following examples are potentially explosive combinations that could result from alphabetical storage patterns:

- aluminum metal and ammonium nitrate
- cupric sulfide and cadium chlorate
- magnesium hydroxide and maleic anhydride
- silver metal and tartaric acid

Other Storage Considerations

- Keep especially hazardous chemicals in their original shipping packaging. Acids and bases may be shipped in Styrofoam cubes, these are useful for safe storage.
- Storage areas should be ventilated (at least four air exchanges per hour). The chemical storeroom ventilation system should be separate from the building's system.
- Do not store chemicals in a fume hood.
- Keep ignition sources away from the chemical storage area.
- If volatile materials are stored in a refrigerator, it needs to be explosion-proof, as there is a potential for sparks (thermostat or light switch) that could lead to an explosion.

Disposal Options

The first step is reduction. Where possible, scale down an experiment and associated quantities of chemicals and move to microscale chemistry or purchase substitutes for hazardous chemicals. Set up the experiments with waste minimization in mind by working in teams, or pre-weighing chemicals for students, or demonstrating some experiments rather than having the entire class perform them. Use spent/recovered solvents for initial rinse and fresh solvents for a final rinse. Include your students in the waste minimization efforts by monitoring reactions closely then adding only what's needed or having them research and brainstorm waste minimization techniques. Teaching resource-efficient policies from the start, that emphasize conservation of water, electricity and other general resources, sets the platform for prevention.

In-House Treatment of Chemical Hazardous Waste

There are times when the wastes produced in the lab can be treated "in-house" by a knowledgeable chemistry teacher. When done correctly, this treatment reduces the risk of storage of hazardous waste and greatly reduces hazardous waste disposal costs. If possible reclaim solvents by filtering spent solvents for reuse or recycle via a solvent recycling service. Establishing a chemical swap for internal surplus or participating in an outside chemical/waste exchange is another reuse option.

According to *Prudent Practices in the Laboratory – Handling and Disposal of Chemicals* (https://www.nap.edu/catalog/4911/prudent-practices-in-the-laboratory-handling-and-disposal-of-chemicals) some water-soluble chemicals may be safely disposed in the municipal sewer provided that the quantities are small, and the chemicals are not unusually toxic. However, it is imperative that any teacher first investigate what regulations are in place before disposing of any chemical compound. Sewer disposal should never be used if it flows directly into a system that enters the groundwater directly such as a septic tank.

Some aqueous solutions may be safely disposed of in the sewer if their pH is in the range of 6 - 10 and they do not contain toxic metals such as cadmium, chromium, lead or mercury, or anions such azides, cyanide or perchlorate. Often, a large volume of waste can be treated to concentrate the toxic material in the form of a precipitate. The remaining bulk of the solution can often be discarded down the drain. The precipitated toxics must be disposed of as hazardous waste or recovered and reused.

In-house treatment is only feasible when the quantities of chemicals use in experiments or demonstrations are kept to a minimum. A microscale approach, combined with sensible choices of lab chemicals, will insure small quantities of treatable waste.

The Flinn Scientific Catalog and Reference Manual offers detailed description of in-house waste disposal treatment for many lab wastes. Always check with your local regulatory agency to make sure these methods do not violate state and federal hazardous waste regulations. Some of these methods also require use of specific equipment.

Disposing of Hazardous Chemicals

When deciding what chemical supplies are in need of disposal, keep in mind the dangers of placing all "unwanteds" in one box. This method potentially places incompatible chemicals in close proximity to one another. Even if the unwanted chemicals are only going to be stored for a short amount of time, before being taken away by a hazardous waste disposal firm, they need to be packed carefully. Plastic bags can isolate and contain hazards in case of breakage. Line boxes containing waste chemicals with vermiculite or cat litter to act as an absorbent in case of spills.

Waste Disposal Using a Hazardous Waste Disposal Company

Often it is necessary to contract with a hazardous waste disposal firm to get rid of unwanted surplus chemicals, spent solvents and reaction products. Although contracting with a hazardous waste disposal company may be expensive, there are ways to decrease the costs associated with hiring a hazardous waste disposal firm. Many companies are willing to help schools prioritize what chemicals to get rid of first. Also, schools may be able to reduce costs by presorting the waste into general categories (flammable liquid, water reactives, etc.).

If you decide it's time to clean out the chemical closet, make sure to communicate your intentions to others in the school who use hazardous products. Often an art or industrial art teacher will have some unwanted hazardous material but will be unaware of the opportunity to dispose of it in an environmentally responsible way.

Remember, what might be considered waste by one individual might be useful to another. For example, excess hydrochloric acid from the chemistry laboratory might be used in the vocational program. Our experience has shown that a systems approach to the purchase and use of chemicals reduces disposal costs.

CHAPTER 8

Resources

FEDERAL AGENCIES

Only those agencies dealing with the handling and disposal of hazardous materials are listed.

United States Environmental Protection Agency
For information regarding U.S. EPA publications:
National Service Center for Environmental Publications
https://www.epa.gov/nscep

Resource Conservation and Recovery Act (RCRA) I nformation
EPA Envirofacts
https://www3.epa.gov/enviro/facts/rcrainfo/search.html

Healthy Schools, Healthy Kids
EPA's Schools Website
https://www.epa.gov/schools
All updated information on school health and safety

EPA's Tools for Schools Program
https://www.epa.gov/iaq-schools
Information on indoor air quality in schools with toolkits, checklists, webinars, and directions for managing a complete indoor air quality program.

Toxic Substance Control Act (TSCA)
https://www.epa.gov/chemicals-under-tsca
Information on chemical management as regulated under TSCA, safer use of chemicals, environmentally preferable products.

Occupational Exposure to Hazardous Chemicals in Laboratories
Title 29 of the Code of Federal Regulations (CFR) 1910.1450
Full Text: https://www.gpo.gov/fdsys/granule/CFR-2011-title29-vol6/CFR-2011-title29-vol6-sec1910-1450/content-detail.html Overview: https://www.osha.gov/OshDoc/data_General_Facts/hazardouschemicalsinlabs-factsheet.html

U.S. Environmental Protection Agency
Office of Land and Emergency Management 5101T
1200 Pennsylvania Avenue
Washington, DC 20460
(202)566-0200
https://www.epa.gov/aboutepa/about-office-land-and-emergency-management
Umbrella Office for Office of Superfund Remediation and Technology Innovation, Office of Resource Conservation and Recovery, Office of Underground Storage Tanks, Office of Brownfields and Land Revitalization, Office of Emergency Management, Federal Facilities Restoration and Reuse Office.

U.S. EPA
Office of Chemical Safety and Pollution Prevention 7101M
1200 Pennsylvania Avenue
Washington, DC 20460
(202) 564-2910
https://www.epa.gov/aboutepa/about-office-chemical-safety-and-pollution-prevention-ocspp

EPA REGIONAL CONTACTS:

REGION 1
States: CT, ME, MA, NH, RI, VT
U.S. EPA Region 1
Office of Environmental Stewardship
5 Post Office Square, Suite 100 (OES-05-4)
Boston, MA 02109-3912
(617) 918-1328

REGION 2
States: NY, NJ, PR, VI
U.S. EPA Region 2
MS-225
2890 Woodbridge Ave.
Edison, NJ 08837-3679
(732) 321-6671

REGION 3
States: DE, MD, PA, VA, WV, District of Columbia
U.S. EPA Region 3 (3LC61)
1650 Arch St.
Philadelphia, PA 19103-2029
(215) 814-3178

REGION 4
States: AL, GA, KY, MS, NC, TN, FL, SC
U.S. EPA Region 4
Lead and Asbestos Section
Sam Nunn Federal Center
61 Forsyth Street, NW
Atlanta, GA 30303
(404) 562-9213

REGION 5
States: IL, IN, MI, MN, OH, WI
U.S. EPA Region 5 (DT-8J)
77 W. Jackson Blvd.
Chicago, IL 60604
(312) 886-7836

REGION 6
States: AR, LA, OK, NM, TX
U.S EPA Region 6
1445 Ross Ave., 12th Floor
Dallas, TX 75202-2733
(214) 665-6711

REGION 7
States: IA, MO, KS, NE
U.S. EPA Region 7
WWPD/TOPE
11201 Renner Blvd.
Lenexa, KS 66219-9601
(913) 551-7261

REGION 8
States: CO, MT, ND, SD, UT, WY
U.S. EPA Region 8 (8P-P3T)
1595 Wynkoop Street
Denver, CO 80202-1129
(303) 312-6966

REGION 9
States: AZ, CA, HI, NV, Guam, Samoa, Guam
U.S. EPA Region 9 (CMD-4-2)
75 Hawthorne St.
San Francisco, CA 94105
(415) 947-4280

REGION 10
States: AK, ID, OR, WA
Regional Contacts:
U.S. EPA Region 10
Pesticides and Toxics Unit (OCE-101)
1200 Sixth Ave.
Seattle, WA 98101
(206) 553-6697

OTHER FEDERAL AGENCIES

U.S. Consumer Product Safety Commission
4330 East-West Highway
Bethesda, MD 20814
(301) 504-7923
https://www.cpsc.gov/

EDUCATIONAL/CONSUMER SAFETY ORGANIZATIONS

American Association of Poison Control Centers
515 King St., Suite 510,
Alexandria, VA 22314
(703)894-1858
http://www.aapcc.org/

American Industrial Hygiene Association
3141 Fairview Park Dr. Suite 777
Falls Church, VA 22042
https://www.aiha.org/
Non-profit dedicated to protecting and educating individuals in the industrial hygiene field.

Environmental Hazards Management Institute
10 Newmarket Road
Durham, NH 03824
Phone: (603)868-1496
Fax:(603)868-1547
http://www.ehmi.org/index.php
Education materials on hazardous materials including the Question and Answer resource in a "slide wheel format," "Auto Recycler Wheel," "Household Hazardous Waste Management Wheel."

Environmental Health Coalition
2727 Hoover Ave., Suite 202
National City, CA 91950
Phone: (619)474-0220
Fax: (619)474-1210
Email: frontdesk@environmentalhealth.org
https://www.environmentalhealth.org/index.php/en/
Social justice organization dedicated to environmental health in communities.

Informed Green Solutions
PO Box 60
East Burke, VT 05832
(802)626-8643
Email: info@informedgreensolutions.org
http://www.informedgreensolutions.org/
Consultants for green cleaning, toxics reduction, indoor air quality, HHW, promoting safer products and practices.

Lab Safety Institute
192 Worcester St.
Natick, MA 01760
(508)647-1900
Email: info@labsafetyinstitute.org
http://www.labsafety.org/
The Laboratory Safety Institute is a nonprofit educational institution providing safety courses and consulting for chemical laboratories worldwide. Also works with K-12 schools.

National Fire Protection Association
Batterymarch Park
Quincy, MA 02169
(800)344-3555
https://www.nfpa.org/
Information and resources on fire prevention and safety.

National Institute for Occupational Safety and Health
1600 Clifton Road Atlanta, GA 30329
(800)232-4636
https://www.cdc.gov/niosh/index.htm
Researched based, under the direction of the Center for Disease Control, examines workplace safety and health.

National Safety Council
1121 Spring Lake Dr.
Itasca, IL 60143-3201
(800) 621-7615
(630) 285-1121
http://www.nsc.org/
The National Safety Council eliminates preventable deaths at work, in homes and communities, and on the road through leadership, research, education and advocacy.

National School Board Association
1680 Duke St. FL2, Alexandria, VA 22314-3493
Phone: (703) 838-6722
Fax: (703) 683-7590
Email: info@nsba.org
https://www.nsba.org/
State school boards associations offer training and other services to help support school board members in their work.

Occupational Safety and Health Administration
200 Constitution Ave., NW,
Washington, DC 20210
(800)321-6742
https://www.osha.gov/
Under the direction of the Department of Labor, sets and enforces standards for workplace health and safety.

Pollution Prevention Infohouse
The Nebraska Business Development Center
University of Nebraska Omaha
http://infohouse.p2ric.org/
The P2RIC InfoHouse is a searchable online collection of more than 50,000 pollution prevention (P2) related publications, fact sheets, case studies and technical reports.

Rutgers Environmental and Occupational Health Sciences Institute
170 Frelinghuysen Road
Piscataway, NJ 08854
Phone: (848)445-0200
Fax: (732)445-0131
Email: info@eohsi.rutgers.edu
Advance understanding of the mechanisms by which environmental and occupational chemical exposures impact human health

The Toxics Reduction Institute (TURI):
University of Massachusetts: Lowell
The Offices at Boott Mills West
126 John Street, Suite 14
Lowell, MA 01852
(978)934-3275
https://www.turi.org/
The Toxics Use Reduction Institute (TURI) at the University of Massachusetts Lowell provides resources and tools to help businesses, municipalities, and communities in Massachusetts find safer alternatives to toxic chemicals.

The University of Nottingham: Periodic Table of Reactions
http://www.periodicvideos.com/
Tables charting the chemical elements have been around since the 19th century - but this modern version has a short video about each one.

ART

Art and Creative Materials Institute
99 Derby St., Suite 200, Hingham, MA 02043
Phone: (781) 556-1044
Fax: (781) 207-5550
https://www.acmiart.org/
The Art and Creative Materials Institute, Inc. (ACMI) is an international association of about 200 art, craft and creative material manufacturers which seeks to promote safety in art and creative products through its certification program.

Arts, Crafts and Theatre Safety
181 Thompson Street, #23
New York, NY 10012-2586
Phone: (212) 777-0062
Email:ACTSNYC@cs.com
http://www.artscraftstheatersafety.org/
ACTS is a not-for-profit corporation that provides health, safety, industrial hygiene, technical services, and safety publications to the arts, crafts, museums, and theater communities.

VOCATIONAL PROGRAMS

Association for Career and Technical Education
1410 King Street, Alexandria, VA 22314
Phone: (800)826-9972
Fax: (703)683-7424
http://www.acteonline.org/

SCIENCE

Cole-Palmer - Chemical Compatibility Database
625 East Bunker Ct Vernon Hills, IL 60061
https://www.coleparmer.com/Chemical-Resistance

National Science Teachers Association
1840 Wilson Boulevard
Arlington VA 22201
(703) 243-7100
http://www.nsta.org/
Provides updated information, statements on science classroom safety, safety issue papers, liability, safety checklists, bulletins, and publications for science teachers and school administrators.

Science Education for Public Understanding Program
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
Phone: (510) 642-8718
Fax: (510) 642-3131
Email: sepup@berkeley.edu
http://sepuplhs.org/index.html

The Tennessee Schools Lab Rehab Program
Department of Environment and Conservation
312 Rosa L. Parks Ave
Nashville, TN 37243
(615)741-9251
https://www.tn.gov/environment/sw-mm-household-hazardous-waste-program/sw-mm-school-labs-tslrp.html

BUILDING AND MAINTENANCE

Beyond Pesticides
701 E Street, SE, Suite 200
Washington, DC 20003
Phone: (202)543-5450
Fax: (202)543-4791
Email: info@beyondpesticides.org*
https://beyondpesticides.org/

Bio-Integral Resource Center
PO Box 7414
Berkeley, CA 94707
Phone: (510) 524-2567
Fax: (510) 524-1758
Email: birc@igc.org
http://www.birc.org/
Integrated Pest Management Services

Healthy House Institute
PO Box 72020
North Charleston, SC 29415
http://www.healthyhouseinstitute.com/

U.S. Green Building Council: Center for Green Schools
http://www.centerforgreenschools.org/

INDUSTRY/INDUSTRY ASSOCIATIONS

American Chemistry Council
700 Second St., NE Washington, DC 20002
Phone: (202) 249-7000
Fax: (202) 249-6100
https://www.americanchemistry.com/
Represents companies across the chemical supply chain providing information on the chemical industry and using best practices for safer technologies and sustainable practices.

American Chemical Society
1155 Sixteenth Street, NW
Washington, DC 20036
(800) 227-5558
https://www.acs.org/content/acs/en.html

American Coatings Association
901 New York Avenue NW
Suite 300 West
Washington, DC 20001
Phone: (202) 462-6272
Fax: (202) 462-8549
Email: members@paint.org
https://www.paint.org/
The American Coatings Association (ACA) represents both companies and professionals working in the paint and coatings industry.

International Safety Equipment Association
1901 North Moore Street Suite #808
Arlington, VA 22209-1762, USA
Phone: (703) 525-1695
Fax: (703) 528-2148
https://safetyequipment.org/

SAFETY AND SCIENCE CHEMICAL SUPPLY COMPANIES

Auro
Roseburg, OR 97471
Phone: (541) 733-8204
Email: info@aurousa.com
http://www.aurointheusa.com/index.html
All-natural paints

Fisher Scientific Education
4500 Turnberry Drive
Hanover Park, Illinois
(800) 955-1177
https://www.fishersci.com/us/en/education-products.html
Sells scientific products to the education sector.

Flinn Scientific
Box 219 Batavia, IL 60510
(866)452-1436
https://www.flinnsci.com/
Provides science education tools and online learning in chemistry K-12 and college.

Grainger
Multiple Locations
https://www.grainger.com/
Safety Products

Safety Inc
119 Foster Street, Bldg. #6
Peabody, MA 01960
(800) 462-1103
http://www.esafetyinc.com/store/index.cfm
Safety Equipment

Sargent-Welch
PO Box 92912
Rochester, NY 14692-9012
USA
(800)727-4368
https://www.sargentwelch.com/store/
Laboratory Equipment Supply

SOURCES FOR LESS HAZARDOUS PRODUCT

Bio-Kleen
810 Lake Street
Kalamazoo MI 49001
United States
(269) 567-9400
https://www.biokleen.com/
Non-toxic cleaning products

Livos
Multiple retail locations
https://www.livosusa.com/
Non-toxic paints, varnishes, sealers etc.

Safety Kleen
2600 North Central Expressway, Suite 400
Richardson, Texas 75080
https://www.safety-kleen.com/
North America's largest collector, recycler and re-refiner of used oil.

Sunburst Chemicals
220 W 86th St
Bloomington, MN 55420
(800)899-7627
Email: sales@sunburstchemicals.com
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Glossary

CHAPTER 9

The following terms have been used in this manual or may appear on Safety Data Sheets.

absorb - To take up or to take in a substance.

acid - A chemical compound that has a pH less than 7. Acids are corrosive to metals and other active ingredients.

active ingredient - The substance in a product that acts as a catalyst for its functioning.

acute toxicity - An immediate illness or effect resulting from a brief exposure to a substance.

asthmagen - A substance that is causally related to the development or exacerbation of asthma symptoms. Occupational asthma is defined as "new onset asthma in which the underlying cause is exposure to an asthmagen while at work."

asthma triggers - Anything that brings on coughing, wheezing, trouble breathing, and other symptoms in a person with asthma. Some common triggers include colds, smoke, cold air, exercise, and certain things that cause allergic reactions, such as dust mites or pollen.

base (also referred to as alkaline) - A chemical which has a pH greater than 7.

carcinogen - Substance capable of causing cancer. "Known" labels indicate that sufficient information exists which shows a definite relationship between exposure to a substance and cancer in humans. "Probable" labels indicate there is limited evidence in humans and/or sufficient evidence in experimental animals.

cardiovascular toxicants - Exposure to chemical substances can cause adverse effects on the cardiovascular (heart and blood vessels) or hematopoietic (blood) systems (Cardiovascular or Blood Toxicity). Exposure to cardiovascular toxicants can contribute to a variety of diseases, including elevated blood pressure (hypertension), hardening of the arteries (arteriosclerosis), abnormal heartbeat (cardiac arrhythmia), and decreased blood flow to the heart (coronary ischemia). Lead, carbon disulfide, arsenic, cadmium, ozone, and vinyl chloride have all been implicated in the etiology of cardiovascular disease. Exposure to hematopoietic toxicants can reduce the oxygen carrying capacity of red blood cells, disrupt important immunological processes carried out by white blood cells, and induce cancer. Chronic exposure to benzene (a component of gasoline fuel) leads to the decreased production of all types of blood cells, and ultimately to leukemia, a cancerous proliferation of white blood cells.

CAS (Chemical Abstract Service) - An organization under the American Chemical Society that abstracts and indexes chemical literature from all over the world. Information about particular substances may be located in the abstracts. CAS Numbers identify specific chemicals or mixtures.

central nervous toxicants - A form of toxicity in which a biological, chemical, or physical agent produces an adverse effect on the structure or function of the central and/or peripheral nervous system.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act, 1980, also known as "Superfund") - Federal legislation, administered by the U.S. EPA, for regulating cleanup and liability for hazardous waste sites. Also establishes reporting requirements for releases of designated substances into the environment.

chemical family - A group of single elements or compounds with a common general name. Example: the "ketone family" includes acetone, methyl ethyl ketone, and methyl isobutyl ketone.

CHP (Chemical Hygiene Plan) - The plan to help protect people working in a laboratory setting. The CHP is described in the OSHA document 29 CFR 1910.1450, Laboratory Standard.

chronic reaction - An illness or effect resulting from repeated or long-term exposure to a toxic substance.

combustible - Classification of certain liquids that have a flash point of 100 degrees or higher. Non-liquid substances, such as wood or paper, are classified as "ordinary combustibles" by NFPA. Combustibles are a category of lower fire hazard than flammables.

concentration - Relative amount of a substance when combined or mixed with other substances.

corrosive - A chemical capable of visible destruction of skin, metal or other materials.

developmental toxicants - Agents that cause adverse effects on the developing child. Effects can include birth defects, low birth weight, biological dysfunctions, or psychological or behavioral deficits that become manifest as the child grows.

dilution - The action of making something weaker in force, content or value.

ECP (Emergency Communication Procedure) - A strategic plan for improving emergency response communications and efforts in the United States. Emergency communications is defined as the ability of emergency responders to exchange data, voice and video.

endocrine toxicants - Exposure to chemical substances can cause adverse effects on the endocrine system, which is comprised of the organs and glands that secrete hormones (Endocrine Toxicity). Hormones control normal physiological processes, maintaining the body's homeostasis.

EPP (Environmentally Preferable Purchasing Program) - Involves purchasing 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.

exhaust ventilation - An engineering control system to reduce exposures to airborne contaminants such as dust, mist, fume, vapor or gas in the workplace. Something that sucks an airborne contaminant out of the workplace.

explosive - An unstable substance capable of rapid and violent energy release.

flash point - The temperature at which a liquid will give off enough flammable vapor to ignite.

flammable - Any solid, liquid or gas which will bum below 140 F, either spontaneously or as a result of coming in contact with already flaming material.

gastrointestinal toxicants - Exposure to chemical substances can cause adverse effects on the gastrointestinal tract, liver or gall bladder (gastrointestinal and liver toxicity). The gastrointestinal tract is the site of entry for chemicals that are ingested.

generator (in terms of hazardous waste) – A person or facility who is responsible for causing the creation of hazardous waste.

HCP (Hazards Communication Plan) - A set of written standards designed to reduce workplace illness and injury by ensuring that all employees are familiar with the names and potential hazards of the chemicals they handle and understand the precautions necessary for protecting themselves and others against any possible risks.

hazardous material - Any item or agent (biological, chemical, radiological and/or physical), which has the potential to cause harm to humans, animals or the environment, either by itself or through interaction with other factors.

hazardous substance - A chemical having one or more of the following characteristics: toxic, flammable, corrosive and/or reactive.

heavy metal - Certain metallic elements having a high density; most heavy metal is toxic and persistent in the environment and human body and have a tendency to bioaccumulate.

herbicide - Chemicals used to kill or limit plant growth.

highly toxic - Agents or substances that, when inhaled, absorbed or ingested in small amounts, can cause death, disablement or severe illness.

household hazardous waste - Waste material generated by households with one or more of the following characteristics: toxic, reactive, corrosive and/or flammable.

IAQ (Indoor Air Quality) - The air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants.

incompatible - Materials that could cause dangerous reactions from direct contact with one another.

ignitable - Easily catches on fire.

ingestion - To take into the body by swallowing.

inhalation - To take into the body by breathing.

inert (ingredient) - The non-active "carrier" or "filler" substance in a product

IPM (Integrated Pest Management) - The management practice of controlling pests by combining the use of predator insects, knowledge of pests' life cycles, crop rotations and minimal use of chemicals.

irritant - A substance that, on immediate, prolonged, or repeated contact with normal tissue, will induce a local inflammatory reaction.

leachate - A liquid that has percolated through the solid waste in a landfill or that has been generated by solid waste decomposition. Leachate carries pollutants from the landfill and has the potential to contaminant ground and surface water.

LD 50 (Lethal Dose 50) - The amount (dose) of a toxic substance which kills 50% of the test population within two weeks of administering the dose.

local effects - Effects on the part of the body directly touched by a hazardous substance.

mutagen - A substance capable of altering the genetic material in a living cell.

NFPA (National Fire Protection Association) - An international membership organization to promote and improve fire protection and prevention. Developed NFPA 704 code, a method for showing hazards of materials.

non-target species - The organisms incidentally harmed or killed by a pesticide.

nontoxic (on a label) - This term has no Federal Regulatory

definition. Often used in product advertising to imply a safe product.

odor threshold - The lowest air concentration of a substance that can be detected by the human nose.

OSHA (Occupational Safety and Health Act, 1970) - The OSH Act covers most private sector employers and their employees in the 50 states, the District of Columbia, Puerto Rico and other U.S. territories. Coverage is provided either directly by the Federal OSHA or by an OSHA-approved state job safety and health plan. The Act assigns OSHA two regulatory functions: setting standards and conducting inspections to ensure that employers are providing safe and healthful workplaces. OSHA standards may require that employers adopt certain practices, means, methods or processes reasonably necessary and appropriate to protect workers on the job. Employers must comply with all applicable OSHA standards and provide workers with a workplace that does not have serious hazards.

oxidizer - A substance that yields oxygen readily. Oxidizers can stimulate and support combustion and are therefore a fire hazard. Examples: chlorate, nitrate.

parts per million/billion/trillion (ppm, ppb, ppt) - A method of expressing concentration. The number of parts per million/billion/trillion of the total.

PEL (Permissible Exposure Limit) - An exposure limit established by the Occupational Safety and Health Administration. The PEL is the highest average concentration of a substance in the air that an employee may legally be exposed to over an eight-hour shift.

percent volatile - The percentage of a liquid or solid that will evaporate at an ambient temperature of 70 F. Examples: gasoline and mineral spirits are 100 % volatile; their individual evaporation rates vary, but over a period of time they will evaporate completely.

PPE (Personal Protective Equipment) - Refers to protective clothing, helmets, goggles, or other garments or equipment designed to protect the wearer's body from injury or infection. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter.

persist - To continue in existence such as when a substance remains in the environment for a significant amount of time.

pesticide - Chemicals used to kill organisms (certain insects, rodents, fungi) that are considered detrimental to humans.

pH - A measure of the acidity and alkalinity of a liquid. The scale indicates neutrality at 7. Acidity is indicated by numbers below 7, down to zero. Alkalinity is indicated by numbers 7 -14.

physiology - The organic processes and phenomena of an organism or any of its parts or of a particular bodily process.

RCRA (Resource Conservation and Recovery Act, 1976) – So-called "Cradle to Grave" federal environmental legislation, administered by the U.S. EPA, aimed at controlling the generation, treatment, storage, transportation and disposal of hazardous waste.

reactive - The tendency of a substance to undergo chemical change with the release of energy, usually with undesirable effects, such as formation of toxic gas. Reaction may occur due to the presence of heat, water, pressure or certain other chemicals.

reproductive toxicants - Chemicals are ubiquitous substances with both positive and negative effects found in workplaces across the globe. Together with other agents (e.g., radiation and bacteria), chemicals may also negatively affect the reproductive systems of male and female workers.

respirator - A device worn on the face to protect a person from breathing hazards.

respiratory toxicants - Exposure to chemical substances can cause adverse effects on the respiratory system, which consists of the nasal passages, pharynx, trachea, bronchi and lungs.

risk - A measurement of the likelihood and severity of injury; possible danger or loss.

SDS (Safety Data Sheet) - A document which gives health, storage and safety information about the hazardous ingredients in a product.

sewer - Pipe system beneath the ground used to transport water and waste to wastewater treatment facility.

septic system - A biological method for treating wastewater.

skin and sense organ toxicants - Exposure to chemical substances can cause adverse effects on skin or the sense organs (Skin or Sense Organ Toxicity). The sense of smell is impaired by exposure to cadmium and nickel. Hearing loss occurs after occupational exposure to lead. Exposure to gases like ammonia, chlorine and formaldehyde causes eye irritation; organic solvents can damage vision. Contact with toxic agents can also cause acute and chronic skin diseases, including dermatitis and photosensitization. Chloracne is a severe and unusual form of acne that can be triggered by exposure to certain halogenated aromatic compounds, such as polychlorinated dibenzo-furans and dioxins.

solvent - A liquid which can dissolve another material. The term "organic solvent" refers to any carbon-based solvent widely used to dissolve organic chemicals.

stability - The ability of a material to remain unchanged. For SDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use.

target species - The organisms intended to be killed by a pesticide.

teratogen - A substance or agent which can adversely affect (malformation) in the fetus.

TLV (Threshold Limit Value) - A term to express the airborne concentration of a material to which nearly all persons can be exposed day after day, without adverse effects. TLV's are expressed as follows:

TLV-TWA: the allowable Time Weighted Average concentration for a normal 8-hour work day or 40-hour work week.

TLV-STEL: the Short-Term Exposure Limit or maximum concentration for a continuous 15-minute exposure period (maximum 4 such periods per day, with at least 60 minutes in between, provided that the daily TLV-TWA is not exceeded.)

TLV-CEL: the Ceiling Exposure Limit; the concentration that should not be exceeded even instantaneously.

toxic - Poisonous; potentially harmful to health and/or reproductive ability of organisms.

toxicant - A toxic agent.

trade secret - A patent on a product or method of production that if released would be detrimental to the manufacturers' livelihood.

vapor density - The weight of a vapor or gas compared to the weight of an equal volume of air. Materials lighter than air have vapor density of 1.0 (examples: acetylene, methane); materials heavier than air have vapor densities greater than 1.0 (propane, chlorine). Lighter materials will tend to rise and dissipate (unless confined); heavier materials are likely to concentrate in low places where they may create fire or health hazards.

volatile - Easily erupting into a violent reaction or readily becoming a vapor at relatively low temperature.

VOCs (Volatile Organic Compounds) - The name given to a substance that contains carbon and that evaporates (becomes a vapor) or "off-gases" at room temperature. Found in aerosol products, paints, cleaners, disinfectants, pesticides, new carpeting, gasoline, furniture, scented candles, laundry soaps and other scented products. VOCs are also associated with asthma, cancer and other disorders.

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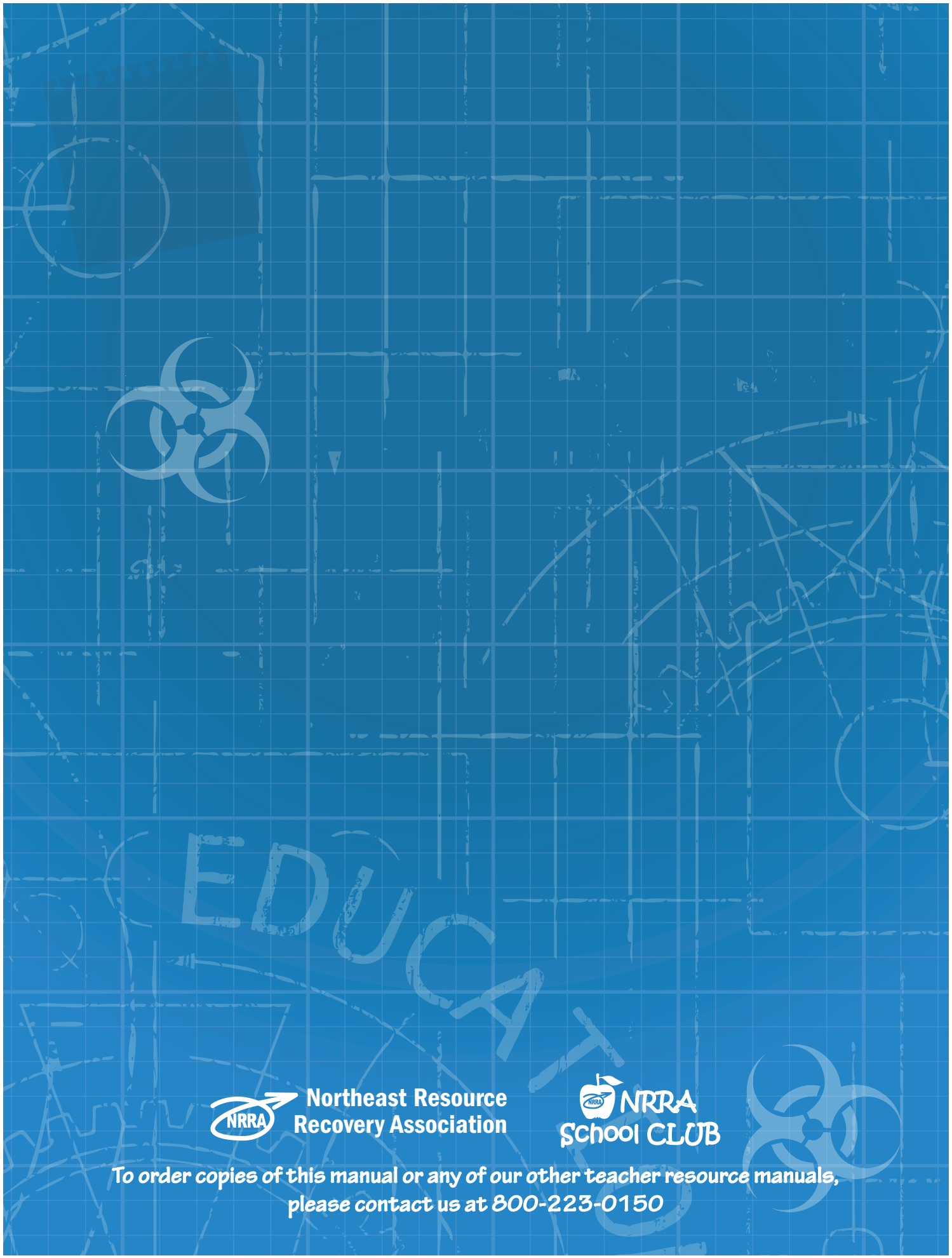

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