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Department of Environmental Conservation

State Education Department

New York State School Science Chemical Management Guidance Manual

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New York State Education Law, 305(19) Chapter 627 of the Laws of 1989

The Commissioner is authorized and directed to require all elementary and secondary schools to store all chemicals present in their science facilities in locked and secure storage rooms and cabinets. Schools shall provide for the placement, spacing, arrangement, ventilation and fire protection of such stored chemicals in accordance with guidelines promulgated by the Commissioner of Education. The Commissioner shall also require all elementary and secondary schools to prepare at least annually an inventory of such chemicals, including the chemical's name, the chemical abstracts service registry number, a hazard warning code, the generally accepted method or methods of disposal, a compatible storage code, the date received, the scheduled date of disposal, the quantity received, the quantity remaining and its location. This inventory must be kept in a secure location and be available for inspection by the Commissioner.

Right-To-Know Law and Hazard Communication Standard

New York State public school districts and other public employers must comply with both the New York State Right-to-Know Law and the federal Occupational Safety and Health Administration's Hazard Communication Standard. Your employer must provide you with training about your legal rights and about any hazardous chemicals you might use. **Private sector employees** are covered ONLY by the Hazard Communication Standard.

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Contributors to the creation of this document:

NYS Department of Environment Conservation
NYS Education Department
Questar BOCES

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Part I: Introduction

1.0 Organization of This Manual

This manual provides a framework to accomplish a complete assessment and inventory of the chemicals used and stored by a school district.

It is designed primarily to serve as a guide to a sustainable chemical management system for a school district. It also provides a framework and tools for developing a comprehensive school Chemical Management System (CMS) as well as an effective Chemical Hygiene Plan that can be tailored to the needs of individual schools. A Chemical Hygiene Plan template can be found in Appendix G.

2.0 Challenges Schools Face in Managing Their Chemicals

2.1 Unmanaged Chemical Stockpiles

Most schools have hundreds of chemicals in science and technology education laboratories, art rooms and maintenance areas. Schools do not often have the proper storage facilities and/or plans for proper disposal of these chemicals. Hazardous chemicals accumulate when there is no tracking system and no disposal plan, especially when there are changes in staff and/or changes in curriculum. Industry donations and the purchase of highly hazardous materials from hardware stores or other retailers can compound this problem. Chemicals donated to the school often do not have an appropriate Safety Data Sheet (SDS) and, while useful to industry, may not be suitable in quantity or composition for student learning.

2.2 Old, Outdated and Unused Chemicals

When teachers retire or leave the school system, the chemicals they used are often left behind. Many chemicals which were useful to them may not be used by their successors. Furthermore, chemicals acquired prior to 1996 may not be needed for curriculum adhering to current NYS learning standards.

The relative age of a chemical can be determined by looking at the label of its container. Labels offer a window to the past. Figure 1 shows a labeling sequence used by one company. The Material Safety Data Sheet (MSDS) did not become mandatory until the mid-1980s. The MSDS is a form containing data regarding the properties of a particular chemical or chemical formulation and required to be included with every chemical shipment. However, as part of the, new Globally Harmonized System of Classification and Labeling of Chemicals, which began on June 1, 2015, Safety Data Sheet (SDS) have now replaced the Material Safety Data Sheet (MSDS).

Figure 1: Chronological Labeling

The GHS "defines health, physical and environmental hazards of chemicals" using available data to standardize health and safety information for each chemical through a *"logical and comprehensive approach"* presented to users across international lines as well as companies.

2.3 Highly Decentralized Chemical Procurement and Usage

Significant challenges to health and safety occur when chemical ordering is not a coordinated effort. Implementation of a school district-wide chemical management program can reduce the quantity of chemicals ordered, used, and ultimately disposed by the district.

2.4 Restricted Budgets

Eventually, schools end up with many more chemicals than they need, plus the added expense of paying for their disposal. Restricted budgets can lead to ordering large quantities of chemicals because it seems cost-effective up front, yet end-of-life chemical disposal can be very expensive. Additionally, this further compromises the health and safety of the school environment.

Chemical users determine what chemicals to order and how much is needed. Long-term storage needs and disposal of chemicals is often an afterthought.

2.5 Lack of Information

A lack of information on proper chemical storage, handling, usage and disposal leads to underestimating the resources required for establishing a chemical management program.

2.6 Lack of Familiarity with Chemical Management Systems

Many schools are unfamiliar with the various approaches available for establishing a chemical management system. Current chemical-related management activities are largely compliance-oriented, focusing on end-of-pipe waste treatment (e.g., hazardous waste storage and

disposal and training in hazardous waste handling) rather than pollution prevention. Pollution prevention, which addresses chemical management from the point of purchase, may prove to be a better alternative to school districts.

Schools face many challenges in the science chemical storage and laboratory areas related to health and safety of both students and faculty. This document was prepared to offer practical guidelines based upon recommendations from the American Chemical Society, the OSHA Laboratory Standard (29 CFR1910.1450), the US Environmental Protection Agency, NYS PESH (Public Employee Safety and Health) and sound chemical management practices. The information in this manual is compiled for New York State schools, but may be applicable to other states as well. Local restrictions may be different; check with your local environmental agency.

Challenges can be overcome by developing and following a comprehensive chemical management system.

Part II: Overview of a School Chemical Management System

The purpose of a Chemical Management System (CMS) is to promote chemical responsibility from procurement through disposal. Adoption of these practices will reduce the risks involved in the handling and storage of chemicals, create efficiencies and improve environmental sustainability.

1.0 Components of a Chemical Management System

A CMS consists of several required components needed to support an on-site chemical safety program. These components are:

- Inventory Tracking and Control of Chemicals
- Identifying and Analyzing Chemical Hazards
- Managing Change
- Emergency Planning and Response

Elements of a system for the tracking and control of chemicals are as follows:

- Acquisition
- Use
- Storage
- Transportation
- Final Disposition
- Automated Tracking

Schools and/or school districts and Boards of Cooperative Educational Services (BOCES) must establish a C*hemical Hygiene Plan per OSHA laboratory standard 29CFR 1910.1450,* which identifies, manages and prevents hazards through all stages of chemical purchasing, storage, use, and disposal. OSHA defines a laboratory as **"***a facility where the 'laboratory use of hazardous chemicals' occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis."*

29CFR 1910.1450 also provides the definition for "***Chemical Hygiene Officer***: "an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure."

The OSHA laboratory standard applies to laboratories where hazardous chemicals are in use. Hazardous chemicals means *"a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard."*

The OSHA laboratory standard applies to those paid by the school or school district. Teachers, maintenance and office personnel are covered by this standard, but students are not. Schools have a responsibility to create a healthy, toxic-free environment conducive to learning. Reductions in hazardous and toxic chemicals may lead to a more productive learning environment.

Adoption and adherence to OSHA guidelines across every area of the school facility where chemicals are present will help reduce the quantity of toxic chemicals used while implementing a school's curriculum. In addition, following the CMS guidelines will help decrease the amount of hazardous chemicals used for the cleaning and maintenance of the school's physical plant. Implementing a CMS should prevent the buildup of a surplus chemical inventory.

2.0 Chemical Management System Goals

A school's CMS should:

- Minimize the volume and types of hazardous chemicals purchased, used, stored and disposed
- Guide development of systems for staff to judiciously purchase, safely use, manage, and dispose of hazardous materials
- Assist in identifying and preventing potential chemical hazards
- Assist in managing existing chemical hazards
- Guide development of plans for responding appropriately to chemical emergencies
- Ensure the school, school district or BOCES complies with environmental, health and safety regulations and adopts "best management practices"
- Model and promote responsible chemical management

3.0 General Considerations

1. The waste from every laboratory experiment is not necessarily hazardous. In fact, it is easier to make a list of what is hazardous than what is not.
2. Laboratory chemicals often exhibit more than one risk factor; not all risks are equal. Be sure to read the container label or the SDS for a particular chemical.
3. All forms of a chemical or the waste generated from reactions involving that chemical are not equally hazardous.
    a. For example, many metal powders in air form serious fire and explosion risks and create inhalation hazards, whereas, these same metals in the form of a wire or sheet may not be hazardous.
    b. For example, a concentrated acid is more hazardous than the diluted form of the acid and usually more hazardous than the salt produced after the acid has been neutralized.
4. The district's chemical hygiene officer should be contacted regarding disposal of chemicals. NYS Hazardous Waste Regulations and the NYS Universal Waste Rule govern disposal methods, and the SDS can provide additional disposal information.
5. School buildings can be on a septic system or a public wastewater system. Schools that are on septic systems have unique environmental challenges which prevent disposal of many chemicals because groundwater contamination and bacterial efficiencies of the on-site system can be compromised. In addition, there are local and state environmental regulations that must be followed. The school district's physical plant director/superintendent of buildings and grounds should be contacted for further guidance.
6. The wastewater treatment plant, also known as, Publicly-Owned Treatment Works (POTW), should be contacted to discuss disposal plans. Local sewer ordinances often place restrictions on what may be discharged into the system.

4.0 Costs to Develop and Implement a Chemical Management Plan

Schools should contact their regional BOCES or environmental health and safety officer for assistance in the organization and disposal of chemicals. Schools in Buffalo, Rochester, Syracuse, Yonkers and New York City, "The Big Five", should contact their city environmental health and safety officer, as these educational entities do not participate with BOCES.

Short Term:

Costs are most likely to be associated with allocation of school staff to conduct a thorough inventory, as well as engaging an appropriate transporter to remove unwanted chemicals.

Long Term:

The CMS plan will require staff time to develop and to maintain systems and procedures. Program implementation may require annual hazardous chemical disposal and staff training. Schools are required to provide protective eyewear and should provide suitable gloves for staff when necessary.

5.0 Steps for Effective Chemical Management

A CMS is a long-term commitment to improving environmental health and safety conditions in a school or school district. This manual advocates the use of a team approach to development and implementation of an effective, user-friendly program. Initial steps are designed to remove imminent hazards and stockpiles of hazardous chemicals. Once the quantity and toxicity of inventory is reduced, schools, school districts and BOCES will be in a better position to implement an efficient management system for remaining chemicals.

Step 1: Form a chemical management team

Step 2: Identify and analyze chemical hazards

Step 3: Conduct a complete inventory and determine usage

Step 4: Establish a sustainable system for purchasing, use, storage and disposal of chemicals

Step 5: Review the school's/district's chemical management practices

5.1 Potential Savings

Once a program is underway, school districts and BOCES can save considerable fiscal resources and improve the learning environment for students, faculty and staff.

Part III: Steps to Begin the Process

1.0 Form a Chemical Management Team

The school should develop the administrative framework to implement a chemical management system. The team is an integral part of this framework and should be given the time and authority to develop the system. The framework should also include:

- Identifying and assigning administrative and staff responsibilities
- Providing staff with resources, including time and training to fulfill their responsibilities
- Identifying and addressing relevant environmental health and safety regulations
- Identifying and addressing relevant best practices
- Developing a budget for chemical management and disposal

1.1 Get Buy-In from the Top

District Program - It is imperative that support for a CMS be enlisted from the top down. This support will ensure the board of education, superintendent, physical plant personnel, faculty and staff will be involved and put forth a coordinated effort. Buy in at upper administrative levels helps secure funding during the budgetary process for chemical disposal.

Individual School Program - The principal's support for development of a CMS is key to enlisting staff to participate on the team and to implement the group's recommendations.

1.2 Who Should Be On the Team

Suggested team members:

- School business official
- Facilities manager and/or head custodian
- Building level administrator(s)
- Curriculum coordinator (science) and/or senior chemistry teacher
- Chemical hygiene officer (who may also be the curriculum coordinator and/or chemistry teacher, depending upon the size of the school and the number of chemical storage locations)

1.2.1 Other Personnel to Consider:

- Art department head or art teacher
- Technology education teacher
- Union representative

1.2.2 Community Members to Consult

Local municipal agencies can provide invaluable assistance to this effort as team members. They can provide expertise that may not be available from school staff and can assist in program planning, policy development, assessment of existing conditions and training. The team should include a member of one or more of the following departments or agencies:

- Fire department's hazmat coordinator
- Local emergency planning committee
- County emergency manager
- Department of public works or solid waste district–recycling or hazardous waste coordinator
- Local industry

1.3 Team Meetings

The team should meet on a regular basis, with all members attending whenever possible. Team members need to make time for meetings and for follow-up work. Some schools have made it easier for staff to participate on a team by:

- Defining the roles of each member of the team
  - One person should act as the lead and serve as the main contact
- Providing a stipend for overtime work
- Providing a designated amount of meeting time per month or semester
- Providing professional development credits
- Providing substitutes to cover other responsibilities

2.0 Identify and Analyze Chemical Hazards

Identification and analysis of chemical hazards require that information on current chemical management practices be gathered and a walk through of the facilities (including a safety pre-screen) be conducted. A safety pre-screen is a process during which you assess your current chemical management system, gather together persons who will be involved in the program, and do a pre-inventory walkthrough of your facilities to determine the locations of chemicals. Appendix F has a sample template of information to consider before conducting a chemical inventory.

2.1 Gather Information on Current Practices

In addition to the Safety Pre-screen Worksheet found in Appendix B, the following questions should be considered when developing the plan:

- Does the school district have a chemical hygiene plan?
  - Does it contain emergency response procedures?
  - Who is responsible for annual updates to the chemical hygiene plan?
- Who currently uses hazardous chemicals, and who is responsible for the individuals who use hazardous chemicals?
- Has the school performed a chemical cleanout in the past? How often are these done?
- Are there any existing chemical inventories?
  - Who maintains them?
- Is there a Safety Data Sheet (SDS) for every chemical the school district buys, including office supplies?
  - Is the SDS readily accessible during each work shift to laboratory employees when they are in their work area? [29 CFR1910.1200(b)(3)(ii)]
  - Are paper copies kept in the building pursuant to NYS Fire Code?
  - Where is the SDS stored?
- Have any school staff received training related to chemical safety, such as Right-to-Know training? [pursuant to OSHA 29CFR 1910.1200 [http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099]

- Do all school personnel and students know the location, condition, amount and appropriateness of:
    - Personnel Protective Equipment (PPE)
    - Emergency showers
    - Emergency eye-wash stations
    - Phones
    - Fire blanket (non-asbestos)
        - If blanket is known to contain asbestos, do not use, and do not touch or move. Asbestos-containing materials can be moved or removed only by a licensed asbestos handler. Your buildings and grounds superintendent will have more information.
    - Fire extinguisher
    - Chemical spill response kits
        - Information on how to create your own chemical spill kit can be found in Appendix C.

2.2 Conduct a Safety Pre-screen

A safety pre-screen identifies and resolves "imminent hazards." Dangerous situations are often discovered when school personnel find previously unknown chemicals stored in out-of-the-way places. It is important to involve a technical expert in chemistry during the pre-screen who can accompany the team throughout the school and identify where chemicals may be stored and any imminent hazards. Of equal importance is the need to wear proper personal protective equipment (PPE) and avoid touching any known chemical hazards or bottles of chemicals that appear unstable in any manner. This is meant to be a "look-see" activity.

Identify areas to evaluate but do not limit the search to known storage and use areas. Chemicals are often used, left and forgotten in non-storage areas. Chemicals are often found in locked drawers and cabinets that are not opened on a regular basis. Take notes for each location visited, and map locations where chemicals are currently used and stored.

If any chemicals found in the pre-screen are classified as imminent hazards, be sure to note as much information about them as possible on the inventory. In some cases, the area will have to be secured, as the chemical may be unstable. In other cases, marking the container may be appropriate. Always include appropriate information on the inventory listing.

2.3 Look for Hazards

Consult *Chemical Compatibilities* in Appendix C and *Hazardous Chemicals to Avoid* in Appendix D. Any one of the following situations is considered an "imminent hazard" and must be corrected before inventory is conducted:

- Corroded or unstable containers
- Sagging cabinets, corroded shelving and/or shelving supports housing chemicals

- Sources of ignition, water and heat that pose a dangerous situation in the chemical storeroom, etc.
- Condition and appropriateness of the chemical storage area, equipment and environmental controls, such as ventilation systems

2.4 Additional Chemical Hazards Which May Be Present

Many chemicals used in schools are the same as those used in industrial and commercial facilities, such as factories and research laboratories. These include but are not limited to:

Chlorinated solvents, such as:

- T-butyl chloride

- Heavy metals and radioactive metals, such as:
  - Mercury,***** lead, cadmium, uranium
- Strong corrosives, such as:
  - Nitric acid, phosphoric acid, picric acid, hydrofluoric acid
- Explosives, such as:
  - Thermite
  - Sodium, calcium and potassium
  - Sec-butyl alcohol
  - Ether
  - Sodium peroxide
- Toxins, such as:
  - Methyl orange
  - Lead(II) nitrate
  - Naphthalene
  - Barium compounds
  - Phenylthiourea (phenylthiocarbamide)
  - Ethidium bromide

****As of 2004, Chapter 145, Title 21, of the Environmental Conservation Law prohibits the use and purchase of elemental mercury in primary and secondary schools.***

3.0 Conduct a Complete Inventory and Determine Usage

3.1 Inventory Preparations

- Contact staff who either will be involved in conducting the inventory or will be having their chemicals inventoried.
- Notify the principal, custodial staff, emergency response coordinator, school nurse, the teachers whose storage areas will be inventoried and other interested stakeholders regarding proposed dates for the inventory.
- Provide an orientation on the inventory process to staff participating in the inventory.
- Ensure that staff know what constitutes an “imminent hazard” and how to handle it, especially if a pre-screening by a qualified chemist has not been performed.

- Ensure the person conducting the inventory schedules time with teachers to *prepare* for the inventory (if someone other than a teacher will be performing the inventory) or
    - Ensure the inventory is scheduled at a time that works for the teacher conducting it.
- Schedule the inventory so students will not be at risk, staff won't be interrupted, and when staff can pair up to work together.
- Conduct the inventory before school, after school, or during days when few students are present, to minimize any risk to them.
- Ensure that someone else is in the building while the inventory is being conducted. No inventory should be conducted alone; two or more people should be present.
- Supply appropriate personal protective equipment such as goggles or safety glasses, gloves, and chemical-resistant aprons or laboratory coats for those conducting the inventory.

3.2 Compiling the Inventory

A complete chemical inventory provides the basis for the CMS. Many vendors sell chemical inventory software; however, a generic spreadsheet or database program may be a cost-effective way to meet chemical inventory requirements. A sample template can be found in Appendix F. Record as much information as possible from the container label, recognizing that some labels may be incomplete.

A user-friendly, universally available program to inventory chemicals will increase the likelihood that it will be consulted during the procurement period.

Chemicals for disposal will be discovered during the inventory.

- Mark all bottles for disposal with an "X" or other notation and note **on the inventory sheet** that it is to be disposed. Inventory should contain at a minimum the storage location, chemical name, container size and/or quantity remaining in the container, and hazard type/class. Use names, not chemical formulas or structural formulas, to identify chemicals. Pay special attention to spelling, as chemical names may vary by only one letter but may be completely different in physical and chemical properties; e.g., ethanal and ethanol are two completely different substances. Each person responsible for using and storing chemicals should review their stock. For **each chemical** found, the following questions should be asked:
    - Is this chemical needed? When was the last time it was used?
    - Is too much of this chemical being stored on site?
    - Will this amount of chemical be used within the next few years? Is a less hazardous chemical available that can be used to meet the same educational objective?
    - Does this chemical have special safety requirements? If so, does the teacher/staff member have the appropriate training to use it?
    - Does the chemical have special storage or disposal requirements?

As a team, conduct a complete inventory of all known locations of chemicals previously identified. If there are multiple prep rooms shared by teachers, at least one of the teachers in each room should inventory that room. This improves accountability and helps spread the workload. The OSHA laboratory standard applies only to the laboratory use of hazardous chemicals (laboratory scale being defined as, "designed to be easily and safely manipulated by one person"). Once the inventory is complete, it can be compiled into one document and shared among faculty.

3.3 Chemicals Needed

Before determining the fate of any chemicals in the inventory, it is best to have a good working knowledge of the breadth of science course offerings at the school. Someone on the chemical management team may unknowingly slate a chemical for disposal that is integral to the school's science curriculum. Disposal lists should be confirmed and approved by the team only after consulting with appropriate personnel.

3.4 Green Chemistry

It is worthwhile to note there are no "green" chemicals *per se*. The "green" in green chemistry refers to an alternative, sustainable method of teaching, learning and conducting chemistry (research, as well as academic pursuits) in a sustainable manner.

Green chemistry includes all substances that are part of the process and recognizes there are significant consequences to the use of hazardous substances. Green chemistry is a way of reducing risk and preventing pollution by addressing the intrinsic hazards of substances rather than using them under conditions that might increase risk to both the user and the environment. It seeks to reduce exposures to toxic chemicals and to reduce or eliminate waste products that would require special handling. Green chemistry often requires a shift in thinking by asking the experimenter to consider the end products or life cycle of the chemicals being used, before beginning the process.

Some chemicals have a higher toxicity than others. For example, all chromates, nickel and cadmium metals and their compounds are known carcinogens, as are some lead compounds. All barium compounds are highly toxic except for barium sulfate. Appendix D has a more complete list of chemicals that should be avoided but are commonly found in high school chemistry storerooms. Virtually all experiments which use these materials have safer substitutes. Section 7.0 provides a number of resources where one can find laboratory activities that offer green chemistry alternatives.

Integration of the "Twelve Principles of Green Chemistry" (John Warner, 2000), referred to in Appendix F, into the curriculum will likely result in fewer chemicals needing storage and ultimately disposal. If schools were to adopt or integrate these principles, the result would be reduced costs for acquisition and disposal, and a smaller footprint required to store the chemicals. Typically, a school needs under 50 chemicals of low or no toxicity for students to complete the required 1,200 minutes of actual, hands-on (not simulated) laboratory experiences to qualify for Regents examinations in the sciences. The "Twelve Principles of Green Chemistry" offers a sustainable method of teaching chemistry to high school students through a life-cycle management approach.

3.5 Rationale for Reducing the Volume of Toxic Chemicals

Many schools have substantial quantities of chemicals they no longer need. Once these chemicals are removed, it is much easier to set up and maintain systems to purchase, track and store the remaining chemicals. Storage needs and supplies of personal protective equipment and emergency response equipment can more easily be determined after the school has reduced the quantity of toxics it possesses.

3.6 Conditions for Suggested Disposals

If a chemical management team member agrees with *any one or all* of the following statements, then it may be time to dispose of the specific chemical.

- Label on the bottle suggests the chemical company is no longer in business
- No SDS for the chemical
- Label cannot be read or is missing
- Chemical has been in storage for more than 10 years, and no one remembers purchasing it
- Person who ordered the chemical has been retired for many years, and current teachers do not use it or plan to use it
- Chemical is no longer used
- Bottle has a metal lid
  - Companies discontinued metal lids in the 1980s
- Bottle is glass
  - Most chemicals currently being sold are in plastic packaging. Some chemicals such as iodine, however, may still require glass packaging. In addition, small quantities of high-purity chemicals are likely to be sold in glass packaging.
- Bottle is broken
- Bottle is plastic but brittle and/or yellowed
- Crystals are forming around the lid
- Contents are either ethyl ether or picric acid. In either case, DO NOT TOUCH OR OTHERWISE DISTURB because the bottle is *potentially explosive*!
- Contents of the bottle are unknown
  - The contents of the bottle have changed form. They have absorbed water, have become one solid mass, have changed color or have been contaminated.
- According to the SDS, the chemical is *dangerously hazardous* in nature.
- District doesn't have proper storage facilities for the chemical
- Experiment that required the chemical is no longer performed

3.7 Remove All Unnecessary Chemicals

While it is best to arrange for disposal of unneeded chemicals at a time when students will not be around, it may not always be practical. If possible, set up a staging area where unwanted chemicals can be placed temporarily. Perform the following:

- Determine your hazardous waste generator status; your facilities manager may already know it: http://www.dec.ny.gov/chemical/60838.html.

- Determine whether the school has a registered hazardous waste generator identification number as required by the United States Environmental Protection Agency (EPA) http://www.epa.gov/region2/waste/csummary.htm. If the school doesn't have a number, then apply for one through the EPA.
- Schedule a disposal with a licensed hazardous waste management firm.
- Further information is provided in the DEC *Environmental Compliance and* Best Management Practices *for New York State Schools*. For a hard copy, send an email request to: dec.sm.GreenChemistryInSchools or download the pdf from the "DEC Chemical Management in New York State Schools' webpage.
- Keep records of hazardous waste disposal (manifest) for no fewer than three years.

Part IV: Establish a Sustainable System for Use, Storage and Disposal of Chemicals

1.0 Inventory Tracking and Control of Chemicals

1.1 Acquisition

After assessing the current chemical management system and removing unnecessary chemicals, the chemical management team should set up a sustainable system to purchase, track, use, store and dispose of all the chemicals in the school district. As the hazard level of chemicals increases, the complexity of management requirements also increases.

Acquisition includes the approval and procurement of chemicals and/or mixtures of chemicals delivered to the school district by individuals and/or organizations. Fiscal constraints, usage rates, storage requirements and disposal methods should be considered before purchasing any chemical.

1.2 Budgetary Concerns

When considering what chemicals to purchase, it is important to keep the chemical life cycle in mind. Budgetary allocations should include costs for procurement, as well as costs for disposal.

2.0 When Purchasing Chemicals

Draw up a chemical procurement plan–a pre-determined procedure for deciding what chemicals need to be ordered. Teachers should purchase only chemicals designated on their chemical procurement plan. Additional quantities of chemicals should not be ordered if adequate quantities of those chemicals are in stock. It is recommended that one person with current knowledge of the existing chemical inventory use a centralized program for all purchasing. Using an inventory tracking system is a good way to note chemicals in stock, which should be used up before purchasing new supplies.

When ordering new chemicals, each should come with an SDS sheet. It is recommended that only chemicals delivered with a SDS sheet be accepted. It also is recommended that receiving room, storeroom and stock room personnel receive training on the proper methods of receiving and handling hazardous substances.

3.0 Before Ordering Chemicals:

- Assess all the hazards and chemical and physical properties of the chemical using the SDS; evaluate both short and long-term risks.
- What is the relative hazard level of the chemical?
    - Is the chemical water or air reactive?
    - Is it corrosive, flammable or hazardous by inhalation?
    - Is the chemical irritating to body tissue or carcinogenic?
- Consider the worst case scenario(s) in the event the substance is mismanaged, spilled or causes personal injury.
- Is there a chemical spill kit on hand and easily accessible by faculty and staff?
    - Chemical spill kits that are present but out of physical reach are not acceptable.
- Make sure the hazardous properties of the chemical do not exceed the educational utility of the experiment.
- What specific topic or lesson does the chemical help teach or illustrate?
    - If the chemical is used infrequently and is extremely hazardous, ****** review the specific laboratory activity to judge its educational value. Further investigation may identify a less hazardous substitute.
- Determine whether a safer, less hazardous chemical can be used.
- Determine whether appropriate facilities are available for proper storage of the chemical and that ventilation is sufficient.
- Is the correct type and size of fire extinguisher present and usable?
- Is a fully operational eye-wash station and safety shower available?
- Is the storeroom properly ventilated?
- Does the acquisition of this material present special containment considerations in the event of a spill, fire or flood?
- Determine whether the proper personal protective equipment and safety equipment is on hand for using the chemical.
- Are gloves, goggles and chemical-resistant aprons readily available to all who must use the chemical?
- Establish whether the chemical or its end product will require disposal as a hazardous waste.
- Are fiscal resources for disposal allocated during the budget process?
- Is a mechanism in place to dispose of the chemical and its end product legally and safely?
- If possible, order reagents in polyethylene bottles or plastic-coated glass bottles to minimize breakage, corrosion and rust.

***** Extremely hazardous chemicals are detailed in the Emergency Planning and Community Right-to-Know Act (EPCRA), also known as Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA).***

- Do not accept any chemicals as donations because their stability, age and purity may not be suitable to the educational environment.
- Only order enough of any particular chemical, and take into account its stability.
    - What is the least amount of chemical that I will need?
        - LESS IS ALWAYS BEST when ordering chemicals. Order the least amount of material needed to save storage space and money.
    - Non-hazardous chemicals that are shelf stable should be stored for only two to five years.
    - Hazardous chemicals and/or those that have poor shelf lives should be stored for only 1 year or less.
    - Consider timed deliveries for items that have very short shelf lives, such as live specimens, bacterial cultures and volatile solvents.

Keep in mind that chemicals received as donations often are not used and incur costs for disposal.

4.0 Receiving Chemicals

Many chemical shipments are delivered to a school district when school is not in session. This can be during the summer or after the school day has ended. Staff receiving or accepting delivery of chemicals must be knowledgeable about proper handling and care techniques and use them.

Individuals who are likely to receive chemical shipments should be trained in how to spot a non-conforming shipment and what to do in the event of such occurrence.

Because front office staff may be the only school personnel available to receive shipments at various times, especially during the summer, they should be included in any chemical hygiene training offered. This training should be over and above what is included in annual “Right-To-Know” trainings. This type of professional development should include:

- How to read an SDS
- What to do and who to call if a shipment arrives looking “wet” or otherwise damaged
- The location of a secure receiving area
- The location of a specially designated place for items that require refrigeration
- The location of a cool, dry place to store the shipment temporarily
- The name and contact information of the person at the school who ordered the material

5.0 Usage Tracking

After the chemical inventory is completed, a school district is responsible for tracking their chemicals from acquisition through use and disposal.

The inventory will contain some chemicals whose necessity will be unknown. A convenient method of assessing whether or not a chemical is needed is to employ the use of colored sticky dots. Affix a sticky dot to a bottle when that bottle is first used during the school year. After the first year,

any bottle without a sticky dot should be questioned as to its use/usefulness. After two years, any bottle without a sticky dot should be properly disposed.

If a chemical is contained in more than one bottle, numbered sticky dots should be attached to each bottle. A "1" should be placed on the oldest bottle. This method not only determines usage, but it can also help determine the amount of that chemical used per year.

A second method of keeping track requires availability of a clipboard, notepad and attached pen (or pencil). The clipboard and notepad should be prominently located in the chemical storeroom. When a chemical is needed, runs out, or is in danger of running out, it can be noted on the clipboard for reference when ordering.

6.0 Internal Controls

Chemicals should always be kept in a locked storage closet, room, or other storage area. This increases the likelihood that the chemicals will be handled only by those authorized to do so.

- Storage areas should contain appropriate shelving and storage cabinets for the chemicals on hand.
- A fume hood with adequate ventilation should be available for the mixing and preparation of all reagents and solutions.
- The SDS of chemicals in use should be available at all times for reference.
- Personal protective equipment should always be available when preparing chemical solutions.

7.0 Waste Minimization

Waste generation will be minimized and costs associated with chemical disposal will be decreased by minimizing the number of chemicals used and the number of chemicals kept in stock.

Waste minimization should be an ongoing effort. Maintaining an accurate and current chemical inventory and referencing it BEFORE chemicals are ordered to determine whether they are needed will help reduce disposal costs.

- When planning chemistry laboratory experiments, keep in mind not only the potential toxicity of the reactants, but also look to the products.
    - Lead (II) nitrate and sodium chloride combine to form lead (II) chloride, a nearly insoluble product. According to the SDS for lead (II) chloride, this chemical is hazardous, cannot be tossed in the trash and must be treated as hazardous waste.
- Consider sharing chemicals between departments. For example, middle school science teachers might need to use some dilute hydrochloric acid or Benedict's solution, or small quantities of solvents on occasion.
    - Use a rubber "boot" or similar safe carrying device to transport chemicals between classrooms.
- Read the "Twelve Principles of Green Chemistry" found in Appendix F to learn additional ways of achieving waste minimization.

8.0 Storage

Storage includes used and unused chemicals such as partially filled containers, chemicals stored in containers other than their original container, chemicals for disposal, and gas cylinders of all sizes.

Often the largest containers that a school chemical laboratory has on hand are the five gallon (20L) cans of ethanol or acetone, two common solvents. Proper chemical storage of individual bottles is as important as storing large containers, drums and/or gas cylinders.

Chemicals are best stored on wooden or chemical-resistant shelving materials. Wood is preferable to metal, as metal can react with many chemicals in the event of an accidental release. Shelving should have a lip to prevent accidental roll-offs. A lip should be added on the edges of existing shelving that doesn't have one. Figure 2 shows how pieces of Plexiglas have been affixed to the edges of the shelving. Wood strips could have been fastened to the outer edges of the shelving as an alternate method.

8.1 Storage Options

Proper use and management of chemicals requires appropriate:

- Storage facilities
- Staff and student training
- Personal protective equipment
- Emergency response equipment
- Handling supplies
- Spill clean-up supplies
- Fiscal resources for waste disposal

Figure 2: Example of Well-organized Chemical Storage in a Small Space

Space is likely the limiting factor in how a school district's chemicals are stored. There are two generally accepted methods for organizing stored chemicals. One is the Color Coding Chemical Storage method. The second is Flinn Scientific's suggested shelf storage pattern. Organization of chemicals alphabetically (except within a hazard class) is NOT an acceptable method, as there are many adverse chemical interactions that can result in the event of an accidental release.

Schools with very limited space for chemical storage could benefit from the Color Coding Chemical Storage method. Many schools use the Flinn Scientific's suggested shelf storage pattern but find they do not always have the space to segregate chemicals appropriately. Additional information on these methods can be found in Appendix F and at the Flinn Scientific website or catalogue. Most educational chemical supply houses currently use the Color Coding Chemical Storage method (See Table 1). Some companies use a colored stripe on the label, while others use a color- coded bottle cap.

Color Coding Chemical Storage Method	
	Red = Flammable
	Yellow = Oxidizers
	Blue = Health Hazards
	White = Corrosives
	Green or Gray = General Storage

Table 1: Color Coding Chemical Storage Method

The most hazardous items in the school district's inventory were most likely disposed during the cleanout. The district should define the chemical acquisition needs for the next year. Some hints to help manage chemical inventory include:

- Upon receipt, remove chemicals from their boxes, and date the individual bottles.
- Bottles are sometimes shipped with excess packaging and minimal identification on the outside of the box.
- As a precaution, completely cover the label with clear packing tape. This prevents degradation of the label over time, especially from iodine vapors or nitric acid vapors.
- When opening a bottle/container for the first time, put the "date opened" on the bottle/container.
- Use a *permanent* marker to write on the bottle's label, on the clear plastic tape.
  - Keep a copy of the inventory posted or accessible for science faculty to view and update as needed.
  - Maintain an orderly collection of all SDS that come with chemical shipments. Make copies according to school district policies.
    - If the district uses an online SDS database, be sure it is accessible/available at all times, whether or not school is in session.

9.0 Disposal of Chemicals

Chemicals no longer being used or chemicals that have passed their expiration dates should be marked for disposal. Many chemicals and/or biological reagents have short shelf lives or require special storage (i.e., refrigeration or freezing). If chemicals cannot be stored properly, they should be disposed. If the physical appearance of any chemical has changed, it should be disposed.

There will be hazardous waste generated periodically and it must be managed according to state and federal regulations. These rules require that hazardous waste be stored separately from other chemical storage. They also limit the quantity of waste that can be stored and the length of time it can be stored.

The types and amounts of waste generated by each department of the school district must be ascertained. This information will help determine the size of the storage area needed and where it should be located. The storage area should be located in proximity to where the waste is generated or in a central location.

The types of storage equipment and emergency response equipment necessary can be determined only after the identity of the waste and quantity of waste generated are known.

10.0 How Long May I Store My Hazardous Waste?

Hazardous waste must be disposed when it reaches specific storage time limits in accordance with your hazardous waste generator status. This involves the identification, collection and disposal of the waste, either through a hazardous waste contractor or through the local municipality. Either way, the hazardous waste contractor can help develop a system for storing the waste by providing the school district with the proper containers.

11.0 NYS Department of Environmental Conservation CleanSweep Program

Periodically, there has been funding for the CleanSweep Program whereby schools, farms and businesses can dispose of their chemicals at significant savings. Visit www.dec.ny.gov/chemical/45366.html to learn more about the program.

12.0 Household Hazardous Waste Collections

Some municipalities hold periodic household hazardous waste collection days. Check with county and/or city officials to determine forthcoming collection dates and whether or not the school building/district may participate.

Part V: Review the School District's Chemical Management Practices

The school district's chemical management practices should include updating the district's chemical hygiene plan or creating one if it does not exist. A chemical hygiene plan template can be found in Appendix G.

1.0 Chemical Hygiene Plan

In addition to the Right-to-Know Law, OSHA requires that a chemical hygiene plan be developed and implemented at a school or school district. The **chemical hygiene plan** is:

> *"…a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meet the requirements of paragraph (e) of this section."*

2.0 Chemical Hygiene Officer

In addition, OSHA requires that a school district designate someone as a chemical hygiene officer.

> "***Chemical Hygiene Officer*** *means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure."*

Source: OSHA 29CFR 1910.1450, subpart Z, Occupational exposure to hazardous chemicals in laboratories
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10106

> *"While a school may choose to retain a third-party consultant as a chemical hygiene officer (CHO), this does not absolve the school of responsibility in designating an internal CHO."*

Source: OSHA Standard interpretation, February 15, 2008
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=27076

3.0 Chemical Emergency Response

Wherever there are chemicals, there is the possibility of an accident. Provisions should be made for the worst case scenario, as well as for minor spills and releases. Training must be provided for all staff and students who work with chemicals on how to respond to a chemical spill or accident.

- Conspicuously post emergency response phone numbers in the laboratory/classroom or anywhere chemicals are used.
- Incorporate emergency response to a chemical spill into the school's annual emergency preparedness drills.
- Provide adequate ventilation and thermal stability of chemical storage areas to avoid accidents which may occur due to overheating or freezing.

An effective emergency response plan can reduce a school's liability. Be sure to coordinate it with other school and municipal emergency policies and protocols.

A chemical emergency response plan should address:

- Preparation for and identification and handling of chemical-related accidents
- Management of leaking or otherwise compromised containers and highly toxic chemicals
- Emergency disposal of shock-sensitive chemicals, other dangerous chemicals and chemical spill materials
- Protocol followed when gas leaks, plumbing leaks, electrical shorts or other utility emergencies are discovered
- Steps taken to evacuate safely if there is an incident

4.0 Designate an Emergency Response Coordinator

Responsibilities assumed by the emergency response coordinator and other staff during an emergency should be included in the emergency response plan. The coordinator serves as the liaison between the school and emergency responders to provide information on:

- Location and details of an incident
- Name of emergency hazardous waste contractor
- Location and contents of the chemical storage area(s)
- School layout
- Location and diagrams of shut-off valves for utilities
- Locations of SDS
- Pertinent information related to an incident

4.1 Develop Emergency Response Protocols

Emergency response protocols should include:

- When to contact the school's emergency response coordinator
- Chemical emergency response training schedules and curricula
- Specific training requirements for the emergency response coordinator and staff, including administrators, who use and/or are responsible for chemicals and procedures outlined in the emergency response plan
- Roles and responsibilities of staff
- Information on potential chemical hazards, how to identify an emergency, worst case scenarios, evacuation plans, alarm systems, emergency shutdown procedures, location and use of common emergency equipment, proper emergency response, and any special chemical hazards in the school
- Diagrams of facility grounds
- Evacuation and accountability plan
- Location, inventory and condition of emergency response equipment and supplies

- Floor drain management, including locations and proper usage
- When to call the fire department
- Communication systems, including a chronological ordering of who to call and what to do if normal modes of communication are disabled

Part VI: References, Rules and Regulations

1.0 Mercury in Schools

The Environmental Conservation Law (ECL) concerning mercury in New York State was enacted in July 2004. Chapter 145 of the Laws of 2004 of the ECL requires the proper management of mercury products. Under the provisions of the law, schools are *prohibited* from using or purchasing elemental mercury (also known as quicksilver) *on or after September 4, 2004*.

2.0 OSHA Hazard Communication Standard 29CFR 1910.1200

This statute's purpose is, *"to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training."*

3.0 OSHA Laboratory Standard 29CFR 1910.1450 Subpart Z and

OSHA Laboratory Standard 29CFR 1910.1450 Subpart Z; Appendix A: National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

Both of these sites offer valuable information to guide you in creating a chemical hygiene plan and provide a comprehensive guide to definitions commonly used.

3.1 Clarification of the OSHA Laboratory Standard

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=27076

4.0 Environmental Conservation Laws

6 NYCRR Part 370-374
http://www.dec.ny.gov/regs/2491.html

5.0 RCRA Listed Chemicals

6 NYCRR Part 371 RCRA Listed Chemicals

http://www.dec.ny.gov/regs/2491.html

6.0 Other Applicable OSHA Standards

29 CFR 1910 OSHA Subpart Z - Toxic and Hazardous Substances
29 CFR 1910.20 - OSHA Access to Employee Exposure and Medical Records
29 CFR 1910.119 - Process Safety Management of Highly Hazardous Chemicals
29 CFR 1910.1200 - OSHA Hazard Communication Standard
29 CFR 1910.1450 - OSHA Occupational Exposure to Hazardous Chemicals in Laboratories
29 CFR 1926.59 - OSHA Hazard Communication for Construction Activities
40 CFR Part 68 - EPA Risk Management Program
40 CFR 370 and 372 - EPA Superfund Amendments and Reauthorization Act (SARA), Title III of SARA, is known as the Emergency Planning and Community Right-to-Know Act
40 CFR 261,262, and 263 - EPA Resource Conservation and Recovery Act (RCRA)
49 CFR - Transportation
Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

7.0 Resources

7.1 Green Chemistry Teaching Resources

US Environmental Protection Agency (USEPA) http://www.epa.gov/greenchemistry/

NYS Department of Environmental Conservation (DEC)
www.dec.ny.gov/education/77750.html

Siena College www.sienagreenchemistry.org

Beyond Benign www.beyondbenign.org

American Chemical Society www.acs.org/greenchemistry

Greener Education Materials for Chemists (GEMs) http://greenchem.uoregon.edu/gems.html

Greenheart Education http://www.greenhearted.org/greening-chemistry.html

The Institute for Green Science at Carnegie Mellon University
http://www.chem.cmu.edu/groups/Collins/

University of Scranton, Green Chemistry
http://academic.scranton.edu/faculty/cannm1/greenchemistry.html

8.0 Chemical Safety and Safety Data Sheets

Information on chemical safety can be found in a number of places. The New York State United Teachers (NYSUT) website is one of the more comprehensive repositories of important information. http://www.nysut.org (search - chemical safety)

The NYSUT provides external links to the following sites:

- **World Health Organization Chemical Safety Cards**
  Chemical safety cards and extensive links available
- **Material Safety Data Sheets on the Internet**
  A glossary of terms used on MSDSs, a quiz to test knowledge of MSDSs, frequently asked questions and search links for specific MSDSs
- **Vermont MSDS Collection**
  80,000 MSDSs which can be searched by name, product name or CAS
- **Cornell University MSDS Archive**
  325,000 MSDS by name and product
- **NFPA Chemical Label Codes**

  (Michigan State Office of Radiation, Chemical and Biological Safety)
  A list of commonly used chemicals and their NFPA listings
- **Environmental Protection Agency**
  EPA chemical substance fact sheets
- **New Jersey Hazardous Substance**
  Downloadable hazardous substance fact sheets on 2,500 chemicals categorized by name, formula or registry number
- **EPA Fact Sheets**
  Information on MSDS for generic chemicals regulated by the EPA. No manufacturer, name or address is provided.
- **National Institutes of Health HazMap**
  Can search occupational exposures to hazardous agents

Appendix A: Duties of a Chemical Hygiene Officer

The OSHA definition is as follows:

Chemical Hygiene Officer means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

The following are duties expected of a chemical hygiene officer:

1. Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices
2. Monitor procurement, use and disposal of chemicals used in the lab
3. Review all POs that include chemical reagents
4. Review all lab procedures, including all new procedures to be introduced
5. Ensure that staff training and facilities are adequate for materials ordered
6. Ensure all SDS forms are available and current
7. See that appropriate audits are maintained
8. Help building safety chairperson, principals and department chairs develop precautions and provide adequate facilities
9. Know the current legal requirements concerning regulated substances
10. Seek ways to improve the chemical hygiene plan
11. Ensure that workers know and follow chemical hygiene rules
12. Provide adequate training for all workers regarding safety, chemical hygiene and chemical hazards
13. Determine the appropriate protective equipment required and ensure it is available and in good working order
14. Provide regular, formal, chemical hygiene and housekeeping inspections:
    a. Stockrooms and storerooms
    b. Lab ventilation
    c. Sinks and clean-up areas
15. Regularly inspect all safety and emergency equipment to ensure it is in good working order:
    a. Fume hoods
    b. Fire equipment
    c. Eye-wash stations and deluge showers
    d. Protective apparel
16. Maintain records for training, inspections, medical, inventory, accidents and spills.

Source: Pacific Lutheran University website www.plu.edu

Appendix B: Safety Pre-Screen Worksheet

Chemical Safety Pre-Screen Planning Worksheet

What would be a good date for the school to schedule a walk through?_____

Who will coordinate with the school's Chemical Committee members and chemist or other knowledgeable technical person to set the walk through date?

_____

Who will notify staff about the pre-inventory walk through date (both those participating and those whose rooms might be screened)? _____

Who will take notes?_____

Who will compile notes?_____

Who will coordinate with the contractor on any emergency response?_____

Who should participate in the pre-inventory walk through?_____

What areas, rooms, closets, outbuildings, sheds should be pre-screened?_____

Who has the keys to these areas?_____

Appendix C: Chemical Compatibilities

Storage of laboratory chemicals presents an ongoing safety hazard for school science departments. A possible solution is to separate chemicals into their organic and inorganic families and then to further divide the materials into related and compatible families[1]. Table 1 and Table 2 below demonstrate compatible family groupings. Chemicals organized for compatible storage markedly increase safety for students and school employees. Handling school chemicals safely is completely at the risk and entirely the responsibility of the school officials. It is always a good practice to consult its SDS[2] when handling any chemical.

Table 1. Flinn Suggested Compatible Family Codes and Shelf Storage Pattern-Inorganic (I)[3]

Inorganic #10 (I10) Sulfur, Phosphorus, Arsenic, Peroxide	**Inorganic #7 (I7)** Arsenates, Cyanides, Cyanates (Store away from any water)
Inorganic #2 (I2) Acetates, Halides, Halogens, Oxalates, Oleates, Phthalates, Phosphates, Sulfates, Sulfites, Thiosulfates	**Inorganic #5 (I5)** Sulfides, Selenides, Phosphides, Carbides, Nitrides
Inorganic #3 (I3) Amides, Nitrates (except Ammonium Nitrate), Nitrites, Azides (Store Ammonium Nitrate away from all other substances-ISOLATE IT)	**Inorganic #8 (I8)** Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates
Inorganic #1 (I1) Metals, Hydrides (Store away from any water) (Store flammable solids in flammables cabinet)	**Inorganic #6 (I6)** Bromates, Chlorates, Chlorites, Iodates, Peroxides, Hydrogen Peroxide, Hypochlorites, Perchlorates, Perchloric Acid
Inorganic #4(I4) Hydroxides, Oxides, Silicates, Carbonates, Carbon	**Miscellaneous (IM)** Inorganic Miscellaneous

Inorganic #9 (I9) Acids, Except Nitric (Nitric Acid is isolated and stored by itself) (Acids are best stored in a dedicated and locked cabinet)

Table 2. Flinn Suggested Compatible Family Codes and Shelf Storage Pattern - Organic (O)[4]

Organic #2 (O2) Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides (Stored flammables in a dedicated cabinets)	**Organic #8 (O8)** Phenols, Cresols
Organic #3 (O3) Hydrocarbons, Esters, Aldehydes, Oils (Store flammables in a dedicated cabinet)	**Organic #6 (O6)** Peroxides, Hydroperoxides, Azides
Organic #4 (O4) Ethers, Ketones, Ketenes, ethylene Oxide, Halogenated Hydrocarbons (Stored flammables in a dedicated cabinet)	**Organic #1 (O1)** Acids, Amino Acids, Anhydrides, Peracids (Store certain organic acids in acid cabinet)
Organic #5 (O5) Epoxy Compounds, Isocyanates	**Organic #9 (O9)** Dyes, Stains, Indicators (Store alcohol-based solutions in flammables cabinet)
Organic #7 (O7) Sulfide, Polysulfides, etc.	**Miscellaneous (OM)** Organic Miscellaneous
Organic #2 (Alcohols, Glycols etc.) Organic #3 (Hydrocarbons, etc.) Organic #4 (Ethers, Ketones, etc.) Organic #9 (Alcohol-based Indicators, etc.) should be stored in a flammables cabinet	**Store Severe Poisons** **In locked Poison Cabinet**

Potential Risks for Storage or Mixing of Incompatible Chemicals

When certain hazardous chemicals are stored or mixed together, violent reactions may occur because the chemicals are unsuitable for mixing, or are incompatible. No single method of determining chemical compatibility is perfect. The reasons are varied such as: Many chemicals belong to more than one hazard class. This can lead to confusion as to which class is appropriate for the chemical in question. The hazard class can change depending on factors such as quantity of materials, and other chemicals in the storage area. Not all chemicals in a given class are compatible. Such as sodium dichloroisocyanurate and calcium hyperchlorite are both oxidizers, yet the mixing of these two materials can lead to the formation of nitrogen trichloride, a shock

sensitive explosive. The sheer number of exceptions to any classification scheme prevents listing all of them in a convenient reference table.

The chemicals listed in Table 3 and Table 4 are not intended to be all inclusive and should not be considered complete. They include only the most common incompatible combinations. The absence of a chemical from this list in the tables should not be taken to indicate that it is safe to mix it with any other chemicals! (Consult a chemical's SDS for additional guidance). The chemicals listed in the following tables react violently when they come into contact with each other and must not be stored together. Mixing incompatible chemicals in a waste container can form an explosive mixture. If a bottle breaks in a waste storage area where incompatibles are/were present, the results could be disastrous. Remember: incompatible bottles of wastes should be stored separately. The objective is to avoid accidents in the laboratory.

Table 3. Possible Reactions May Occur Due to Improper Storage of Incompatible Chemicals[5]

Chemicals Stored Together	Possible Reaction
Acetic Anhydride & Acetaldehyde	Reaction can be violently explosive
Aluminum Metal & Ammonium Nitrate	A potential explosive
Aluminum & Bromine Vapor	Aluminum foil reacts with bromine vapor at room temperature and incandesces
Ammonia Vapor & Bromine Vapor	Unstable nitrogen tribromide is formed, explosion may result
Ammonium Nitrate & Acetic Acid	A mixture may result in ignition, especially if acetic acid is concentrated
Cupric Sulfide & Cadmium Chlorate	Will explode on contact
Hydrogen Peroxide & Ferrous Sulfide	Forms a vigorous, highly exothermic reaction
Hydrogen Peroxide & Lead II Or IV Oxide	Violent, possibly explosive reaction
Lead Perchlorate & Methyl Alcohol	Forms an explosive mixture if agitated
Lead Sulfide & Hydrogen Peroxide	Vigorous, potentially explosive reaction
Mercury II Nitrate & Methanol	May form mercury fulminate - an explosive
Nitric Acid & Phosphorus	Phosphorus burns spontaneously in the presence of nitric acid
Potassium Cyanide & Potassium Peroxide	A potentially-explosive mixture if heated
Sodium Nitrate & Sodium Thiosulfate	A mixture of the dry materials can result in an explosion

Table 4. Potentially Explosive Combinations of Common Reagents[6]

Acetone + Chloroform in the presence of base
Acetylene + Copper, Silver, Mercury or their salts
Carbon Disulfide + Sodium Azide
Chlorine + an Alcohol
Chloroform or Carbon Tetrachloride + Powdered Aluminum or Magnesium
Decolorizing Carbon + an Oxidizing Agent
Diethyl Ether + Chlorine (including a chlorine atmosphere)
Dimethyl Sulfoxide + Chromium Trioxide
Ethanol + Calcium Hypochlorite
Ethanol + Silver Nitrate
Nitric Acid + Acetic Anhydride or Acetic Acid
Picric Acid + a heavy metal salt such as Lead, Mercury[7], or Silver Oxide + Ammonia + Ethanol
Sodium + a Chlorinated Hydrocarbon
Sodium Hypochlorite + an Amine

References for Appendix C:

1. Flinn's "Scientific Catalog Reference Manual", 2012 and its Safety Data Sheet (SDS) on Line: http://www.flinnsci.com/msds-search.aspx
2. SDS: Safety Data Sheet
3. Flinn Inorganic Compatible Family Codes (I1 to I10 and IM); Flinn's "Scientific Catalog Reference Manual", 2012, p1167
4. Flinn Organic Compatible Family Codes (O1 to O9 and OM); Flinn's "Scientific Catalog Reference Manual", 2012, p1167
5. "Analytical Chemistry Resources; http://delloyd.50megs.com/moreinfo/storage.html
6. University of Notre Dame, Risk Management and Safety Website: http://riskmanagement.nd.edu/.../incompatible_chemicals.pdf%22%3Eincompa
7. New York State Environmental Conservation Law Title 21; 27-2107

Appendix D: Hazardous Chemicals to Avoid

Elemental mercury may no longer be purchased or used in schools as of September 4, 2004, according to the Environmental Conservation Law, Article 27, and Title 21.

The following lists are not intended to be complete nor representative of the chemicals found in every NYS school science storeroom. Use of these chemicals is not restricted in NYS at this time (except in the case of elemental mercury); the lists are intended to serve as an overview of chemicals of known hazards which can be avoided. Chemicals are listed in no particular order under a heading (i.e., Nickel is not more or less of a hazard and benzene, both are known carcinogens).

The information stated in the following tables is based on the Safety Data Sheet (SDS) posted on the Flinn[1] website unless otherwise indicated.

Known Human Carcinogens

- Benzene - Carcinogen and mutagen
- Cadmium and Cadmium Compounds - Carcinogen and highly toxic.
- Chromates and Dichromates - Carcinogen and mutagen
- Nickle – Carcinogen by inhalation
- Nickle Compounds – Carcinogen
- Cobalt Chloride - Carcinogen
- Polychlorinated Biphenyl – Carcinogen[2]

Probable or Possible Carcinogens

- Lead - Possible carcinogen
- Lead Acetate - Probable carcinogen and reproductive hazard
- Lead Dioxide - Possible carcinogen
- Cobalt - Possible carcinogen and may be fatal by inhalation dust
- Some Cobalt Compounds - Possible carcinogen
- Dichlorobenzene - Possible carcinogen
- Naphthalene - Possible carcinogen
- Phenolphthalein - Possible carcinogen
- Polybrominated Biphenyl - Possible carcinogen[3]
- Chloroform - Possible carcinogen and mutagen
- Carbon Tetrachloride - Possible carcinogen. Higher level can cause coma and death[4]

Possible or Probable Mutagens/Teratogens

- Ethyl Ether - Possible mutagen and mental disturbances
- Lithium Chloride - Possible teratogen
- Methyl Red - Possible mutagen
- Phenyl Salicylate - Possible teratogen
- Mercury Compounds - Possible mutagen
- Nitrophenols - Possible mutagen

There are many chemicals are highly toxic/hazardous or poisonous with respect to its certain route of exposure and its concentration such as barium compound (except barium sulfate), nitric acid, sulfuric acid, hydrochloric acid, hydrobromic acid, mercury, xylene toluene, phenols, methyl alcohol, ethylene glycol.

Dangerous Chemicals Potentially Found In High School Chemical Storage Room

Chemicals Name	Toxicity/Hazard/Poison	Notes and Comments
Ammonium bifluoride[5] (NH4F.HF)	Extremely hazardous in case of skin and eye contact, ingestion and inhalation	Never add water to this product. It may corrode glass. Store in an appropriate container
Bromine[1,6]	Highly toxic by inhalation and ingestion; severe skin irritant; very strong oxidizer; poison inhalation hazard zone-tear gas	Emit fumes of bromine and bromides upon thermal decomposition
Cyanides[5] (CN-)	Potentially fatal if inhaled or swallowed. Vapor may cause flash fire. May polymerize. Container may rupture or explode	May react on contact with air, heat, light or water
Diethyl Ether[7]	Severe fire and explosion hazard	Dispose of within twelve months of receipt, or six months of opening, whichever is shorter
Hydrofluoric Acid[7]	Exposures greater than 25 sq. in. of body surface area may be fatal	Call safety officer immediately in the event of a spill
Hydrazines[5] (N2H4)	Very hazardous and extremely reactive and many are carcinogens. Hazardous by definition of OSHA: 29 CFR 1910.1200	Keep locked up. Keep container dry. Keep away from heat, source of ignite, direct sunlight

Hydrogen Peroxides[1] (30%)	Severely corrosive and cause severe skin burns and eye damage. May cause fire or explosions	Keep away from heat, sparks, open flames, and hot surfaces. No smoking
Mercury and all of its compounds[5]	Highly toxic chemical, toxic effects include damage to the brain, kidneys and lungs	No primary or secondary school in New York state may use or purchase elemental mercury[8]
Organic Peroxides[5]	Highly flammable and explosive	Sensitive to heat, shock, fraction or contact with combustible materials
Perchloric Acid[7]	Dedicated, specially-constructed chemical fume hoods are needed for perchloric acid use. When perchloric acid condenses on hood, duct, and fan components, condensed vapors can react with hood gaskets, greases and other collected materials to form explosive compounds	Perchloric acid fume hoods must be used only for perchloric acid applications, and should never be used for other chemical procedures
Picric Acid[7]	Picric acid is a high-powered explosive when allowed to dehydrate, and can form shock sensitive metal picrates when in contact with metals	Need to be disposed by local bomb squad or fire department[1]
Phosphorus (White, Yellow) [5]	White or Yellow form is Pyrophoric, a poison, and ignites spontaneously in air. (Red form is not pyrophoric but is very flammable and can react explosively with oxidizing agents)	Store under water and an inert gas. Handle under water. Avoid breathing vapors
Potassium Metal[1]	Extremely dangerous in contact with moisture and water. Cutting or handling yellow-coated potassium (old, peroxide coatings) may result in a violent explosion. When exposed to air or oxygen, it ignite spontaneously. It can cause severe skin burns	Must be stored under dry oil
Sodium Metal[1]	Dangerous when exposed to heat or flame; dangerous by reaction with moist air, water or any oxidizer. Spontaneously flammable when heated in air; reacts violently with water, producing very dangerous hydrogen gas	Sodium metal must always be stored under dry mineral oil to prevent contact with moist air

References for Appendix D:

1. http://www.flinnsci.com/msds-search.aspx

2. https://en.wikipedia.org/wiki/Polychlorinated_biphenyl#Cancer

3. https://en.wikipedia.org/wiki/Polybrominated_biphenyl#Possibility_of_carcinogenicity

4. nj.gov/health/eoh/rtkweb/documents/fs/0347.pdf

5. Google MSDS/SDS online search

6. Princeton University on line MSDS:

   http://www.princeton.edu/prism/mnfl/current-users/safety/msds/

7. Wayne State University, Office of Environmental Health and Safety" website:

   http://oehs.wayne.edu/labsafety/hazardous-chemicals.php

8. New York State Environmental Conservation Law Title 21; 27-2107

Appendix E: Template for Chemical Inventory

School Name _____ **Date:** _____

Contact Name _____ **Storage Room No.** _____

Phone Number _____ **MSDS[1]/SDS[2,3] Location** _____

Chemical Name	Receipt Date	Expiration Date (Per Label)	Number of Containers	Total Amount	Container Type	Manufacture	Color Coding[4] Chemical Storage* Page 2		Chemical Storage Per Flinn**		Notes or Comments
							Location	Color	Storage Code Page 2	GHS Chemical Hazards Classification	
Sodium Sulfide (nonhydrate)	1/4/2016	1/4/2018	2	25g	P	Wards	Shelf 1	white	I 1	IV 1	
Methylene Blue	1/4/2016	No	1	10g	P	Flinn	Shelf 2	green	O 9	IV 2	
Ethylene Glycol	1/4/2016	1/4/2019	2	500ml	P	Scholar	Shelf 3	green	O 2	IV 4	

There are two chemical storage systems * and ** listed in the table. Only one system should be used as your preference.

Summary for Coding, Acronyms, Units and Definitions Used in the Table

Definitions of Units and Notes in the Table

The units listed are as marked on the container. The quantity should be estimated if it was used: ml = milliliter; gal = gallon; lb = pound; fl oz = fluid ounce; oz = ounce, L = liter; qt = quart; g = gram; kg = kilogram

In the "**Container Type**" column, P = Plastic; G = Glass; M = Metal

In the "**Color Coding Chemical Storage**" column, the colors will be determined by its hazard classification and Safety Data Sheet (SDS) information.

In the "**Chemical Storage Per Flinn, Storage Code**" column, I = Inorganic; O = Organic; Mis = Miscellaneous. See appendix D in this New York State School Science Chemical Management Guidance Manual for the details.

In the "**GHS Chemical Hazards Classification**" column, Roman numbers combine with GHS Classification for Chemical Hazards are used. See definitions on page 3.

One chemical may require multiple storage color codes and have multiple hazard characteristics. The highest hazardous code and highest toxicity category should be selected in the table.

Color Coding Chemical Storage

Blue (Health Hazard-Toxic):
Chemical is hazardous to health if ingested, inhaled or absorbed through the skin. Store separately in a secure area

Red, Red Stripe (Flammable): Store separately only with other flammable chemicals

Yellow (Oxidizer-Reactive):
Reactive/Oxidizer. May react violently with water, air or other chemicals. Store separate from combustible/ flammable reagents

White, White Stripe (Corrosives):
May be harmful to eyes, mucous membranes and skin. Store separate from combustible and flammable chemicals

Globally Harmonized System (GHS) Combined with Roman Numbers for Chemical Hazards

This modified chemicals hazard classification is based on GHS and Environmental Health & Safety Assistant (EHSA's) online "chemical inventory worksheet instruction"[6]. Roman numbers were used for identifying six different hazardous categories and numerical numbers 1 to 5 follow Roman numbers to indicate the hazardous level for a chemical (1 is for most severe and 5 is least severe)

I: Fire Hazard - includes products which are flammable, combustible liquid, pyrophoric, and/or an oxidizer

II: Pressure Hazard - includes products which are explosive or compressed gases

III: Reactivity Hazard - include products which are unstable reactive, organic peroxides, and/or water reactive

IV: Acute Health Hazards (immediate) - includes products which are highly toxic, corrosive, toxic, irritants, sensitizers, and other hazardous chemicals which cause an adverse effect to a target organ within a short period of time

V: Chronic Health Hazards (delayed) - includes products which are carcinogens, mutagens, or teratogens, and other hazardous chemicals which cause an adverse effect to a target organ after a long period of time

VI: Environmental Hazards*** - is the state of events which has the potential to threaten the surrounding natural environment and adversely affect people's health
*** Definition is from Wikipedia

Use GHS classification is in compliance with OSHA's regulation: June 1, 2015 - Chemical manufacturers and distributors must complete hazard reclassification and produce GHS styled labels and safety data sheets. Distributors get an additional 6 months to complete shipments of old inventory[7]. All new purchased chemicals will have GHS required labeling and hazard classification.

References for Appendix E:

1. MSDS: Material Safety Data Sheet
2. SDS: Safety Data Sheet
3. Flinn's "Scientific Catalog Reference Manual", 2012 and its Safety Data Sheet (SDS) on Line: http://www.flinnsci.com/msds-search.aspx
4. About Education: http://chemistry.about.com/od/chemistrylab/a/Chemical-Storage-Color-Codes.htm
5. GHS: Globally Harmonized System
6. Texas A & M University, Environmental Health & Safety on Line: https://ehsd.tamu.edu/Pages/LabSafety.aspx (Chemical Inventory Worksheet)
7. MSDS online, GHS 101: U.S. Adoption (Hazcom 2012): https://www.msdsonline.com/resources/ghs-answer-center/ghs-101-u-s-adoption

Appendix F: "Twelve Principles of Green Chemistry"

"Twelve Principles of Green Chemistry"*

1. **Prevention**
   It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom Economy**
   Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less Hazardous Chemical Syntheses**
   Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals**
   Chemical products should be designed to affect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries**
   The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficiency**
   Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks**
   A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives**
   Unnecessary derivation (use of blocking groups, protection/no protection, temporary modification of physical/chemical processes) should be minimized or avoided if possible because such steps require additional reagents and can generate waste.
9. **Catalysis**
   Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for Degradation**
    Chemical products should be designed so that at the end of their function, they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention**
    Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently Safer Chemistry for Accident Prevention**
    Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

*Anastas, P. T.; Warner, J. C.; *Green Chemistry: Theory and Practice*, Oxford University Press: New York, 1998, p.30. By permission of Oxford University Press

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Appendix G: Chemical Hygiene Plan Template

School District

CHEMICAL HYGIENE PLAN

For

High School Laboratories

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Important School Contacts in the Event of an Emergency

EMERGENCY 911

Buildings and Grounds Supervisor	_____
School Nurse	_____
Main Office	_____
District Science Coordinator	_____
On-Site Chemical Hygiene Officer	_____
Chemical Hygiene Officer	_____
Director of Health and Safety	_____
CHEMTREC	1-800-262-8200

GENERAL GUIDELINES FOR WORKING WITH LABORATORY CHEMICALS

1. It is essential to minimize chemical exposure to the greatest extent possible. Because few laboratory chemicals are without hazards, precautions for handling all chemicals should be exercised. As a rule, skin contact with chemicals should always be avoided.
2. Avoid an underestimation of risk. Exposure to laboratory chemicals should be minimized even for substances of no known significant hazard. Special precautions should be taken for those substances which have special health hazard risks. One should assume that any mixture of substances will be more toxic than either of its single components alone. One should also assume that all substances of unknown toxicity are toxic.
3. Adequate ventilation must be provided. The best way to prevent exposure to hazardous substances is to prevent their escape into the atmosphere by use of fume hoods and other ventilation controls.
4. Institute a chemical hygiene committee to minimize exposures to toxic substances. It is recommended under the OSHA Laboratory Standard 1910.1450.
5. Observe the PEL's and TLV's. The OSHA Permissible Exposure Limits and the American Conference of Governmental Industrial Hygiene Threshold Limit Values should not be exceeded.

CHEMICAL HYGIENE RESPONSIBILITIES

1. **(Name, Title)** has the ultimate responsibility for chemical hygiene and must, with other administrators, provide support for the chemical hygiene plan.

2. **(Name, Title)** is responsible for chemical hygiene in the building.

3. **(Name, Title)** has the responsibility for chemical hygiene in the lab, including the responsibility to:

    - Ensure that affected personnel know and follow all safety rules, use appropriate personal protective equipment, and provide students with appropriate safety training.
    - Conduct regular formal housekeeping inspections, including inspections of emergency equipment.
    - Know the current legal requirements concerning regulated substances.
    - Ensure that the facilities are adequate for any material being used.
    - Plan and conduct each lesson in accordance with the chemical hygiene program. Lesson plans should include all possible hazards, preventive measures and emergency responses for each hazard.
    - Develop and follow sound personal chemical hygiene habits.

THE LABORATORY FACILITY

1. DESIGN

- An appropriate ventilation system should have air intakes and exhausts located to avoid recirculation of contaminated air.
- The facility should provide adequate, well-ventilated storerooms, laboratory fume hoods and sinks.
- Other safety equipment shall include eye-wash stations and drenching showers.

2. VENTILATION

- Natural Dilution: This system should provide a source of air for breathing. It will not be relied upon for protection from toxic substances released into the lab.
- Hoods: A laboratory fume hood should be provided for demonstration. Each hood will be monitored for adequate performance by **(Name, Title)**.
- Modifications: Any alterations to the ventilation system should be made only by qualified personnel (HVAC engineer), and if testing indicates that worker protection from airborne toxic substances will continue to be adequate.
- Quality: Airflow should be six air changes per hour. The hood face velocity should be maintained 60 - 100 linear feet per minute, at minimum.

COMPONENTS OF THE CHEMICAL HYGIENE PLAN

1. PROCUREMENT

- No container will be accepted if leaking or without an adequate label and Safety Data Sheet.

2. STORAGE

- Toxic substances should be segregated in a chemical storage cabinet off limits to unauthorized individuals.
- Stored chemicals should be examined at least annually for replacement, deterioration and container integrity by **(Name, Title)**. Amounts will be stored in the smallest practicable quantity. Yearly inventories will be conducted, and unneeded items will be properly disposed.
- Chemicals will be stored in accordance with accepted standards of compatibility using either the ChemAlert (NFPA) system or Flinn system. An inventory list arranged alphabetically will be posted in the storage room. Safety Data Sheets will be arranged alphabetically and located in the storage room.

3. DISTRIBUTION FROM STORAGE AREA

- When bulk quantities of chemicals are hand carried, the container will be placed in a bottle carrier or bucket.

4. AIR MONITORING

- Monitoring of airborne concentrations of toxic substances may be appropriate when testing or redesigning hoods or when highly toxic substances are used on a regular basis which is not anticipated, or when using chemicals that require initial monitoring.

5. HOUSEKEEPING

- Formal housekeeping and inspections will be performed at least biannually.
    - The purpose of this is to identify hazards and determine whether to implement control measures such as ventilation, modified work practices or additional personal protective equipment.
    - Suitable facilities for the quick drenching of personnel exposed to corrosive or injurious chemicals will be used for eye-wash and shower emergencies. This device will be inspected at least biannually.
    - Informal inspections will be continuous.
    - Eye-wash fountains and safety showers should be inspected and tested quarterly.
    - Records of testing and inspections should be maintained.
    - Procedures for restarting out-of-service equipment should be established.
    - Stairways and hallways *should not be used as storage areas*.
    - Access to exits, emergency equipment, and utility controls should **never** be blocked.

6. MEDICAL PROGRAM

- Spills or emergencies where employees show signs and symptoms of overexposure should be immediately reported to the school nurse.

7. PROTECTIVE EQUIPMENT AND APPAREL

- Splash goggles
- ANSI-approved safety glasses
- Chemical-resistant aprons
- Gloves
- Hair ties

8. RECORDS

- Accident reports will be written and retained for all accidents involving injuries, property damage and near misses.
- Inventories, Safety Data Sheets and records indicating attendance at Employee Right–to-Know training will be maintained in accordance with the Federal Hazard Communication Standard.
- Maintain records of measurement of employee exposure and any medical consultations and exams that are conducted for [40 years or for the duration of employment plus 20 years, whichever is longer, or in accordance with 1910.20].

9. SIGNS AND LABELS

- Emergency telephone numbers will be posted in labs and the main office.
- Identifying labels must show contents of containers and associated hazards.
- Location signs for safety showers, eye-wash stations, first aid equipment, exits, areas where food and beverages are prohibited and warnings at areas where unusual hazards exist will be posted.

10. SPILLS

- The administration will be notified by **the main office**.
- It is the responsibility of the administration to evacuate school if necessary.
- In the case of a fire or major spill, the employee is responsible for evacuating the premises by fire alarm.
- The written emergency action plan is located in **the main office** and will be communicated to all personnel.
- Spill control procedures will include approved containment, cleanup and transportation methods.

11. INFORMATION AND TRAINING

- Employees will be trained *upon initial assignment* concerning chemicals available, procedures, location of the chemical hygiene plan, location of Safety Data Sheets, and method of hazard identification (refer to paragraph F of occupational exposure to hazardous chemicals in the Chemical Hygiene standard).
- Annual refresher training will be scheduled with the (school science contact), coordinating schedules among faculty to schedule yearly training.
- New employees will be expected to attend a course in laboratory safety.

12. WASTE DISPOSAL PROGRAM

- This program will describe how waste is to be collected, segregated, stored and disposed of.
- Unlabeled containers of chemicals and solutions should be promptly identified and disposed of as required. Indiscriminate disposal by pouring waste chemicals down the drain or adding them to refuse for landfill burial is unacceptable. Contact **the Director of Facilities** to arrange for a hazardous waste disposal pickup through certified waste haulers.

GENERAL LABORATORY RULES/STANDARD OPERATING PROCEDURES

I. EMERGENCY FIRST AID PROCEDURES

a. Eye Contact: Flush eyes with copious amounts of water for at least 15 minutes and seek medical attention.
b. Ingestion: Read the label for directions and immediately seek medical attention. Contact the 24-hour National Emergency Poison Control Center at 1-800-222-1222, or call 911.
c. Skin Contact: Flush the affected areas with copious amounts of water and remove any contaminated clothing. If symptoms persist after flushing, seek medical attention.

II. PERSONAL PROTECTIVE EQUIPMENT

A. Whenever appropriate:
   a. ANSI-approved eye protection must be worn.
   b. Gloves will be worn which will resist penetration by the chemical being handled and which have been checked for pin holes, tears or rips.
   c. Lab coats or aprons to protect skin and clothing from chemicals will be worn.
   d. Footwear should cover feet completely and open-toed shoes will be prohibited.

III. HAZARD PREVENTION

a. Conduct periodic in-house safety and health inspections with an emphasis on identifying safety hazards.
b. Carry out regular fire or emergency drills and review the results.
c. Have actions planned in case of an emergency (e.g., equipment should be turned off, planned escape routes, designated meeting place outside the building and designated person to authorize the re-entry into the building).
d. Have the appropriate equipment and materials available for spill control.
e. Keep up-to-date emergency phone numbers posted next to the telephone.
f. Reduce risk by using diluted substances instead of concentrates.
g. If feasible, use smaller quantities of hazardous materials for laboratory demonstrations.
h. Use films, videotapes, or other methods rather than experiments involving extremely hazardous substances.
i. Substitute with a less hazardous substance.
j. Analyze accidents to prevent repeat performances.
k. Purchase chemicals in minimum quantities, wherever feasible.
l. Do not use damaged glassware.

IV. GENERAL LABORATORY SAFETY

a. Obtain and read the Safety Data Sheet for each hazardous chemical.
b. Analyze new lab procedures in advance to identify possible hazards.
c. Wash hands before and after work, and after spill cleanups.
d. Do not smell or taste chemicals.
e. Never work alone in a science laboratory or storage area and do not allow students to work unsupervised.
f. Never eat, drink, smoke, or chew gum or tobacco in the laboratory environment.
g. Never store food in laboratory refrigerators.
h. Never pipette liquids by mouth.
i. Restrain loose clothing, long hair, and dangling jewelry.
j. Never leave a heat source unattended (gas burners, hot plates, mantels, etc.).
k. Do not store reagents or apparatus on a lab bench and keep shelves organized.
l. Always use a fume hood when working with volatile substances.
m. Never lean into the fume hood while hazardous chemicals are being used or when in use.
n. Do not use the fume hood as a storage area.
o. Do not mix chemicals in the sink drain.
p. Always inform co-workers of plans to carry out hazardous work.
q. Avoid horseplay, practical jokes, and any other distracting behavior.
r. Be alert to unsafe conditions and correct them when detected.
s. Label all chemicals accurately with date of receipt or preparation and any other precautionary information for handling.
t. Never use a reagent until the label has been read and contents checked.

V. FACILITY MAINTENANCE

a. Place fire extinguishers near escape routes, and also in areas of high hazards.
b. Regularly inspect fire extinguishers, maintain records of inspections and train personnel in the proper use of extinguishers.
c. Never block escape routes.
d. Never block a fire door opening.
e. Never store materials in aisle ways.
f. Have separate containers for trash and broken glass.
g. Regularly inspect safety showers and eye-wash stations and keep records of inspections.
h. Regularly check the ventilation in hoods for proper air flow.
i. Chemical storage shelves with closeable doors should be used for flammable materials and acids.