Hazardous Materials

Many administrators, teachers, and students incorrectly assume that hazardous chemicals in schools and colleges reside only in science laboratories. This misconception underscores a broad lack of awareness of hazardous chemicals in general, and specifically of hazardous chemicals, products and by-products that reside, or are produced, in numerous non-science areas throughout educational institutions. This lack of awareness also emphasizes the need for implementing effective chemical hazard communication programs in each department (not just science laboratories) that will both inform and protect employees, students, and physical facilities.

The spectrum of chemical hazards in non-science areas is far more diverse than most people expect. Flammable materials are broadly distributed through art, industrial art, home economics, health, office, custodial and maintenance, athletic, and many other work areas. Corrosive chemicals and products are common in photography, printing, art, the cafeteria, custodial, and maintenance work sites. Poisons of various potencies are present in nearly all non-science locations. Chemicals that can cause cancer or birth defects are common in art materials (e.g., glazes and paints), office supplies (e.g., rubber cement and White Out/Liquid Paper), industrial art products, as well as custodial and maintenance products. Inhalation is the primary route of exposure to many of these hazardous materials, but some of these chemicals and products can be absorbed through the skin if proper precautions are not followed.

Most employees in educational institutions are also unaware of their potential occupational exposure to "natural sources" of hazardous chemicals. For example, exposure to the radioactive radon gas generated by the natural decay of substances in rocks and soils beneath educational facilities may increase risks for lung cancer in thousands of institutions nationwide. Improper location of air intake vents has resulted in the internal redistribution of noxious building exhausts picked up from nearby exhaust vents, automobile/bus exhausts from nearby parking lots, groundskeeping pesticide sprays applied near intake vents, or industrial wastes from nearby chemical plants. Few employers and employees are aware that all photocopy machines produce toxic levels of a "natural gas" if not housed in a well-ventilated room. Even the "natural" process of installing carpets in classrooms. Or tarring a roof has produced "crises of the first order" in many educational institutions by the release of hazardous and/or noxious solvents and odors. These "natural sources" of hazardous chemicals usually become apparent after employees and/or students have suffered ill effects.

Many educational institutions have inappropriately focused their chemical hazard communication programs in science departments, thinking that science teachers will know how

to properly deal with hazardous chemicals. Unfortunately, few science teachers, including college chemistry professors who train science teachers, have any formal training in chemical hazards, proper precautions, appropriate personal protective equipment, emergency procedures, or proper chemical disposal. Hazard communication programs in non-science areas are often minimal to nonexistent because the responsible science personnel are unfamiliar with hazardous chemicals and products in non-science areas, and have little time and little incentive to become familiar with the diversity of potentially hazardous circumstances in the non-science areas. Some academic institutions, including many large school districts and universities, have found that an effective chemical hazard communication program requires implementation either by an external consultant organization, or by consultants working with institutional personnel to achieve an integrated, balanced program in both science and non-science areas.

ART MATERIALS

Art and craft materials present specific chemical hazards for teachers, students, artists, and hobbyists who may be exposed to a myriad of art and craft supplies.

Hazards from Common Art Materials

Materials	Chemicals
Flammables	
Brush Cleaner	Benzene, kerosene, toluene, acetone, mek
Duco cement	Acetone
Fluorescent spray paint	Toluene
Protective clear spray	Toluene
Rubber Cement	Hexane, benzene, toluene, xylene
Shellac	Methyl alcohol
Spray Paint	Acetone, toluene, methyl isobutyl ketone
Stabilizer and replenisher	Formaldehyde
Turpentine	Turpentine
Varnish remover	Benzene, denatured ethyl alcohol, methanol, Methylene chloride, toluene
Varsol	Benzene
Wil-Bond	Acetone, isopropanol, methanol, sec-butyl Acetate, xylenes, toluene
Woods dough	Isopropyl alcohol, mek, acetone
Corrosive Hazards	
Developer-replenisher	Hydroxylamine sulfate

Developer	Potassium hydroxide, hydroquinone
India ink	Ferrous sulfate
Photo activator	Potassium hydroxide
Stop Bath	Acetic Acid
Poison Hazards	
Bleach fix-replenisher	Ammonium thiosulfate
Ceramic glazes	Lead, cadmium
Clear shellac spray	Toluene
Cordovan dye	1,2-dichlorobenzene
Latex Paints	Titanium dioxide
Paints	Cadmium, chromium, lead, manganese, mercury
Carcinogen Hazards	
Brush cleaner	Benzene, kerosene, toluene, acetone, methyl alcohol
Ceramic glazes	Lead, cadmium
Rubber cement	Hexane, benzene-50%, toluene, xylene
Stabilizer and replenisher	Formaldehyde-55%
Varnish remover	Benzene, denatured ethyl alcohol, methanol, toluene

Most people think art materials are not harmful, but a careful review of product labels reveals a broad spectrum of health and physical hazards. Because children frequently use art and craft materials, their exposure to these hazardous substances is especially critical.

Children of all ages are considered high risks for hazardous chemical exposures, with very young children being the most susceptible. This is due to several factors: (1) incompletely developed body systems that break down and excrete hazardous chemicals, (2) small lung passages that are more sensitive to inflammation and spasms, (3) rapidly growing tissues that are much more easily damaged by poisons or lack of oxygen or nutrients, and (4) low body weight (or smaller body masses) for chemical dilution. In addition, children are often unable to comprehend dangers, let alone anticipate them – consider their tendency to put things in their mouths. A combination of any of these factors makes children more susceptible to smaller amounts of toxic materials than might harm an adult.

Art and craft materials that may be harmful to adults and children include the following:

- Paints and solvents
- Drawing Inks
- Dyes
- Pottery clay (silica)
- Sculpture and molding materials
- Resins, dusts, and paints
- Silk screen solvents and pigments
- Wood preservatives
- Printing solvents, washes, and inks
- Aerosol sprays
- Glues and adhesives

- Permanent markers

These materials can produce a wide variety of acute (short-term) and chronic (long-term) health effects that range from light-headedness, coughing, and skin irritation through possible birth defects and cancer. Hazards associated with art chemicals are real, and lack of awareness on the part of art educators and their students increases the likelihood of accidental and unnecessary employee or student exposures.

The following checklists for art areas will enable teachers to evaluate their work practices. Hazardous chemical inventories, protective equipment, and safety procedures. Prevention is the goal, and use of these checklists will provide a focus for improving your program and reducing risks associated with your art and craft hazardous chemicals.

General Precautions

- Make sure that ventilation is adequate for all work areas, and exhaust does not contaminate the outside environment.
- Make available fireproof metal cabinets and automatic sprinkler systems, or other appropriate extinguishers, for areas with flammable materials.
- Locate fire extinguishers in each art workplace. Place fire extinguishers according to the type of material used in the area and the class of fire that may result.
- Smoke detectors are particularly important where art materials are used, and in all chemical storage areas.
- A source of fresh running water must be readily available for first aid and clean-up.
- There should be at least two exits from work areas where hazardous chemicals are used.
- Adequate lighting is needed for working safely with hazardous chemicals.
- A good first-aid kit should be readily available.
- A list of emergency phone numbers should be available and posted in an accessible location.

Precautions for Flammable and Combustible Materials

- All containers of flammable and combustible liquids must be covered.
- Do not permit smoking in any room with flammable materials.
- Ground any metal drums with contents that could be ignited by static electricity created by pouring.
- Store waste liquids, rags, or paper soaked with flammable or combustible liquids in approved, fireproof waste disposal cans with self-closing tops, and dispose of them daily.
- Avoid storing flammable or combustible liquids near escape routes.
- Use only space heaters approved for use in the presence of flammable materials.
- Place any solids that could undergo spontaneous combustion in sealed containers to exclude all air. Prevention of heat accumulation can be achieved with good ventilation.

- Carefully wt-mop or wet vacuum explosive dusts and other combustible solids and store in approved self-closing, noncombustible waste cans.

Special Precautions for Liquids

- Use gloves or protective barrier creams to protect hands against dermatitis from solvents, acids, and alkalies.
- Wipe up spills immediately and place rags or used paper towels in an approved waste disposal can.
- Where possible, pump rather than pour liquids from a container.
- Wear unvented safety goggles when pouring liquids that splash.
- Do not pour water-insoluble liquids down the drain.

Special Precautions for Powders

- Transfer powders that create dusts with spoons, cups, or similar implements. Ground containers if their contents will be poured.
- Handle dusts in wet form whenever possible, preventing harmful inhalation.
- Unless you are working in a fume hood, wear an approved dust respirator when transferring and handling toxic dusts.
- Minimize dusts created by cutting stone and plastics by lightly spraying the work area with water.
- Immediately clean up spills with wet paper towels and water, using neoprene gloves if the spilled powders are corrosive.
- Store powders that come in a paper, plastic, or fabric bag in a metal or plastic container with a lid. This procedure is especially important once the bag is opened.

Industrial Arts – Special Hazards

The diversity of hazards in woodworking, autobody repair, printing, cosmetology, and electronics shops is too broad and too specialized in for detailed discussion. The classes of hazardous chemicals in each of these areas, however, are similar and include:

- Flammables
- Corrosives
- Poisons
- Carcinogens
- Mutagens
- Teratogens

In addition, primary risks in essentially all industrial art areas arise from inhalation exposure (e.g., paints and solvents in woodworking, welding and exhaust fumes in autobody shops, ink and wash solvents in printing, nail polish remover and hair spray solvents in cosmetology, and spray solvents and solder fumes in electronics shops). Each of these areas also involves secondary risks from skin exposure. These similarities in classes of hazardous chemicals and routes of exposure enable proper safety management of these areas to be somewhat standardized despite the breadth and specialized hazards in each area.

Employee and student protection should focus on three priorities:

- Fire prevention
- Avoiding exposure to vapors and fumes
- Prevention of skin exposures

Fire prevention requires storage of flammable materials in metal, fireproof cabinets, use of safe procedures, effective student training, and availability of appropriate fire extinguisher systems (e.g., fire extinguishers, sand, automatic sprinklers, and fire alarms close at hand).

Inhalation exposure to vapors and fumes can be prevented by appropriate work site ventilation, including local spot vents, generalized room ventilation (exhausted directly to the outside, not recirculated!), air dilution techniques (e.g., standing fans and open door and windows), and personal protection equipment (e.g., cartridge respirators and "backpack" respirators).

Skin exposures can be minimized by the use of appropriate personal protective equipment (e.g., gloves, aprons, safety glasses, goggles, face shields, and full body clothing) and effective personal hygiene, including the availability of nearby hand and face washing facilities, an eye wash fountain, and a full body shower with appropriate drainage. Employees and students working with hazardous chemicals in industrial art areas should wash their hands before and after using the bathroom, eating, or drinking.

Administrators and industrial art instructors must plan and prepare properly if fire, inhalation, and skin hazards are to be prevented. The following checklists will help evaluate your status for selected hazardous situations in industrial art areas.

General Precautions

- Wear appropriate protective equipment at all times; the type of equipment used depending on the type of work being done.
- Make sure work areas are free from grease or oil. Wipe up any oily areas on machinery, floor, or body.
- Provide adequate ventilation that will not physically impair the worker or work area (e.g., blowing sawdust, loud air moving equipment).
- Check tools and equipment for any abnormalities.

Special Precautions for Welding

- Do not weld near spray paints, solvents, or other flammable materials.
- Wear welding goggles with varying shade numbers.
- Use a welding helmet for very heavy welding.
- Avoid clothing with cuffs, pockets, or other folds that could trap sparks, tape them closed if necessary.
- Wear protective leather gloves, long-sleeved wool shirts and pants, and a leather apron to protect against flying sparks, hot metal, wood chips, and overspray.
- Wear leather shoes or ANSI-approved safety shoes rather than shoes with rubber or crepe soles.
- Make sure welding work surfaces are made or steel. Cover any nearby flammable or combustible materials (e.g., liquids, wooden floors, walls and classroom projects stored nearby) with fireproof materials.

Special Precautions for Handling Gas Cylinders

- Always refer to the type of gas used by its proper name.
- Store oxygen, acetylene, propane, butane, and other flammable gases away from each other in fireproof areas.
- Securely attach all gas cylinders to a permanent fixture (e.g., wall or bench) or to a stable, portable cart.
- Know how to properly turn the cylinder valve on and off.
- Do not hit or force a stuck cylinder valve.
- Make sure that oil or grease of any kind does not come in contact with oxygen cylinders, valves, regulators, hoses, or fittings.
- All cylinder valves should be opened slowly.
- Attach a suitable pressure-reducing regulator to the cylinder valve.
- Remove leaky cylinders to the open air, away from lights or electrical equipment. Notify the cylinder manufacturer immediately.
- Test connections with soapy water, never with an open flame.
- Do not drop, roll, or misuse cylinders in any way.

Special Precautions for Brazing and Silver soldering

- Wear protective goggles with a shade number of at least 4.
- Always use leather protective gloves when handling hot metals.
- Avoid cadmium-containing silver solders.
- Avoid zinc chloride flux whenever possible.
- Provide adequate local exhaust ventilation or wear a respirator with an acid gas cartridge and fume filter.

- Blow soldering fumes away from your face without containing the work area for other employees or students.

Special Hazards in Photography Facilities

Many schools and most colleges have at least one darkroom, and many academic institutions have several photography areas to support various departments. Many potentially hazardous chemicals used to develop film are not effectively labeled; furthermore, employees and students often handle these hazardous chemicals carelessly.

Photographic chemicals include corrosives, poisons, and some carcinogens and flammables. Most darkrooms are inadequately ventilated and typically "reek" with pungent chemical odors, but users of these facilities seldom question the potential impact of exposure to these chemicals. Similarly, personal protective equipment is often inadequate, and available gloves, goggles, tongs, etc., are not always used.

Development of a proper safety protocol for photographic facilities should be a priority. These procedures should include the proper storage of hazardous chemicals and products, and the availability of adequate ventilation, eyewash fountains, and other appropriate safety equipment. The following checklist will help you evaluate procedures.

Checklist for Photography and Photoprocesses

- Wear an approved dust respirator when pouring developer powders.
- When handling developers in powder form or liquid solution, wear goggles and rubber gloves.
- Wash gloves before reusing.
- Be sure eyewash facilities are accessible and functional in a darkroom area.
- Use tongs, not bare hands, when using developer baths.
- If developer solution splashes in your eyes or on your skin, flush with plenty of water for at least 15 minutes. For eye splashes or serious skin exposures, see a physician as soon as possible.
- Carefully label all solutions so that accidental ingestion does not occur.
- Do not use paraphenylene diamine, or its derivatives, if at all possible.
- Adequate ventilation will reduce the hazards of acetic acid and other harmful vapors.
- Store concentrated acids and other corrosive chemicals on low wooden shelves in ventilated cabinets or work areas to reduce the chance of face or eye damage should a container break.
- Always add acid to water, never water to acid.
- Make sure all solutions are covered when not in use.

OVERLOOKED HAZARDS IN OFFICE AREAS

School and college administrators and office employees alike generally consider office areas to be free of hazardous chemicals. Certainly the chemical population is considerably less than that present in science, art, industrial art, custodial, and maintenance areas. Nonetheless, flammable, poisonous, carcinogenic, and teratogenic chemical products are used routinely in office areas. Although office employees often recognize odors from rubber cement and other adhesives, duplicating machines, laminating machines, permanent markers, and rubbing alcohol, most do not understand that these products contain hazardous chemicals.

The fire danger from flammable products and inhalation exposure represent the two primary concerns in office areas. Fire injuries and damage can occur from inappropriate or careless use of any office products that contain flammable solvents (e.g., duplicating fluid, rubbing alcohol, rubber cement, and fingernail polish remover). Inhalation exposures usually result from inadequate ventilation. Some inhalation risks are the result of disturbance or inadequate sealing of building material (e.g., asbestos and fiberglass).

Air Pollutants common to office areas include:

Asbestos
Fiberglass
Formaldehyde
Photocopy toner
Ozone

The following checklists will facilitate evaluation of overlooked hazards in your office areas.

Asbestos

Buildings constructed between 1958 and 1970 used a wide variety of asbestos building materials, mainly for fireproofing and acoustical and thermal insulation. Asbestos fibers can become loose and circulate through ventilation systems. Asbestos has been found to be carcinogenic in men and women. The U.S. Asbestos Hazard Emergency Response Act (AHERA) required that every public and private school in the United States be completely inspected for asbestos and an Asbestos Management Plan (AMP) be submitted to the governor of the school's state by October 12, 1988, unless a school had previously been granted an extension.

Special Precautions for Asbestos

- Use only a certified asbestos inspector to evaluate your facilities for asbestos.
- Check the building to verify the construction date.

- Make sure acoustical tiles, insulation, and roofing materials are asbestos free. If there is any cracking of flaking, a licensed firm should be contracted to test and remove the asbestos-containing materials.

Fiberglass

Fiberglass particles fall from ceiling insulation or get caught in the ventilation system. These fibers can be inhaled into the lungs, where they can become permanently lodged. Fiberglass is a skin irritant.

Special Precautions for Fiberglass

- Check the building insulation and other materials or fabrics that may contain fiberglass.
- Make sure that the damaged fiberglass is repaired and sealed.
- Maintain humidity levels to reduce skin irritation.

Formaldehyde

Formaldehyde is used in various building materials such as adhesives, insulation, particle board, plywood, and textiles. Building products containing this chemical have a tendency to emit fumes as they age. Formaldehyde contributes to respiratory problems as well as nausea and dizziness.

Photocopy Machines

Nitropyrenes and ozone are hazardous chemicals found in two different brands of photocopy materials. In 1978 the substance that was the "ink" of some dry toner photocopiers was found to contain a harmful possible by-product, nitropyrenes. The manufacturer changed the formula in 1980, drastically reducing the nitropyrenes content.

Ozone is a colorless gas that deteriorates materials such as rubber, textiles, and pigments. This gas is also a strong irritant to the respiratory system. Ozone is produced when oxygen molecules in the air are exposed to the high voltage and ultraviolet light of photocopy machines. Ozone can accumulate to levels that can produce sore throat, headache, and nausea in rooms with inadequate ventilation.

Special Precautions When Using Photocopy Machines

- Make sure machines are kept in well ventilated areas.
- Wear gloves when changing the toner.
- Wash hands immediately after coming in contact with the toner.
- Keep powder toner contained.
- Always follow the manufacturer's instructions regarding use of the photocopier.

HAZARDOUS CHEMICALS IN CUSTODIAL AND MAINTENANCE AREAS

Many chemical products used by custodial and maintenance personnel are either flammable or corrosive. Essentially every flammable product also represents an inhalation health hazard, and every corrosive product also represents an inhalation exposure health hazard (Table Below). Most custodial and maintenance employees, however, regularly endure exposures to these hazardous chemicals and products unaware of the potential for injury, even when they experience symptoms like coughing, tearing eyes, headache, dizziness, itching skin, or hand rashes. Too often these employees do not use protective gloves, respirators, or dust masks, even when they are available.

The inappropriate mixing of various custodial and maintenance products results in hundreds of serious, hazardous chemical exposures each year. For example, the relatively common practice of mixing ammonia and bleach to produce a "super floor cleaning solution" sent two custodians and four rescuers to the hospital in Utah as a result of exposure to the resultant corrosive gas. In another case, a $200,000 lawsuit was filed against one institution when a visitor was hospitalized after being overcome by a toxic gas in a restroom. The gas was produced as a result of a contract plumbers leaving toilet bowl cleaner in a repaired toilet and an unwary custodian subsequently adding ammonia to the same toilet. Chemical interaction hazards are highly serious and warrant specialized training for all custodial and maintenance personnel.

Table

Hazards from Common Maintenance Materials

Flammable – (inhalation hazards)

- Denatured Alcohol (ethyl and methyl alcohol)
- Duplicating fluid (methyl alcohol)
- Floor Finish (xylene)
- Gasoline
- Kerosene
- Marine paint (xylene)
- Mineral Spirits
- Paint brush cleaner (benzene, kerosene)
- Paint remover (benzene, methyl alcohol)
- Rubber cement (benzene, hexane, toluene, xylene)
- Rubbing alcohol (methyl alcohol)
- Shellac (methyl alcohol)
- Turpentine
- Vandal mark remover (toluene, xylene)
- Varsol (benzene)
- Will-Bond (isopropanol, toluene, methanol, acetone, xylene, sec-butyl acetate)
- Wood alcohol (methyl alcohol)

Corrosive (skin and eye hazards)

- Ammonia
- Bleach (sodium hypochlorite)
- Drano (sodium hydroxide)
- Ground stripper (ethanolamine, potassium hydroxide)
- Toilet bowl cleaner (hydrochloric and sulfuric acid)

Oxidizer

- Cleansing powder (chlorine)

Inappropriate storage of custodial and maintenance chemicals can result in accidental hazardous chemical interactions. For example, leaking or spilled ammonia and bleach will produce the same corrosive gas mentioned above. Chlorine oxidizers used in powdered cleansers and swimming pool additives can interact with combustible materials (i.e., paper or cloth), or flammable products, to produce spontaneous fires. Storage of hazardous custodial and maintenance chemicals near, or above, food products can result in food contamination from spilled or leaking containers. Hazardous custodial and maintenance chemicals and products should be stored by hazard class, away from foods, in appropriate, well-ventilated cabinets or rooms.

Custodial and maintenance personnel must also know the hazards associated with chemicals and products in other departments so they are not inadvertently exposed to unfamiliar hazardous products or circumstances. For example, custodians, asked to remove chemicals from a science laboratory, could readily and unwittingly mix incompatible chemical and cause a spontaneous fire or explosion. Or, custodial or maintenance personnel may be working in an art room while a kiln is firing and the exhaust fan is off. Plumbers may need to work near water-reactive chemicals and electricians in rooms filled with flammable vapors. Effective hazard communication and employee education and training are especially important in custodial and maintenance areas. The following checklist will assist in the evaluation of hazardous chemical procedures in custodial and maintenance departments.

Checklist for Custodial and Maintenance Areas

- Store chemicals and products by hazardous chemical classes.
- Include only necessary products in the variety and quantity of custodial and maintenance products.
- Properly dispose of all others.
- Evaluate custodial and maintenance products to identify those that can be replaced with equivalent safer brands (e.g., flammable sprays replaced by combustibles).
- Limit access to the main storage area, and limit the inventory in each janitorial closet.
- Ensure that all containers are properly labeled with hazard warnings (including individual squeeze bottles).

- Implement a single, internal labeling system throughout the institution to ensure that custodial and maintenance, as well as other, personnel are familiar with hazard information, even on unfamiliar chemicals and products.
- Keep all chemical and product containers clean and functional to prevent leakage and ensure that material will not accumulate on the outside of the container.
- Train all custodial and maintenance personnel (including part-time employees) at least annually about hazardous chemicals and products they use and that reside in other departments.
- Also train all custodial and maintenance staff, including part-time help, about personal protective equipment and proper spill clean-up procedures.
- Provide appropriate gloves for every custodial and maintenance employee, and have cartridge respirators, dust masks, and aprons available on request.
- Provide written educational information to each employee and have other reference data available during the work shift (i.e., MSDSs).