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NEW PRAGUE AREA SCHOOLS
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Management Plan for Chemical Hygiene

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New Prague Area Schools

Management Plan for Chemical Hygiene

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New Prague Area Schools* Annual Review Form *Management Plan for Chemical Hygiene

Created or revised by:	Sue Liebl Print Name	Health & Safety Consultant Print Title
	Signature	03/19/15 Date
Authorized review:	Greg Sayler Print Name	Chemical Hygiene Officer Print Title
	Signature	Date
Reviewed and Accepted by:	Craig Most Print Name	Director of Operations Print Title
	Signature	Date

Program reviews and follow-up of program-related issues are documented below.

Dates	Action/Comments	Reviewed by:	Accepted by:
03/05/12	Reviewed – no changes	Sue Liebl	
02/21/14	Reviewed – no changes	Sue Liebl	
03/19/15	Reviewed – no changes	Sue Liebl	

1.0 Objectives

New Prague Area Schools strives to maintain a safe work place and learning environment for employees and students. The purpose of the Chemical Hygiene Program is to address policies, procedures, equipment, and classroom practices utilized to protect district science instructors, classroom aides, and other facility occupants from health and safety hazards associated with the use of hazardous laboratory chemicals. Compliance requirements of OSHA Standard 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, are met through implementation and active practice of the elements of this plan. Though not required by regulation, additional objectives of the plan are to improve student safety and guide a more complete educational experience in the science laboratory.

The Management Plan for Chemical Hygiene has been developed specifically for use within New Prague Area Schools and is written to address "laboratory use" of hazardous chemicals. The plan is not intended to address the use of non-laboratory hazardous chemicals such as corrosive chemicals used for boiler treatment or custodial cleaning supplies. The district's *Employee Right-to-Know Program* contains information on non-laboratory chemical safety and education.

To meet our objective of providing a safe laboratory work and learning environment, the district works toward optimizing the following general principles of good chemical hygiene:

- Minimize chemical exposures through prudent laboratory practices and good common sense.
- Use the smallest quantity of chemicals or other potentially hazardous materials necessary to demonstrate the principle of an experiment or demonstration.
- Reduce the number and type of hazardous materials used in the science laboratory by substituting currently-used hazardous materials with less hazardous materials whenever possible.
- Assume all chemicals have potential toxicity that require safe handling and control. Do not underestimate the actual or potential risk inherent to any chemical substance or process.
- Provide and use engineering and administrative controls as well as personal protective equipment (PPE) to reduce the potential for exposure to hazards. Examples include fume hoods, laboratory policies, and safety eyewear.
- Teach and demonstrate laboratory safety to our students.

2.0 Coordination with Other District Health and Safety Plans

A significant number of protective measures must be considered and implemented to provide safe laboratories for both staff and students. This plan intends to address those measures, but only to the extent they are not addressed in separate health and safety programs. Specific references to other safety programs are indicated where appropriate.

3.0 Responsibilities

The Management Plan for Chemical Hygiene is written to be functional and performance-orientated, which means it addresses laboratory safety and health issues applicable to our school environment and guides employees to make realistic attempts to optimize employee and student laboratory safety. Successful implementation and functioning of this plan is contingent upon well-defined expectations and voluntary acceptance of assigned responsibilities, as follows:

District Administration

District administration is responsible for supporting a performance-orientated chemical hygiene program that protects district employees from health and safety hazards associated with science laboratory activities. District administration acknowledges the importance of laboratory safety and is willing to become involved when deficiencies cannot otherwise be controlled. Plan development and associated activities may be delegated to other parties, such as district staff or third-party consultants, but ultimate responsibility and support cannot be reassigned.

Director of Buildings and Grounds
The Director of Buildings and Grounds has general responsibility for coordination of the district health and safety programs and will therefore be involved to whatever extent necessary to achieve program success.

Principal or Supervisor
The immediate supervisor or principal of any employee engaged in laboratory activities is responsible for his or her employees and is held accountable for acceptable job performance, as assigned. Administering and tracking employee training may be delegated to another responsible person or third party.

Instructors
District science instructors or associated laboratory support staff are responsible for attending scheduled safety training sessions, following laboratory safety guidelines as made known to them, and to otherwise perform all duties and responsibilities to achieve a safe working and instructional environment. Lack of compliance or other disregard for rules governing laboratory safety will be promptly addressed and corrected.

Chemical Hygiene Officer
The Chemical Hygiene Officer (CHO) for New Prague High School is Greg Sayler and can be reached at 952-758-1262. The CHO is a liaison between staff members, district administration, safety representatives, and others involved in, and/or responsible for, laboratory safety. The CHO assists with:

- Developing, reviewing, and implementing laboratory work practices, procedures, student safety procedures, and various control measures
- Monitoring chemical use, safety procedures, housekeeping, and other aspects of good laboratory practices through periodic inspections and general observations
- Coordinating laboratory safety training activities
- Developing and supporting rules regarding procurement, distribution, and storage of chemicals
- Identifying needs for appropriate PPE and safety devices
- The annual Chemical Hygiene Plan review
- Completion of the *Periodic Laboratory Checklist*, *Science Safety Checklist*, and *End-of-Year Laboratory Closure Checklist* (see Appendices)
- Weekly inspection of emergency eyewash stations and safety showers
- Monthly fire extinguisher inspections
- Annual inspections of fume hoods with results posted on the hood

4.0 Basic Rules and Procedures

Science laboratories and associated work areas are intended to be serious learning and working environments. Lack of instructor observation, inappropriate student behavior, or similar inattention to the fundamental importance of control and safety in the laboratory can lead to illness and injury. Common laboratory hazards and health effects of chemical hazards are described in the appendices. To enhance safety and the educational benefit to students, each instructor must provide ultimate guidance and lead by example at all times. The following are fundamental rules and behaviors to support a safe laboratory environment.

Avoidance of Routine Exposure
Develop and encourage safe habits in the laboratory workplace, such as:

- Do not smell or taste chemicals.
- Do not use mouth suction for pipetting or to start a siphon.
- Eating or drinking is not allowed in any science area, especially where chemical or biological science activities take place.
- Do not apply cosmetics in the laboratory.

- Do not store food items in laboratory refrigerators. Signs are used to advertise this restriction.
- Label all chemical containers as to content and hazards. Do not use chemical formula as a means of labeling.
- Label hot surfaces accordingly.
- Guard against physical hazards. Use protective covers on moving belts and pulleys, never leave heat sources unattended, and dispose of broken glass and other sharps in sharps boxes.

Supervision and State of Mind

A qualified instructor is present at all times while students are present in the laboratory. Hazardous laboratory experiments are never left unattended. All persons are in good mental condition when working in the laboratory and associated work areas. Intoxication, medical drug use, extreme fatigue, stress, and other distractive conditions can cause serious mistakes to be made.

Horseplay

Conduct that may be termed “practical joking”, “fooling around”, or “horseplay” is strictly prohibited at all times in the laboratory and classroom. Any person displaying such conduct is counseled immediately and/or removed from the environment.

Clothing and Jewelry

Clothing must be suitable for the laboratory environment and associated hazards. Loose clothing and hair is confined. Loose neck jewelry, rings, bracelets, and watches are not worn in order to prevent chemical seepage under the jewelry, contact with electrical sources, catching on equipment, and damage to the jewelry itself. Substantial footwear is required to prevent exposure to chemical and physical hazards. High-heeled or open-toed shoes, sandals, or shoes made of woven material are not worn in the laboratory. Shorts, cutoffs, and miniskirts are also not allowed when working with chemicals.

Glassware

Handle all glassware carefully and do not use if chipped, cracked, broken, or otherwise damaged. In addition, the following safety measures are taken:

- Glassware is cleaned at the laboratory sink or in laboratory dishwashers.
- Hot water is used where available, and soap or other detergent is used rather than strong cleaning agents such as nitric acid, chromic acid, sulfuric acid, strong oxidizers, or any chemical with a "per" in its name (such as perchloric acid, ammonium persulfate, etc.) unless specifically instructed otherwise. The use of flammable solvents is minimized.
- Rubber or plastic mats are placed on the bottom of sinks to help minimize glass breakage.
- The workspace around a sink is normally limited, and piling up dirty or cleaned glassware leads to breakage. Remember that the turbid water in a sink may hide a jagged edge on a piece of broken glassware that was intact when put into the water. A pair of heavy gloves may be useful for removing broken glass, but care must be exercised to prevent glove contamination.

Personal Protection

PPE is worn as appropriate for the laboratory exercise (see section 9.0 for more information). Tight-fitting goggles that have an indirect vent or are non-vented are worn by students, staff, and visitors when working with chemicals in the laboratory or preparation area. PPE is inspected before use and maintained properly.

Fume Hoods

Chemicals are only used when adequate ventilation is available. Fume hoods are used when working with volatile or hazardous chemicals. Where fume hood control is required but is not available, the chemical experiment will not be conducted. In addition, the following rules apply to fume hoods:

- Hoods are closed at all times except when adjustments within the hood are required.
- Fume hoods are not used for general storage.

- Fume hoods are not used to evaporate chemical solvents as a means of disposal.
- Placement of equipment within the hood is not allowed, as it may restrict airflow or otherwise negatively affect hood performance.
- Fume hoods are clean and orderly at all times.
- Fume hood airflow is inspected at least annually or if mechanical systems are adjusted.

Electrical Hazards

Electric wiring throughout the district complies with the National Electric Code. In addition, the following rules apply:

- Strip sockets, extension cords, or "octopus" arrays of plugged in wires and cords are not used in place of permanent wiring.
- Frayed or otherwise damaged wires and cords are removed from service.
- Wires and cords do not lie in puddles of water or liquid chemicals.
- Electrical wires and cords are kept away from sources of heat, flame, corrosive materials, or oxidizing agents that might be spilled.
- Plugs that are broken, corroded, or become hot are not used.
- Outlets equipped with ground fault circuit interruption protection are used in wet environments.

5.0 Chemical Procurement, Distribution, and Storage

Procurement

The district works to maintain reasonable chemical inventories. To meet this goal, we support careful laboratory planning and centralized purchasing of laboratory chemicals. Instructors are encouraged to not attempt to consume excess budgets through excess chemical purchases and to critically evaluate if quantity-based purchase savings will pay off in the long run. Sometimes the cost to dispose of excess and/or outdated chemicals exceeds the initial bulk-purchase savings. Responsibility for inventory control will be delegated as appropriate. Recommendations for chemicals appropriate for each level of curriculum can be found in the appendices.

Chemicals are ordered individually by each teacher. Before a new chemical that is known or suspected to be hazardous is received, those individuals who will handle it have information on proper handling, storage, and disposal. It is the responsibility of the Director of Buildings and Grounds and the CHO to make sure that the laboratory facilities in which the hazardous chemicals will be handled are adequate. If additional training is required on incoming chemicals, the district's Health and Safety Consultant will arrange training for those who will handle the chemicals.

Note: No container should be accepted without an adequate identifying label.

New Prague Area Schools does not accept free products containing hazardous chemicals unless the following conditions are met:

1) The amount of free material that may be accepted by an individual, laboratory, or other administrative unit must be limited to the amount that is likely to be actually needed in the proposed program.
2) The donor must agree in writing to accept the return of any unused amounts. The recipient may agree to waive this requirement if the donor is prepared to pay for the legal and safe disposal of the material from his own funds.
3) If the utilization or storage of the free material is likely to pose any substantive risk to personnel or property, the CHO, facility manager, or safety consultant must become involved prior to formalizing the agreement. This will allow time to evaluate the risks involved and determine if adequate facilities are available before the proposed use is formally approved by the district.

New Prague Area Schools *is a mercury-free environment.* Employees are not authorized to purchase, rent, accept donations of, or bring in mercury containing science equipment or chemicals. For questions regarding the district's Mercury Free Program, please contact the CHO or Craig Most, Director of Buildings and Grounds.

Distribution and Transfer

Chemicals are delivered to the building's main office throughout the school year. The chemicals are then arranged to be delivered to the science department after arrival. The CHO will store the chemicals in the chemical storage area along with the product's original Material Safety Data Sheet (MSDS), which is provided by the vendor. The following procedures are followed when transporting or transferring chemicals:

- Two hands are used when carrying a chemical container.
- The container-within-a-container concept is used whenever moving chemical containers more than a short distance. Large containers of corrosives are transported from central storage in a chemically resistant bucket or other container designed for this purpose. Stairs must be negotiated carefully. Elevators are not used for carrying chemicals.
- When a flammable liquid is withdrawn from a drum, or when a drum is filled, both the drum and the other container are electrically wired to each other and to the ground in order to avoid the possible buildup of a static charge. Only small quantities are transferred to glass containers. If transferring from a metal container to glass, the metal container is grounded.

Storage

New Prague Area Schools permit as little chemical storage as is practical for the curriculum. The following procedures are followed where chemicals are stored:

- Chemicals are stored according to established compatibility and segregation principles. See the appendices for recommended storage patterns.
- Flammable liquids are stored in approved cabinets.
- Ethers and other forms of peroxidizable materials are not stored past their expiration date, as they will tend to form explosive and shock-sensitive peroxides.
- New bottles of chemicals are dated and properly stored.
- Boxes of chemicals are not stored on top of one another.
- Aisles are not blocked with equipment or chemicals.
- Materials are not stored in front of safety eyewashes and showers, exit doors, fire extinguishers, or other safety equipment.
- Laboratory equipment or other materials are not stored within eighteen inches of sprinkler heads.
- Liquid chemicals are not stored on shelves above eye level.
- Storage shelves have one-inch stops installed on the front of the shelf.
- Chemicals are properly labeled (see Section 10.0 for more information).

6.0 Environmental Monitoring

The district is responsible to provide a work environment where chemical exposure limits are not exceeded. This can be accomplished in laboratories by engineering controls, prudent practices, and use of personal protective devices. For maximum benefit, engineering controls must not be circumvented or made less effective, and PPE must meet requirements and be utilized as required.

If there is reason to believe that a district employee has, or possibly could be, exposed to a hazardous material in excess of established exposure guidelines, the district will take appropriate steps to assess the exposure situation. If this assessment reveals an over-exposure, the district will take immediate steps to inform the employee in writing and through conversation and will promptly address the hazardous chemicals and/or process involved.

All data accumulated during monitoring surveys will be kept on file by the Human Resources department.

7.0 Medical Program

Whenever an employee develops signs or symptoms associated with exposure to a hazardous chemical, the employer provides the employee with an opportunity to receive a medical consultation and examination, as applicable. Where monitoring reveals an exposure above the action level or Permissible Exposure Limit (PEL), medical surveillance is established for the affected employee according to the relevant standard for that substance. Whenever an event such as a spill, leak, or explosion takes place, the affected employee is provided an opportunity for a medical consultation to determine if there is a need for a medical examination.

All medical examinations and consultations are performed by a licensed physician and are provided at no cost to the employee, without loss of pay, and at a reasonable time and place. All records will be maintained for the employee's duration of employment plus 30 years at a minimum.

The district will provide the following information to the physician:

- The identity of the hazardous chemicals
- A description of the conditions of exposure
- A description of the signs and symptoms the employee is experiencing, if any

The district will obtain a written opinion from the physician that includes:

- A recommendation for further follow-up, if necessary
- The results of the medical examination and associated tests
- Any medical condition revealed in the course of the examination that may place the employee at increased risk as a result of exposure to a hazardous chemical
- A statement that the employee has been informed by the physician of the results of the consultation or examination and any condition that may require further examination or treatment

The written opinion shall <u>not</u> reveal specific findings of diagnoses unrelated to occupational exposure

8.0 Housekeeping and Inspections

<u>Housekeeping</u>

In the laboratory and elsewhere, keeping things clean and neat generally leads to a safer environment. Avoid unnecessary hazards by keeping drawers and cabinets closed while working. Never store materials, especially chemicals, on the floor, even temporarily. Workspaces and storage areas should be kept clear of chemicals, scraps of paper, and other clutter. Keep aisles free of obstructions such as chairs, boxes, and waste receptacles. Avoid slipping hazards by keeping the floor clear of ice, water, stoppers, glass beads or rods, other small items, and spilled liquids.

<u>Inspections</u>

The following inspections are conducted:

- Fume hoods – annually
- Science safety checklists (MDE Attachment 5) – annually
- Formal laboratory inspections – semi-annually
- Fire extinguishers – monthly
- Eyewash and shower stations – weekly
- Personal protective equipment – prior to each use

A calendar of inspections and forms for each inspection listed above can be found in the appendices.

9.0 Personal Protective Equipment (PPE)

There is no single material that will protect against all possible chemicals in the laboratory. Knowledge of the hazardous chemical and its intended use will guide proper selection of the protective equipment. Some level of basic protection is necessary in most laboratory environments.

Eye Protection: All persons *working with hazardous substances or being near work operations* in the laboratory and/or science classroom must wear eye protection at all times. Impact and chemical splash are primary concerns, so tight-fitting goggles are worn. Contact lenses are not recommended when working with laboratory chemicals.

Protective Clothing: Clothing worn in the laboratory should offer protection from splashes and spills and should be equipped with snap fasteners instead of buttons, for ease of removal. Nonflammable, nonporous aprons offer the most satisfactory and the least expensive protection.

Hearing Protection: School laboratories are not expected to have noise levels that exceed established guidelines. All noise issues will be managed in accordance with the district's *Hearing Conservation Program*.

Respiratory Protection: Employees required to wear respirators or voluntarily selecting to use respirators will participate in the district's *Respiratory Protection Program*.

10.0 Records, Signs, and Labels

Records

The Chemical Hygiene Plan is maintained in each secondary building's chemistry department and at the Operations Offices. In addition, the following records are retained at the Operations Offices:

- Accident investigations
- Chemical inventories
- Material safety data sheets (MSDSs)
- Medical records
- Training agenda and participant signatures and/or quizzes

Signs

Signs of the following type are prominently posted:

- Emergency telephone numbers
- Location signs for emergency eyewash and shower stations
- Location signs for first aid equipment
- Food/beverage signs
- Warnings at areas or equipment where unusual hazards exist

Labels

All hazardous chemicals are clearly labeled with the hazardous chemical identity and an appropriate hazard warning. The chemical formula is not used as a means of labeling. In addition, the following procedures are implemented:

- All incoming hazardous chemicals are checked to make sure the manufacturer's labels and warnings are correct and have not been removed.
- If a hazardous chemical is received with a label that has been removed or defaced, the CHO is notified so it can be labeled properly.
- Stationary processing units or machines are labeled with the identity and hazard warnings for hazardous chemicals that may be used in these machines.
- Hazardous waste is properly characterized, labeled, and stored until disposal is arranged.

11.0 Employee Information and Training

Employees are provided appropriate information and training at the time of assignment to a chemical work area and prior to assignments involving new exposure situations. This training aims to protect employees by helping them to understand and appreciate the hazards involved in their work environment. Employees attend an annual refresher-training course or participate in annual online training. Standard information and training provided includes:

- Contents of the law
- Location and availability of the *Chemical Hygiene Plan*
- The name, location, and phone number of the CHO
- Information regarding exposure limits established by OSHA or the ACGIH
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory
- The locations and availability of known reference materials, such as MSDSs
- Labeling procedures
- Methods and observations that may be used to detect the presence or release of a hazardous chemical
- General information regarding physical and health hazards of chemicals in the work area
- Measures employees can take to protect themselves from exposure to hazardous chemicals and reduce the overall potential for accidents and incidents
- Waste management

12.0 Spills and Accidents

A written emergency response plan has been developed by the district, including information on spill response, fire or other evacuation, medical care, and drills. Please reference the district's *Emergency Action Plan* for details.

Accidents involving injury are immediately assessed for severity. If the injury can be handled internally, the employee or student is taken to the nurse's office. If the injury is more severe, 911 is called and emergency responders will take the lead. In the event of a chemical spill, the following basic chemical spill procedures are followed. Emergency contact information is provided in the appendices and posted outside the chemical prep/storage room.

Solid Material Spills

- Alert other persons of the spill and the need to evacuate the area.
- Determine the degree of hazard before attempting to clean up and take the necessary preventative measures (e.g., PPE).
- Wear PPE appropriate for the situation.
- Generally, solids of low toxicity can be swept up into a dustpan and placed into a container compatible with the chemical. Damp toweling should be used to pick up and transfer materials of higher toxicity level to a compatible waste container. Confirm with the chemical's MSDS that the material is not water sensitive before using this procedure.
- Double bag contaminated clean up materials and seal. Label all disposal containers or bags with a descriptive name, the words "Hazardous Waste," and the date.
- When clean up operations are complete, wash hands with soap and water.
- Clean, dry, and place PPE back in storage.

Liquid Chemical Spills

- Alert other persons of the spill and the need to evacuate the area.
- Determine the degree of hazard before attempting to clean up and take the necessary preventative measures (e.g., PPE).
- Wear PPE (goggles, face shield, gloves) appropriate for the situation.
- Confine or contain spill to smallest area possible with sand or other absorbent material.

- For small quantities of acids, use a neutralizing agent or absorbent mixture (e.g., soda ash, sodium bicarbonate, diatomaceous earth). Bases can be neutralized by using citric acid or boric acid. Check spill area with a pH indicator paper to confirm complete neutralization.
- For small quantities of flammable/combustible liquids, a commercially purchased spill pillow (specifically designed for solvents) can be used. Mineral absorbent materials, such as vermiculite, sand, or kitty litter can be used; however, fumes can still volatilize from these materials. Commercial absorbent powders are available.
- For small quantities of other materials, absorb the materials with non-reactive materials (e.g., vermiculite, clay, dry sand, towels).
- Mop up the spill if necessary, wringing out the mop in a pail equipped with rollers. Do not use your hands.
- Carefully pick up any broken glass using mechanical means such as tongs or a broom and dustpan (do not use your fingers).
- Carefully pick up and clean any cartons, bottles, or equipment that may have been splashed and contaminated. If absorbent has been used to clean up flammable or volatile chemicals, it must be stored in a well-ventilated area, away from sources of heat or ignition.
- Double bag contaminated clean up materials and seal. These materials must be disposed of as hazardous waste. Label all disposal containers or bags with a descriptive name, the words "Hazardous Waste," and the date.
- When clean up operations are complete, wash hands with soap and water.
- Clean, dry, and place non-disposable PPE back in storage.

Never assume gases or vapors do not exist or are harmless because of a lack of smell. Many chemicals anesthetize the nose and the sense of smell is eliminated, or they do not have any odor at all.

13.0 Emergency Equipment

Eyewash and shower stations, first aid kits, and spill kits are present in the chemical storage area. Equipment is inspected consistent with Section 8.0 and is used only as intended (i.e., eyewashes are not used as drinking fountains). Eyewash and shower stations are not blocked, and first aid kits and spill kits are maintained in an accessible area.

14.0 Chemical Waste and Disposal Information

The disposal of hazardous waste is conducted according to the district's Management Plan for Hazardous Waste. Some of the buildings in **New Prague Area Schools** are characterized as very small quantity generators (VSQG). Each facility generating waste has been given a unique EPA Identification Number. The appropriate number should be used when hazardous waste is generated and transported.

MNR000064139 - Transportation Building

The following rules apply to disposal of hazardous waste:

- Chemical waste is not disposed of down the sink unless specifically authorized to do so.
- Evaporation (i.e., in a fume hood) is not used as a means of chemical disposal.
- Non-compatible chemical wastes are not mingled.
- Chemical waste collection and storage containers are clearly labeled with a descriptive name, the words "Hazardous Waste," and the accumulation start date.
- Waste materials are disposed of in accordance with applicable rules and regulations.
- When disposal is necessary, the Director of Buildings and Grounds is contacted.

14.0 Recommended References

Prudent Practices for Handling Hazardous Chemicals in Laboratories
National Academy Press
2101 Constitution Avenue NW
Washington, DC 20418

Emergency Medical Treatment for Poisoning
National Poison Center Network
125 Desoto Street
Pittsburgh, PA 15213

Fire Prevention Guide on Hazardous Materials
National Fire Protection Association (NFPA)
Batterymarch Park
Quincy, MA 02269

First Aid Manual for Chemical Accidents
Lefevre, Marc J.
Dowden, Hutchinson & Ross
Stroudsburg, PA 18360

NIOSH/OSHA Pocket Guide to Chemical Hazards DHHS (NIOSH) Publication Number 78-210
U.S. Government Printing Office
Washington, DC 20402

Appendix A

Chemical Inventory

Chemical Inventory

The inventory of chemicals used in the science department at the High School is located with the MSDS binder in the Chemistry office/department. Online access to the inventory and MSDSs is available at Damarco.com.

The following recommendations are made for each level of curriculum:

Elementary Schools: Eliminate the use of hazardous chemicals. Examples of appropriate chemicals/products may include sugars, vinegar, cornstarch, litmus, and agars. (Note: vinegar is an eye irritant)

Middle/Junior High Schools: Minimize the amount of hazardous chemicals as much as possible. Attempt to dilute acids as much as the experiment allows, and substitute less hazardous chemicals for more hazardous ones (replace formaldehyde with Bioperm or another preservative that is less hazardous). Examples of appropriate chemicals include dilute acids/bases, amino acids, and chemicals with low toxicity and reactivity.

High Schools: A larger variety of hazardous materials are allowed in high school laboratories. While this may be appropriate, always attempt to limit the amount of chemical used, and minimize its strength whenever possible. Examples of appropriate chemicals include standard and dilute student laboratory acids and bases, flammable liquids, oxidizers, and metal-containing compounds. Eliminate, if possible, the use of carcinogenic, explosive, highly reactive, and peroxidizable substances.

Appendix B

Health Effects
Common Lab Hazards

Health Effects – Definitions and Criteria

Chemicals that meet any of the following definitions or criteria are considered health hazards:

CRITERIA

1. *Carcinogenicity:* A determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this appendix.
2. *Human data:* Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.
3. *Animal data:* Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results.
4. *Adequacy and reporting of data:* The results of any study which is designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be sufficient basis for a hazard determination.

DEFINITIONS:

1. *Carcinogen:* A chemical is considered a carcinogen if:
   - It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
   - It is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens* published by the National Toxicology Program (NTP) (latest edition); or
   - It is regulated by OSHA as a carcinogen.

2. *Corrosive:* A chemical that causes visible destruction or irreversible alterations in living tissue by chemical action at the site of the contact. This term shall not refer to action on inanimate surfaces.

3. *Highly toxic:* A chemical falling within any of the following categories:
   - A chemical that has a median lethal dose (LD_{50}) of 50 mg or less per kilogram of body weight when administered orally to albino rats weighing between 200-300 g each.
   - A chemical that has a median lethal dose (LD_{50}) of 200 mg or less per kilogram of body weight when administered by continuous contact for 24-hours (or less if death occurs within 24-hours) with the bare skin of albino rabbits weighing between 2-3 kg each.
   - A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200-300 grams each.

4. *Irritant:* A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. *Sensitizer:* A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

6. *Toxic:* A chemical falling within any of the following categories:
   - A chemical that has a median lethal dose (LD_{50}) of 50 mg per kilogram but not more than 500 mg per kilogram of body weight when administered orally to albino rats weighing between 200-300 g each.
   - A chemical that has a median lethal dose (LD_{50}) of 200 mg per kilogram but not more than 1000 mg per kilogram of body weight when administered by continuous contact for 24-hours (or less if death occurs within 24-hours) with the bare skin of albino rabbits weighing between 2-3 kg each.
   - A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million by volume of gas or vapor, but not more than 2000 parts per million by volume of gas or vapor, or more than 2 mg per liter but not more than 20 mg per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between
     200-300 grams each.

7. *Target organ effects:* Following is a target organ categorization of effects that may occur, including examples of signs and symptoms and chemicals that have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace and the broad scope to be considered in this area but are not intended to be all-inclusive.

Hepatotoxins:	Chemicals that produce liver damage *Signs and Symptoms*: Jaundice, liver enlargement *Chemicals*: Solvents such as toluene, xylene, carbon tetrachloride, nitrosamine
Nephrotoxins:	Chemicals that produce kidney damage *Signs and Symptoms*: Edema, proteinuria, hematuria, casts *Chemicals*: Halogenated hydrocarbons, uranium
Neurotoxic:	Chemicals that produce their primary effect on the nervous system *Signs and Symptoms*: Narcosis, behavioral changes, coma, decrease in motor functions *Chemicals*: Mercury, carbon disulfide, lead
Blood affecting agents:	Decrease hemoglobin function; deprive the body tissue of oxygen *Signs and Symptoms*: Cyanosis, anemia, immune function depression *Chemicals*: Carbon monoxide, cyanide
Lung damaging agents:	Chemicals that damage the pulmonary function *Signs and Symptoms*: Cough, tightness in chest, shortness of breath *Chemicals*: Silica, asbestos, organic fibers such as cellulose-cotton
Reproductive toxins:	Chemicals that affect the reproductive capabilities *Signs and Symptoms*: Birth defects, sterility, functionality *Chemicals*: Lead, DBCP, some blood pressure medications
Cutaneous hazards:	Chemicals that affect the dermal layer of the body *Signs and Symptoms*: Defatting of the skin, rashes, irritation, and discoloration *Chemicals*: Ketones, chlorinated compounds, soaps, solvents
Eye hazards	Chemicals that affect the eye or visual capacity *Signs and Symptoms*: Conjunctivitis, corneal damage, blephaharitis *Chemicals*: Organic solvents, acids, alkalis

Common School Laboratory Hazards

Explosions

Explosions may occur under a number of conditions:

- Runaway or exceedingly violent chemical reaction
- Ignition of escaping gases or vapors
- Ignition of confined vapors with subsequent rupture of the containment vessel
- Rupture of a system due to overpressure caused by other mechanisms
- Violent implosion of a large vessel operating below atmospheric pressure

Injuries can occur because of:

- The shock wave from a detonation or deflagration
- Heat or flames from the explosion
- Flying debris

There are certain precautions that can be taken to reduce the risk of an explosion or the damage from an explosion:

- Do not store flammable materials in close proximity to a fume hood (less fuel for the fire)
- Do not use a fume hood as a storage area (less fuel for the fire and less flying debris)
- Minimize the amount of material involved in an experiment
- Provide and require the use of protective equipment such as safety goggles

Explosives

Most school facilities should not have explosive materials in their laboratories; however, there may be potential explosives in certain circumstances.

Highly Reactive Shock/Heat-Sensitive Materials

Ammonium Perchlorate	1-Chloro-2, 4-Dinitrobenzene	Ethyl Nitrate
Ammonium Permanganate	Cumene Hydroperoxide	Hydroxylamine
Anhydrous Perchloric Acid	Diacetyl Peroxide	Peroxyacetic Acid
Butyl Hydroperoxide	Dibenzoyl Peroxide	Picric Acid
Butyl Perbenzoate	Diisopropyl Peroxydicarbonate	Trinitrobenzene
Butyl Peroxyacetate, tert	Dinitrobenzene (ortho)	Trinitrophenol
Butyl Peroxypivalate, tert	Ethyl Methyl Ketone Peroxide	Trinitrotoluene

Safety measures taken in storing potential explosives are as follows:

- Keep the minimum quantities needed in a cool, dry area, protected from heat and shock.
- The materials should be segregated during storage from materials with which they could react as well as flammables, corrosives, and other chemicals, which are likely to interact with each other.
- Potentially explosive materials should be stored and used in an area posted with a sign in prominent letters:

CAUTION! POTENTIAL EXPLOSIVE HAZARD

- If the material is being kept because of its potentially explosive properties, it should be treated as an explosive of the appropriate class and kept in a magazine or the equivalent.
- Make sure that all occupants of the laboratory are aware of the potential risks and are trained in emergency procedures, including evacuation procedures, fire containment, and emergency first aid for physical injuries that might result from an explosion.

Ethers
Ethers tend to form explosive peroxides with age, due to exposure to light and air. It is therefore preferable to use small containers when working with ethers. Peroxides can be unstable and detonate with extreme violence when they become concentrated by evaporation or distillation, when combined with other compounds that give a detonatable mixture, or when disturbed by unusual heat, shock, or friction.

Some Materials That Tend to Form Peroxides

Acrolein	Cumene	Diethylene Glycol Diethyl Ether	Methyl Acetylene
Aldehydes	Cyclohexane	Diethyl Ether	o-methylanisole
Allyl Ethyl Ether	Cyclooctene	Dimethyl Ether	Tetrahydrofuran
Butadiene	Diacetylene	Dimethyl Isopropyl Ether	Vinyl Acetate.

Perchloric Acid
Perchloric acid is a strong, colorless, and oily liquid. Contact with the skin, eyes, or the respiratory tract will produce severe burns. When cold, its properties are those of a strong acid, but when hot, the acid acts as a strong oxidizing agent.

Aqueous perchloric acid can cause violent explosions if misused or when in concentrations greater than the normal commercial strength (72%).

Anhydrous perchloric acid is unstable even at room temperatures and ultimately decomposes spontaneously with a violent explosion. Contact with oxidizable material can cause an immediate explosion. Anhydrous perchloric acid will explode when in contact with wood, paper, carbon, and organic solvents.

Flammable Liquids
Flammable liquids are stored in flammable material storage cabinets, preferably with venting.

Two of the most dangerous storage units in any laboratory are the ordinary refrigerator and freezer. Refrigerators intended for the storage of laboratory supplies and chemicals should not be used for personal items, especially food and beverages. Refrigerators contain sources of ignition, such as the light, the thermostat, or the defrost heater. A refrigerator is also a confined space in which vapors can be trapped. The combination of these two situations represents a potential explosion hazard.

Gas Cylinders
Compressed gas cylinders are under high pressure and have varying hazardous compositions. The integrity of the cylinder must be maintained. When working with compressed gas cylinders, please follow the procedures listed in the district's *Management Plan for Compressed Gas*.

Corrosive Chemicals
Corrosive chemicals can cause severe injuries if they are splashed on the body, especially in the eyes. Resulting skin injuries are slow to heal and eye injuries may be permanent. Corrosive chemicals can also cause severe injury to the respiratory system through inhalation. Ingestion can cause immediate injury to the mouth, throat, and stomach. Work with corrosive materials should be conducted in a fume hood, especially when there is concern about inhalation hazards. Every student laboratory should be equipped with deluge shower/eyewash combinations and appropriate PPE must be available and used. Make sure you and all laboratory occupants know the location and function of safety eyewash and shower devices.

Keep container sizes and quantities on hand as small as possible. Always store chemical containers in a cabinet or on low shelves and follow all chemical segregation rules. Keep unused containers in storage and store the containers in cabinets or on low shelves.

Always add acid to water and never water to acid.

Some classes of corrosive chemicals:

- Strong Acids: In general, inorganic acids are more dangerous than organic acids.
- Strong Alkalis: Ammonium hydroxide, sodium hydroxide, and calcium hydroxide are examples.
- Non-Metal Chlorides: Phosphorous trichloride and corresponding bromides react violently with water.
- Dehydrating Agents: When added to water too rapidly, these materials can cause violent reactions accompanied by sputtering. Examples are: H_2SO_4, NaOH, P_2O_5, CaO, $C_2H_4O_2$.
- Halogens: Because these chemicals are gases, they present inhalation hazards.

High Energy Oxidizers

Oxidizing agents such as chlorates, perchlorates, peroxides, nitric acid, nitrates, nitrites, and permanganates undergo vigorous reactions when they come into contact with easily oxidized materials such as metal powders, wood, paper, and other organic compounds. Fluorine, chlorine, bromine, and iodine react similarly to oxygen and are classified as oxidizing agents as well. Containers of oxidizing agents may explode if they are involved in a fire.

The quantities of strong oxidizing agents within the laboratory is minimized and separated from incompatible materials. The containers should be protected glass with inert stoppers instead of rubber or cork.

Work with oxidizers should always be performed in a hood with appropriate safety features. Oxidizing agents should be heated with fiberglass heating mantles or sand baths. Sturdy gloves and eye protection that provide chemical splash and impact protection are mandatory.

Examples of High-Energy Oxidizers:

Ammonium Permanganate (NH_4MnO_4)
Ammonium Nitrate (NH_4NO_3)
Bromine (Br)
Calcium Chlorate ($Ca[ClO_3]_2.2H_2O$)
Chlorine Trifluoride (ClF_3)
Chromic Acid (CrO_3)
Hydrogen Peroxide (H_2O_2)
Nitric Acid (HNO_3)
Perchloric Acid ($HClO_4$)
Potassium Bromate ($KBrO_3$)
Potassium Chlorate ($KClO_3$)
Potassium Perchlorate ($KClO_4$)
Potassium Peroxide (K_2O_3)
Sodium Chlorate ($NaClO_3$)
Sodium Chlorite ($NaClO_2$)
Sodium Perchlorate ($NaClO_4$)
Sodium Peroxide (Na_2O_2)

Flammable Solvents

When working with flammable solvents, there should be no sources of ignition in the vicinity, and use only non-sparking equipment. When transferring flammable liquids using metal containers, the containers are bonded to prevent accumulation and discharge of static energy. Flammables are heated with safe heating mantles, heating baths, or explosion-proof heating equipment. Any spark-emitting motors are removed from the area. Flammable materials are stored in an approved area, storage cabinet, refrigerator, or freezer.

Reactive Metals.
Lithium, potassium, and sodium, as well as many other substances react vigorously with moisture. Lithium and sodium are stored in mineral oil or other hydrocarbon liquids that are free of oxygen and water. Potassium is stored under dry xylene. No one should plan to work with these materials without carefully evaluating the chemistry involved for potential hazards. The materials are treated with care, which their properties demand at all times.

These materials should always be used in a hood and a Class D fire extinguisher should be available. Carbon dioxide or halogenated types should not be used. PPE is required.

Carcinogens
Chemicals are classified as to their carcinogenic risks to humans and by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP); and the Environmental Protection Agency's Integrated Risk Information System (IRIS).

Use of known carcinogenic chemicals and/or materials for classroom experiments is prohibited. All carcinogenic chemicals and/or materials must be substituted with a less hazardous material or use a different, less hazardous experiment.

Mercury
Very high exposures to mercury vapor can cause acute poisoning and/or death. Symptoms usually begin with cough, chest tightness, difficulty breathing, and upset stomach. Acute inhalation of mercury vapor may result in chills, nausea, general malaise, tightness in the chest, chest pain, difficulty breathing, cough, kidney damage, gingivitis, salivation, diarrhea, and death. Mercury is considered a poison and the routes of exposure include inhalation, ingestion, and absorption. The most common route of exposure for elemental mercury is inhalation. The most common route for of exposure for organic mercury is ingestion. The district has been working toward becoming a mercury-free environment. Employees are not authorized to purchase, rent, accept donations of, or bring in mercury containing science equipment or chemicals.

Electrical Systems
Most hazards associated with the use of electricity stem from electrical shock, resistive heating, and ignition of flammables. Accidents and incidents occur because of a failure to anticipate all of the ways in which these hazards may occur in a laboratory environment.

Resistive heating can occur in a number of ways, including poor connections, undersized wiring or electrical components, overloaded wiring or components, or inadequate ventilation of equipment. Do not use sparking motors in equipment that will be used where vapors can be generated, such as blenders, evaporators, or stirrers. Induction motors should be used in most laboratories instead of series-wound electric motors. Ordinary household equipment is not suitable for use in laboratories that use flammable solvents. Any device in which an electrical circuit makes and breaks, such as an on/off switch, is a potential source of ignition for flammable gases.

Choose equipment that can be used safely by staff and students. A few methods to prevent individuals from coming into contact with electricity are:

- Exclude unqualified personnel from working on or near electrical equipment
- Provide insulation, grounding, good wiring practices, and mechanical devices
- Use good judgment and exercise appropriate care to the risk
- Maintain a scheduled program of preventative maintenance

Precautions for Using Electrical Equipment

Under certain circumstances, contact with as little as twenty-four volts of electricity may result in a fatal shock. Low-voltage DC circuits do not normally present a hazard to human life, although severe burns are possible. The time of contact with a live circuit affects the degree of damage, especially as far as burns are concerned. Recommendations for minimizing electrical hazards follow:

- Only individuals qualified by training or experience should maintain electric or electronic equipment.
- Electric wires should never be used as supports. Live wires should not be pulled.
- Any electrical failure or any evidence of undue heating of equipment should be reported immediately to the CHO and/or the maintenance department.
- All electrical equipment should be periodically inspected to be certain the cords and plugs are in a safe condition and that only three-wire grounded, double insulated, or isolated wiring is used in 110v - 115v AC applications.

Static Electricity and Spark Hazards

Some protection from static electricity and sparks in hazardous areas and in handling flammable solvents and other chemicals is obtained by proper grounding of containers and equipment. Static electricity is magnified by low absolute humidity, such as experienced during cold weather. Some common potential sources of sparks and electrostatic discharges are:

- Ungrounded metal tanks and containers
- Clothing or containers made of plastic or synthetic materials
- The making and breaking of an electric circuit while the circuit is energized (switching, pulling plugs)
- Temperature control systems in hot plates
- Metal-based clamps or wire used with non-conducting hoses
- Brush motors and hot air dryers

Distillation Units

Distillation is a common method of separation and purification used in laboratories. Potential dangers arise from pressure buildup, the common use of flammable materials, and the necessity for heat to vaporize the chemicals involved. A variety of apparatus designs are used to accomplish distillations at atmospheric pressure, under inert atmospheres, at reduced pressure (vacuum distillation), or the addition of steam to the distillation mixture (steam distillation).

Careful design and construction of the distillation system is required to accomplish effective separation and to avoid leaks that can lead to fires or contamination of the work area. Smooth boiling is necessary during the separation process to avoid bumping which can blow apart the distillation apparatus. Stirring the distillation mixture is the best method to avoid sudden boiling (bumping).

The use of boiling stones is only effective for distillations carried out at atmospheric pressure. Be sure that fresh boiling stones are used when a liquid is to be boiled without stirring. Do not add boiling stones or any other solid material to a liquid that is near its boiling point because this may cause it to boil over spontaneously.

The source of heat is an important factor in the distillation process. Even heating can best be done by using an electric mantle heater, a ceramic cavity heater, steam coils, or a nonflammable liquid bath. Silicone oil or suitable high-boiling oil can be used if heated on a hot plate. Hot water or steam may be used where practical. An additional thermometer may be inserted very near the center bottom of the distilling flask to warn of dangerous, exothermic decomposition. Always avoid heating above the temperature directed in the procedure.

Organic compounds must never be distilled or evaporated to dryness unless they are known to be free of peroxides. Most ethers, including cyclic ethers, form dangerously explosive peroxides on exposure to air and light. Many alcohols, unsaturated hydrocarbons, potassium metals, and other reagents can also form peroxides.

Superheating and bumping frequently occur when distilling using reduced pressure. Therefore, it is important that the assembly be secured and the heat be distributed more evenly than is possible with a flame. Evacuate the assembly gradually to minimize the possibility of bumping. Stirring or use of an air or nitrogen bleed tube provides good vaporization without overheating and decomposition. A standing shield should be in place for protection in the event of an implosion. After finishing a reduced pressure distillation, cool the system before slowly bleeding in air because air may induce an explosion in a hot system. Pure nitrogen is always preferred to air and can be used even before cooling the system.

When carrying out a steam distillation, minimize the accumulation of condensate in the distillation flask. Remember that the heat of condensation of steam is very high. Overfilling the flask is less likely if heated or insulated to prevent excessive condensation. Do not flood the condenser by running the steam in too fast.

Most distillation units operate with water-cooled condensers, therefore, it is essential for safe operation that the water supply be dependable. It is important that the line voltage used for the distillation remain relatively constant since even moderate changes will affect the rate of distillation. Do not allow distillation units to operate unattended.

Breakage of the glass in a distillation unit can be caused by residual internal stresses in the glass, improper external supports, or by an accidental blow.

It is strongly recommended that all parts of the glass distillation equipment be carefully annealed and checked for residual stress by means of polarized light. The column, head, and receivers can be supported by a rigid rod and heavy-duty clamps with clamp holders. Specific recommendations for support can be found in the *CRC Handbook of Laboratory Safety* and other sources. Breakage due to accidental blows should be prevented by locating the still in a corner of the laboratory, out of the main line of traffic, and by the use of adequate safety shields.

Extractions

Extractions can present a hazard because of the potential buildup of pressure from a volatile solvent and an immiscible aqueous phase. Glass separatory funnels used in laboratory operations are particularly susceptible to problems because their stoppers or stopcocks can be forced out, resulting in a spill of the contained liquid. It is even possible for pressure to burst the vessel. Here is the way to use a separatory funnel correctly:

> Do not attempt to extract a solution until it is cooler than the boiling point of the extractant. When a volatile solvent is used, the unstoppered separatory funnel should first be swirled to allow some solvent to vaporize and expel some air. Close the funnel and invert it with the stopper held in place and immediately open the stopcock to release more air plus vapor. This should be done with the hand encompassing the barrel to keep the stopcock closed, shake with a swirl, and immediately open the stopcock with the funnel in the inverted position to again vent the vapors. If it is necessary to use a separatory funnel larger than 1 liter for an extraction with a volatile solvent, the force on the stopper may be too great and cause the stopper to be expelled. Consider performing the extraction in several smaller batches.

Temperature Control

Many reactions must be initiated by heating. Since the rates of most reactions increase as the temperature increases, highly exothermic reactions can become dangerously violent unless provisions are made for adequate cooling. If too much of a reagent has been added initially, late induction of the reaction can cause it to become too vigorous for effective condensation of vapors unless a cooling bath is quickly applied to the reaction vessel. Viscous liquids transfer heat poorly and require special precautions. Reactions usually require some temperature control, and the apparatus should be assembled in such a way that either heating or cooling can be applied or withdrawn readily.

Test tubes are held with a test-tube holder and heated gently along the side, not at the bottom, to minimize superheating, which may cause the contents to be ejected. Avoid pointing a test tube toward yourself or any nearby person. If possible, test tubes should be heated by placing them in a suitable hot water or hot oil bath.

Oil and Sand Baths

When hot oil or sand is used for heating purposes, extreme care must be taken to avoid overturning the bath, hazardous splattering caused by water falling into hot oil or hot sand, smoking caused by decomposition of the oil or of organic materials in the oil, and fire caused by overheated oil bursting into flames. Make sure to properly label, which includes the name of the oil and its safe working temperatures. Operating baths should not be left unattended without a warning label (*hot oil*) and a high-temperature shutoff. Precautions should be taken to contain any spills of hot oil caused by breaking or overturning of the baths.

Important considerations when using these types of baths include:

- Size and location of the bath
- Operating temperature and temperature control devices
- Type of oil used; e.g., silicone oil, Dow Corning 550, is suggested for most heating needs
- Available ventilation
- Method of cooling the hot oil
- Storage of oil for reuse
- Proximity to possible sources of spilled water or chemicals

Cooling Baths and Cold Traps

When ice water is not cool enough for use as a bath, salt and ice may be used. For even lower temperatures, dry ice may be used with an organic liquid. An ideal cooling liquid for use with dry ice should have nontoxic vapors, low viscosity, non-flammability, and low volatility.

Ether, acetone, and butanone are too volatile and flammable. The final choice of a liquid will also depend on the temperature requirements. Although no substance meets all these criteria, the following are suggested (numbers in parentheses signify above criteria which are not met):

- Ethylene or propylene glycol in a 3:2 ratio with water & thinned with isopropyl alcohol (criterion 2)
- Isopropyl alcohol (criterion 3)
- Some glycol ethers (criterion 2)

Add the dry ice to the liquid or the liquid to the dry ice in small increments. Wait for the foaming to stop before proceeding with the addition. The rate of addition can be increased gradually as the liquid cools. Do not lower your head into a dry ice chest as no oxygen is present, and suffocation can result. Do not handle the dry ice with bare hands; if the skin is even slightly moist, severe burns can result. Use dry leather or suitable cryo-gloves. When chipping dry ice, wear goggles.

Reduced Pressure Operations

Vacuum desiccators should be protected by covering with cloth-backed friction or duct tape or enclosed in a box or approved shielding device for protection in case of an implosion. Only chemicals being dehydrated should be stored in a desiccator. Before opening a desiccator under reduced pressure, make sure that atmospheric pressure has been restored. A "frozen" desiccator lid can be loosened by using a single-edge razor blade as a wedge that is then tapped with a wooden block to raise the lid.

All vacuum lines should be trapped and shielding should be used whenever the apparatus is under reduced pressure.

Water aspirators for reduced pressure are used mainly for filtration purposes, and only equipment that is approved for this purpose should be used. Never apply reduced pressure to a flat-bottomed flask unless it is a heavy-walled filter flask designed for the purpose. Place a trap and a check valve between the aspirator and the apparatus so that water cannot be sucked back into the system if the water pressure should fall unexpectedly while filtering. These recommendations also apply to rotary evaporation equipment where water aspirators are being used for reduced pressure.

If vacuum pumps are used, a cold trap should be placed between the apparatus and the vacuum pump so that volatiles from a reaction or distillation do not get into the pump oil or out into the atmosphere of the laboratory. When possible, exhausts from pumps should be vented to a hood. Pumps with belt drives should also have belt guards to prevent hands or loose clothing from being caught in the belt pulley.

Appendix C

Chemical Hygiene Program Activities
Comprehensive Laboratory Inspection Checklist
(MDE Attachment 5)
Periodic Laboratory Inspection Checklist
Chemical Fume Hood Evaluation
End-of-the-Year Laboratory Closure Checklist
Checklist for the Chemical Hygiene Officer

Overview of Chemical Hygiene Program Activities
New Prague Area Schools Public Schools

September
Periodic Laboratory Safety Checklist*
Fume Hood Evaluation*
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

October
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

November
Science Safety Checklist*
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

December
Periodic Laboratory Safety Checklist*
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

January
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

February
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

March
Periodic Laboratory Safety Checklist*
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

April
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

May
Annual Compliance Checklist for the CHO*
End of School Year Lab Closure Checklist*
Weekly Eyewash/Shower Inspection & Flush
Fire Extinguisher Inspections

To Be Determined
Chemical Hygiene Training for Science Teachers

As Needed
Student Safety Instruction & Contract

Ongoing
Update Chemical Inventories & MSDSs

*** File in Chemical Hygiene Program binder – Send copy to IEA @ Central Services Office**

Chemical Fume Hood Evaluation Form

Name of School:_____Date:_____

Lab or Room #: _____Evaluator:_____

Hood Number and Identification:_____

Measuring Device:___Vaneometer ___ Thermal Anemometer ____ VelociCalc Air Velocity Meter

Procedure

1. Verify hood is turned on and functioning.
2. Ready the measuring device.
3. Advise all room occupants to minimize movement while measurements are taken.
4. Raise the hood sash to approximately eighteen inches or until contact is made with the sash travel stoppers. Enter height of sash
5. Take nine airflow measurements in the center of equally distributed quadrants, as shown. Allow the measuring device to stabilize before reading value. Write the values at the "X".

HOOD **Sash Height**

X= fpm	X= fpm	X= fpm	_____inches
X= fpm	X= fpm	X= fpm	↓
X= fpm	X= fpm	X= fpm	

X = Placement of measuring device

6. Average the nine flow readings:_____fpm(80-100 is optimum, 100-120 fpm is OK)

Survey Notes

Does the hood function well? ☐Yes ☐No

What items are stored in the hood?_____

What items are stored under the hood?_____

Is the hood orderly? ☐Yes ☐No

Corrective action recommended:_____

Other Comments:_____

_____

_____

_____ _____

Signature of Inspector Date

End-of-the-Year Laboratory Closure Checklist

School: _____ **Instructor:** _____

Room #: _____ **Date of Inspection:** _____

This checklist has been developed to make sure each science laboratory is properly "closed" at the end of the school season. Proper closing will help reduce the potential for incidents and accidents during summer cleaning and will provide you a better work environment upon return to school next fall.

Please indicate the status of each item below. Please explain all answers marked as "NO". This checklist will be reviewed by the District Chemical Hygiene Officer and Third-Party Safety Consultant.

YES	NO	N/A	CLOSING ACTION
___	___	___	The main natural gas valve is in the OFF position.
___	___	___	All workstation gas valves are in the OFF position.
___	___	___	All laboratory glassware is clean and properly stored in drawers or on shelves.
___	___	___	All chemical preparation areas (bench, sink, cart, etc.) are clean and free of clutter.
___	___	___	All laboratory hoods are clean and in good condition.
___	___	___	All laboratory chemicals are sealed, labeled, and properly stored.
___	___	___	The chemical storage area is neat and orderly.
___	___	___	All biology specimens are properly sealed and stored.
___	___	___	All miscellaneous items are properly stored. No dangerous overhead storage.
___	___	___	The laboratory refrigerator is clean and unplugged, and the door is forced ajar.
___	___	___	All electrical appliances have been unplugged and properly stored.
___	___	___	All extension cords have been unplugged and properly stored.
___	___	___	All valuable personal items have been taken home.
___	___	___	Maintenance work orders have been submitted for items needing repair.

Explanations for "**NO**" Answers: _____

_____

_____

_____

Comments:_____

_____

_____

_____

_____ _____

Instructors Signature **Date**

Annual Program Compliance Checklist for the Chemical Hygiene Officer

Name of Chemical Hygiene Officer: _____

School: _____

YES	NO		Comments
		Adequate time is provided in your schedule to review, guide, and improve upon the CHP.	
		Corrective actions resulting from previous audits and reports have been completed to date.	
		Required PPE and other safety devices are available.	
		Rules regarding procurement, distribution, and storage of chemicals are being followed.	
		All signs and labels are in place with respect to general product information.	
		MSDSs are available and complete.	
		Waste is identified and stored appropriately.	
		End of year laboratory checklists are being used and submitted for review.	
		Housekeeping and other laboratory conditions are generally acceptable.	
		Emergency equipment is inspected, as per requirements.	

Please list other deficiencies or areas in need of improvement:

_____
_____
_____
_____
_____

Please list noteworthy improvements and successes you wish to be made known:

_____
_____
_____
_____
_____

_____ _____

Signature of CHO Date Signed

Appendix D

Emergency Phone Numbers

Emergency Information

Call 911

Name and phone number of the Chemical Hygiene Officer:

_____

Name and phone number of the Director of Building and Grounds:

_____

Name and phone number of the Exposure Control Officer:

_____

EPA ID No. for hazardous waste:

MNR000064139

Other Emergency Response Numbers:

- **MN Poison Control:** 1-800-222-1222 (24 hours/7days)
- **Nearest hospital:** New Prague Area Hospital
- **Nearest walk-in clinic:** New Prague Area Clinic
- **Health & safety consultant:** Sue Liebl, IEA, 763-315-7900 / 800-233-9513
- **Maintenance department number(s):** _____
- **Principal:** _____
- **Assistant principal:** _____
- **Nurse's office:** _____
- **Safety committee chairperson:** _____

Please post on door to chemical prep/storage room.

Appendix E

The Laboratory Facility
Chemical Storage Recommendations
Laboratory Floor Plans

The Laboratory Facility

Design

All district chemical laboratories and associated work areas are supplied with properly functioning equipment as well as safety devices capable of adequately protecting laboratory instructors and students. Ownership and responsibility for each of these areas and associated equipment and safety devices is assigned by district administration or the CHO, as appropriate. Examples of required safety devices may include, but are not limited to:

- Personal protective equipment (goggles, gloves, aprons)
- Emergency shower and/or eyewash stations
- Fire extinguishers
- Spill control supplies
- Wash sinks and personal hygiene supplies
- Ventilation appropriate to control exposure hazards
- Appropriate laboratory cleaning supplies

Use

Laboratories and other science areas must be used for education purposes only. Any actual or suspected use other than for educational purposes must be promptly addressed by the instructor, CHO, and/or principal.

Ventilation

Ventilation systems greatly affect laboratory air quality. In Minnesota the current building code for ventilation follows ASHRAE Standard 62.1-2004. This standard specifies the amount of fresh air required to be delivered to classrooms based on occupancy, size of room, occupant usage of room, and effectiveness of ventilation systems.

Ventilation is very important in chemical storerooms. Four air exchanges per hour is a minimum requirement. Air should be "pulled" from the floor level and exhausted directly to the outdoors.

Exhaust

Science lab classrooms require an exhaust rate of one cubic foot per minute per square foot of classroom area. This general exhaust is required in addition to any fume hood exhaust that may exist in the classroom.

PDF of Flinn Storage Recommendations

Insert lab floor plans if desired

Appendix F

Student Laboratory Safety Instruction Agenda
Science Safety Contract for Students

Student Laboratory Safety Instruction Agenda

Recommended Instruction Topics

The Importance of Personal Safety - general

Laboratories are Serious Work and Learning Environments

- Dangers inherent to the chemical/biological laboratory
- No place for unsafe behaviors
- The importance of paying attention
- Your safety is your neighbor's safety
- Housekeeping, housekeeping, housekeeping
- Learning good habits for the future
- Specific laboratory techniques

Safe Laboratory Work Practices

- Review list on back of student contract
- Safety symbols

Safety Devices and Equipment Inspections

- Safety goggles – why important, how eye damage can occur
- Safety eyewash and showers (importance, clear access, demonstration)
- Fire blanket, if applicable
- Inspect safety and lab equipment prior to use

How to Handle Laboratory Emergencies

- Chemical exposures/poisoning
- Chemical spills
- Fires
- Cuts and burns

Student Lab Safety Quiz

Science Safety Contract for Students

Science Safety Contract for Students
New Prague Area Schools Public Schools

Dear Parent or Guardian:

Your daughter/son will be taking a science laboratory course this school year. As part of our effort to provide a beneficial and safe classroom environment, I request that, together, you and your daughter/son read the list of science safety rules on the reverse side of this letter. Please discuss these rules to ensure complete understanding, then both of you sign where indicated and return the lower portion of this letter to me. Your signatures simply indicate that you have indeed read these rules and that your child agrees to abide by them.

Safety is a very important part of our science curriculum. Students must display sound judgment and good behaviors at all times while in the laboratory environment. If any student's behavior is severely disruptive or unsafe, she/he will be removed from the activity.

Thank you for helping us to provide a safe learning experience for your student.

Sincerely,

_____
New Prague Area Schools School Science Department

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I have read and understand the science safety rules provided to me through this *Science Safety Contract for Students* and agree to abide by those rules and display safe behaviors during laboratory activities.

_____ _____
Student Acknowledgement Parent/Guardian Acknowledgement

On this _____ day of _____ in the year _____
day month year

Science Safety Rules for Students

Avoidance of Routine Exposure

- Do not smell or taste chemicals.
- Do not use mouth suction for pipetting or to start a siphon.
- Eating or drinking is not allowed in any science area, especially where chemical or biological science activities take place.
- Do not apply cosmetics in the laboratory.

Supervision

A qualified instructor is present at all times while students are present in the laboratory. All persons are in good mental condition when working in the laboratory and associated work areas. Intoxication, medical drug use, extreme fatigue, stress, and other distractive conditions can cause serious mistakes to be made. Hazardous laboratory experiments are never left unattended.

Horseplay

Conduct that may be termed "practical joking", "fooling around", or "horseplay" is strictly prohibited at all times in the laboratory and classroom. Any person displaying such conduct is counseled immediately and/or removed from the environment.

Clothing and Jewelry

Clothing must be suitable for the laboratory environment and associated hazards. Loose clothing and hair is confined. Loose neck jewelry, rings, and watches are removed prior to working in the laboratory. Substantial footwear is required to prevent exposure to chemical and physical hazards.

Personal Protection

PPE is worn as appropriate for the laboratory exercise. Tight-fitting goggles are worn by students, staff, and visitors when working with chemicals in the laboratory or preparation area. PPE is inspected before use and maintained properly. Do not use the eyewash station as a drinking fountain or for washing laboratory equipment

Fume Hoods

- Hoods are closed at all times except when adjustments within the hood are required.
- Fume hoods are not used for general storage.
- Placement of equipment within the hood is not allowed, as it may restrict airflow or otherwise negatively affect hood performance.
- Fume hoods are clean and orderly at all times.

Electrical Hazards

- Frayed or otherwise damaged wires and cords are removed from service.
- Wires and cords do not lie in puddles of water or liquid chemicals.
- Electrical wires and cords are kept away from sources of heat, flame, corrosive materials, or oxidizing agents that might be spilled.
- Plugs that are broken, corroded, or become hot are not used.