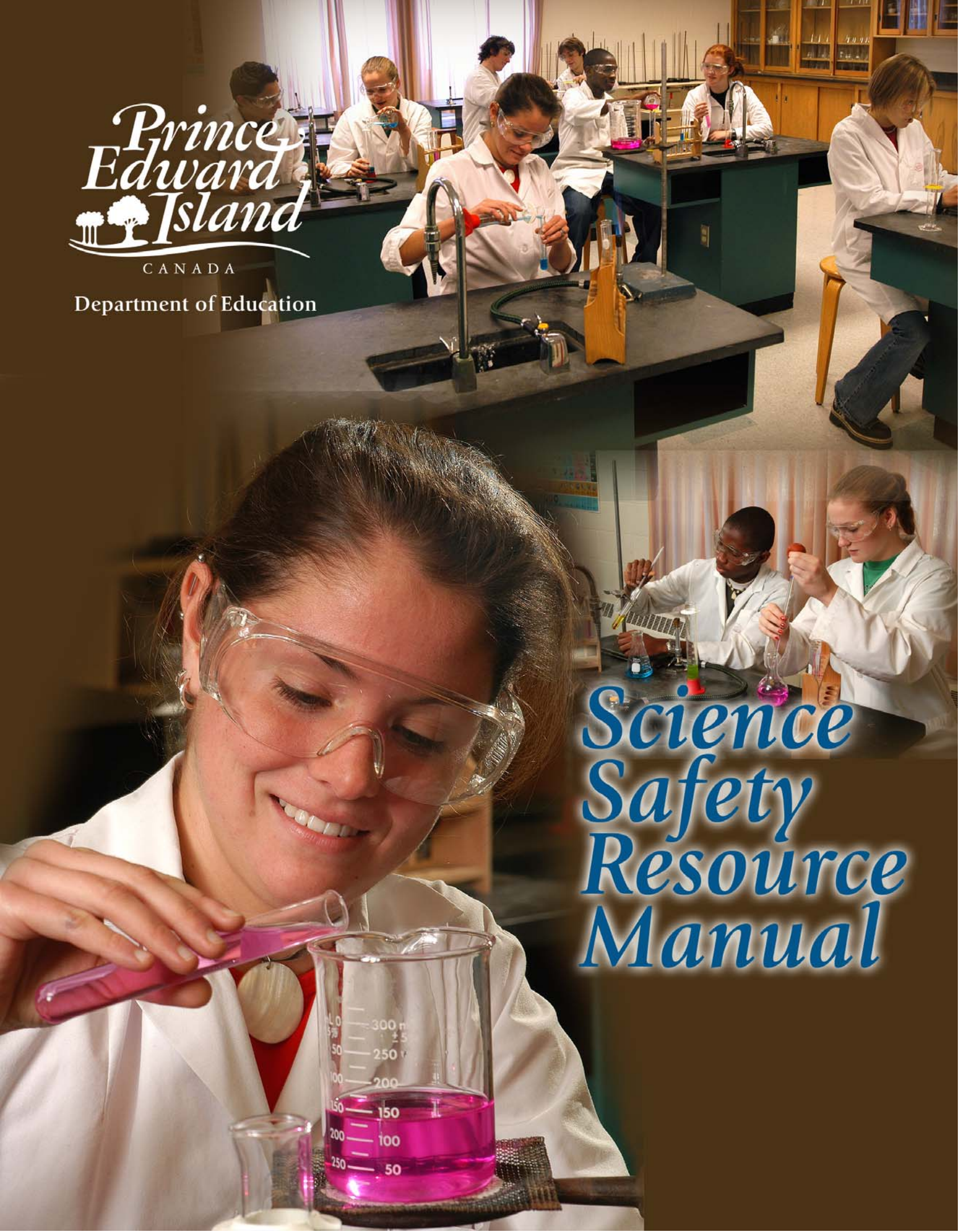
Prince Edward Island

CANADA

Department of Education



Science Safety Resource Manual

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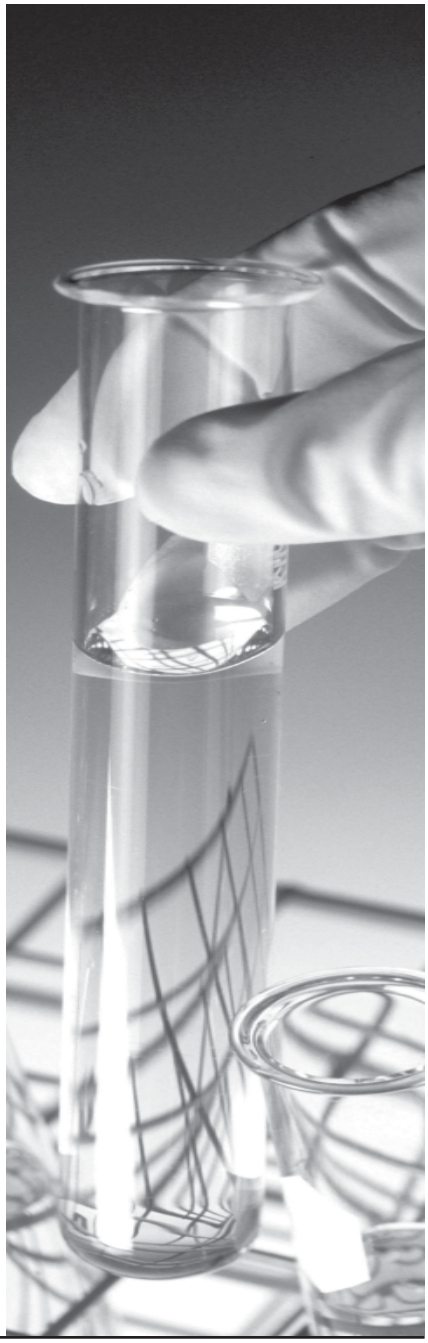

Science Safety Resource Manual
Department of Education
Prince Edward Island
2004

Acknowledgements

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***Disclaimer**

Introduction to Science Safety

In today's world, a scientifically and technologically literate population is more important than ever. As a global community, we are experiencing rapid and fundamental economic, environmental, social and cultural changes that affect our quality of life. Science education is a key element in developing scientific literacy among today's and tomorrow's youth. They will need to understand the major concepts and principles of science and be able to use this knowledge. The development of scientific literacy is supported by instructional environments that engage students in active inquiry, problem solving and decision making. (pan-Canadian Science Curriculum Framework, page 8)

With active inquiry comes an element of caution and safety that must be followed. The safety consciousness of society in general and science educators in particular has been raised substantially over the past few years. As stated in the pan-Canadian Science Curriculum Framework, ".... students will be encouraged to demonstrate a concern for safety in science and technology contexts. Science education can contribute to attitudinal growth when students are encouraged to assess and manage potential dangers and apply safety procedures, thus developing a positive attitude toward safety." (page 18)

This manual has been developed to address the need for an increased safety consciousness. The teaching of science requires the active involvement of students and any safety guidelines should support and encourage the investigative approach generally and laboratory instruction specifically, while at the same time assisting in the development of a safe teaching environment.

The information in this manual is intended to help educators provide a science safety program that supports an exciting and meaningful science curriculum and reduce the risk of injury to staff and students.

School Science Safety

Encouraging a positive safety attitude is a shared responsibility among the school board, school administration, and the teacher of science. The cooperation of these groups is necessary to develop a strong safety culture both inside and outside our schools.

With each activity and investigation, the teacher should weigh the total benefits against potential hazards. In the final analysis it is the science teacher in the classroom who is the best person to decide which particular activities should be performed by the students; done as a demonstration or omitted entirely. This manual has been compiled to assist educators, in particular, the classroom teacher, in making sound decisions regarding science safety.

Elementary Science

Although experimentation in the elementary years may not be in as much depth as in secondary school, and the equipment and chemicals may not be as sophisticated, the attention to safety is just as important. More detailed information may be found throughout this document. Safety is an important concern in the elementary science classroom because students are learning new skills and working with unfamiliar equipment and materials that can pose some degree of hazard. Safety in the elementary school science classroom depends upon the wise selection of experiments, materials, resources and field experiences as well as consistent adherence to correct and safe techniques. Some work procedures require thorough planning, careful management and constant monitoring of students' activities. Teachers should be knowledgeable of the properties, possible hazards, and proper use and disposable of all materials used in the classroom. This information can be attained through the Material Safety Data Sheets (MSDS).

The Safe Classroom

Some general principles of safe science classroom management may be identified:

- Prepare, maintain, and prominently display a list of emergency telephones numbers.
- Identify people within the school who are qualified to administer first aid.
- Annually review and complete the safety checklists relevant to your situation.
- Familiarize yourself with the relevant medical histories of individual students.
- Review basic first aid procedures regularly.
- Formulate, in consultation with administration and other teachers, an action plan to deal with accidents in the classroom and also on activities such as field trips.

Non-Hazardous Chemicals

The following chemicals can be used safely by students (but remember that any substance, even salt, can be harmful if taken in sufficient quantity). Be aware that any substance in a fine powder or dust form can be inhaled and thus harm health.

- Aluminum Foil
- Antacid preparations
- Baking powder (sodium bicarbonate and tartaric acid)
- Baking soda (sodium bicarbonate)
- Bath salts/Epsom salts (magnesium sulfate)
- Borax (sodium borate)
- Carbonated drinks (fizzy)
- Chalk (calcium carbonate)
- Charcoal
- Citric acid crystals
- Clay (moist)
- Cobalt chloride paper (only the paper)
- Copper foil
- Cream of tartar (tartaric acid and potassium hydrogen tartrate)
- Detergents, hand-washing types (but not dishwashing)
- Food Colouring
- Glycerine (glycerol)
- Iron filings
- Lemon juice (contains citric acid)
- Marble chips (calcium carbonate)
- Litmus paper or solution
- Milk
- Oils, vegetable and mineral (but not motor oil)
- Plaster of Paris or cellulose fillers ('Polyfilla')
- Salt (sodium chloride)
- Sand
- Soap
- Starch
- Steel wool
- Sugar
- Tea (contains tannic acid)
- Universal (pH) indicator paper or solution
- 'Vaseline'
- Vinegar (dilute acetic acid)
- Vitamin C (ascorbic acid)
- washing powder, hand-washing types
- zinc foil

Dangerous Household Chemicals

Some common products are potentially hazardous and should not be used in the elementary classroom. Consider warning the students about the dangers in their homes.

Bleach	Fine powdered substances	Pesticides, fungicides, and insecticides
Caustic soda (sodium hydroxide)	Fireworks, sparklers and party poppers	Some plant growth substances (e.g. rooting powders)
Rust-removal solution	Gasoline and other fuels	Scale removers
Dishwasher detergents	Hydrogen peroxide (more than a 3% solution)	Toilet cleansers
Drain cleaner	Laundry detergents	Weed killers
Dry cleaning fluids	Oven cleaners	Some fertilizers
	Paint strippers	

Disposing of Chemicals

- The disposal of non-hazardous, water-soluble liquid wastes (e.g. liquid handsoap, vinegar) should involve diluting the liquid waste before pouring it down the drain, then running tap water down the drain to further dilute the liquid.
- Non-hazardous solid wastes (e.g. iron filings, table salt) should be disposed of in a waste container.

Plant and Animal Care in the Classroom

(http://www.sasked.gov.sk.ca/docs/elemsci/corgesc.html)

Teachers are responsible for familiarizing themselves with any local, provincial, or federal statutes pertaining to the care of plants or animals. If in doubt, inquire. Pet shops or plant shops may have useful information. Remember that there are regulations preventing the picking of wild flowers, or the captive use of migratory birds or endangered species. The following are some guidelines for the care of plants and animals in the classroom:

- Be wary of any possible signs of allergic reactions among students to any plants or animals.
- Inform the administration before bringing any animals into the school.
- Inquire about specific feeding and facility requirements for classroom pets.
- Be wary of possible diseases that may be spread by animals, or by people to animals.
- Poisonous animals and plants, or other potentially dangerous animals such as venomous snakes and spiders should not be kept in the classroom.
- Wear gloves when handling animals in the classroom. Over-handling can put the animals under excessive stress.
- Involve students in helping to care for plants and animals.
- Make arrangements to have the plants and animals looked after over holidays and on weekends.

Regulations for Animal Experimentation in Science Fairs

There are strict safety requirements. Teachers are asked to ensure that students adhere to these rules at all times. Live animals are not to be displayed and procedures which could harm or distress animals are not to be used. Safety requirements are constantly being reviewed and updated. If an experiment can be performed in some other way than by using live or preserved specimens, then do so. Alternatives might include computer simulations and research projects.

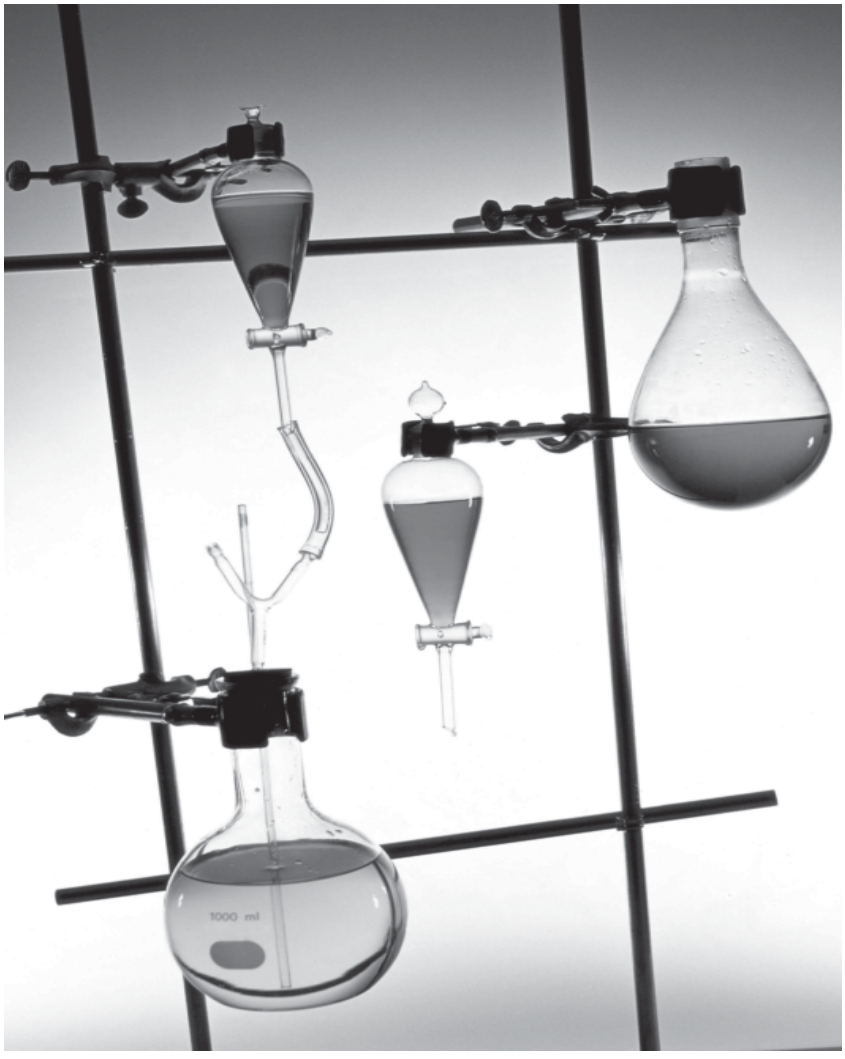
For the most current information please refer to http://stas.edu.pe.ca or the Youth Science Foundation Canada at http://www.ysf.ca/. This organization has established guidelines for the Canada-Wide Science Fair Program.

Science Safety Rules and Procedures for Elementary Science Students **(not a conclusive list)**

1. Read all written instructions before doing an activity.
2. Listen to all instructions and follow them carefully.
3. Make sure you understand all the safety labels.
4. Always ask your teacher if you do not understand.
5. Wear proper safety protection as instructed by the teacher.
6. Never remove your goggles during an activity.
7. Tie back long hair and avoid wearing loose clothing such as scarves, ties or long necklaces.
8. Know the location of safety and first aid equipment.
9. Work carefully and make sure that your work area is not cluttered.
10. Always cut away from yourself and others when using a knife.
11. Always keep the pointed end of scissors or any other sharp object facing away from yourself and others if you have to walk with it.
12. Dispose of broken glass as your teacher directs.
13. Do not smell a substance directly. Fan the odor toward you with your hand.
14. Never eat or drink in the laboratory.
15. Never drink or taste any substances.
16. Never use cracked or broken glassware.
17. Make sure that your hands are dry when touching electrical cords, plugs, or sockets.
18. Handle hot objects carefully.
19. Tell your teacher immediately if an accident or spill occurs, no matter how minor.
20. Never do an experiment without the approval and direct supervision of your teacher.
21. Clean equipment before you put it away.
22. Dispose of materials as directed by your teacher.
23. Clean up your work area upon completion of your activity.
24. Wash your hands carefully with soap and water after handling chemicals, after all spills and at the end of each activity.

Secondary Science

No matter what age level, safety is a primary concern in the science classroom. Secondary students should already have experience handling chemicals and science equipment. As they progress through secondary school, more opportunity is given to them to work with more sophisticated apparatus and chemicals. The following are guidelines, cautions and recommendations for teaching science in a secondary classroom.



Science Safety Rules and Procedures for Secondary Science Students (not a conclusive list)

1. Read all directions before starting an experiment.
2. Know the location of safety equipment.
3. Always alert the teacher in case of any accident.
4. If any foreign substance enters the eye, rinse the eye immediately for 15 minutes and inform your teacher.
5. If you wear contact lenses, notify the teacher. Some activities may require you to remove contact lenses.
6. When instructed, wear safety goggles and protective clothing.
7. Wear closed shoes during laboratory sessions.
8. Long hair should be tied back.
9. Do not use cracked or chipped laboratory glassware.
10. Take only as much chemical as needed and never return excess chemicals to the original container.
11. Dispose of chemicals as directed by your teacher.
12. Bottles should never be held by the neck.
13. Taste nothing unless you are instructed to do so.
14. Never eat or drink in the science classroom.
15. Never enter the chemical storeroom without permission.
16. Always clean off the bench and sink after completion of an experiment.
17. At the end of the activity wash your hands thoroughly with warm water and soap.
18. Replace the bottle lid as soon as you have taken the materials you need.
19. Unless you know definitely that a substance is not toxic, treat it as though it were.

Please note: All chemical spills in the work area (table, benches, desks, floor, etc) should first be wiped off and the area flushed thoroughly with water. If a chemical comes in contact with the skin it should not be wiped. Rinse off immediately with large amounts of cold water for at least 5 minutes.

Safety Equipment for Science Classrooms

The following equipment is often found in secondary classrooms/labs where science activities are performed.

Equipment	Comments
Heat resistant gloves	Gloves should be made of treated textured silica or woven fabric. Do not use asbestos gloves.
Eyewash station	Eye wash facilities should be maintained in good working order
One fire blanket with wall stand mounted low on wall	The only use is to smother clothing fires
One dry chemical fire extinguisher	After use, the extinguisher will require service. Demonstrations should not be carried out with this extinguisher. A spare extinguisher reserved for that purpose should be used. Fire exits and routes out of science classroom must be clearly marked and kept clear of obstruction at all times.
Sand bucket (approximately 20 L of sand)	For small fires only
Safety glasses, goggles or face shields	Teachers and students must wear eye protection whenever there is the likelihood of eye injury. It is good practice to wear eye protection in laboratories at all times.
Lab coats, aprons, sleeve protectors	Personal protective equipment should be worn when there is a possibility of exposure to corrosive or other harmful chemicals. It is good practice to wear a lab coat in laboratories at all times.
Safety/beaker tongs	If necessary, use with heat resistant gloves when handling very hot equipment. Extreme care should be taken to avoid accidents with heated material.
Fume hood	Should be maintained in good working order
Handwashing facilities	Should be in or near each science classroom
Safety showers	Should be maintained in good working order
Spill kits	Absorb spills or dilute solutions of chemicals. The spill kits should be specific to the chemicals being handled.
Pails containing 12 to 15 L of kitty litter or bentonite	Containers should be clearly labelled and contents disposed of safely

Equipment	Comments
Metal container with lid	It is preferred that materials soiled with combustible or flammable agents be disposed of in a metal container with a lid
Weak acid solution (acetic acid). Large container of dry Na_2HCO_3 (baking soda)	To neutralize small alkali spills. To neutralize strong acids before disposal.
First Aid Kit	Should be refreshed regularly
Step-stool, step ladder	To aid in reaching high storage areas safely
One plastic hand dustpan, brush, gloves, and a scoop	Used for brushing up used sand, vermiculite, protective broken glass, etc. as both pan and brush will be contaminated after use. Wash and clean up thoroughly.
Chemically resistant rubber gloves	Gloves should always be worn when dealing with spills. Often broken glassware is involved, and the danger of toxic chemicals entering through open cuts is serious.

First Aid

General Procedures

In the event of a serious accident involving personal injury, the teacher should:

1. Report immediately to the school office and calmly explain where the accident occurred, how many students were injured and how serious the injuries appear to be.
2. During the time required for emergency personnel to arrive, remove everyone from the vicinity of the accident and administer first aid.

First Aid in the Science Classroom

Injury	Response
Burns and Scalds	• If minor - immerse the wound in cold water. Where immersion is not possible, apply towels or cloths soaked in clean, cool water to the affected area and change frequently. • Do NOT apply any lotions or ointments. • Do NOT remove clothing if stuck to the burned area. • Arrange for medical attention
Bruises	• Apply cold compresses.
Fainting	• Leave the person lying down • Loosen any tight clothing • Keep crowds away.
Inhalation of toxic fumes or gases	• Summon trained personnel who can administer oxygen and other medical procedures
Poisoning	• Note the suspected poisoning agent. • Call the Poison Control centre: 1-800-565-8161 • Call an ambulance. Send container and contents with casualty to hospital.

Cuts		Control the bleeding by:
	Severe bleeding:	• Compress the wound with a cloth or whatever is available. • Elevate the injury above the level of the heart.
	If blood is spurting:	• Place a pad directly on the cut. • Wrap the injured person (to avoid shock). • Apply firm pressure. • Get immediate medical attention.
	Less severe bleeding:	• Wash the cut. • Apply a pressure pad firmly on the wound. • If bleeding continues or if any pieces of glass have to be removed, seek medical attention. • Use disposable gloves when in contact with blood.
Chemical Spills Splashes on the skin		• Flush the affected area with cold water for at least 5 minutes. • Wash affected area with a mild detergent, preferably soap and water. • Do **NOT** neutralize chemicals on the skin. • Remove any clothing contaminated with chemicals. Use caution when removing pullover shirts or sweaters to prevent contamination of the eyes. • Depending on the nature of the chemical, seek medical help.
	In the eyes	• Check for, and remove contact lenses before irrigation. If contact lenses are difficult to remove, begin irrigation with lenses in place. • Irrigate both eyes immediately with steady gentle stream of tap water for at least 15 minutes. • Arrange for medical help and continue irrigation while victim is transported to emergency care facility. Notes: • Alkali splash in the eyes is more dangerous than acid at the same concentration because of its rapid penentration into tissue of the skin and eye. Protective goggles or preferably face shields must be worn when handling caustic solutions. • Fresh tap water is preferable to stored saline or bacteriostatically treated water which may become contaminated. **DO NOT USE HOT WATER.**
Ingestion of Hazardous Chemicals		• Encourage the victim to drink large amounts of water while en route to medical assistance. Never give anything by mouth to an unconscious person.
Electrical Accident		• Do not touch a person in contact with a live electrical current. Disconnect power first. Administer C.P.R. if necessary and treat burns.

Eye Hazards

The eyes are probably the most vulnerable portion of the body surface from an injury standpoint. Every effort should be made to protect them. Protective eyewear such as spectacles, goggles, or face shields must be worn whenever there is significant risk of damage to the eyes.

Potential Eye Injuries

Hazard	Description
Foreign bodies	• some particles can lodge on the surface of the eye where they can become very irritating • sharp objects may penetrate more deeply into the eye where they may cause no pain (eg. shards of flying glass from an exploding test tube or flask)
Chemical Agents	• acids, alkali, and other caustic materials
Radiation	• ultraviolet, visible, and infrated radiation can all damage eye tissue if the intensity level is sufficiently high

Contact Lenses

The wearing of contact lenses in the science lab has long been a controversial issue and a topic of much debate. The arguments against wearing contact lenses while conducting experiments are based on the following points:

- Dust or chemicals can be trapped behind the lens and cause irritation or damage to the cornea.
- Gases and vapours can become trapped behind the lenses and cause irritation and extensive eye watering.
- A chemical splash may be more injurious when contact lenses are worn. This increased risk is related to the removal of lenses. If removal is delayed, first aid treatment may not be as effective and in turn the eye's exposure time to the chemical may be increased.

On the other hand, the opposite may be true as well. Contact lenses may prevent some substances from reaching the eye, and thus minimize or even prevent an injury from occurring. Both situations have been documented.

The critical point to remember is that contact lenses are not intended to be used as protective devices. They are not a substitute for personal protective equipment (PPE) - if eye and face protection is required for certain work operations then all workers, including contact lens wearers, should wear the proper protective devices. Safe work conditions for all workers are only possible when basic occupational health and safety practices and procedures are followed.

Are there situations where it may be hazardous to wear contact lenses?

While the following conditions may be hazardous to all students, contact lens wearers should be aware that certain conditions may make it necessary to avoid wearing their lenses. Each situation should be carefully investigated. These situations may include:

- exposure to chemical fumes and vapours
- areas where potential for chemical splash exists
- areas where particular matter of dust is in the atmosphere
- exposure to extremes of infrared rays
- intense heat
- dry atmosphere
- flying particles
- areas where caustic substances are handled, particularly those used or stored under pressure

In workplaces with ultra-violet and infrared radiation sources, users of contact lenses require protection just as non-users do. Contact lenses absorb infrared radiation. This effect is potentially more harmful to the soft lens wearer as it could alter the water balance of the contact lens.

Are some hazards specific to soft contact lens wearers?

Soft lenses are made from a type of plastic that contains a large proportion of water. The soft lens adheres more tightly to the cornea and does not have as much fluid as the hard contact lens. For these reasons, some researchers think the soft lens offers some, but not total, protection against entrapment of foreign substances between the contact lens and the cornea.

The major risks for soft contact lens wearers are from chemical splashes and from hot, dry environments. Because of the high water content of the soft contact lens, some chemicals can pass through the lens and be held against the cornea by the lens itself.

Hot, dry environments can lead to problems because they can cause the tear layer (upon which the lens sits) to dehydrate. This situation results in eye discomfort.

Are some hazards specific for hard contact lens wearers?

Hard lenses are made from an impervious material. Increased risk may result if foreign substances, such as dust or small metal fragments, become trapped behind the cornea lens. Since the hard contact lens floats on the tear film in front of the cornea (not in a fixed position), there may be an abrading action between the contact lens and the foreign substance that may result in injury to the cornea. Also, chemicals may become trapped behind the contact lens and held in place against the cornea. In dirty, dusty environments, the wearing of the hard lenses may be more hazardous than soft contact lens.

Understanding Chemicals

Terminology such as *corrosive, hazardous, toxic, poisonous, explosive, asphysciant, and contaminant* are all terms that should be taken very seriously when encountered. Because of this everyone should have a common understanding: there is no such thing as a harmless chemical but there is a safe way of using and handling chemicals.

Chemicals are a fact of life. All living things are made from chemicals. Everything from the air we breathe to the ground we walk on is made from chemicals and chemical compounds. A chemical can be in the form of a solid, liquid or gas. The physical form is critical in evaluating a potential risk associated with the chemical. The way the chemical is used, the conditions under which it is used, the frequency of use, and the quantity of the substance are all factors that influence the risk of harm and the potential ill effects that can result from chemical use. How much of a substance comes in contact with the body will determine the potential ill effects. For example an extremely toxic substance in a small enough dose may have no harmful effects, while a naturally occurring substance found in food can indeed be harmful, if taken in large enough doses.

Know Your Chemicals

A chemical can cause harm to persons, property and the environment. Therefore, it is imperative that science teachers understand the hazards associated with the chemicals they use so they can safely purchase, handle, use, store, and dispose of chemicals.

In order to safely use and handle chemicals, science teachers must understand what happens when two or more substances are combined, and the resulting properties of by-products and finished products.

Harm Caused By Chemicals

Toxic substances include corrosive as well as poisonous materials. A toxic substance has the potential to cause injury by direct chemical reaction with body systems. Almost any substance is toxic when taken in excess of “tolerable” limits. It is the dose that frequently determines the extent of damage to the body. Many other factors including time of exposure, route of entry, age, sex, life style, allergic factors, previous sensitization, and genetic disposition may impact the overall effect that a chemical can have on a person.

Chemicals can also cause harm when they ignite or explode. Fire and explosion caused by chemicals usually occurs when a flammable vapour is given off from a material or chemical and is in the presence of oxygen and a source of ignition. Therefore, the temperature of a substance and the availability of oxygen are two crucial ingredients when evaluating the potential fire hazard. If these factors are considered along with the type of container and separation of materials, many of the hazards can be reduced.

Property can also be harmed by chemicals if proper procedures are not followed. Environmental pollution is caused when a chemical gains uncontrolled access to the environment. i.e: spills, leaks, air contamination.

Routes Of Entry Into The Body

There are four potential routes of entry into the body:

Absorption - caused by direct physical contact with toxic materials; absorbed through skin, mucous membrane, and eyes; can result in a variety of problems including burns, tissue damage, dermatitis and allergic reactions. Usually materials that can be absorbed take the form of either a liquid, vapour, spray or mist. A chemical absorbed into the body may cause acute and/or chronic poisoning or have no harmful effect at all. It might show no harmful effects in small doses however, many small doses might produce a cumulative effect and lead to a slow forming illness.

Inhalation - inhaling poisonous or corrosive vapours and dust is by far the most common route by which toxic materials enter the body. To enter the lungs a chemical must be in the form of smoke, fumes, mist, dust or vapour.

Ingestion - swallowing liquid or solid toxic materials.

Injection - direct entry to the blood stream - chemicals in open wounds may be rapidly distributed throughout the body. (Direct injection through punctures can occur).

For more information about this topic, we recommend the publication “Chemical Safety for Teachers and Their Supervisors”, American Chemical Society, 2001, available from the American Chemical Society free as a single copy. There is a charge for more than one copy. The publication can be viewed at this web site. http://membership.acs.org/c/ccs/pub_1.htm

Note** (pub_1.htm) This is the correct ending for the above url.

Workplace Hazardous Materials Information System (WHMIS)

WHMIS is an acronym for Workplace Hazardous Materials Information System. It was created in response to the Canadian workers' right to know about the safety and healthy hazards that may be associated with the materials or chemicals they use at work. It is mandated under Federal Law, namely the Hazardous Products Act (HPA) and the associated Controlled Products Regulations (CPR). In Prince Edward Island, the Workers' Compensation Act and Occupational Health and Safety Regulation apply to workers and employers.

Exposure to hazardous materials can cause or contribute to many serious health effects such as effects on the nervous system, kidney or lung damage, sterility, cancer, burns and rashes. Some hazardous materials are safety hazards and can cause fires or explosions. WHMIS was created to help stop the injuries, illnesses, deaths, medical costs, and fires caused by hazardous materials. It is a comprehensive plan for providing information on the safe use of hazardous materials used in Canadian workplaces. Information is provided by means of:

a) bilingual product labels providing basic hazard information in a specific format,
b) materials safety data sheets (MSDS) containing more detailed technical information and
c) worker education programs.

Three major components to WHMIS:

Labels (supplier label, workplace label)
Material Safety Data Sheets (MSDS)
Education and Training

Labels

Labels on chemicals from laboratory supply houses which are packaged in quantities less than 10 kg must disclose the following information in both English and French:

A **supplier label** must:

- appear on all controlled products received at workplaces in Canada
- contain the following information
  - product identifier (name of product)
  - supplier identifier (name of company that sold it)
  - a statement that an MSDS is available
  - hazard symbols [the picture of the classification(s)]
  - risk phrases (words that describe the main hazards of the product)
  - precautionary measures (how to work with the product safely)
  - first aid measures (what to do in an emergency)
  - have all text in English and French
  - have the WHMIS hatched border

If chemicals are removed and transferred to another container, the transfer container must be labelled clearly with enough information to enable the safe handling of the material. Supplier labels for materials from a laboratory supply house that are intended for use in a laboratory in amounts less than10 kg and any controlled product sold in a container with less than 100 mL may contain less information than listed above.

Sodium Acetate, Trihydrate

NOT FOR FOOD OR HOUSEHOLD USE

Avoid dusting when handling. Do not ingest. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles, such as metals or strong acids or oxidizing agents. Keep container tightly closed in a cool, well-ventilated place. Maintain good housekeeping procedures to prevent accumulation of dust.

SKIN: Wash contaminated skin with soap and water. EYES: flush with plenty of water for at least 20 minutes, occasionally lifting the upper and lower eyelids. Seek medical attention.
INHALATION: move exposed person to fresh air. If irritation persists, get medical attention.
INGESTION: do not induce vomiting. If affected person is conscious, give plenty of water to drink. Seek medical attention.

TARGET ORGANS: Not available

See Material Data Safety Sheets

Acétate de sodium, trihydraté

PAS COMME NOURRITURE OU POUR UNE UTILISATION DOMESTIQUE

Éviter la formation de poussières au cours de la manutention. Ne pas ingérer. Si ingérqé, consulter immédiatement un médecin et lui montrer l'emballage ou l'étiquette. Conserver à l'écart des matières incompatibles telles que les métaux et les acides ou les comburants forts. Conserver le récipient bien fermé dans un endroit frais et bien ventilé. Maintenir de bonnes procédures internes pour éviter l'accumulation de poussières.

PEAU: Laver la peau contaminée à l'eau at as savon. YEUX; Rincer immédiatement à l'eau courante pendant au moins 20 minutes, en soulevant occaisionnellement les paupières supérieure et inférieure. Consulter un médecin. INHALATION: Transporter la personne incommodé e a l'air frais. Si l'irritation persiste, consulter un médecin. INGESTION: Ne pas faire vomir. Si la personne incommodée est consciente, lui faire boire beaucoup d'eau. Consulter un médecin.

ORGANES CIBLES
Scholar Chemistry

Non disponible
Voir la fiche signalétique

Manufactured by:
Columbus Chemical Industies, Inc.
N4335 Temkin Rd.
Columbus, WI 53925
Tel: (920) 523-2140

If the product is always used in the container with the supplier label, no other label is required (unless the supplier label falls off or becomes unreadable). However, sometimes you will want to put some of the material into another container for use in the workplace. This new container does require a workplace label.

A **workplace label** must:

- appear on all controlled products produced in a workplace or transferred to other containers by the employer
- may appear in placard form on controlled products received in bulk from a supplier
- have the following information:
  - product identifier (product name)
  - information for the safe handling of the product
  - statement that the MSDS is available
  - may contain the WHMIS hazard symbols or other pictograms

These are the minimum requirements for workplace labels. The employer may wish to put more information on the labels but it is not required under the law.

Outside the laboratory, transfer containers must carry a workplace label. This form of label has three components – the chemical identifier, instructions for safe use (combination of risk phrase and precautionary statement), and a reference to the MSDS.

Acceptable format for the workplace label

Product Identifier
Phrases for Safe Handling Information
See MSDS

An example of a workplace label

Acetone
Keep away from heat, sparks, and flames.
Wear safety goggles and butyl rubber gloves
Use with local exhaust ventilation.
MSDS available

Example from http://www.worksafebc.com/publications/health_and_safety_information/by_topic/assets/pdf/whmis.pdf

Material Safety Data Sheets (MSDS)

A Material Safety Data Sheet (MSDS) is a document prepared by the supplier that contains much more information about the material than the label. It includes nine categories of information related to potential hazards and safe handling of the product.

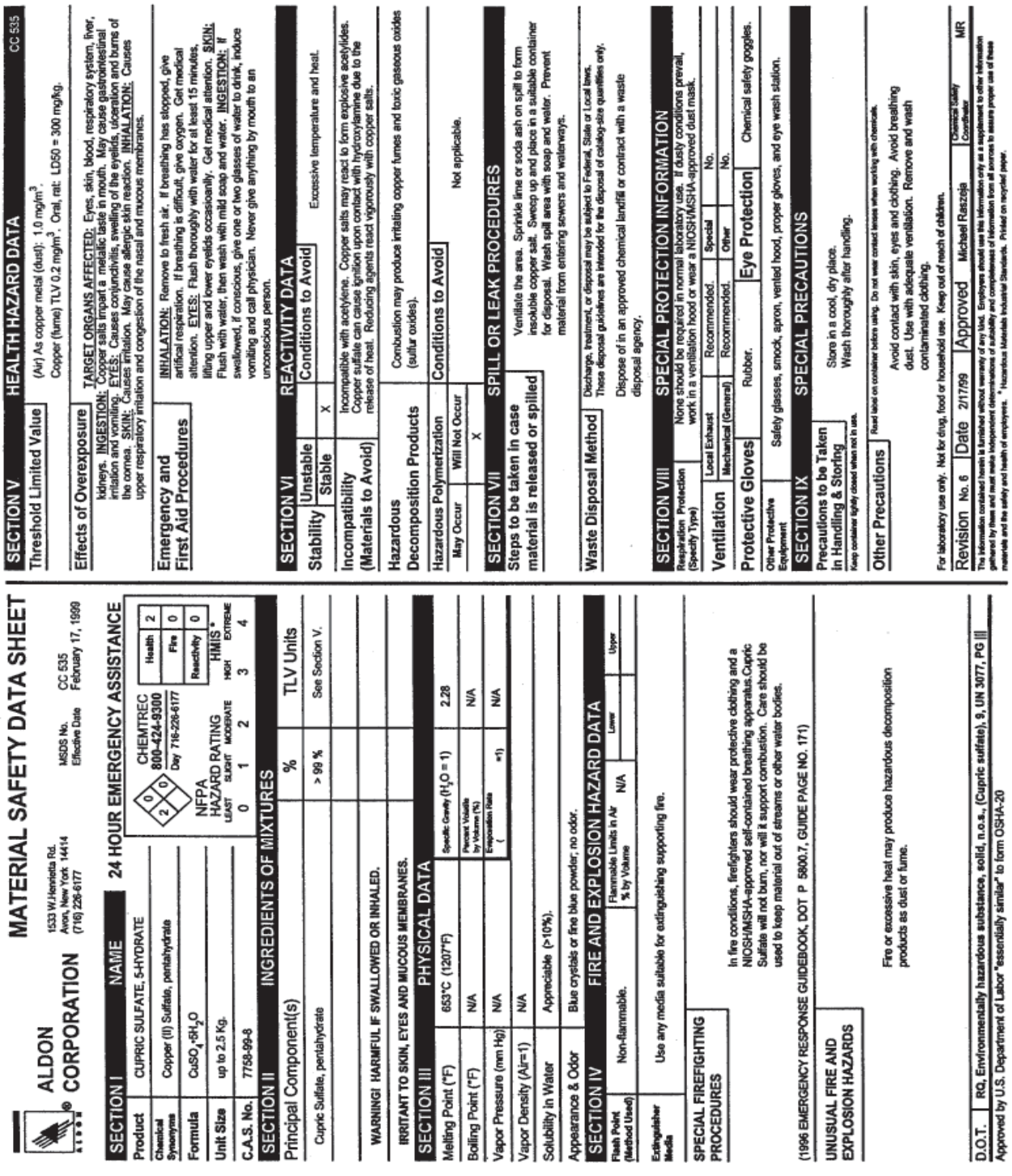
Teachers must make sure that all controlled products have an up-to-date (less than three years old) MSDS when it enters the school. The MSDSs must be readily available to the workers who are exposed to the controlled product and to the health and safety committee or representative. If a controlled product is made in the workplace, the teacher has a duty to make an MSDS for any of these products and to properly label the product.

In Canada, every material that is controlled by WHMIS (Workplace Hazardous Materials Information System) must have an accompanying MSDS that is specific to each individual product or material (both the product name and supplier on the MSDS must match the material in use). Therefore, all chemicals in stock in the schools must have an MSDS sheet.

Teachers and students should be familiar with the type of information contained in MSDS. WHMIS legislation does not require a standard format for the layout of MSDSs. MSDSs may look very different and information items may be located in different sections.

Sample: Material Safety Data Sheet

Each MSDS, for chemicals in the school, must be updated at least every three years and a copy must be available in the lab for use by teachers and students.



MATERIAL SAFETY DATA SHEET

ALDON CORPORATION
1533 W.Henrietta Rd.
Avon, New York 14414
(716) 226-6177

MSDS No. CC 535
Effective Date February 17, 1999

SECTION I NAME — 24 HOUR EMERGENCY ASSISTANCE

CHEMTREC 800-424-9300
Day 716-226-6177

NFPA HAZARD RATING (LEAST SLIGHT MODERATE HIGH EXTREME): 0 1 2 3 4

HMIS*: Health 2; Fire 0; Reactivity 0

Product	CUPRIC SULFATE, 5-HYDRATE
Chemical Synonyms	Copper (II) Sulfate, pentahydrate
Formula	$CuSO_4 \cdot 5H_2O$
Unit Size	up to 2.5 Kg.
C.A.S. No.	7758-99-8

SECTION II INGREDIENTS OF MIXTURES

Principal Component(s)	%	TLV Units
Cupric Sulfate, pentahydrate	> 99 %	See Section V.

WARNING! HARMFUL IF SWALLOWED OR INHALED.

IRRITANT TO SKIN, EYES AND MUCOUS MEMBRANES.

SECTION III PHYSICAL DATA

Melting Point (°F)	653°C (1207°F)	Specific Gravity (H_2O = 1)	2.28
Boiling Point (°F)	N/A	Percent Volatile by Volume (%)	N/A
Vapor Pressure (mm Hg)	N/A	Evaporation Rate (=1)	N/A
Vapor Density (Air=1)	N/A		
Solubility in Water	Appreciable (>10%).		
Appearance & Odor	Blue crystals or fine blue powder; no odor.		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	Non-flammable.	Flammable Limits in Air % by Volume	Lower N/A	Upper

Extinguisher Media: Use any media suitable for extinguishing supporting fire.

SPECIAL FIREFIGHTING PROCEDURES: In fire conditions, firefighters should wear protective clothing and a NIOSH/MSHA-approved self-contained breathing apparatus.Cupric Sulfate will not burn, nor will it support combustion. Care should be used to keep material out of streams or other water bodies.

(1996 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.7, GUIDE PAGE NO. 171)

UNUSUAL FIRE AND EXPLOSION HAZARDS: Fire or excessive heat may produce hazardous decomposition products as dust or fume.

D.O.T. RQ, Environmentally hazardous substance, solid, n.o.s., (Cupric sulfate), 9, UN 3077, PG III

Approved by U.S. Department of Labor *essentially similar* to form OSHA-20

SECTION V HEALTH HAZARD DATA CC 535

Threshold Limited Value: (Air) As copper metal (dust): 1.0 mg/m^3. Copper (fume) TLV 0.2 mg/m^3. Oral, rat: LD50 = 300 mg/kg.

Effects of Overexposure: TARGET ORGANS AFFECTED: Eyes, skin, blood, respiratory system, liver, kidneys. INGESTION: Copper salts impart a metallic taste in mouth. May cause gastrointestinal irritation and vomiting. EYES: Causes conjunctivitis, swelling of the eyelids, ulceration and burns of the cornea. SKIN: Causes irritation. May cause allergic skin reaction. INHALATION: Causes upper respiratory irritation and congestion of the nasal and mucous membranes.

Emergency and First Aid Procedures: INHALATION: Remove to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention. EYES: Flush thoroughly with water for at least 15 minutes, lifting upper and lower eyelids occasionally. Get medical attention. SKIN: Flush with water, then wash with mild soap and water. INGESTION: If swallowed, if conscious, give one or two glasses of water to drink, induce vomiting and call physician. Never give anything by mouth to an unconscious person.

SECTION VI REACTIVITY DATA

	Conditions to Avoid	
Stability	Unstable	
	Stable	X

Excessive temperature and heat.

Incompatibility (Materials to Avoid): Incompatible with acetylene. Copper salts may react to form explosive acetylides. Copper sulfate can cause ignition upon contact with hydroxylamine due to the release of heat. Reducing agents react vigorously with copper salts.

Hazardous Decomposition Products: Combustion may produce irritating copper fumes and toxic gaseous oxides (sulfur oxides).

Hazardous Polymerization	Conditions to Avoid
May Occur	Will Not Occur
	X

SECTION VII SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled: Not applicable. Ventilate the area. Sprinkle lime or soda ash on spill to form insoluble copper salt. Sweep up and place in a suitable container for disposal. Wash spill area with soap and water. Prevent material from entering sewers and waterways.

Waste Disposal Method: Discharge, treatment, or disposal may be subject to Federal, State or Local laws. These disposal guidelines are intended for the disposal of catalog-size quantities only. Dispose of in an approved chemical landfill or contract with a waste disposal agency.

SECTION VIII SPECIAL PROTECTION INFORMATION

Respiration Protection (Specify Type): None should be required in normal laboratory use. If dusty conditions prevail, work in a ventilation hood or wear a NIOSH/MSHA-approved dust mask.

Ventilation				
	Local Exhaust	Recommended.	Special	No.
	Mechanical (General)	Recommended.	Other	No.

Protective Gloves: Rubber. Eye Protection: Chemical safety goggles.

Other Protective Equipment: Safety glasses, smock, apron, vented hood, proper gloves, and eye wash station.

SECTION IX SPECIAL PRECAUTIONS

Precautions to be Taken in Handling & Storing: Store in a cool, dry place. Wash thoroughly after handling.

Other Precautions: Read label on container before using. Do not wear contact lenses when working with chemicals. Avoid contact with skin, eyes and clothing. Avoid breathing dust. Use with adequate ventilation. Remove and wash contaminated clothing.

For laboratory use only. Not for drug, food or household use. Keep out of reach of children.

Revision No. 6 | Date 2/17/99 | Approved Michael Raszeja | Chemical Safety Coordinator | MR

The information contained herein is furnished without warranty of any kind. Employers should use this information only as a supplement to other information gathered by them and must make independent determinations of suitability and completeness of information from all sources to assure proper use of these materials and the safety and health of employees. * Hazardous Materials Industrial Standards. Printed on recycled paper.

These nine categories must be on each MSDS.

	Category	Information
1	Product Information	• name of product • intended product use • manufacturer's name and address • supplier's name and address • emergency phone numbers
2	Hazardous Ingredients	• lists the specific chemical names, percentages, and acute toxicity data for the individual components.
3	Physical Ingredients/data	• general information on physical and chemical properties such as the specific gravity, melting and boiling point, evaporation rate, colour, form, solubility, vapour pressure
4	Fire and Explosion Hazard	• flammibility • flashpoint • fire fighting procedures
5	Reactivity Data	• information on the chemical instability of a product • substances it may react with
6	Toxicological Properties	• identifies if the product has known long-term health effects such as liver or kidney damage, sensitization, cancer, or reproductive effects
7	Preventative Measures	• how the substance enters the body • possible health effects from single or repeated exposures • protective clothing • protective equipment • how to safely cleanup spills • how to safely use, handle, store, dispose of and transport
8	First Aid Measures	• instructions for the immediate treatment of a worker who has inhaled or swallowed the product or who has had skin or eye contact with the product.
9	Preparation Information	• who is responsible for preparation and date of preparation of MSDS

Alternative MSDS's

In certain circumstances, the school may need to obtain an MSDS from a source other than the manufacturer or supplier. Schools can use an up-to-date MSDS from a database if the MSDS was prepared by the supplier or manufacturer of the product they have purchased. If a school chooses to use an MSDS prepared by someone other than the supplier of manufacturer of the purchased product, then the school becomes responsible for all of the information on that MSDS. This includes ensuring that the information is accurate, complete, and current and is reviewed at least every three years. If an MSDS is not available, request one from the manufacturer or subscribe to an online MSDS information service. Some sites that you may wish to explore are: http://msdsonline.com or http://www.msdssearch.com/ or http://wwwilpi.com/msds/index.html

Education and Training

WHMIS is a system of information delivery to workers.

- Schools must ensure that their employees are informed about the hazards of any controlled products they may work with.
- The employer is responsible for worker education and training within WHMIS.
- The school is responsible for developing safe work procedures using knowledge of the job, information from the labels, and MSDS sheets.
- All science teachers should be sufficiently trained to use the information to protect themselves and their students.
- It is the responsibility of all teachers to adhere to safe working procedures and the responsibility of principals to insist that they are followed.
- Science teachers have a responsibility to educate their students in the aspects of WHMIS.
- The training programs must include all controlled products in use, including those which have been exempted from the Federal WHMIS requirements of supplier label and MSDS.

The WHMIS Symbols

	Class A - Compressed Gas	Contents under high pressure. Cylinder may explode when heated, dropped, or damaged.
	Class B - Flammable and Combustible Material	May catch fire when exposed to heat, spark, or flame. May burst into flames.
	Class C - Oxidizing Material	May cause fire or explosion when in contact with wood, fuels, or other combustible material.
	Class D, Division 1 - Poisonous and Infectious Material: Immediate and serious toxic effects	Poisonous substance. A single exposure may be fatal or cause serious or permanent damage to health.
	Class D, Division 2 - Poisonous and Infectious Material: Other toxic effects	Poisonous substance. May cause irritation. Repeated exposure may cause cancer, birth defects, or other permanent damage.
	Class D, Division 3 - Poisonous and Infectious Material: Biohazardous infectious materials	May cause disease or serious illness. Drastic exposures may result in death.
	Class E - Corrosive Material	Can cause burns to eyes, skin, or respiratory system.
	Class F - Dangerously Reactive Material	May react violently causing explosion, fire, or release of toxic gases when exposed to light, heat, vibration, or extreme temperatures.

WHMIS Classification System

In order to protect people, property and the environment, the science teacher must have a thorough understanding of the WHMIS regulations. WHMIS Regulations provide information about hazardous materials used in workplaces such as the school. For easy identification of chemicals WHMIS has developed a classification system consisting of six hazard classes depicted by eight hazard symbols.

Class A	Compressed Gases
Class B	Flammable and Combustible Materials
Class C	Oxidizing Materials
Class D	Poisonous and Infectious
Class E	Corrosive Materials
Class F	Dangerously Reactive

Class A - Compressed Gases

Compressed gases include dissolved gases, and gases liquified by compression or refrigeration. This class poses explosion danger because the gas is under pressure. If the pressure in the container is greater than 40 psi, the gas is a Class A product. If heated or dropped, compressed gas containers may explode. All compressed gas containers should be stored and secured in an upright position in a designated area and kept tightly closed, as liquified compressed gases can cause severe frostbite, i.e., oxygen, acetylene, propane.

Class B - Flammables and Combustible Materials (six divisions)

Division 1: Flammable Gases
These are compressed gases that form flammable mixtures in air. i.e., butane, propane, hydrogen gas.

Division 2: Flammable Liquids
These are liquids that have a flash point below 37.8 degrees C. A flash point is the lowest temperature at which vapours from these liquids will catch fire from nearby sparks or open flames. i.e., acetone, gasoline, isopropyl alcohol.

Division 3: Combustible Liquids
These are liquids that have a flash point between 37.8 degrees C and 93.3 degrees C. i.e., kerosene, mineral spirits, butyl cellosolve.

Division 4: Flammable Solids
This is a special group of solids (usually metals) that meet very specific technical criteria such as the ability to cause fire through friction or to ignite and burn so vigorously and persistently that they create a hazard. i.e., various magnesium alloys, beryllium powder.

Division 5: Flammable Aerosols
These products are packaged in aerosol containers. Either the aerosolized product itself or the propellant may catch fire. Flammable vapours can travel large distances. There have been demonstrations of these vapours flowing down a slope to a lighted candle, illustrating both the hazard and the fact that flammable vapours tend to be heavier than air. i.e., propane, butane, isobutane.

Division 6: Reactive Flammable Materials
These products react dangerously in one of two ways. Either (1) they spontaneously create heat or catch fire under normal conditions of use or they create heat when in contact with air to the point where they begin to burn, or (2) they emit a flammable gas or spontaneously catch fire when in contact with water or water vapour. i.e., aluminum alkyl compounds, metallic sodium, white phosphorous.

In some cases there can be more than one hazard associated with a chemical. An example of multiple hazards for a chemical is *concentrated acetic acid*. It is primarily a corrosive material, but it is also flammable under the right conditions. Dilute acetic acid is not flammable, but is still corrosive, so both the chemical's identity and concentration must be taken into account.

Knowledge of all hazards associated with a chemical is mandatory, and the first place to look is the MSDS sheet.

Class C - Oxidizing Materials

These materials increase the risk of fire if they come in contact with flammable and combustible materials. These materials can also cause burns to skin and eyes. i.e., perchloric acid, hydrogen peroxide, permanganates, compressed oxygen.

Class D - Poisonous and Infectious Materials (3 divisions)

Division 1: Materials Causing Immediate and Serious Toxic Effects

These materials can cause death or immediate injury when a person is exposed to small amounts. ie: sodium cyanide, hydrogen sulfide.

Division 2: Materials Causing Other Toxic Effects

These materials can cause life-threatening and serious long term health problems as well as less severe but immediate reactions in a person who is repeatedly exposed to small amounts. Ethyl alcohol is a good example; short-term exposure results in inebriation. A single high-level exposure can result in alcohol poisoning and possibly death. Long-term high-level exposure can result in cirrhosis of the liver.

Health problems associated with these types of materials include immediate skin and eye irritation, allergic sensitization, cancer, serious impairment of specific body organs and systems and reproductive problems.

Allergens: can lead to dermatitis and asthma. These reactions affect people in different ways and become more serious with repeated exposures.

Carcinogens: are capable of causing cancer. The dose required depends on the chemical and how it is absorbed into the body.

Mutagens: can change the genetic code of cells.

Teratogens: can effect the growth of the fertilized egg and the embryo, ie: Xylene, asbestos, isocynates.

Division 3: Biohazardous Infectious Materials

These materials contain harmful micro-organisms that have been classified into Risk Groups 2, 3, and 4 as determined by the World Health Organization (WHO) or the Medical Research Council of Canada. Examples include cultures or diagnostic specimens containing salmonella bacteria or the hepatitis B virus.

Class E - Corrosive Materials

The most familiar corrosive chemicals encountered in laboratories are the acids and bases. They can be of two types, *irritants* and *sensitizers.* Irritants cause harm through skin absorption or inhalation. Any exposure to these chemicals that results in skin or respiratory irritation should result in the person being evaluated by a doctor.

Sensitizers cause harm because exposure to them is cumulative and the person develops a reaction to the chemical over time. If sensitivity to a particular chemical is noted, medical evaluation is necessary and an alternate chemical should be investigated.

Corrosive materials can be of any phase (gas, liquid, or solid). Corrosive chemicals, when in direct contact with skin can cause injury to body tissue including skin burns, blindness, and internal organ damage.

Corrosive Liquids
Perhaps the most important category is the liquid corrosive. The most typical ones encountered in school laboratories are the acids (hydrochloric, sulphuric, nitric, and acetic) and the bases (sodium hydroxide, potassium hydroxide, ammonium hydroxide).

Acids act on body proteins causing denaturation and destruction of the protein structure. The denatured protein produces a protein barrier which will limit the activity of the acid (although this is very painful). Bases however penetrate deeply with little or no pain and no protein barrier is produced. Bases can cause greater skin or eye damage than acids because the protein barrier formed by acids is not formed by bases.

Corrosive Solids
It is a mistake to think of corrosive solids as being relatively harmless because they can be removed more easily than liquids. The effects of solid corrosives is related to their solubility in skin moisture and the duration of contact. Solid corrosives are rapidly dissolved by moisture in the skin and even more rapidly by moisture in the respiratory and digestive systems. Solutions of corrosive solids absorbed through the skin can result in a delayed injury.

Corrosive substances may react with another material to give off corrosive, toxic and flammable gases, and may react to produce other hazardous substances.

Corrosive Gases
Perhaps the most serious hazard associated with corrosives is from substances in the gas phase. Gases enter the body via absorption through the skin or by inhalation. Corrosive substances may react with another material to give off corrosive, toxic, and flammagle gases, and may react to produce other hazardous substances.

Examples:

Halogens	Will support combustion; may ignite powered metals (on contact). May react violently with organic substances
Hydrochloric Acid	Can liberate gases such as hydrogen and hydrogen cyanide. With formaldehyde produces chloromethoxychloromethane, a very potent carcinogen.
Nitric Acid	Can oxidize cellulose material creating a self-igniting condition. Extremely exothermic when mixed with organic materials.
Sulphuric Acid	Powerful oxidizer. Can dehydrate organic material rapidly with the production of heat.

Precautions When Handling Corrosive Matherials
Any emergency involving corrosives should be taken seriously. Should a spill occur, the material should be neutralized with acid (or base) neutralizer, absorbed with vermiculite or other absorber, and cleaned up. Once a spilled corrosive has been neutralized it can safely be disposed of in the waste. Proper disposal is mandatory.

Precautions in the handling of corrosives include eye protection, gloves, protective clothing, particularly if concentrated corrosive chemicals are being used. Using the smallest quantity possible, and purchasing the smallest bottle needed for the next 12 months is prudent. Should larger bottles (2.5L) be used, the use of a face shield, a rubber apron, and heavy-duty gloves is recommended. Concentrated mineral acids in any size should only be purchased in a plastic-coated safety bottle. In all cases where a procedure involves a corrosive chemical, wear protective goggles. If corrosive gases or solids are involved where dusting may occur always use the fume hood.

Note: The use of contact lenses in some laboratory environments can pose a danger to the eyes and/or lenses. Contact lenses should not be worn where water soluble gases, vapours, dusts or other material may be released into the atmosphere.

Emergency Response
Should a corrosive be spilled on a person in an area other than the eyes, begin flushing the area with water immediately. The safety shower should be used if the spill is large. In that case a thorough rinsing of the area is required. Carefully remove and discard clothing including socks and shoes. Continue to flood the area, while clothing is being removed. If the spill is very small, such as on a hand, rinsing the affected area thoroughly under the tap is possible. In either case, quick attention to the problem and medical attention is advised due to the possible health effects of the corrosive chemical.

In the event of contact with eyes, remove contact lenses if worn, then immediately flush the eyes with water and continue to flush for 15 minutes. Seek medical attention. An eyewash fountain is preferred, however, an eyewash hose or any other source of water should be used in an emergency. Remember, the one and only emergency treatment is to dilute the chemical immediately by complete flushing with water. The patient's eyelids may have to be forced open, so that the eyes may be flushed. Alkali (base) burns are usually more serious than acid burns.

The precautionary warning on the product label should be consulted for full first-aid information. Provide the label information to the attending physician. Neutralizers and solvents (alcohol, etc.) should not be used by the first aid attendant. The spread of a skin absorbing corrosive poison can result in death.

Class F - Dangerously Reactive Materials

Reactive chemicals can be referred to as substances which will, under certain conditions, undergo spontaneous violent reactions and generate large quantities of heat, light, gas, or toxicants. Reactive chemicals generally are unstable (i.e., form peroxides) or have a large amount of internal energy (i.e., nitrates). The internal chemical energy, when released, can result in fire or explosion. These types of chemicals can also react with each other on the shelf, generating a dangerous situation. One example of this is sodium and sulfur, which can explode if mixed. A proper storage method for chemicals, with isolation compartments provided, can help prevent problems here. Keeping chemicals beyond their shelf life, especially reactive chemicals, is not advised. A chemical inventory, noting the date the bottle was opened or received, is most useful in managing hazards.

Frequent accidents occur in laboratories simply because the effects of a particular chemical combination have not been anticipated. This is not uncommon even among highly experienced chemists. The mishandling of reactive chemicals has been a well known problem in all types of science laboratories. The literature contains many case histories of explosions, fires, burns and other bodily injuries which have been caused by improper and careless handling of reactive chemicals. Misuse does not necessarily refer to problems occurring while the reactive chemicals are being used. It can also consist of improper storage, record keeping and labelling.

Types of Reactive Chemicals

Explosives	substances which will decompose with such speed as to cause rapid expansion of air, sometimes accompanied by burning gases and flying objects
Acid Sensitive Chemicals	react with acids to release heat, hydrogen, exposive gases, and toxicants
Oxidation-Reduction	reactions can occur in any phase and tend to generate heat and are often explosive
Pyrophoric Substances	burn when exposed to air

Each chemical's MSDS will indicate reactivity hazards, and that document should be carefully reviewed prior to the chemical's use.

Reactive Type	Examples	Specific Hazards	Precautionary Steps
Acid Sensitive Chemicals	Alkali Metals Alkaline Hydroxides Carbonates Nitrides Metals Sulphides	Liberation of heat, flammable gases, and toxicants.	Islolate from reactive substances, wear and use adequate protection.
Water Senstive Substances	Strong Acids and Bases Acid Anhydrides Alkali Metal Hydrides Aluminum Chloride (anhydrous)	• Heat generation • Hydrogen generation • Ignite in moist air, can cause explosions • Can form Acetyline or Methane • Spontaneously decomposes on long storage and can explode on opening container	Isolate for other reactive substances. Store in cool, waterproof area. Wear protective gear.
Oxidation Reduction	Oxidizers Oxygen Mineral Acid Nitrites and Nitrates Chromates and Dichromates Permanganates Halogens Reducers Alkali Metals Metallic Hydrides Hydrogen Peroxide	All generate heat and can be explosive.	Isolate from each other and other potentially reactive substances. Use adequate protection.
Pyrophors	Sodium	• Flammable and may also polymerize violently • Explodes with many oxidants • Initiation of fire • Spontaneously sensitive when exposed to moisture.	Protect from air.

There are nine basic categories of materials that are not covered by WHMIS. When WHMIS was created it was recognized that a lot of safety information was already being transmitted to workers for many of these products under other laws. To prevent delay in starting WHMIS, exclusions were made.

They are:

- consumer restricted products (those products sold to people in regular stores that are already labelled following the rules of the Hazardous Products Acts).
- explosives (as defined by the Explosives Act)
- cosmetics, drugs, food or devices (as defined by the Food and Drug Act)
- pest control products (pesticides, herbicides, insecticides, etc.) (as defined by the Pest Control Products Act)
- radioactive materials (as defined by the Atomic Energy Control Act)
- wood and products made of wood
- a manufactured article
- tobacco or products made of tobacco
- hazardous wastes

Other Hazards

Mechanical Hazards and Electrical Hazards

Mechanical and Electrical Hazards will seldom exist in a well maintained laboratory where commercially produced, approved equipment is in good working order. With all protective devices and guards in place, there is little opportunity for an accident to occur.

Mechanical Hazards

Rotating Machinery

When guards, lids and covers are not in place over-exposed shafts, belts, and pulleys, loose clothing, hands and long hair can quickly get caught.

Tools (including glass cutting operations)

Carelessly used tools, and tools in poor condition are the source of many accidents resulting in crushed or cut fingers and hands, eye injuries, lesions and abrasions on arms, legs and head.

Heavy Equipment and Materials Stored Overhead

An accident can cause “mechanical” injuries to the back, arms, legs, and head if a heavy overhead item slips while being moved. Mechanical injuries are the result of excessive forced applied to the body.

Electrical Hazards

Faulty Equipment

Poor broken connections (e.g. frayed connecting cords) may lead to overheating of the input lead or the device itself, or shorting of the circuit to some part of the equipment touched by people (i.e., the metal case). Damage to the equipment, or a fire or electrical shock may result.

Improperly Used Equipment

Equipment damage and overheating, and therefore fire, are possible if equipment is in prolonged use at power ratings greater that for which the item was designed. Electrical equipment should never be used near water sources (i.e., laboratory sinks).

Mechanical and electrical hazards accident prevention will depend on the proper maintenance of all mechanical and electrical equipment and the careful instruction of students in the safe use of the equipment. The onus is on the teacher to be aware of potential dangers and to convey this information to students.

Fires

Burning is the rapid oxidation of a fuel by an oxidizer (usually air) with the liberation of heat and (usually) light. A fire can be started when sufficient energy is present to initiate the reaction. The process of burning involves the four interrelated components: fuel, oxidizer, an energy source and uninhibited chemical chain reaction. Removal of at least one component is the basis of fire control.

Sources of Fires

Fire has always been one of the attendant hazards of laboratory operation. Laboratories make use of flammable materials including solids, liquids, and gases. The following are among the more common sources of fire hazards encountered in school laboratories:

- ignition by solvent vapours
- ignition by reactive chemicals
- uncontrolled chemical reactions
- inadequate storage and disposal techniques
- heating due to electrical faults
- loose clothing and hair ignited by Bunsen burner
- misuse of gas cylinders
- inadequate maintenance
- static electrical buildup
- inadequate laboratory design
- inadequate temperature control, especially in areas where solvents are stored

Fire Safety

The goal of every science teacher should be to reduce the chance of fire to the lowest probability possible. Elements of a successful fire control program include:

- adequate education of students in the hazards of fire
- the use of proper lab procedures
- the maintenance of proper chemical storage facilities and
- the provision and maintenance of effective fire control equipment

Fire Safety Equipment

- Fire Blankets - made of fireproofed wool/rayon material and are not to be used where spillage and fire spreading is possible.
- Sand Bucket and Scoops - useful for small fires of all kinds.
- Fire Extinguishers - The type of fire and the extinguisher used are related. Teachers should learn the different classes of fire and the proper extinguisher to use. An extinguisher may act on any single fire component, or on all four of them. An extinguisher either cools the area so a fire will not burn (removes energy source) or smothers the fire (removes oxidizer) or both.

Fire Classification	Fire Extinguisher
Class A - fires involving ordinary combustible materials, such as wood, cloth, paper	Water Dry chemical extinguisher can also be used
Class B - fires involving flammable liquids such as solvents, greases, gasoline, and oil	Dry chemical foam, $C0_2$
Class C - fires involving electrical equipment	Non-conducting agents such as dry chemical or carbon dioxide
Class D - fires involving combustible metals, such as magnesium, sodium, lithium	Special dry powder medium or dry sand

Locating and Maintaining Fire Extinguishers

- Maintain in operable condition - have a complete check at least annually.
- Never re-use a used extinguisher - have it recharged.
- Have all extinguishers clearly marked as to the class and use.
- Locate conspicuously - have location marked with signs - preferably near an exit door.
- Mount at an accessible height.
- Locate convenient to area of use.
- Check monthly.

If the fire appears to be controllable and where there is little personal risk, the teacher will:

- use the fire extinguisher available in the laboratory
- direct the discharge at the base of the flames
- start at one side and work across the base
- alway fight a fire from a position of escape

Do Not

- throw water over a chemical fire
- use a fire extinguisher on standing beakers and flasks
- turn on water after a flaming container is placed in a sink

Dealing with a Small Fire in a Container

- Immediately instruct all students to keep away.
- If only a small amount remains to burn and flames are unlikely to ignite other materials, allow material to burn out.
- If more than a small amount of burning material remains, place a fire resistant cover over the mouth of the container. Avoid breathing fumes. (Wear heat resistant gloves and face shield if necessary.)

Dealing with a Person on Fire

- drop and roll the individual
- douse the individual with water and/or
- wrap the person in a fire blanket

Dealing with Large Fires

In the event of a large fire, follow school district/board evacuation policy and procedures.

Radiation Hazards

Most of the radiation hazards in schools are of an insidious nature. All potentially hazardous equipment and materials must be available for use only under the direct supervision of a teacher familiar with the safe use of the item. The onus is on the teacher to be aware of potential dangers and to convey this information to the students. The teacher must instruct students in proper operating and handling procedures and must insist that they be followed.

Note: Infra-red and radio wave sources used in schools are usually of very low intensity and used only occasionally. If this practise continues, they do not appear to present a significant hazard. Any change in these conditions should be accompanied by precautions to reduce the exposure of students and teacher to the radiation.

The aim of safe procedures for handling radiation sources is to do everything possible to reduce the exposure to radiation at all times. Three general principles can be used to minimize exposure:

- Stay as far away from the source as possible. For collimated and focused beams of radiation, always stay out of the beam path. For uncollimated emissions, the intensity is inversely proportional to the square of the distance between you and the source. Distance is the best and often simplest protection.

- Know what kind of shielding is effective in absorbing the radiation and use it.

- Keep the time for potential exposure at a minimum. In most cases, your body is capable of quickly repairing or compensating for many small amounts of physiological damage spread over a long time. But its repairability can be overcome if the same total amount of damage is done during one continuous interval.

Ultra-Violet Lamps and Electric Arcs

Ultra-violet can cause very painful inflammation of some parts of the eye. The eye can be permanently damaged by intense ultra-violet light from electric arcs. Prolonged exposure of skin can produce “sunburn”.

Intense Visible Light Sources (Lasers, etc.)

The light receiving retina in the back of your eye can be permanently damaged by direct viewing of very bright light sources.

The beam of light from even low power lasers when focused by the lens of the eye, can cause severe retinal damage with very brief exposure. Lasers must be used under the close direction of a teacher in a well-lit room so that the pupils of the eye are small and only when positioned in such a way that the beam cannot enter anyone's eye, either directly or by reflection. It should also be noted that the direct or reflected viewing of any intense visible light source-electric, arc, burning magnesium ribbon, the sun, collimated or focused beams from ordinary tungsten lights-can cause retinal damage.

Microwave Ovens

Microwaves can cause the body to overheat and permanently damage heat sensitive organs.

Insidious Hazards

Chemical emergencies can result from insidious hazards. Insidious hazards are conditions within the laboratory that represent potential health hazards. All too often insidious or hidden hazards are overlooked during routine safety inspections. In the laboratory, one common source of insidious hazards is the sink drain. If aqueous solutions are disposed of by flushing down the drain, this can lead to the build up of toxic or other hazardous materials that may be released into the air upon contact with a catalyst. They may cause local or systemic, acute or chronic effects, depending upon the nature of the substance and duration of exposure. In addition, insidious hazards represent a type of problem that one may never be aware of until chronic, systemic poisoning has occurred.

The School Laboratory

School laboratories should be organized such that chemical stock is minimized and stored properly. Self-handling and disposal of chemical and biological materials is of paramount consideration.

Hazards Associated With Chemicals

The potential for contact with toxic materials exists in many areas of the school curriculum. Chemistry experiments are the most obvious situations with potential hazard. However, a person may be exposed to toxic substances. Toxic materials may be involved incidently as part of a laboratory or demonstration procedure. Careful consideration must be given to all materials used and produced in an activity. For example, the dust of heavy metal minerals may be inhaled during the breaking of rock samples. Inadequate clean-up can lead to exposure to toxic materials after a lab procedure is finished. Substances left on benches, beakers, and bottles may be contacted by the next person working with the articles. Students may ingest toxic materials they have been in contact with if they do not wash very thoroughly before eating or smoking. Foods and beverages readily absorb many vapours and must not be brought into a lab. Chewing of gum should also not be allowed.

Accident prevention will depend on forethought, identification of hazards, and careful instruction of the students. The onus is on the teacher to be aware of potential dangers and convey this information to students. The teacher must instruct students in proper handling procedures and must insist that they be followed.

Chemical Stock and Minimizing Waste

The acquisition, use, and storage of chemicals must be related to real needs. A major problem is associated with the quantities of chemical stock ordered from year to year and the cost of chemical disposal. The following are suggestions to help reduce the amount of chemicals that need to be stored and disposed:

- purchase smaller size packages of chemical stock for your school that you will use in a 12-month period
- if you only need a dilute solution, buy the solution and not a large bottle of the solid
- buying chemicals in bulk to save a few dollars ends up costing more in disposal costs
- maintain an up-to-date inventory of your chemicals
- date and label your chemicals and only buy from chemical supply companies that date and label their chemicals
- chemicals should be dated when the container is opened
- use older chemicals first, before they decompose
- provide good climate control for the chemical storeroom
- prepare only enough solution for immediate use and always label the solution bottle
- never store chemicals or solutions in containers not designed for chemical storage
- store hygroscopic and deliquescent chemicals in proper containers
- follow good laboratory practices
- never accept donations of chemicals
- purchase chemical demonstration kits or chemistry students kits that contain exact quantities of chemicals
- properly dispose of waste chemicals immediately after they are generated
- keep waste solutions separate
- label all waste containers

Chemical Storage

A first step towards preventing chemical accidents is the proper storage of chemicals. It is recommended that every school set up a system to properly store and maintain up-to-date inventory of chemicals. An active inventory of biological, chemical, or physical agents stored and/or handled must be maintained, as well as for any tool, equipment, machine or device. Hazard information, or material safety data sheets (MSDS), must be readily available for any chemical or biological substance that could cause an adverse health effect.

Safe Chemical Storage and Organization

- a chemical storage room must be secure. Only authorized personnel should have access to the chemical storage room.
- an effective ventilation system is needed and the room itself must be adequately vented
- shelf assemblies should be firmly secured to walls. Avoid island shelf-assemblies.
- ideally, shelving assemblies would be of wood construction that have anti-roll-off lips on all shelves
- avoid metal, adjustable shelf supports and clips. It is better to use fixed, wooden supports.
- compile an inventory list with MSDS for each chemical. The MSDS's can be no more than three years old.
- all containers of chemicals should bear a purchase as well as an expiry date
- use a WHMIS-approved labelling system that segregates all chemicals into classes making it easy to access the chemicals and replace them in their proper storage position
- each chemical must be individually evaluated to determine where and how it should be stored
- organize chemicals into their compatible chemical families. The actual sequence of compatible families on the shelves in not critical. What is important is to keep the incompatible families separate and to keep the organic and inorganic families as far apart as possible.
- as a general rule, flammable/combustible liquids, toxic chemicals, explosive chemicals, oxidizing agents, corrosives, water sensitive chemicals, and compressed gases should be segregated
- avoid floor chemical storage (even temporarily)
- no top shelf chemical storage as chemicals should not be stored above eye level
- store acids in an acid cabinet. Store nitric acid in the same cabinet ONLY if isolated from organic acids. Store 'mineral' acids (HN_3, H_3P_4, H_2S_4, HBr) in the same cabinet but each acid should be placed in a plastic tub to contain the liquid in case of bottle failure. Organic acids such as acetic acid, formic acid and salicylic acid can be stored together and often with other organics provided ventilation is adequate. Never store organic acids with nitric and sulphuric acids.
- store alkaline solutions in corrosion resistant plastic trays as close to the floor as possible and away from acids
- store flammables in a dedicated flammables cabinet
- store severe poisons in a dedicated poisons cabinet
- explosives - NEVER store explosives in schools
- pressurized/compressed gases - The number of compressed gas cylinders stored in laboratories should be restricted to those in daily use. Compressed gas cylinders of all sizes must be kept upright and fully secured against falling. Valve caps must be kept on all cylinders that are not being used. Before compressed gas cylinder are used, all fittings and regulators must be checked for defects, leaks, oil, and grease. Bulk storage of cylinders should be in a well-ventilated area, segregated from flammable and corrosive materials. Flammable gases

should be separated from oxidizing gases by combustible partitions. Cylinders should be protected for excessive variations in temperature, from sources of ignition and from direct contact with the ground.
- in laboratories, chemicals other than dilute reagents should not be stored on the open working bench or the shelving above it
- toxic materials should be used only when there is adequate protection from exposure

Alternatives to a Separate Chemical Storage Room

While a separate room is preferable for chemical storage, the principles of proper chemical storage can be maintained without a separate room. If a science preparation room is used as a chemical storage room, it is appropriate to:

- prevent the accumulation of harmful vapours by adequately and continuously venting to the exterior with an exhaust fan.
- equip the room with a properly vented flammables cabinet to house all solvents and flammable materials.
- store acid and basic (alkaline) solutions separately in closed and vented cabinets.
- keep toxic chemicals (poisons) in a separate locked cupboard.
- keep oxidizers and reducers on separate shelves as far from each other as possible.
- store hydrolyzing (water reactive) solids in a separate area.
- store alphabetically general miscellaneous chemicals if they are compatible.

Examples of Incompatible Chemicals

Various chemicals will react dangerously when mixed with certain other materials. Some of the chemicals regularly used by science teachers along with the chemicals that they are incompatible with are listed in the following table. These lists should not be considered all-inclusive. The absence of a chemical from this list should not be taken to indicate that it is safe to mix with any other chemical. Understand and double-check your data before storing your chemicals.

Chemical	Is Incompatible With
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals, such as sodium, potassium, lithium, magnesium, calcium, powdered aluminum	Carbon dioxide, carbon tetrachloride, other chlorinated hydrocarbons (also prohibit the use of water, foam, and dry chemical extinguishers on fires)
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organics, combustible
Arsenates and arsenites	Any reducing agents
Calcium oxide	Water
Carbon activated	Calcium hypochlorite, other oxidants
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organics, combustibles
Chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, turpentine, alcohol, other flammable liquids
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Hydrides	Water
Hydrocarbons (butane, propane, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, peroxides

Incompatible Chemicals

Chemical	Is Incompatible With
Hydrogen peroxide	Copper, chromium, iron, most metals, or their salts, any flammable liquid, combustible materials, aniline, nitromethane
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous)
Nitrates	Acids, oxidizing agents
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, nitratable substances
Nitrites	Acids, oxizing agents
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury and their salts
Oxygen	Oils, grease, hydrogen, flammable materials (liquids, solids or gases)
Peroxides, organic	Acids (organic or mineral); avoid friction, store cold
Phosphorous pentoxide	Alcohol, strong bases, water
Potassium Chlorate (see also chlorates)	Acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver and silver salts	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulmic acid (produced in nitric acid-ethanol mixtures)
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sulfides	Acids
Sulfuric acid	Chlorates, perchlorates, permanganates
Tellurides	Reducing agents

Excessive Risk Chemicals - Risk Exceeds Educational Utility

The following list of chemicals should not be considered all-inclusive. The absence of a chemical from this list should not be taken to indicate that it is safe to use. Understand and double-check your information and data about the chemical before using it.

Chemical Name	Hazards
Acetic Anhydride	Explosive potential, corrosive
Acetyl Chloride	Corrosive, dangerous fire risk, reacts violently with water and alcohol
Acrylamide	Toxic by absorption, suspected carcinogen
Acrylonitrile	Flammable, poison
Adipoyl Chloride	Corrosive, absorbs through the skin, lachrymator
Aluminum Chloride, anhydrous	Water reactive, corrosive
Ammonia, gas	Corrosive lachrymator
Ammonium bifluoride	Reacts with water, forms hydrofluoric acid
Ammonium bichromate	May explode on contact with organics, suspect carcinogen
Ammonium chromate	Oxidizer, poison, may explode when heated
Ammonium dichromate	Reactive, may cause fire and explosion
Ammonium perchlorate	Explosive, highly reactive
Ammonium sulfide	Poison, corrosive, reacts with water and acids
Aniline	Carcinogen, toxic, absorbs through skin
Aniline hydrochloride	Poison
Anitmony oxide	Health and contact hazard
Antimony powder	Flammable as dust
Antimony trichloride	Corrosive, emits hydrogen chloride gas if moistened
Arsenic Compounds	Poison, carcinogen
Asbestos	Inhalation health hazard, carcinogen
Azide compounds	Explosive in contact with metals, extremely reactive, highly toxic

Excessive Risk Chemicals

Chemical Name	Hazard
Barium chromate	Poison
Benzoyl peroxide	Organic peroxide, flammable oxidizer
Beryllium and its compounds	Poison, dust is P-listed and highly toxic, carcinogen
Bromine	Corrosive, oxidizer, volatile liquid
Cadmium compounds	Toxic heavy metal, carcinogen
Calcium fluoride (Fluorspar)	Teratogen, emits toxic fumes when heated.
Carbon tetrachloride	Prohibited, toxic, carcinogen
Chloral hydrate	Hypnotic drug, controlled substance
Chlorine	Poison gas, corrosive
Chlorobenzene	Explosive limits 1.8 to 9.6, toxic inhalation and contact hazard
Chloroform	Carcinogen, if old forms deadly phosgene gas
Chlorosulfonic acid	Toxic, also known as sulfuric chlorohydrin
Chromic acid	Strong oxidizer, poison
Dichloroethane	Flammable, toxic
Dinitrophenol	Explosive, “Bomb Squad”
Dinitrophenyl hydrazine	Severe explosion and fire risk
Dioxane	Flammable, peroxide former
Ether, ethyl	Flammable, peroxide former
Ether, isopropyl	Flammable, highest risk peroxide former
Ethylene dichloride	Toxic, contact hazard, dangerous fire risk, explosive in air 6-16%
Ethyl nitrate	Explosive, “Bomb Squad”
Ethyleneimine	Flammable, toxic, P-listed

Chemical Name	Hazard
Formaldehyde (Formalin)	Toxic, carcinogen, sensitizer
Gunpowder	Explosive
Hydrazine	Flammable, absorbs through skin, carcinogen, corrosive
Hydriodic acid	Corrosive, toxic
Hydrobromic acid	Corrosive, poison
Hydrofluoric acid	Corrosive, poisonous
Hydrogen	Flammable
Hydrogen sulfide, gas	Poison, stench
Immersion oil (old)	May contain 10-30 PCB's such as Arochlor 1260
Iron (II) sulfide	Spontaneously ignites with air if wet
Isopropyi ether	Flammable, highest-risk peroxide former
Lithium aluminum hydride	Flammable, reacts with air, water and organics
Lithium metal	Reacts with water, nitrogen in air
Mercaptoethanol	Flammable, corrosive, intense stench
Mercury compounds	Poisonous heavy metal
Mercury, liquid	Toxic heavy metal, carcinogen
Methylene chloride	Toxic, carcinogen, narcotic
Methyl ethyl ketone	Flammable, toxic, dangerous fire risk,
Methyl iodide (Iodomethane)	May be a narcotic, carcinogen, lachrymator
Methyl isocyanate	Flammable, dangerous fire risk, toxic
Methyl isopropyi ketone	Toxic
Methyl methacrylate	Flammable, vapour causes explosive mix with air

Excessive Risk Chemicals

Chemical Name	Hazard
Naphthylamine, a-	Combustible, toxic, carcinogen
Nickel Oxide	Flammable as dust, toxic, carcinogen
Nicotine	Poison, P-listed extremely hazardous
Nitrilotriacetic acid	Corrosive
Nitrobenzene	Highly toxic
Nitrocellulose	Flammable, explosive
Nitrogen triiodide	Explosive, “Bomb Squad”
Nitroglycerin	Explosive, “Bomb Squad”
Osmium tetraoxide (Osmic acid)	Highly toxic, P-listed extremely hazardous
Pentachlorophenol	Extremely toxic
Perchloric acid	Powerful oxidizer, reactive
Phosphorus pentasulfide	Water reactive, toxic, incompatible with air and moisture
Phosphorus pentoxide	Oxidizer, toxic
Phosphorus, red	Flammable solid
Phosphours, yellow or white	Air reactive, poison
Picric acid, trinitrophenol	Explosive when dry
Potassium cyanide	Poison, P-listed extremely hazardous
Potassium perchlorate	Powerful oxidizer, reactivity hazard
Potassium sulfide	Flammable, may ignite spontaneously
Potassium metal	Water reactive, peroxide former (orange fog/crystals)
Pyridine	Flammable, toxic, vapor forms explosive mix with air
Selenium	Toxic
Silver oxide	Poison

Chemical Name	Hazards
Silver cyanide	Extremely toxic
Sodium metal	Water reactive, ignites spontaneously in dry hot air, corrosive
Sodium arsenate	Toxic, carcinogen
Sodium arsenite	Toxic, carcinogen
Sodium azide	Poison, explosive reaction with metals, P-listed extremely hazardous
Sodium borohydride	Flammable solid, water reactive
Sodium cyanide	Poison, P-listed extremely hazardous
Sodium fluoride (Bifluoride)	Highly toxic by ingestion or inhalation; strong skin irritation
Sodium fluoroacetate	Tox-X deadly poison
Sodium peroxide	Water reactive, may cause fire and explosion
Sodium sulfide	Fire and explosion risk
Strontium	Flammble, store under naphthla, reacts with water
Tetrahydrofuran	Flammable, peroxide former
Thioacetamide	Toxic, carcinogen, combustible
Thionyl chloride	Corrosive
Thiourea	Carcinogen
Titanium trichloride	Flammable, fire risk
Triethylamine	Flammable, toxic, irritant
Trinitrobenzene	Explosive, “Bomb Squad”
Trinitrophenol	Explosive, “Bomb Squad”
Trinitrotoluene	Explosive, “Bomb Squad”
Uranium/Uranyl compounds	Radioactive

High Risk Chemicals - Avoid Using these Chemicals if Possible

This table is a list of chemicals that should not be in a chemical storage area at all, unless there are very specific reasons to have the chemical. These high risk chemicals should only be stored in small quantities and used in research, teacher demonstrations or advanced placement-type environments, and then only after proper training and assessment of the risks.

Chemical Name	**Hazards**
Acetamide	Carcinogen, P-Listed extremely hazardous
Ammonium nitrate	Powerful oxidizer, reactive
Barium peroxide	Fire and explosion risk with organic materials, oxidizer, toxic
Butyric acid	Corrosive, intense stench
Cadmium sulfide	Highly toxic, carcinogen
Calcium carbide	Flammable, reaction with water
Chromium trioxide	Oxidizer, poison
Ethidium bromide	Potent Mutagen
Hexamethylenediamine	Corrosive, absorbs through skin, lachrymator
Hexanediamine, 1-6	Corrosive, absorbs through skin, lachrymator
Hydrogen peroxide, >29	Powerful oxidizer, corrosive to skin
Lead compounds	Highly toxic
Lead nitrate	Toxic heavy metal Oxidizer
Magnesium, powder	Flammable
Mercury thermometers	Toxic heavy metal Oxidizer
Phenol	Poison
Potassium chlorate	Powerful oxidizer, reactive

Chemical Name	Hazards
Potassium chromate	Oxidizer, toxic
Potassium dichromate	Powerful oxidizer, carcinogen
Radioactive materials	Radioactive
Sebacoyl chloride	Corrosive fumes, lachrymator
Silver compounds	Toxic
Sodium chlorate	Powerful oxidizer
Sodium chromate	Oxidizer
Sodium dichromate	Reactive, may cause fire and explosion
Sodium, metal	Water reactive, corrosivve
Strontium nitrate	Oxidizer, may explode when heated or shocked
Thermite	Flammable solid
Toluene	Flammable, dangerous fire risk, toxic
Wood's metal	Poison
Xylene	Flammble, toxic

Safe Handling Practices

A chemical emergency can result in a physical hazard - the material spilled could be slippery preventing easy exit from the room. Other physical hazards could result from poor housekeeping or lab practices, but they are very real and can contribute to problems in any emergency. Proper housekeeping, including keeping aisles and doors clear, and keeping the fume hood sash in the proper position, will help minimize physical hazards. Other “best practices” include:

- the chemical storage room should not be used as a general teacher planning/working area
- do not store chemicals on the floor or within a fume hood
- maintain good classroom management while students are in the laboratory
- only permit proper clothing apparel while students are in the laboratory
- use adequate personal protective equipment (e.g. safety screen, lab coat, safety goggles/face shield, and gloves)
- use adequate respiratory protection (fume hood)
- have adequate exhaust ventilation where corrosive hazards are present
- have plenty of water available for flushing, including eyewash
- have plenty of sodium bicarbonate available for neutralizing liquid corrosive spills
- obtain immediate medical attention upon accidental contact
- store corrosive chemicals properly

Things to Remember

- handling toxic materials in open containers - vapours, dust, liquids can easily escape during normal handling
- heating toxic materials - smoke and vapours may be released in much greater quantity when material is hot
- creating dusts of toxic material - crushing and grinding solids, transferring powder may release dusts into the air
- use of toxic materials in areas without adequate ventilation - toxic vapours can rapidly accumulate to dangerous levels in a room, or part of a room that does not have a constant replacement of contaminated air. Toxic vapours can be in high concentration immediately above an open bottle even in well ventilated rooms. Do not lean over the bottle.
- storage of toxic materials without proper ventilation - dangerous levels of toxic substances accumulate in the air and on surfaces in closed-in, unventilated storage areas
- storage of toxic materials without proper hazard identification - the hazards must be clearly seen and understood every time a substance is used in order to avoid dangerous mistakes
- use of toxic materials without proper protective gear - skin contact with hazardous materials and inhalation of toxic vapours must be prevented by the use of correct clothing, face protection, fume hoods or respirators
- storing or consuming food and beverages, chewing gum and smoking in an area where toxic materials are used. Food, beverages, and cigarettes can readily absorb toxic vapours or become contaminated with unseen toxic dust. Poisons may be transferred from hands to food and cigarettes.

Cleaning Up Spills

Spills are a frequent occurrence in science classrooms/labs. The first priority of the teacher is to ensure that no students have been injured by the material spilled and then clean up the spill immediately. Students should be encourage to report spills are breakages so that they can be cleaned up immediately. Refer to MSDS sheet for clean-up directions.

Spill Kits
The items listed below will enable you to deal with most common spills of acids, alkalilne solutions, and flammable solvents. Commercial spill kits are available and convenient to use.

- Vermiculite (6 kg) and Activated Charcoal (1 kg) mixture
- Bentonite or cat litter (10 kg)
- Sodium bicarbonate (baking soda) or sodium carbonate (soda ash) (3-4 kg of dry solid)
- Weak acid (boric or citric) (liquid or solid - 2 kg)
- Plastic Aspirator Bottle (250 mL cap.)
- Various size “Freezer Bags” with ties
- dustpan and whisk broom
- Labels and tape
- Metal containers for flammable wastes
- Plastic buckets
- Protective gloves
- Mask with organic cartridge to cover nose and mouth
- Heavy duty apron
- Full eye protection
- Floor cloths (old rags)
- Paper towels
- Rubber boots
- Spill Control Pillows (commercially purchased Spill Control Pillows can be used to absorb spills of hazardous chemicals. Applied directly, they will absorb and contain most spills within 30 seconds. The pillows contain an inert inorganic absorbent that is safe to use on flammable liquids, concentrated acids and bases. Spills control pillows are available to handle spills of varying sizes (e.g. 250 mL, 1.0 L, and 4.0 L)

For All Spills

- Advise all students to vacate the immediate area of the spill.
- Determine the degree of hazard before attempting to clean up and take necessary preventative measures (i.e. protective equipment, eye protection, gloves, etc.)

Spillage of	Procedure
Corrosive Liquids (acids and bases)	• Neutralize acids. Test with indicator paper after bubbling has stopped. • Bases should be neutralized with boric or citric acid. Test with indicator paper. • scrap or sweep up the residue that remains after all reaction has stopped • wash the spill area with water and wipe dry with paper towels
Flammable Liquids	• shut off all sources of ignition • cover the spill with mineral absorbent (e.g. cat litter or vermiculite) • scoop the contaminated absorbent into a heavy guage polythene bag or plastic bucket and arrange disposal • mop the area of the spill or wipe with a damp disposable cloth • open windows to ventilate the room
Other Liquids	• for water soluble liquids - dilute and mop up using paper towels or cloths • for water immiscible liquids - cover the spill with mineral absorbent (e.g. cat litter) to prevent spreading. Then scrape and mop into a suitable container for disposal. (Only very small bench spills should be treated by swabbing into a sink followed by flushing with large volumes of water). • wash down the spill area with water and wipe dry with paper towels • place any contaminated cloths and/or mops in a suitable container for disposal
Large Spills	• for large spills of poisonous, corrosive, or reactive materials, evacuate the lab, notify administration
Solids	• sweep up with a brush into a dustpan, taking care to avoid raising dust. If it is a highly reactive solid, such as alkali metals, gather using tongs • wipe the area with a damp disposable cloth • determine appropriate disposal procedures • clean, broken glass should be placed in the glass disposal container

Disposal of Chemical Materials

The disposal of waste chemicals and potentially hazardous materials is by necessity a common occurrence in school science laboratories. Management of chemical wastes is everyone's responsibility. Failure to appropriately dispose of chemical materials properly creates the risk of harm to people and the environment and could lead to prosecution if the appropriate procedures are not followed.

The science teacher must be fully acquainted with the properties of each chemical and the methods of safe handling. Science teachers must also have access to the appropriate Material Safety Data Sheets (MSDS). MSDS sheets can be obtained by contacting the manufacturer or searching the internet. This manual does not provide specific detailed information for the disposal of all materials. If a science teacher has questions about the disposal of any chemical materials, they should contact their immediate supervisor.

The following are some general guidelines for the handling and disposal of chemical and biological materials.

Chemical Waste Handling and Disposal

Disposing of unwanted chemicals should be a part of your routine housekeeping practices at the end of each school year. **All chemicals that can be safely diluted and/or neutralized for disposal should be done by the teacher. If the teacher is unsure of proper disposal practices for specific chemicals the following procedure should be adhered to.**

- place each chemical container (jar, tin, etc.) in a heavy clear plastic bag. Freezer bags work well.
- pack the bag in a box of vermiculite, styro-foam chips, kitty litter, or similar material
- if the collection of disposables is large, pack chemicals from different hazard groupings in separate boxes (i.e., keep acids and reducing agents separate)
- do not pack explosive or highly reactive (NFPA code reactivity 4) substances in this way
- broken glass, metal or similar waste must be placed in a sealed, puncture-proof container. It must be clearly marked "SHARPS" and placed in the waste container.
- organic solvents and flammable waste must be collected in separate, tightly-covered containers and disposed of according to municipal, provincial, and federal regulations
- prepare an inventory of materials for disposal submit the inventory to your reporting supervisor for submission to the School Safety Consultant

Disposal of Biological Materials

The disposal of waste and potentially hazardous materials is by necessity a common occurrence in school science laboratories. Management of biological wastes is everyone's responsibility. Failure to appropriately dispose of biological materials properly creates the risk of harm to people and the environment and could lead to prosecution if the appropriate procedures are not followed.

The science teacher must be fully acquainted with the properties of each chemical and the methods of safe handling. Science teachers must also have access to the appropriate Material Safety Data Sheets (MSDS). MSDS sheets can be obtained by contacting the manufacturer or searching the internet. This manual does not provide specific detailed information for the disposal of all materials. If a science teacher has questions about the disposal of any chemical materials, they should contact their immediate supervisor.

Biological wastes may contain infectious agents and should be treated as biohazardous waste. Autoclaving potentially infectious waste is the preferred method of rendering tissue culture and microbiological waste non-infectious waste prior to disposal. Autoclave used petri dishes and cultures in autoclavable disposable bags before disposal in a landfill site. Autoclave liquid cultures and pour into a drain with large amount of water. If the waste contains dangerous materials such as phenol, formaldehyde or radio-iodine, that are likely to be evolved by heating in the autoclave, the waste must not be autoclaved or incinerated.

The following are some general guidelines for the handling and disposal of biological materials.

- broken glass, metal or similar waste must be placed in a sealed, puncture-proof container. It must be clearly marked "SHARPS" and placed in the waste container
- prepare an inventory of materials for disposal submit the inventory to your reporting supervisor for submission to the School Safety Consultant
- biological waste must be segregated and disposed of safely
- prepare an inventory of materials for disposal
- submit the inventory to your reporting supervisor for submission to the School Safety Consultant

To properly dispose of unwanted specimens and preservative solutions contact the School Safety Consultant at the school board/district office.

Specific Laboratory Operations

A number of specific laboratory operations deserve special attention when microorganisms are involved. It is recommended that teachers and students not use human tissue and fluids.

Pipetting - The greatest hazards are:	• production of aerosols • accidental ingestion of fluid • contamination of the mouthpiece • the last two hazards can be eliminated by the use of a pipetting bulb • never use a pipet to bubble air through a contaminated liquid • liquid should never be forcefully blown out of the pipet • the pipet should be discharged with the tip below the surface of the receiving liquid • Immediately after use, contaminated pipets should be immersed in a germicidal solution, and then autoclaved
Syringes- The greatest harzards are:	• accidental inoculation • aerosol production
Inoculating Loops	• use care as the film held by a loop may break and cause atmospheric contamination. A hot loop may cause a liquid to spatter upon insertion into the liquid. Allow it to cool first. A contaminated loop may produce an aerosol by boiling and volatilization when it is placed into a flame for sterilization, even before all pathogenic organisms are killed. Whenever inoculating loops are used, any actions that might result in the generation of an aerosol (i.e. jerky motions, shaking the loop, agitating liquids) must be avoided. • teachers/technicians should dip inoculating loops into ethanol before flaming (prevents aerosol formation) • **Note:** Care must be taken because of the flammability of ethanol.
Centrifuges	• centrifuges can be cleaned with ethanol to kill any bacteria present. Use the fume hood.
Growing Your Own Bacteria Cultures	• keep in mind that there is always the possibility of a few spores of pathogenic bacteria being introduced from the atmosphere. Be sure the culture medium is properly sterilized by autoclaving. After inoculating the medium with bacteria be sure to wash hands and clean up any spills with a good disinfectant. • it is recommended that disposable petri dishes be used. • when finished with the bacterial cultures, the dishes should be collected in a bio-hazard plastic bag and then autoclaved before disposal.

Item	Precaution
Handling micro-organisms	• avoid bacteria, fungi, etc. known to be pathogenic • do not encourage growth of any microorganisms other than those that occur naturally on moldy bread, cheese, or mildewed objects • cultures should be grown at room temperature in the range of 25° C to 32° C. incubation at 37° C encourages growth of microorganisms that are capable of living in the human body • Clean and disinfect all work surfaces before and after handling microorganisisms. All apparatus used in microbiology must be autoclaved. Liquid disinfectants and germicidal agents generally have limited effectiveness and should not be relied upon for complete sterilization. • do not culture anaerobic bacteria, soil bacteria or swabs from any surface which may contain micro organisms from a human source • petri dishes containing cultures should be sterilized (autoclaved) before disposal • transparent tape should be used to seal petri dishes before they are passed around the class • avoid spattering cultures to prevent aerosol formation which is a common means of infection • flame wire loops and needles before and immediately after tranfer of cultures • do not move throughout the lab with a wire loop containing a culture
Dissections	• do not dissect wild or stray animals found dead outside • any organs used should be federally and provincially inspected • use dissecting instruments with care; make sure they are rust free and clean • when making incisions, cut down and away • formaldehyde (for preserving specimens) is not allowed in schools; instead use 70% solution of ethanol in water. If by chance your school has biological speciments preserved in formaldehyde (formalin), contact your immediate supervisor for information and procedures for proper disposal • it is recommended that vacuum pack specimens be used • specimens should be discarded as waste immediately after dissection as there are some species of bacteria that can begin to grow even on specimens which have been in preservatives • students should use disposable gloves • wash hands before and after dissections • use a wax or Styrofoam pan to dissect; never dissect in your hands • use IWMC guidelines for sharps disposal. Waste sharps including laboratory glass must be placed in a sealed puncture proof container clearly marked “SHARPS” and discarded in waste container.

Item	Precaution
Plants	• handle with care • treat as though it were poisonous • do not allow students to put any part in or near their mouths • avoid contact with the juice or sap of plants
Food	• must not be stored in refrigerators in laboratories • no food shall be stored or consumed in the lab or supply room
Animals	• any animals kept in the lab must be maintained in a clean, healty environment

Safety Contact List

WHMIS - Workplace hazardous materials information system
health Canada
Website: http://www.hc-sc.gc.ca/ehp/psb/whmis.htm

Canadian Centre for Occupational Health and Safety (CCOHS)
Website: www.ccohs.ca
E-mail: inquiries@ccohs.ca

Poison Control 1-800-565-8161

References

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Flinn Chemical and Biological Catalog Reference Manual

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